Title
Selected Abstracts & Bibliography of International Oil Spill Research, through 1998

Author
Louisiana Applied Oil Spill Research & Development Program Electronic Bibliography

Publication Date
1998-12-31

Selected Abstracts & Bibliography of International Oil Spill Research, through 1998

Compiled by the Louisiana Applied Oil Spill Research & Development Program Electronic Bibliography, Baton Rouge, Louisiana

1987. Sensors and transducers: gaging physical qualities. Machine Design 59(May 14):135.
Key words: Sensors

1988. Improved biomass utilization through the use of nuclear techniques. Report of the final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques held in Ljubljana, Yugoslavia, 11-14 May 1987. Final research co-ordination meeting on development of improved rural methane production from biomass by utilizing nuclear techniques. 114.
Biomass is a major by-product resource of agriculture and food manufacturing, but it is under-utilized as a source of food, fibre, and chemicals. Nuclear techniques provide unique tools for studies of the capabilities of micro-organisms in methane digestor operation and in the transformation of lignocellulosic materials to useful products. Nuclear techniques have also been effectively employed as mutagenic agents in the preparation of more efficient microbial strains for the conversion of biomass. This report reviews the variety and diversity of such applications with focus on the development of microbial processes to utilize agricultural wastes and by-products. The value of nuclear techniques is manifestly demonstrated in the production of efficient microbial mutant strains, in the tracing of metabolic pathways, in the monitoring of lignin degradation and also of fermenter operation.
Key words: methane, biosynthesis, radiation effects, biological pathways, fermentation, tracer techniques, mutants, irradation.

1988. Proceedings of the Annual Gulf of Mexico Information Transfer Meeting (9th), October 25-27, New Orleans, Louisiana.
Key words: Oil Spills, Gulf of Mexico, Offshore Drilling, Water Pollution, Geographic Information System
In 1981, the Minerals Management Service held the first Information Transfer Meeting to exchange regional, environmental, and socioeconomic information among Federal and State governments, industry, academia, and public interest groups concerned with the effects of oil and gas activities on the Gulf of Mexico. The Gulf of Mexico Information Transfer Program has three goals: (1) to provide a forum for 'scoping' topics relative to environmental assessment or offshore oil and gas activities; (2) to present the accomplishments of the

MMS Gulf of Mexico Environmental Studies Program and other MMS research programs or study projects;
and (3) to foster exchange of information of regional interest among scientists, agencies, regionally-important
industries, and academia. The volume summarizes the presentations given at the Ninth Annual Gulf of
Mexico Information Transfer Meeting held in October 1988. Eleven sessions included the following topics:
wetlands concerns; oil spill control and cleanup; marine mineral resources in the Northern Gulf; contributed
papers: current Gulf marine research; chemosynthetic communities; risk perception, assessment and
management; MS/AL shelf marine ecosystems; marine ecosystems; and Geographic Information Systems
(GIS) and data sources.

1989. Foam-X sorbent evaluation. Canadian Petroleum Association, Calgary, AB (Canada). Prairie Region
Oil Spill Containment and Recovery Advisory Committee. 25.
Tests on Foam-X sorbents potential to absorb retain spilled oil and to reduce a hydrocarbon's flammability
are described. The sorbent is placed on the surface of an oil slick where the spilled oil is recovered by either
adsorption or absorption. Foam sorbents have a distinct cellular structure which does not depend on the
nature of various oils to provide coherence of the oil/sorbent mixture. An open cell polyurethane foam
supplies a large surface area of porous material with open ended interconnected pores. The tests conducted on
Foam-X include: Canadian Standards absorbency test, water column visual analysis, suface oil retention
visual analysis, and gas chromatograph vapor analysis. These tests were done on Foam-X, peat moss and
vermiculite sorbents and the results compared. Conclusions are: Foam-X sobent is capable of ab/adsorbing
significant amounts of oil per unit weight of sobent with relatively short contact times. It is 100%
hydrophobic and is able to maintain ad/absorbed oil on the water surface for extended periods of time without
any visual effect on the water column. Oil can be effectively recovered from Foam-X and Foam-X appears to
reduce the release of vapors from spilled hydrocarbons. 12 refs., 22 figs., 7 tabs.|
Key words: oil spills, sorbent, recovery systems, comparative evaluation, absorption, gas chromatography,
polyurethanes, chromatography, materials, organic compounds, organic polymers, petrochemicals,
polyamides, polymers, separation processes, synthetic materials.

1989. In situ investigations into the feasibility of bacterial oxidation of methane. CMRS Bulletin (India).
16:3:9, 11-12.
The technique of in-situ bacterial degradation of methane, using Methanotrophs, has been utilised in five coal
mines in India. In each case methane emission decreased, with treatment time ranging from 30 to 120 days.
Key words: coal seams, degassing, biodegradation, underground

mining, minerals resources, geologic
deposits.

1989. Bioprocessing of fossil fuels program: Summary of AR and TD sponsored activities for the period
01/01/89 through 03/31/89. 22.
An experiment was conducted to determine the effect of six different microorganisms on Illinois No. 6
solubilized coal. The microorganisms had been previously shown to alter or degrade dibenzothiophene
(DBT). Three methods were investigated to determine the effect of the microorganisms on the solubilized
coal. The methods were Fourier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy
(XPS), and pyrolysis/mass spectrometry (PY-MS). Pyrolysis/mass spectrometry (PY-MS), determines the
form of organic sulfur present in the coal by pyrolyzing a sample at high temperature in an inert atmosphere
and analyzing the fragments by mass spectrometry. This method can identify the molecular ion from each
organosulfur compound produced in the pyrolysis, which requires a library of known compounds as
references. Although there is at the present time a limited number of reference compounds, the method does
reveal differences or patterns amongst samples. In the present experiment, analysis of the solubilized coal in
the presence of organisms C18 and E1 showed an enhancement in the number of terpenoid-like compounds.
Additional analysis of the pyrolysis-mass spectral data showed the presence of several organosulfur
compounds in bacterially treated coal that were not identified in the untreated coal. These compounds were
tentatively identified as dibenzothiophene, benzothiophene and diphenyl sulfoxide. Organosulfur and
terpenoid structures may be more resistant to microbial degradation than other coal constituents such as
aliphatic or aromatic hydrocarbons. Thus, the enrichment of organosulfur and terpenoid structures in
microbially treated solubilized coal may be accounted for either by the degradation of readily metabolized
coal components leaving minor components more easily identified such as aliphatic and aromatics or
microbes may catalyze the formation of these compounds.
Key words: organic sulfur compounds, biodegradation, pyrolysis, chemical reactions, materials, measuring
instruments, mass spectrometers, coal, fossil fuels.

1990. New company tackles waste the way earth would. New Technology Week (July 9).
Key words: Waste Disposal, Oil Spills

1990. California firm touts bioremediation taracevicz: the system is clean, contained and reliable
Environment Week (July 12)
Key words: Bioremediation, Oil Spills

1990. Installation-restoration program: preliminary

assessment.Unpublished report prepared for 222nd Combat Communications Squadron, Costa Mesa Air National Guard Station, California Air National Guard, Costa Mesa, CA. Oak Ridge, TN: Martin Marietta Energy Systems, 54 pp.
Key words: Groundwater, Oil Spills, Waste Disposal, California
The preliminary assessment included the following activities: (1) An on-site visit, including interviews and field surveys; (2) Acquisition and analysis of information on past hazardous materials use, waste generation, and waste disposal at the station; (3) Acquisition and analysis of available geological surveys, hydrological data, meteorological data, and environmental data; and (4) Identification and assessment of sites where contamination of soils, groundwater and/or surface water may have occurred. Operations that have involved the use of hazardous materials and the disposal of hazardous wastes include vehicle maintenance and maintenance of aerospace ground equipment (AGE). The hazardous wastes disposed of through these operations include varying quantities of fuels, acids, points, thinners, strippers, solvents, and oils. The field surveys and interviews resulted in no sites being identified that exhibit the potential for migration of contaminants from toxic hazards such as oil spills, industrial wastes, etc.

1990. Manufacturers highlight selected insecticide products: an in-depth look at pest control chemicals. Agribusiness Worldwide 12(March):20

1991 (June). Strategic petroleum reserve annual site environmental report for calendar year 1990. Unpublished report prepared for the U.S. Department of Energy. 127 pp.
Key words: Groundwater, Oil Spills, Strategic Petroleum Reserve
This report, provided annually in accordance with DOE Order 5400.1, summarizes monitoring data collected to assess Strategic Petroleum Reserve (SPR) impacts on the environment. The report serves as a management tool for mitigating such impacts, thus serving the public interest by ensuring environmentally sound operation of the SPR. Included in this report is a description of each site's environment, and overview of the SPR environmental program, and a recapitulation of special environmental activities and events associated with each SPR site during 1990. The active permits and the results of the environmental monitoring program (i.e., air, surface water, groundwater, and water discharges) are discussed within each section by site. The quality assurance program is presented which includes results from laboratory and field audits and studies performed internally and by regulatory agencies. In general, no significant adverse environmental impact resulted from any SPR activities during 1990. Environmental areas of concern, such as potential groundwater contamination, are fully addressed in the applicable section by

site. The SPR continues to maintain an overall excellent environmental record. 22 refs., 15 figs., 29 tabs.

1991 (May). Bioremediation for marine oil spills. Unpublished report prepared for the Office of Technology Assessment. 39 pp.
Key words: Oil Spills, Bioremediation, Groundwater
The study examines the potential of bioremediation technologies to clean up marine oil spills and to minimize the damage they cause. Thus, the study evaluates a small, but highly visible, subset of the many possible applications of bioremediation technologies to environmental problems. Among the other applications for which bioremediation is being considered or is currently in use are: (1) treatment of nontoxic liquid and solid wastes; (2) treatment of toxic or hazardous wastes; (3) treatment of contaminated groundwater, and (4) grease decomposition. Although recent marine oil spills and bioremediation efforts have called attention to the potential of bioremediation as an oil spill response technology, some of the other applications, in particular the treatment of hazardous waste, appear to have greater potential. Officials at approximately 135 hazardous waste sites, for example, are now either considering, planning, or operating full-scale bioremediation systems.

1991. Proceedings of the 1991 ISA Marketing & Sales, Scientific Instrumentation & Research, Process Measurement & Control, Robotics & Expert Systems, Maintenance, & Water & Wastewater Division Symposia, June, Edmonton, Alberta, Canada.
Key words: Real-Time Monitoring, Oil Spills
The Proceedings of the Symposium contains 20 papers dealing with the following subjects: a metering research facility for the natural gas industry; automated sampling and analysis system for use in chemical defense related trials; design and testing of a microwave-based instrument for the measurement of water in oil sands flotation product; micromachined silicon sensors for pressure measurements; silicon mass airflow sensors in control systems; micro gas chromatography; applying low-power electronic gas flow measurement in a custody transfer environment; field computers for control and accuracy; measurement of pressure vessel wall coke; small process control applications using programmable controllers; PLC/DCS integration techniques; an intelligent motion control project; real time artificial intelligence applications at the Alberta Research Council; real time expert system advisory control applications in the control room; VIEW: the vision implementer's extensible workbench; the role of variable speed pumps and flow modulating valves in the control of Edmonton's water supply system; potential for energy conservation in Alberta 1988-2005; overflow protection alarm system with automatic self-checking fail-safe; monitoring of a recycle water

treatment plant at the Alberta Enmvironmental Centre; environmental issues in mined oil sands development.

1991. Chemical and biochemical micro-sensorss using semiconductors. French Technology Survey (Dec.):19 20.
Key words: Sensors, Gases
France: Chemical and biochemical semiconductor sensors have been produced from research conducted jointly by the Industry-Research Club and the Laboratory for the Physics & Chemistry of Interfaces (LPCI).
A field effect transistor or a captive structure in insulated silicon comprise the transducer portion of the sensors. LPCI has developed special ISFETs (Ion Sensitive Field Effect Transistors) for detecting ions, and molecular species such as glucose and urea have been detected via Enzymatic Field Effect Transistors (ENFETs). Sensitization methods similar to those used in producing these sensors are being used to develop intrinsic optical gas fiber sensors. For more information or subscriptions, contact: ADITECH, 96, Bd. Aguste Blanqui, 75013 Paris, France. Tel. 33 (1) 470 71441 or Tlx. 33 MRIACR 204643F.

1992 (November). Oil spill case histories, US and international, 1967 1991 (for microcomputers). National Oceanic and Atmospheric Administration, Seattle, WA. Data file, 10pp.
Key words: Oil Spills, Contingency Planning, Coast Guard, Remedial Action
By providing insights into past experiences, the database of oil spill case histories will benefit those involved in spill response and contingency planning. These case histories, developed by National Oceanic and Atmospheric Administration with significant funding and consultation by the U.S. Coast Guard Research and Development Center, are intended as planning aids for scientific and operational decision-making at spills, and to ensure that particular strategic elements are properly addressed in contingency planning. They can be used for constructing scenarios and for 'gaming' a spill. The information was collected from interviews with representatives of U.S. and international oil spill response agencies. The information covers significant spills in U.S. and international waters from 1967-1991 in which more than 100,000 barrels were spilled internationally or 10,000 barrels spilled in U.S. waters, dispersants or bioremediation agents were used, and involved severe environmental impacts. The disk includes a HyperCard stack of approximately 100 files. Each file represents one spill and is searchable using keywords and other descriptors, using standard HyperCard search functions. The disk also includes a keywork dictionary and an introduction describing the project.

1992. Public-health assessment for Whitehouse Waste Oil Pits,

Whitehouse, Duval County, FL, Region 4,
CERCLIS No. FLD980602767. Unpublished final report prepared for Florida State Dept. of Health and
Rehabilitative Services. Atlanta, GA: Agency for Toxic Substances and Disease Registry. 45 pp.
Key words: Florida, Groundwater, Waste Oils, Remedial Action, Waste Disposal, Hydrogen Compounds, Oil
Spills
The Whitehouse Waste Oil Pits National Priorities List (NPS) site is located about 0.5 miles northwest of the
community of Whitehouse in western Duval County, FL. After waste oil spilled into the northeast tributary of
McGirts Creek in 1968 and 1976, the Environmental Protection Agency stabilized and covered the remaining
waste oil from the abandoned oil recycling business. Soils and groundwater at the site are contaminated with
heavy metals, primarily lead. The residents are particularly concerned about children who play on the site
being exposed to toxic chemicals and about contamination of their private portable wells. Dermal contact
with the exposed waste oil is a likely exposure pathway for childen and other trespassers on the site. Dermal
contact with the waste oil by remediation workers and ingestion of contaminated gourndwater by nearby
residents are potential exposure pathways. The data and information have been evaluated for appropriate
health follow-up activities by the Agency for Toxic Substances and Disease Registry (ATSDR).

1992. Health Assessment for Sealand Restoration, Lisbon, St. Lawrence County, New York, Region 2.
CERCLIS No. NYD980535181. Preliminary report prepared for the New York State Dept. of Health.
Atlanta, GA: Agency for Toxic Substances and Disease Registry. 34 pp.
Key words: Groundwater, Oil Spills
The Sealand Restoration site is located in the Town of Lisbon, St. Lawrence County, New York. Sealand
Restoration, Inc., used the site in the late 1970s for the disposal of waste oil, oily debris (materials used in the
clean-up of oil spills), and drums of chemical in three on-site facilities: a drum storage area, a disposal pit,
and landspreading areas. These facilities comprise approximately 200 acres. On-site subsurface soils in the
pit area and shallow groundwater are contaminated. The most significant contamination is confined to the pit
area, which has been remediated and secured. St. Lawrence County and NYSDEC have cleaned up part of the
site; however, additional samples and monitoring are needed. Potential public health concerns are: (1)
approximately 25 private residences within 1 mile of the site are dependent on groundwater for drinking
water, and (2) exposure to remaining contamination on-site through direct skin contact with or ingestion of
subsurface soils could occur if the pit area is disturbed. Based on the information reviewed, the site is an
indeterminate public health hazard because further investigation

is required.

1993 International oil spill conference: Prevention, preparedness, response. In: Proceedings of the 13. biennial international conference on the prevention, behavior, control and cleanup of oil spills, March 29 April 1 1993, Tampa, FL, 931 pp.
Key words: Oil Spills, Environmental Effects, Petroleum, Biodegradation
This book contains the proceedings of the 1993 International Oil Spill Conference which took place March 29 - April 1 in Tampa, Florida. It was jointly sponsored by the American Petroleum Institute, the US Coast Guard, and the US Environmental Protection Agency. Topics discussed included all aspects of spill prevention and preparedness, including planning, training, and research and development. Response issues, including fate and effects of spilled oil, cleanup, bioremediation, and in situ burning were also discussed. Legal and economic issues were also analyzed in the form of case studies.

1993. Sandia tests oil slick detection technology. E&P Environment (July 9). Pasha Publications.
Key words: Oil slick

Aamand, Jens, Claus Jorgensen, Erik Arvin, and Bjorn K. Jensen. 1989. Microbial adaptation to degradation of hydrocarbons in polluted and unpolluted groundwater. Journal of Contaminant Hydrology. 4(4):299-312.
Key words: Groundwater, Pollution, Hydrocarbons, Degradation, Bacteria

Abbott, J.A., and D.J. Tookey.1993. Oil Spill Cleanup for Soft Sediments. In: Proceedings of the 13th bien api et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf (Tampa, Fla, 3/29/93 4/1/93) Proc Pp 117 121. (5 Refs).
Key words: oil spill, business operation, cleaning, mud (geology), salvaging, sediment (Geology), spill, transportation, vehicle, waste oil recovery, wetland accessibility, amphibious transportation, bearing capacity, capacity.

Abdul, A.S., T.L. Gibson, T.L., and D.N. Rai. 1990. Use of humic acid solution to remove organic contaminants from hydrogeologic systems. Environ Sci Technol. 24(3):328-333.
Key words: Oil Spill, Groundwater, Soil Pollution

Abdul, A.S., Kia, S.F., Gibson, T.L. (General Motors Research Labs., Warren, MI (USA)). 1989. Limitations of monitoring wells for the detection and quantification of petroleum products in soils and aquifers. The proceedings of the third national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods, National Water Well

Association outdoor action conference.
1611(p):357-372.
Key Words: Ground water contamination, ground water petroleum, oil spills environmental transport, water wells design, water wells monitoring, aquifers, fluid flow, sampling, soils, energy sources, fossil fuels, hydrogen compounds, mass transfer oxygen compounds.

Abdul, A. S. 1992. A new pumping strategy for petroleum product recovery from contaminated hydrogeologic systems: laboratory and field evaluations. Ground Water Monitoring Review 12(1):105 114.
Key words: Groundwater, Oil Spills
More than 200,000 gallons of automatic transmission fluid (ATF) leaked from an underground storage tank system and contaminated an area of about 64,000 ft (sup 2) of a soil and groundwater system. A pumping strategy for improved drainage and recovery of free oil was developed, tested in a laboratory model aquifer, and implemented (1) the oil recovery rate is carefully controlled to maximize the pumping rate while maintaining continuity between the oil layer in the soil and the recovery well, to avoid isolation of the oil in the subsurface; and (2) the rate of groundwater pumping is controlled to maintain the depressed oil/water interface at its prepumped position. This approach prevents further spread of oil into the groundwater, prevents reduction in the volume of recoverable oil due to residual retention, and maintains a gradient for oil flow toward the recovery well. In a model aquifer study, nearly 100% of the recoverable volume of ATF was pumped from the system, and about 56,000 gallons of the ATF has been recoverd from the field site.

Abdul, Abdul S., Thomas L. Gibson, and Shelia F. Kia. 1990. Contamination of soil and groundwater by automatic transmission fluid. Site description and problem assessment. Journal of Hydrology.
121(1-4):133-153.
Key words: Soil Pollution, Water Pollution, Oil Spill, Petroleum, Hazardous Wastes, Core Sampling
Soil and groundwater beneath a region of a manufacturing plant are contaminated with automatic transmission fluid (ATF). The extent of contamination was assessed by maximizing the use of real-time data from soil-core sampling and monitoring wells. The number, location, and depth of cores and of monitoring wells were determined during the investigation based on: (1) inspection and analysis of soil-core samples immediately after each core was taken; (2) physical and chemical measurements of core samples at the end of each day; (3) measurements in monitoring wells at several stages during the investigation. This approach differs significantly from the conventional approach of randomly placing wells through the hydrogeologic system. Soil cores were taken and

monitoring wells installed at 53 locations.
The perched aquifer extends to about 13ft. and is comprised
mainly of sandy materials, which have spatial
heterogeneity in size distribution and hydraulic properties.
About 208000 plus or minus 33000 gal. of ATF
has spread over an area of about 64000 ft.2. The region of ATF
contamination is comprised of three
distinct and contiguous layers. The center layer is about 2.6 ft.
deep at its thickest point and extends to
about 250 ft. at its widest point. The soil in this zone is about
85% saturated with 133000 plus or minus
21000 gal. of ATF, which has depressed the water table into the
aquifer. (Edited author abstract) 10 Refs.

Abdullah, Z. 1987. The potential use of remote sensing techniques
in environmental research and
monitoring programmes in Malaysia. In: Proceedings of the
Regional Seminar on the Application of
Remote Sensing Techniques to Coastal Zone Management and
Environmental Monitoring, November
18 26 1986, Dhaka, Bangladesh, pp. 205-206.
Key words: Remote Sensing, Environmental Monitoring, Oil Spills,
Pollution Detection
Details are given of some programs proposed by the Department of
Environment to the National Remote
Sensing Centre of Malaysia. Thefollowing activities are covered:
1) surveillance and monitoringactivities;
2) oil spill detection; 3) thermal discharge; 4) land use; 5)
strip mines, gravel pits and quarries; 6) point
sources monitoring; and 7) erosion and siltation.

Abercrombie, H.J. 1990. The influence of mircobial degradation of
hydrocarbons on natural and co-
produced water compositions, cold lake Bitumen deposit, Alberta.
In: Proceedings of the Annu Geol Soc
Amer et al Mtg, Oct 29-Nov1, 1990, Dallas, TX.
Key words: Bacteria, Biodegradation, Canada, Water Pollution,
Weathering

Abernathy, S. A. 1989. Drilling and production discharges and oil
spills in the marine environment.
Minerals Management Service, Herndon, VA. Atlantic OCS Region.
Report No.
OCS/EIS/EA/MMS-89-0065, 75 pp.
Key words: Offshore Drilling, Environmental Impacts, Crude Oil,
Water Pollution, Dispersion, Sorbents,
Containment
In compliance with the procedures and goals established by the
National Environmental Policy Act, the US
Department of the Interior, through the Minerals Management
Service, prepares Environmental Impact
Statements (EIS's) and other documentation for proposed Outer
Continental Shelf (OCS) Oil and Gas
Lease Sales. The report discusses the major issues and areas of
concern for the mid-Atlantic environment
that are considered in the planning process for oil and gas
leasing and operation on the OCS. The issues

are addressed with respect to the potential environmental consequences of mid-Atlantic oil and gas exploration, development, and production.

Aboul-Fetouh, Mostafa E. 1992. Felt efficiently absorbs oil in drum skimming operation.
Al-Azhr Univ. Cairo Egypt Oil Gas J. 90(3):46-7.
Key words: Textiles, Felt, Adsorbent, Petroleum, Oil Spills

Abrahams, Cdr. R. N. and E. R. Miller, Jr. Oil Spill Containment System Development and Testing
Program. In Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973
in Washington, D.C. Year.
Key words: oil spill, containment, development

Abril, M.A., Michan, C., Timmis, K.N., Ramos, J.L. 1989. Regulator and enzyme specificities of the
TOL plasmid-encoded upper pathway for degradation of aromatic hydrocarbons and expansion of the
substrate range of the pathway. Journal of Bacteriology. 171(12): 6782-6790.
In the present study, we analyzed the effector profile of the TOL plasmid upper pathway regulator, the
XylR protein, and the substrate profile of the TOL upper pathway enzymes, namely, toluene oxidase (TO),
benzyl alcohol dehydrogenase (BADH), and benzaldehyde dehydrogenase(BZDH). Our analyses showed
that TO activity is the main bottleneck for the transformation of certain substituted toluenes, such as
p-ethyltoluene and m-chlorotoluene. Isolation of one TO mutation in plasmid pWW0-EB62 which, in
addition, exhibits a modified meta-cleavage pathway for the metabolism of alkylbenzoates, allowed the
mineralization of p-ethyltoluene. Furthermore, transfer of the TOL plasmid into Pseudomonas sp. strain
B13 led to the isolation of m-chlorotoluene degraders|
Key words: specificity, effector, proteins, regulation(control), plasmid, catabolism, hydrocarbon, aromatic
compound, substrate specificity, enzyme, mutation, chlorocarbon, pseudomonas putida

Abuzar, M., and I. Al-Ghunaim. 1993. Classification of temporal thematic mapper data for the delineation
of an oil spill in the Arabian Gulf. Canadian journal of remote sensing. 19(2):179-185.
Key words: Arabian Sea, Remote Sensing, Pollution, Oil Spills

Achong, I., J. Bennett, C. Hatfield, and N. Boston. The Venezuelan National Oil Spill Contingency
Plan. In Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February
28 March 3, 1983 in San Antonio, TX Year.
Venezuelan, oil spill, contingency, plan

Acton, D.W., and J.F. Barker. 1992. In Situ biodegradation potential of aromatic hydrocarbons in

anaerobic groundwaters. Contam Hydrol. 9(4):325-352.
Key words: Hydrocarbons, Biodegradation, Groundwater, In-situ, Bacteria, Microorganism, Ontario
The anaerobic nature of many landfill leachate plumes sometimes hinders the biodegradation of aromatic hydrocarbons contained in the leachate. Static laboratory experiments, in situ biodegradation column experiments, and forced-gradient injection experiments were conducted to evaluate possible mechanisms by which the in situ biodegradation of landfill leachate aromatic hydrocarbons could be induced. Research focused on an Ontario, Canada, aquifer. Some aromatics, such as ethylbenzene, toluene, and several xylenes, were substantially biodegraded under anaerobic conditions even without inducements. Much of the biodegradation induced by the experimental in situ columns is thought to have been caused by fermentative and methanogenic bacteria.

Adams, J. K., A. J. Heikamp, Jr., and R. P. Hannah. Method For Ranking Biological Resources in Oil Spill Response Planning. In Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983 in San Antonio, TX Year.
Key words: biological, resources, oil spill, response, oil spill, response

Adams, R. B., J. W. Hayman, R. L. Eisenbach and T. E. Dove. Leaking underground hydrocarbon storage tanks: a worldwide problem requiring site-specific solutions. In: Proceedings of the First USA/USSR joint conference on environmental hydrology and hydrogeology, June 18 21, Leningrad, USSR. Kendall/Hunt Publishing Company: Dubuque, IA, pp. 2 10.
Key words: Oil Spills, Remedial Action, Underground Storage, Groundwater
The problem of hydrocarbons leaking from underground storage tanks (USTs) is a very serious concern in the US where there are an estimated 1,800,000 USTs, of which about 1,200,000 contain petroleum (hydrocarbon) products. Leaks and spills occur from tanks, product piping, connections, dispenser pumps, and overfilling. The issue of leaking USTs is not confined to the US, it is a worldwide problem. The USSR, a leading industrial nation, faces the same potential impact upon the environment, particularly drinking water supplies. Proper assessment of the environmental effect resulting from UST leaks and spills is essential so that responsible parties can determine what action is needed. Assessment procedures and techniques have been well refined in the US where much emphasis has been placed on remediating problems caused by leaking USTs. This paper presents (1) considerations applicable to most UST leak/spill assessment scenarios and (2) the elements of the UST leak/spill assessment process. The UST assessment process encompasses the range of assessment tasks from discovery

of a problem to design of a remedial
response.

Adams, R.H. 1991. Degradation of PCBs: Construction of
chlorobiphenyl-utilizing bacteria by continuous
amalgamated culture. California Univ., Riverside, CA (United
States). 135.
Recombinant strain Pseudomonas sp. CB15, which mineralizes
3000-chlorobiphenyl, was constructed from
Pseudomonas sp. HF1, which grows on 3-chlorobenzoate, and
Acinetobacter sp. P6 which grows on
biphenyl. The causes of the inability of the recombinant to also
utilize 3,3{prime}-dichlorobiphenyl
(3,3{prime} DCBP) were investigated. Incompatibility between the
meta- and ortho-fission pathways
during growth on 3-chlorobiphenyl was observed. The meta-fission
of 2,3-dihydroxybiphenyl, (the
nonchlorinated analogue of the metabolic intermediate
3-chloro-2{prime},3{prime}-dihydroxybiphenyl)
was affected by substrate inhibition and was also inhibited by
3-chlorocatechol. The ortho-fission of
3-chlorocatechol followed Michaelis-Menten kinetics but the
addition of 2,3-dihydroxybiphenyl inhibited
the reaction. The growth rate of 3-chlorobiphenyl was increased,
however, by the addition of surfactant or
by mechanical fragmentation of the substrate, which resulted in
complete mineralization in 2.8 days.
Nevertheless, neither of these methods allowed strain CB15 to
grown on 3,3{prime} DCBP. Addition of
3,3{prime} DCBP into the culture medium had no effect on the rate
of 3-chlorobiphenyl mineralization,
which indicates that toxic intermediates are not produced from
the transformation of 3,3{prime} DCBP.
The inability to grow on 3,3{prime} DCBP is more likely due to
the low transformation rate, which was
about one-fifth the rate of 3-chlorobiphenyl by resting cells.
Key words: bacteria, growth, chlorinated, biodegradation,
continuous culture, metabolism, pseudomonas.

Adams, William R. The Maine Law: A Precursor for the Oil
Terminaling States. In Proceedings of Joint
Conference on Prevention and Control of Oil Spills, June 15 17,
1971 in Washington, D.C. Year.
Key words: marine law, oil, terminaling

Adenekan, A.E., and T.W. Patzek. 1992. Removing petroleum
hydrocarbons from soil and groundwater
by steam injection: numerical modeling. In: Proceedings of the
ACS Explor, Characterization &
Utilization of Calif Heavy Fossil Fuel Resources Symp, April
5-10, 1992, San Francisco, CA, pp.
866-873.
Key words: Remediation, Soil Pollution, Water Pollution,
Groundwater, Tank, Oil Spill

Adriaens, P., Focht, D.D. 1990. Continuous coculture degradation
of selected polychlorinated biphenyl

congeners by Acinetobacter spp. in an aerobic reactor system. Environmental Science and Technology (United States). 24:7:0013-936X.
A coculture of two Acinetobacter spp. was applied to degrade polychlorinated biphenyls during a 42-day incubation study in a continuous aerobic fixed-bed reactor system, filled with polyurethane foam boards as support for bacterial biofilm development. The reactor was supplied with mineral medium containing 500 ppm sodium benzoate as a growth (primary) substrate, while the incoming airstream was saturated with biphenyl vapors to induce for PCB cometabolism in Acinetobacter sp. strain P6. The chlorobenzoates thus generated from 4,4{prime}-dichlorobiphenyl (4,4{prime}-DCBP), 3,4-dichlorobiphenyl (3,4-DCBP), and 3,3{prime},4,4{prime}-tetrachlorobiphenyl were further metabolized by Acinetobacter sp. strain 4-CB1. The chlorobenzoate metabolites, as well as ring-fission product ({lambda}{sub max} = 442 nm) from the PCB congeners, accounted for the degradation of 63% (2.8 mM) of the 4,4{prime}-DCBP, 100% (0.5 mM) of the 3,4-DCBP, and 32% (0.12 mM) of the 3,3{prime},4,4{prime}-TCBP, the biofilm responded with a concurrent higher release of chlorobenzoates and chloride through cosubstrate utilization.
Key words: chlorinated aromatic hydrocarbons, decomposition, chemical reactions.

Adriaens, P. 1989. Coculture degradation of selected PCB congeners by two Acinetobacter sp. California Univ., Riverside, CA (United States). 210.
Polychlorinated biphenyls (PCBs) have been introduced in the environment for nearly six decades and are considered to be refractile to microbial attack, since PCBs have to be degraded via cometabolic processes, which occur in the obligate presence of an alternative growth substrate. However, cometabolism of PCBs has been demonstrated to accumulate chlorobenzoates as the main intermediates. Therefore, the complete mineralization of PCBs can only be obtained by coculturing at least a PCB cometabolizing and a chlorobenzoate utilizing microorganism, or by constructing a recombinant strain harboring the complementary pathways of both strains. Therefore, coculture mineralization of PCBs in suspended culture was obtained by providing biphenyl or 4-chlorobiphenyl as the growth substrate for Acinetobacter sp. strain P6, a PCB cometabolizer, while the chlorobenzoates were used as growth substrates by Acinetobacter sp. strain 4-CB1, which was isolated on 4-chlorobenzoate. 4-Chlorobenzoate (4-CB) was metabolized after hydrolytic dehalogenation to 4-hydroxybenzoate (4-HB) via the protocatechuate pathway. Acinetobacter sp. strain 4-CB1 has the metabolic ability to carry out the degradation of 3,4-DCB. Although this strain does not grow on this compound, it cometabolizes 3,4-DCB to

3-chloro-4-hydroxybenzoate (3-C-4-OHB), which is used as a growth substrate and further metabolized via 4-carboxy-1,2-benzoquinone. This degradation process was termed cryptic cometabolism. 3,4-DCB has shown to be a substrate inhibitor (Ki = 1,840 {mu}M) and an uncompetitive inhibitor for 4-CB metabolism. Additionally, 3-C-4-OHB was a competitive inhibitor (Ki = 12 {mu}M) for the 4-HB monooxygenase, while the quinone uncompetitively inhibited 4-CB metabolism (Ki = 50 {mu}M).
Key words: bacteria, growth, chlorinated water, organic compounds, aromatic hydrocarbons.

Aeckersberg, F., F. Bak, F. Widdel. Anaerobic oxidation of saturated hydrocarbons to CO2 by a new type of sulfate-reducing bacterium. Arch. Microbiol. (1991): 156.
Key words: bacteria, hydrocarbons
n-Hexadecane added as electron donor and carbon source to an anaerobic enrichment culture from an oil production plant or to anoxic marine sediment samples allowed dissimilatory sulfate reduction to sulfide. A pure culture of a sulfate-reducing bacterium, strain Hxd3, with relatively tiny cells (0.4 0.5 by 0.8 2 mu m) was isolated that grew anaerobically on hexadecane without addition of further organic substrates. Measured degradation balances and enzyme activities suggested a complete oxidation of the alkane to CO 2 via the carbon monoxide dehydrogenase pathway. The new sulfate reducer grew on alkanes from C12 to C20, 1-hexadecene, 1-hexadecanol, 2-hexadecanol, palmitate and stearate. Best growth occurred on stearate (doubling time around 26 h).

Aelion, C. Marjorie, Bradley, Paul M., McMahon, Peter B. 1990. Potential for in situ bioremediation of a jet fuel spill near Charleston, South Carolina. Abstracts - American Association for the Advancement of Science. Pacific Division. Annual Meeting. 156:29.
Key Words: South Carolina, environmental geology, reclamation, Southeastern U.S. Eastern U.S., United States, Charleston, South Carolina, Charleston County, South Carolina, oil spills, bioremediation, sediment, ground water, hydrocarbons, organic materials, aquifers.

Aggarwal, P.K., Hinchee, R.E. 1991. Monitoring in situ biodegradation of hydrocarbons by using stable carbon isotopes. Environmental Science and Technology (United States). 25:6:0013-936X.
Spilled or leaked nonhalogenated petroleum hydrocarbons in the soil can generally be metabolized by indigenous, aerobic bacteria. In situ biological degradation of hydrocarbons may be accelerated by supplying inorganic nutrients and/or oxygen. Approaches to monitoring and verifying enhanced in situ biodegradation have included measurements of changes over time in the (a) concentration of hydrocarbons,

(b) temperature, (c) number of hydrocarbon-degrading microorganisms, (d) ratio of fast-degrading hydrocarbons (e.g., pristanes or phytanes), and (e) metabolic intermediates. Measurements of oxygen consumption over time and elevated carbon dioxide concentrations in soil gas also have been used as indicators of hydrocarbon degradation. An alternative approach that may help substantiate biodegradation is to measure stable carbon isotope ratios in soil gas CO{sub 2}. Stable carbon isotope ratio analysis is inexpensive and commercially available at many laboratories. Carbon dioxide produced by hydrocarbon degradation may be distinguished from that produced by other processes based on the carbon isotopic compositions characteristic of the source material and/or fractionation accompanying microbial metabolism. Here the authors demonstrate the applicability of the stable isotope technique for monitoring enhanced aerobic biodegradation of hydrocarbons using data from three locations in the United States.
Key words: oil spills, biodegradation, carbon dioxide, hydrocarbons.

Aggarwal, P. K., Means, J. L., Hinchee, R. E., Headington, G. L., Gavaskar, A. R. July 1990. Method to Select Chemicals for In Situ Biodegradation of Fuel Hydrocarbons.
Final rept. Nov 88-Jan 90. 167.
Key Words: Aquifers batch processing, biodeterioration, chemicals, citrates, formulations, fuels, geochemistry, ground water, hydrocarbons, hydrogen peroxide, laboratory procedures, laboratory tests, models, nutrients, phosphates, precipitation, scientists, simulators, solubility, stabilization systems, test and evaluation, transport.

Agnedal, P. O. Tagging Oil-Residues in Tankers with Microparticles. In Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973 in Washington, D.C. Year.
Key words: oil-residues, tankers, microparticles

Ahmad, D. Sylvestre, M. Bergeron, J. Larose, A., Shareck, F., Sondossi, M. 1993. Cloning, sequencing and expression of bph D gene involved in degradation of 2,hydroxy-6-oxo-6-phenylhexa2,4-dienoic acid (ring-metacleavage compound) to benzoic acid in BP/PCB-degrading Pseudomonas testosteroni, strain B-356 and its homology to other published gene sequences.
Abstracts of the Annual Meeting of the American Society for Microbiology (United States). 401.
Short communication.
Key words: polychlorinated, biphenyls, biodegradation, pseudomonas, amino acid sequence, benzoic acid, bph, cloning, gene recombination,, protein, engineering, amines, aromatics, bacteria, carboxylic, acids, chemical, reactions, chlorinated, aromatic, hydrocarbons, decomposition, halogenated, aromatic,

hydrocarbons, hydroxy, compounds, microorganisms, molecular, structure, monocarboxylic acids,
organic acids, organic chlorine compounds, organic compounds, organic halogen compounds.

Ahola, Pekka J., Jorma Pallonen, and Martti Hallikainen. 1991. X-band side-looking airborne radar for
remote sensing. In: Proceedings of the 1991 International Geoscience and Remote Sensing Symposium -
IGARSS'91, Espoo, Finland, pp. 607 608.
Key words: Radar, Remote Sensing
A side-looking airborne radar (SLAR) has been designed and constructed. The SLAR provides a
microwave backscattering image of the target. The maximum measurement distance is 19 km. The spatial
resolution of the radar is presently about 75 m by 75 m. The radar has been tested using a helicopter but it
is possible to use the equipment in an airplane as well. The applications of the SLAR are mapping of sea
ice, forests and oil spills.

Aiken, George R., Capel, Paul D., Furlong, Edward T., Hult, Marc F., Thorn, Kevin A. 1991.
Mechanisms controlling the transport of organic chemicals in subsurface environments. Water-Resources
Investigations. 633-637.
Key Words: Minnesota, pollution, ground water, environmenta geology, oil spills, transport, USGS,
Midwest, United States, North-Central Minnesota, Bemidji, Minnesota, Beltrami County,
Minnesota, aquifers, controls, organic materials.

Aines, R., Newmark, R., McConachie, W., Rice, D., Ramirez, A. March 1992. Dynamic Underground
Stripping Demonstration Project. Interim progress report, 1991. Lawrence Livermore National Lab., CA.
15(p).
Key Words: Gasoline, soils, tanks chemical spills, ground water, Lawrence Livermore Laboratory, leaks,
plumes, pollution control, progress report, removal, underground storage.

Aislabie, Jackie, Asim K. Bej, Harrell Hurst, Stephen Rothenburger, and Ronald M. Atlas. 1990.
Microbial degradation of quinoline and methylquinolines. Applied & Env Microbiology. 56(2):345-351.
Key words: Microorganism, Hydrocarbons, Bacteria, Groundwater, Degradation
Bacterial cultures were isolated that are able to degrade quinoline and to transform or to degrade
methylquinolines. The degradation of quinoline by Pseudomonas strains produced hydroxyquinolines and
other undetermined products. The quinoline-degrading strains of P. aeruginosa and P. putida hydroxylated
a limited number of methylquinolines but could not degrade them. P. aeruginosa was able to degrade or to
transform quinoline and other methylquinolines in a complex

heterocyclic nitrogen-containing fraction of a
shale oil.

Aivasidis, A., Wandrey, C., Hilla, E. 1989. Studies on reaction techniques concerning reactor design for
the anaerobic degradation of complex substrates with the example of the methanation of effluents in the
fermentation industry. Bioprocess Eng.(Germany, Federal Republic of). 4:2:63-74.
Two fixed-bed loop reactors were used to evaluate single- and separated-phase anaerobic treatments of a
high strength waste-water from ethanol fermentation. The one-phase system consisted of an anaerobic
fixed-bed loop reactor containing both acidogenic as well as methanogenic populations allowing a complete
conversion of the carbon source into gaseous end products and biomass. The two-phase system consisted of
a second fixed-bed loop reactor operated as a methanogenic unit, which was proceeded by a CSTR for
acidification, both connected in series allowing sequential acidogenesis and methanogenesis of the organic
components. The reactors were operated under steady state and variable process conditions. By gradually
increasing the feed supply in both systems, maximum turnover of COD was determined. The
separated-phase system consistently gave a better quality effluent with lower suspended solids and total
COD. Maximum loading rates and COD elimination of the methanogenic phase of the two-phase system
was over two times higher than that of the one-phase system. Proxess stability was also higher. On
overloading the methane reactor of the two phase system accumulation of different fatty acids within the
reactor was observed. Hydrogen concentration in the biogas can be used as a reliable indicator for system
overloadings. At least, continuous online monitoring of hydrogen in the methanogenic reactor gas should
provide a convenient alternative to other analyses for process control.
Key words: bioreactors, anaerobic digestion, biodegradation, chemical oxygen demand, bioconversion,
chemical reaction, gas yields, packed bed, substrates, elements, hydrocarbons.

Akhter Hossain, M., Yavuz Corapcioglu, M. Nov-Dec 1988. Modifying the USGS solute transport
computer model to predict high-density hydrocarbon migration. Ground Water. 26(6):717-723.
Key Words: Water pollution, oil spills, aquifers, computer simulation, flow of water mathematical
models, water resources groundwater, geochemistry groundwater, hydrocarbons.

Akin, C., Smith, J. 1990. Gas, oil, coal, and environmental biotechnology III. 3. Institute of Gas
Technology (IGT) annual oil, gas, coal, and environmental biotechnology symposium. 291-301:546.

Dibenzyldisulfide (DBDS), a compound that serves as a model for disulfide functional groups in coal and petroleum, was reductively degraded by mixed cultures of strict anaerobic bacteria. That cultures were obtained from such diverse sources as pond sediment and anaerobically stored swine waste suggests that reduction and subsequent desulfurization of disulfides is a common activity in anaerobic environments. To monitor DBDS degradation, whole culture hexane extractions were analyzed for DBDS remaining using GC-FID. Up to 37% degradation occurred within 12 days at 25 C under N{sub 2}. Sulfurous products included H{sub 2}S, dimethyl sulfide (DMS) and benzyl mercaptan (BM), which is a probable intermediate in the degradation pathway. A desulfurized product, toluene, was identified using GC-MS. Attempts are underway to optimize this activity, the goal being to develop an organic biodesulfurization method for coal.
Key words: desulfurization, petroluem, anaerobic, digestion, chemical reactions.

Akin, C., Smith, J. 1991. Gas, oil, coal, and environmental biotechnology III.
3. Institute of Gas Technology (IGT) annual oil, gas, coal, and environmental biotechnology symposium.
39-54:546.
New molecular tools are being developed and tested to ascertain the biodegradability of hazardous wastes by soil bacterial population. The potential for manufactured gas plant (MGP) soil bacterial populations to degrade naphthalene, as a component mixture of polynuclear aromatic hydrocarbons, was evaluated by the detection of a naphthalene biodegradative genotype by DNA probe hybridization with DNA extracts and colonies of cultured bacteria of the MGP soils. The activity of the naphthalene-degrading populations was evaluated by mineralization assays, {sup 14}CO{sub 2} production from {sup 14}C-naphthalene. Direct messenger RNA (mRNA) extraction from MGP soil was evaluated as an instantaneous measure of naphthalene catabolic gene expression in MGP soil. The bioavailability of naphthalene for bacterial degradation within the MGP soils was assessed by measuring the bioluminescent response of a naphthalene-lux catabolic reporter strain Pseudomonas fluorescens HK44 (pUTK21). DNA extracted from 5 MGP soils and 1 creosote-contaminated soil and hybridized with a nahA gene probe indicated that the naphthalene degradative genes were present in all samples in the range of 0.06 to 0.95 ng/100 {mu}l DNA extract which was calculated to represent 3.58 {times} 10{sup 8} to 1.05 {times} 10{sup 10} nahA positive cells/g soil. Phenanthrene, anthracene, and benzo(a)pyrene were mineralized also by some of the soils.
NAH7 homologous messenger RNA transcripts were detectable in one MGP soil and in the

creosote-contaminated soil.
Key words: bacteria, bioassay, biodegradation, anthracene, benzopyrene.

Al-Saad, Hamid T., and Amina A. Al-Timari. 1989. Distribution of polycyclic aromatic hydrocarbons
(PAH's) in marsh sediments, Iraq. B Env Contam & Tox. 43(6):864-869.
Key words: Hydrocarbons, Iraq, Hydrocarbons, Degradation
Anthropogenic PAHs can be harmful to the aquatic environment. They accumulate in bottom sediments
due to their high affinity to sorb to the suspended particulate matter and to their low water solubility. In the
southern marsh region of Iraq, sediment samples were collected with a van Veeb grab sampler and a
phleger type corer. Grain-size and total organic carbon analyses were performed. PAH persisitence was
found to be related to molecular weight^low weights being volatile and more rapidly degraded with
microorganisms. Organic matter content and grain-size properties may effect organic compound
preservation and transport and absolute quantity of sedimentary hydrocarbons. The main factor found was
organic matter-enriched clay and silt particle settlement. Both anthropogenic and biogenic PAHs have
contaminated the marshes, but the low levels found are attributable to photo-oxidation and bacterial
degradation.

Al-Thukair, A. 1993. Environmental status of algal mat sites located at the east coast of Saudi Arabia
following the Gulf War. In: Proceedings of the 1993 meeting of the Phycological Society of America
(PSA), August 1 5 1993, Ames, IA, 29:Suppl.3, 22pp.
Key words: Algae, Biological Effects, Oil Spills, Biological Effects, Remote Sensing
Remote sensing techniques and ground truth verification were used to provide information on algal mat
locations and damage intensity caused by the oil spill. Pre and post oil spill satellite images, ground truth
assessment were compared for damage evaluation. Locations and sites status (heavily oiled, recovering,
and no algal mats) were conveyed in maps. Recovered sites are found in Abu Ali and Tanajib areas.
However, recovery seems to be slower in Abu Ali area as compared to Tanajib. Different types and
formations of algal mats were found in both areas. This differentiation is more likely to be attributable to
coastal topography and tide regimes.

Al-Nakib, Capt. Namir A. The Kuwait National Contingency Plan in Action. In Proceedings of the 1987
Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987 in Baltimore, MD Year.
Kuwait, contingency, plan

Al-Saad, H.T., and A.K. Al-Timari. 1993. Seasonal variations of

dissolved normal alkanes in the water
marshes of Iraq. Marine pollution bulletin. 26(4):207-212.
Key words: Water Pollution, Bacteria, Hydrocarbon, Biodegradation
The distribution and seasonal variations of n-alkanes in the
dissolved water of the marshes have been
determined by gas-chromatography. Temperature variations,
including evaporation, bacterial degradation
and adsorption as well as photochemical oxidation, are postulated
to produce pronounced seasonal
variations of n-alkanes in the water. Higher concentrations of
n-alkanes were observed in the winter than
in the summer. The n-alkanes showed a regular distribution
pattern of the odd and even carbon number
compounds between C13 to C34 with additional characteristics
associated with biological phenomena;
abundance of C17, C19 of algal origin and C25, C27, C29 of
terrestrial plant inputs was evident.

Al-Rabeh, A.H., H.M. Cekirge, and N. Gunay. 1992. Modeling the
fate and transport of Al-Ahmadi oil
spill. Water, Air and Soil Pollution. 65(3-4):257-279.
Key words: Oil Spills, Environmental Impact
Over the period January-May 1991 Iraqi forces, occupying the
state of Kuwait, caused a massive amount
of oil to be released in the waters of the Arabian Gulf. The
volume of oil released may have been as large
as 6 multiplied by 106 bbls. Most of the oil was released at or
near Mina Al-Ahmadi in southern Kuwait.
Two mathematical models, GULFSLIK II and OILPOL, were used to
simulate the fate and transport of oil
spilled at Al-Ahmadi. The oil spill trajectory model GULFSLIK II
was used in an operational real time
mode to predict the surface trajectory of oil spills at various
locations. The real time trajectory analysis
was used to support tactical spill response. Short term
predictions were made using 7-d wind forecasts.
Long term predictions were made using monthly wind averages.
Comparisons between predicted
trajectories and actual sightings show that GULFSLIK II is
reasonably accurate. The oil spill fate and
transport model, OILPOL, was applied to compute surface and
subsurface distribution of oil, and analyze
the fate of the spilled oil. An oil spill size of 4 multiplied by
106 bbls was assumed. OILPOLL results were
used to support damage assessment studies and environmental
impact statements. The distribution of oil on
the surface and subsurface layers were obtained daily for a
period of 80 d. Oil concentration at strategic
locations in the Gulf were also computed. Surface oil
distribution as predicted by OILPOL was compared
with sighting data. The results show excellent agreement. (Author
abstract) 18 Refs.

Al-Mazidi, S.M., and O. Samhan. 1987. A survey of oil spill
incidents and dispersant applications in
Kuwait. In: Proceedings of the 1987 API - EPA - U.S. Coast Guard
Oil Spill Prev. Behavior Control

Cleanup Conf., March 6 9 1987, Baltimore, MD, API PUBL. N.4452, pp. 247-53.
Key words: Animal, Crude Oil, Environmental Impact, Pollution Control

Al-Ghunaim, I., M. Abuzar, F.S. Al-Qurnas. 1992. Delineation and monitoring of oil spill in the Arabian
Gulf by using Landsat thematic mapper (TM) data. In: Proceedings of the 1st US Environ Protect Agency
et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA,
2:1151-1160.
Key words: Environmental Pollution, Oil Spill, Remote Sensing, Oil Spill, Soil Pollution

Al-Mallah, M., Goutx M., Mille G., Bertrand, J.C. 1990. Production of emulsifying agents during growth
of a marine Alteromonas in sea water with eicosane as carbon source, a solid hydrocarbon. Oil &
chemical pollution. 6: 289-305.
Key words: water pollution, experimental study, degradation, bacteria, alteromonas, analysis method,
parameter, salinity, emulsification, application.

Alba International 1991. Gulf war: Bureaucracy clogs clean-up. Chemistry and Industry. 4:106.
Key words: Animal, Biology, Bird, Business Operation, Cooling Equipment, Crude Oil, Diaster Control,
Economic Factor, Pollution Control

Alba opd ltd. 1988. Cork granules handle oil spillage. PET. REV. 42(501):32.
Key words: Additive, Adsorbent, Boom, Fuel Oil, Oil Waste, Pollution Control, Equipment, Tanker,
Washing

Albasri, S.A.I. 1992. Spillage recovery. Patent No. GB 2250450A920610, 15 pp.
Key words: Oil Skimming, Oil Spill, Pollution Control, Crude Oil, Remote Sensing

Alberts, Donald A. Clean Caribbean Cooperative. In Proceedings of the 1979 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979 in Los Angeles, CA Year.
Key words: Caribbean

Alberts, Donald A., Sr., LCDR William C. Park III. 1975. An Organization plan for minimizing the
damaging effects of a major oil spill. In: Proceedings of the 1975 Conference on Prevention and Control
of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil spill.

Aldrich, T.L., Frantz, B., Chakrabarty, A.M., Hemphill, D.D. 1987. Molecular evolution of genes for
the degradation of synthetic environmental pollutants. Trace

substances in environmental health-XXI. 21.
annual conference on trace substances in environmental health.
329-340.
Synthetic compounds, particularly highly chlorinated aromatics, are widely used in our society. Although they are usually beneficial, the environmental pollution problems they occasionally create must be addressed. Despite the fact that such compounds are generally recalcitrant to microbial degradation, some bacteria are capable of dissimilating many synthetic compounds having a low degree of chlorination. Studies have demonstrated that many of the enzymatic activities required are plasmid-encoded. Amino acid sequences of several degradative enzymes are available, and they have significant homology, either near active sites of throughout the sequences, with chromosomal genes encoding enzymes for analogous reactions. Comparative sequence homology studies, as well as the presence of putative insertion sequence elements located near new degradative genes, suggest that gene duplications and divergence along with illegitimate recombinations may be involved in the evolution of new catabolic functions. Understanding these evolutionary mechanisms is essential for the development of improved microorganisms capable of catabolizing recalcitrant, highly chlorinated compounds present in the environment.
Key words: chlorinated aromatic hydrocarbons, amino acid sequence, biological evolution, enzyme activity, halogenated aromatic hydrocarbons, chemical reactions, decompostion, organic halogen compounds, molecular structure, gene recombinatino, genes.

Aleev, R.M., and V.A. Ovsyannikov. 1992. Effectiveness of airborne thermal-imaging equipment for detecting oil contamination of water surfaces from their polarization contrast. Soviet Journal of Optical Technology. 59(10):592-593.
Key words: Polarization, Oil Spills, Thermal Analysis, Water Pollution, Remote Sensing
The possibility of detecting oil films on a water surface by means of airborne thermal-imaging equipment using the different degree of polarization of the intrinsic radiation of clean and contaminated water surfaces is evaluated. The required values of the basic technical parameters of this equipment are determined. 7 refs.

Alejandro, A.C., J.L. Buri. 1987. M/V alvenus anatomy of a major oil spill. In: Proceedings of the 1987 API - EPA - U.S. Coast Guard oil spill prev. behavior control cleanup conf., April 6 9 1987, Baltimore, MD, API PUBL. N.4452, pp. 27 32.
Key words: Accident, Beach, Boom, Crude Oil, Pollution Control

Alejandro, Capt. Anthony C., Lt. Alvin M. Crickard. 1989. Corpus Christi Catastrophe: case of a classic

cleanup. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words; cleanup.

Alexander, M. 1989. Biodegradation of Chemicals at Trace Concentrations. Army Research Office, Research Triangle Park, NC. Report No. ARO-23543.19-LS, 28 pp.
Key words: soil pollution, water pollution, groundwaters, biodeterioration
Studies were conducted to evaluate factors affecting the biodegradation of toxic and hazardous organic chemicals in soils and surface, ground and waste waters. The factors determined to be of importance to these transformations and to proposed bioremediation actions were protozoan predation, inorganic nutrient supply, concentration of the test organic compound, the presence of inhibitors and alternative sources of biodegradable molecules, and the sorption and water solubility of the toxicants. Keywords: Soil pollution, Water pollution, Pollution, Mineralization, Soils, Groundwaters, Chemical fate, Inoculation. (AW).

Alexander, Steve K., James W. Webb, Jr. 1983. Effects of oil on growth of Spartina alterniflora. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: Spartina alterniflora.

Alexander, Steve K., James W. Webb, Jr. 1985. Seasonal response of Spartina alterniflora to oil. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25-27, Los Angeles, CA.
Key words: Spartina alterniflora.

Alexander, M. 1991. Research needs in bioremediation. Environ Sci Technol. 25(12):1972 1973.
Keywords: Alaska, biodegradation, bioremediation, government, microorganism, oil spill, pipeline leak, Prince William Sound, regulatory agency, soil pollution, soil remediation, water pollution

Alexander, S.K., and J.W. Webb. 1987. A field study of the relationship of spartina alterniflora (smooth cordgrass) growth to sediment oil content following an oil spill. In: Proceedings of the 1987 API - EPA - U.S. Coast Guard Oil Spill Prev. Behavior Control Cleanup Conf., March 6 9 1987, Baltimore, MD, API Publ. N.4452, pp. 445-49.
Key words: Beach, Boom, Concentration, Crude Oil, Environmental Impact, Pollution Control

Alexander, A. Gilliam, Zettowoch, Douglas D., Unthank, Michael D. Burns, Robert B. 1992.
Contamination of soil, soil gas, and ground water by hydrocarbon

compounds near Greear, Morgan
County, Kentucky. Water-Resources Investigations.
Key Words: Alluvium, clastic sediments, crude oil, gas
chromatograms, Greear, Kentucky, ground
water, hydrocarbons, hydrochemistry, Kentucky, Morgan County,
Kentucky, Northwestern Kentucky, oil
spills, organic materials, pollution, sediments, soil gases,
United States, USGS, volatile organic
compounds, volatiles.

El-Kadi, Aly I., Elnawawy, Osman A., Kobe, Pamela K. van der
Heijde, Paul K.M. 1991. Modeling
multiphase flow and transport. GWMI (International Ground Water
Modeling Center). 91(4).
Key Words: Pollution, ground water, soils, transport, oil
spills, hydrocarbons, organic materials,
underground storage, models multiphase flow, NAPL, nonaqueous
phase liquids.

Alexander, Maurice M., Patricia Longabucco, David M. Phillips.
1981. The Impact of Oil on Marsh
Communities in the St. Lawrence River. In: Proceedings of the
1981 Oil Spill Conference (prevention,
behavior, control, cleanup), March 2-5, Atlanta, GA.
Key words: oil, marsh.

Alexander, Steve K., James W. Webb, Jr. 1987. Relationship of
Spartina alterniflora growth to sediment
oil content following an oil spill. In: Proceedings of the 1987
Oil Spill Conference (prevention, behavior,
control, cleanup), April 6 9, Baltimore, MD.
Key words: Spartina alterniflora.

Alfieri, D.J. 1987. Lessons to be learned from an oil spill.
Pollut. Eng. 19(6):40-41.
Key words: Amendment, Boom, Construction, Diesel Fuel, Economic
Factor, Pollution Control, Oil Spill,
Stream

Alleman, J.E. 1988. Respiration-based evaluation of nitrification
inhibition using enriched Nitrosomonas
cultures. In: Proceedings of the Conference on Biotechnology for
Degradation of Toxic Chemicals in
Hazardous Wastes, August 1986, Arlington, VA, pp. 642-650.
Key words: Bacteria, Biodegradation, Industrial Wastes,
Monitoring, Waste Water
The enriched Nitrosomonas bioassay procedure described in this
paper has proven to be an extremely
useful, expedient, and cost-effective mechanism for the rapid
evaluation of waste water toxicity. Extending
beyond this immediate application, the procedure has been
employed for investigative evaluations of
suspected industrial waste generators. Furthermore, this test has
been successfully used to diagnostically
determine appropriate dilution levels for industrial waste
streams at their respective sewer outfalls.
Although this bioassay may be completed with either respirometric
on oxygen uptake rate or colorimetric

(based on NH4-N oxidation rates) analyses, the oxygen uptake rate (OUR) strategy appears preferable due to its simplicity. Monitoring of the ammonium-nitrogen oxidation rate with a colorimetric NH4-N test requires tedious sample clarification and treatment. Within an eight workday, two laboratory technicians can routinely complete between 100 and 200 bioassay tests based on the OUR procedure; this number of samples is approximately four times larger than that which can managed with the colorimetric procedure. As with any bioassay procedure, questions may be raised about the inherent reliability and veracity of the tests. In the particular case of its use by the City of Indianapolis, however, the enriched Nitrosomonas bioassay technique has proven to be an excellent indicator procedure.

Allen, A.A. 1991. Oil spill response blowouts at sea. 1st Victorian Dep. Manufacturing Ind. Develop. et al. Offshore Australia Conf., November 25 27 1991, Melbourne, Australia, Petroleum Abstracts, Abstr. No. 538,507 32(48).
Key words: Abstract, Additive, Business, Operation, Contingency Plan, Pollution Control

Allen, A.A., and E.M. Fischer. 1988. Test and evaluation of a new and unique fire containment boom. Spill Technology Newsletter (Canada). pp. 48-54.
Key words: oil retention booms, evaluation, fire resistance, testing, water pollution control
During the fall of 1987, a new concept for fire containment booms was evaluated during burn tests in Hastings, Minnesota, and in Kenai, Alaska. The 3M Company used specially fabricated, high-temperature ceramic materials to develop a curtain boom with semi-solid flotation. The fire containment boom was designed to appear and function as a conventional boom with a sacrificial outer layer covering its internal fire-resistant components. Test sections of boom with a cylindrical buoyancy component 25.4 cm in diameter were formed into closed loops and subjected to a continuous flow of oil (heptane and Prudhoe Bay crude). The oils were ignited exposing the test booms to peak flame temperatures typically between 800{degree}C and 1000{degree}C. Following tests with total exposures and six hours (with heptane) and 24 hours (with crude oil), the booms were found to have minimal thermally-induced degradation of their ceramic components and no degradation of their primary structural members above and below water. The burn tests and subsequent sea trials in Port Canaveral, Florida, involving 152 m of fire boom reveal that the boom will survive prolonged exposures to burning oil and that the boom has good sea-keeping and oil-containment characteristics while under tow in light seas. This project has provided important information leading to the development of a unique oil spill

containment barrier for controlling an
accidental fire or for enhancing a deliberate attempt to burn oil
in situ. 9 refs., 11 figs.

Allen, A.A. 1990. Contained controlled burning of spilled oil
during the Exxon Valdez spill. In:
Proceedings of the Thirteenth Arctic and Marine Oil Program
technical seminar, June 6 8 1990,
Edmonton, AB, pp. 305 313.
Key words: Alaska, oil spills, combustion, field tests, oil
retention booms, performance
During the evening of the second day following the Exxon Valdez
oil spill, an estimated 15,000 to 30,000
gal of North Slope crude oil were eliminated using in-situ
combustion techniques. The oil was collected
with a fire resistant boom towed in a U-configuration behind two
fishing boats. Working with 500 ft long
tow lines, a 450 ft long boom was moved at about {1/2} to 1 knot
through slightly emulsified oil patches in
the downwind region of the spill. Once oil had filled the
downstream portion of the U, and the boats were
clear of any surrounding slicks, a gelled-fuel igniter was
released from one of the tow boats. Shortly after
ignition, flames gradually spread out over the entire area of the
contained oil. As flames reach 200 to 300
ft into the air, the area of the contained oil layer (and
therefore the size and intensity of the fire) could be
controlled by adjusting the speed of the vessels. The total burn
time was approximately 1 h 15 min; the
intense part of the burn lasted for about 45 min. Using several
methods to estimate the volume of oil
collected, this volume (likely between 15,00 and 30,000 gal)
resulted in approximately 300 gal of stiff,
taffy-like burn residue that could be picked up easily upon
completion of the burn. The controlled
elimination of crude oil therefore resulted in an estimated 98%
or better efficiency of burn. 5 figs.

Allen, A.A. 1992. Oil spill burned at sea. Pollution Prevention,
2(4):47,49-50.
Key words: environment, transport & storage, health, environment,
water pollution control, boom, crude
oil

Allen, A.A. 1991. Controlled burning of crude oil on water
following the grounding of the Exxon Valdez.
In: Proceedings of the API - EPA - USCG 1991 Oil Spill
Prevention, Behavior, Control, Cleanup
Conference, March 4 7 1991, San Diego, CA, API Publication
N.4529, pp. 213 16.
Key words: Accidental Fire, Alaska, Boom, Crude Oil, In-situ,
Incineration, Pollution Control, Waste
Material

Allen, Alan A. 1988. Comparison of response options for offshore
oil spills. In: Proceedings of the Env
Canada Arctic & Marine Oilspill 11th Technical Sym, June 7 9

1988, Vancouver, B.C., pp. 289 307.
Key words: Oil Spill Cleanup, Marine Pollution Equipment, Oil Skimmers
Oil spill response options in an offshore environment entail the use of mechanical cleanup systems,
chemical dispersants, and/or in situ burning. Each response approach can be associated with a specific set
of operational, environmental, and oil slick conditions. Pictorial representation of these conditions and
related performance characteristics reveal acceptable operating windows for each response method. By
translating these operational windows into comparative plots of spill access and control rates, meaningful
assessments can be made of the relative merits of each response action. Such assessments for major
offshore oil spills provide the basis for determining the most effective use of available resources needed for
mechanical, chemical, and burning techniques.

Allen, P.G. 1993. Biosurfactant production by gasoline-degrading bacteria from a contaminated aquifer.
Rice University, Houston, Tx. MS Thesis. Masters Abstr Int. 31(1):255.
Keywords: biodegradation, hydrocarbon, oil spill, remediation

Allen, M.A., and J.T. Fetcko. Oil Spill Recovery Method and Apparatus. Exxon Chemical Patents In.
World 92/19814, p 11/12/92, f 5/8/92, pr US 5/8/91 (Appl 697090) (E02b-015/04; d04h-001/56) pct gaz v
1992, no 28, p 13034, 11/12/92 (issn 02507757; abstract only) (ao)
1992
Key words: waste oil recovery, absorbent, absorption, business operation, marine transportation

Allen, T.E. Solve Your Spill Response Problem with a Cooperative. Halliburton Services
Pennwell Conf & Exhibit Co Petro-Safe 92 Conf (Houston, 1/27-29/92) Proc book 3, PP 873-879, 1992
(3 refs)
1992
Key words: oil spill, administration, association, business operation

Allen, Tom E. 1985. New concepts in spraying dispersants from boats. In: Proceedings of the 1985 Oil
Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: dispersants.

Allen, Alan A., William G. Nelson. 1981. Oil spill countermeasures in landfast sea ice. In: Proceedings of
the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: sea, oil spill.

Allen, A.A. 1991. In-situ burning of spilled oil. Spill

Technology Newsletter (Canada). 16(4):1-23.
Key words: Oil Spills, Combustion, Oil Retention Booms, Pollution Control, Equipment
Laboratory and field investigations have now demonstrated that the effective, sustained combustion of spilled oil on water requires that the oil being burned be at least 2-3 mm thick. This requires a properly manipulated fire containment boom to keep the spilled oil thick enough to support combustion. There are numerous situations where controlled in-situ burning of spilled oil can be carried out quickly, safely, and effectively. Some of the more significant burn experiences, the basics of controlled burning, and several different spill scenarios in which burning could be used as an effective response technique are presented. These scenarios include offshore exploration and production operations, marine pipeline accidents, tanker accidents, and spills into rivers and streams. Environmental constraints on in-situ burning are discussed. Nomograms are included which can be used to calculate the boom capacities and burn rates. 15 refs., 10 figs.

Allen, Alan A., Ronald J. Ferek. 1993. Advantages and disadvantages of burning spilled oil. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil.

Allen, Alan A. 1979. Containment and recovery techniques for cold weather, inland oil spills. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: containment, oil spill.

Allen, A.A., and R.J. Ferek. 1993. Advantages and disadvantages of burning spilled oil. In: Proceedings of the 1993 International oil spill conference: Prevention, preparedness, response, March 29 April 1 1993, Tampa, FL, pp. 765-772.
Key words: Oil Spills, Combustion, Oil Spills, Remedial Action
The full potential for in situ burning as a controlled oil spill response technique is a subject of growing interest throughout the world. Information now available from burning oil during accidental fires, war-related fires in Kuwait, spillage from the Exxon Valdez, and controlled test burns, permits an objective and comprehensive assessment of both the positive and negative aspects of in situ burning. A thorough analysis has been made of direct and indirect impacts and concerns typically associated with the decision, to burn or not to burn. These factors, together with the comparative costs of various response techniques, have been identified and described to provide spill control planners and response organizations

with a means of assessing the potential use of burning to clean up offshore oil spills. Some of the advantages for in situ burning are high elimination rate, minimal environmental impact, minimal disposal and cleanup, and ease of control. Some of the disadvantages are localized reduction of air quality, oil conditions, and limited window of opportunity.

Allen, Alan A. 1991. In-situ burning of spilled oil. Spill Technol Newsl. 16(4):1 12.
Key words: Fires, Physical Treatment, Oil Spill, Cleanup, Risk Assessment
In-situ burning has been used as a treatment technology for marine oil spills for many years, with technological advancements in the 1980s increasing the efficacy of this method. This method is applicable to spills with oil at least 2-3 cm thick, only when a fire-containment boom is available to maintain this thickness. The new fire-resistant booms can be used for burning spills offshore caused by tanker accidents, pipeline spills, and exploration/production operations. Risk factors include secondary fires, smoke, and the effects of tides and winds. In addition to oil spill thickness, other combustion considerations are oil access, boom capacity, burn rate, efficiency, volume-control rate, and storage requirements.
Full text available from Congressional Information Service.

Allewell, Norma. Evolving to dissimilate hydrocarbons. Trends in Biochemical Sciences - TIBS (1989): 14
Key words: bacteria, biodegradation, hydrocarbon
This article describes how the studies of bacterial metabolic pathways may provide new insights into molecular evolution, illustrated by the investigation of the Beta-ketoadipate pathway. It is suggested that transfer of DNA sequences between genes combined with a strong dependence of mutation frequency on position may account for phenomena as repeated sequences or sequence homology between distantly related genes. Differences in regulatory mechanisms are taken as an evidence for selection first at the level of catalysis and then at the level of regulation. Examining the protein structure evoutionary relationships can be discerned which may be explained as a consequence of convergent as well as divergent evolution.

Almquist, G.L., R.G. Forrest, C.A. Gazda. 1985. A case history illustration of EPA's Region VI Spill Prevention, Control, and Countermeasures Program. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.

Alonso, J. C., F. Bauhof, W. Schramm and R. Burnette. 1992. Remediation of two fuel storage facilities, MacDill Air Force Base, FL. In: Proceedings of HMC-South '92

Exhibitor Conference and Exhibition,
Feb. 26 28, New Orleans, LA. Hazardous Materials Control Research
Institute: Greenbelt, MD, pp.
59 66.
Key words: Oil Spill, Remedial Action, Water Pollution,
Underground Storage
This paper reports that as part of MacDill Air Force Base's
underground storage tank management plan,
design specifications were developed and on-site observation was
provided for the removal of underground
storage tanks at two former storage facilities and the
installation of a groundwater remediation system at
one of the sites. Design development activities included
implementaions of a focused site investigation to
supplement existing site information. Remedial construction
activities included tank removal, cleaning, and
disposal; contaminated soil identification, segregation, and
treatment; and hazardous liquid disposal. The
construction management approach for the remediation successfully
integrated personnel from several
organizations.

Altenschmidt, U., Fuchs G. 1991. Anaerobic degradation of toluene
in denitrifying pseudomonas sp.:
indication for toluene methylhydroxylation and benzoyl-CoA as
central aromatic intermediate. Archives of
microbiology. 156(2): 152-158. Federal Republic of Germany.
Key words: pseudomonas, toluene, biodegradation, anaerobiosis,
metabolic intermediate, enzymatic
activity, microorganism growth.

Alvarez, P.J.J., Vogel, T.M. 1991. Substrate interactions of
benzene, toluene, and para-xylene during
microbial degradation by pure cultures and mixed culture aquifer
slurries. Applied and Environmental
Microbiology (United States). 57:10:0099-2240.
Release of petroleum hydrocarbons in the environment is a
widespread occurrence. One particular concern
is the contamination of drinking water sources by the toxic,
water-soluble, and mobile petroleum
components benzene, toluene, and xylene (BTX). Benzene, toluene,
and p-xylene (BTX) were degraded
by indigenous mixed cultures in sandy aquifer material and by two
pure cultures isolated from the same
site. Although BTX compounds have a similar chemical structure,
the fate of individual BTX compounds
differed when the compounds were fed to each pure culture and
mixed culture aquifer slurries. The
identification of substrate interactions aided the understanding
of this behavior. Beneficial substrate
interactions included enhanced degradation of benzene-dependent
degradation of toluene and p-xylene by
Arthrobacter sp. strain HCB. Detrimental substrate interactions
included retardation in benzene and
toluene degradation by the presence of p-xylene in both aquifer
slurries and Pseudomonas incubations. The
catabolic diversity of microbes in the environment precludes

generalizations about the capacity of
individual BTX compounds to enhance or inhibit the degradation of
other BTX compounds.
Key words: biodegradation, toluene, bacteria, catabolism, cell
cultures.

American Trader. 1990. California oil spill. Marine Pollution
Bulletin. 21(4):170.
Key words: Accident, Alaska, Boom, Petroleum, Crude Oil,
Pollution Control, Skimmer, Supertanker

American Petroleum Institute. 1989. This 1989 API, EPA, USCG Oil
Spill Prev. Behavior Control
Cleanup Conf., February 13 16 1989, San Antonio, TX, 587 pp.
Key words: Additive, Animal, Busines Operation, Contingency Plan,
Economic Factor, Environmental
Protection Agency

American Petroleum Institute. 1972. The API program and approach
for waste oil disposal. In Natl Pet
Refiners Assoc Natl Fuels & Lubr Meet (NY 9/14 15/72).
Key words: water pollution, pollution, control

American Petroleum Institute. 1991. Adaptation of the incident
command system to oil spill response
during the American Trader spill.. In: Proceedings of the 1991
Oil Spill Conference(Prevention, Behavior,
Control, Cleanup), March 4 7, 1991. 267 272. San Diego, CA:
Washington, D.C.: American Petroleum
Institute.
Keywords: oil spill, response, American Trader.

American Petroleum Institute. 1989. Support for regional oil
spill response in the ROPME sea area. In:
Proceedings of the 1989 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), February 13 16,
1989. pp. 215 220. San Antonio, TX : Washington, D.C.: American
Petroleum Institute.
Keywords: oil spill, response, ROPME.

American Petroleum Institute. 1981. Spill impacts and shoreline
cleanup operations on Arctic and Sub-
Arctic Coasts. In: Proceedings of the 1981 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup),
March 2 5, 1981. pp. 305 310. Atlanta, GA : Washington, D.C.:
American Petroleum Institute.
Keywords: spill, impacts, shoreline, Arctic, coasts.

American Petroleum Institute. 1991. Shoreline cleanup:
reconnaissance, evaluation, and planning
following the Valdez oil spill. In: Proceedings of the 1991 Oil
Spill Conference(Prevention, Behavior,
Control, Cleanup), March 4 7, 1991. pp. 149 152. San Diego, CA:
Washington, D.C.: American
Petroleum Institute.
Keywords: shoreline, cleanup, evaluation, planning, Valdez, oil
spill.

American Petroleum Institute. 1971. Removal of oil from sunken tankers. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971. pp. 205 208. Washington, D.C.: Washington, D.C.: American Petroleum Institute.
Keywords: oil, tankers.

American Petroleum Institute. 1991. Rehabilitation of oiled seabirds and bald eagles following the Exxon Valdez oil spill. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991. pp. 235 242. San Diego, CA: Washington, D.C.: American Petroleum Institute.
Keywords: oil, seabirds, eagles, Exxon Valdez, oil spill.

American Petroleum Institute. 1993. Biological conditions of shorelines following the Exxon Valdez spill. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993. pp. 287 292. Tampa, Florida: Washington, D.C.: American Petroleum Institute.
Keywords: shorelines, Exxon Valdez, spill.

American Petroleum Institute. 1985. Patterns and trends in reported small oil spills. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. pp.141 148. Los Angeles, CA: Washington, D.C.: American Petroleum Institute.
Keywords: oil spills.

American Petroleum Institute. 1983. Oil residence and oil spill biological sensitivity indices for coastal marine environments. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. 581 pp.. San Antonio, TX: Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, biological, sensitivity, coastal, marine environments.

American Petroleum Institute. 1983. Oil spill contingency planning and scientific support coordination in Bermuda: a successful model. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. pp.149 154. San Antonio, TX : Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, contingency planning, Bermuda.

American Petroleum Institute. 1971. Oil contaminated Beaches. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971. pp. 505 522. Washington, D.C.: Washington, D.C.: American Petroleum Institute.

Keywords: restoration, oil-contaminated, beaches.

American Petroleum Institute. 1983. Characteristics of resource protection plans: an analysis of methods.
In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February
28 March 3, 1983. pp. 171 174. San Antonio, TX : Washington, D.C.: American Petroleum Institute.
Keywords: resource.

American Petroleum Institute. 1973. Jet oil recovery device. In: Proceedings of Joint Conference on
Prevention and Control of Oil Spills, March 13 15, 1973.pp. 601 616. Washington, D.C.: Washington,
D.C.: American Petroleum Institute.
Keywords: oil recovery.

American Petroleum Institute. 1993. Field studies to determine the ecological effects of cleanup methods
on oiled shorelines. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness,
Response), March 29 April 1, 1993. pp. 401 406. Tampa, Florida: Washington, D.C.: American
Petroleum Institute.
Keywords: ecological, effects, cleanup, shorelines.

American Petroleum Institute. 1987.A history of the development of oil dispersant guidelines for Alaska.
In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9,
1987. pp.189 192. Baltimore, MD : Washington, D.C.: American Petroleum Institute.
Keywords: development, oil dispersant, guidelines, Alaska.

American Petroleum Institute. 1979. Comparison of hydrocarbons in benthic fish from coal oil point and
tanner bank, California. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control,
Cleanup), March 19 22, 1979. pp. 573 578. Los Angeles, CA : Washington, D.C.: American Petroleum
Institute.
Keywords: hydrocarbons, fish, coal oil point, Tanner Bank, California.

American Petroleum Institute. 1993. A program approach for site safety at oil spills. In: Proceedings of
the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, pp. 99 104.
Tampa, Florida: Washington, D.C.: American Petroleum Institute.
Keywords: safety, oil spills.

Ammon, Douglas C., S. Robert Cochran. 1987. Underground storage tank corrective action technologies.
In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9,
Baltimore, MD.
Key words: underground storage tank.

Amoco Research Center, Naperville, IL (U.S.A.). Waste oil management conference. In Waste oil management conference in Naperville, IL, U.S.A. Year.
Key words: oil, disposal, waste oils, recycling
Proceedings from a conference dealing with the conservation, reclamation, recycling and reuse of lubricating oils are presented. The following topics are discussed: in-plant oil accounting; regulatory aspects of waste oil disposal; measurements and standards for recycled oils; conservation measures, service reclamation techniques and processes; re-refining processes and products; quality control; a methodology for determining the economic viability of in-plant used oil recycling; and pollution control financing. Separate abstracts have been prepared for each item within the scope of the Energy Data Base.

AMOP. 1991. Arctic and Marine Oil Spill Program Technical Seminar: Proceedings. Report No. SSC-EN40-11/5-1991, 691 pp.
Key words: Oil Spills, Meeting, Biodeterioration, Risk assessment, Remote Sensing
Papers presented at the technical seminar, covering the behaviour and fate of oil, biological degradation and biological effects, activity reports and preparedness, computer systems, the legal and social context, risk analysis and state-of-the-environment, in-situ burning, spill countermeasures, remote sensing and mapping, shoreline cleanup, and recent spill accidents. Papers include work in Canada, the US, Norway, the UK, and Japan. Specific areas covered include the Persian Gulf, Prince William Sound in Alaska, Vancouver and the Juan de Fuca Strait on the BC coast, the Mackenzie Delta and the Arctic, and Norway.

Amstutz, D. E., and W. B. Samuels. 1984. Offshore oil spills: analysis of risks. Mar Environ Res 13(4):303 319.
Key words: Oil Spill, Offshore, Risk Assessment

Amstutz, D. E., and W. B. Samuels. 1983. An oil spill risk analysis for the North Atlantic (February 1984) Lease Offering. US Geol Surv Open-File Rep No. 83-567.
Key words: Oil Spill, Atlantic Coast, Risk Assessment

Ananyeva, N.D., N.N. Naumoya, J.E. Rogers, and W.C. Steen. 1992. Microbial transformation of selected organic chemicals in natural aquatic systems. Environmental Research Lab., Athens, GA. Report No. EPA/600/A-92/217, 22 pp.
Key words: pollutants, biodegradation
A method for describing the microbial degradation of xenobiotics through the use of a second-order reaction equation was tested in several water bodies in the United States and Russia. The experiment was aimed at studying the microbial transformation of a herbicide

widely used in rice growing, propanil; of a promising new fungicide, metalaxyl; and of phenol and p-cresol. The method described, in a satisfactory way, the process of microbial degradation of potentially toxic chemicals undergoing hydrolytic or oxidative transformation. Prediction of the fate of persistent compounds, like metalaxyl, is difficult, however. A data bank of second-order rate constants for organic chemicals would permit the prediction of contaminant fate in any natural water source. Such predictions would be important for assessing contaminant fate and exposure in natural waters.

Anderson, Charles B., Starer, Brian D., Haight Gardner Poor & Havens, New York City, NY. Mar 5, 1990. Contingency Planning Crucial to Oil-Spill Response. Oil & Gas J. 88(10):41(4).
Key Words: Oil spill cleanup, emergency planning, oil spill detection, data reporting-mandatory, Fed Water Poll Cont Act 77, pollution liability insure, oil spill analysis, oil booms, oily wastes.

Anderson, M.A. 1992. Influence of surfactants on vapor-liquid partitioning. Environ Sci Technol. 26(11):2186-2191.
Key words: Groundwater, Oil Spill, Pollution Control, Water Pollution

Anderson, R.C. Offshore platform pollution oil spill containment device, protects environment from massive oil spills spreading into water as system is ready for instant deployment. Patent No. US 379362_890713.
Key words: Air, Boom, Containment, Diffusion, Displacement, Pollution Control, Waste Material

Anderson, J.W., S.L. Kiesser, J.W. Blaylock. 1979. Comparative uptake of Naphthalenes from water and oiled sediment by benthic amphipods. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: water.

Anderson, E., S. Marquis, S. Hurlbut. 1989. Oil spill transport animations. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil spill transport.

Anderson, Cheryl A., Robert P. LaBelle. 1987. Revised offshore oil spill occurrence rates for the outer continental shelf. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: offshore oil spill.

Anderson, Eric L. 1983. Study of wind and current datasets for

IXTOC oil spill hindcast. In: Proceedings
of the 1983 Oil Spill Conference (prevention, behavior, control,
cleanup), February 28 March 3, San
Antonio, TX.
Key words: oil spill.

Anderson, John B., Richard B. Wheeler, Rudy R. Schwarzer. 1981.
Sedimentologic and geochemical
results of the buccaneer oil/gas field. In: Proceedings of the
1981 Oil Spill Conference (prevention,
behavior, control, cleanup), March 2 5, Atlanta, GA.

Anderson, Jack W., et al. 1981. Toxicity chemically dispersed oil
to shrimp exposed to constant and
decreasing concentrations in a flowing system. In: Proceedings of
the 1981 Oil Spill Conference
(prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.

Anderson, Jack W., et al. 1985. Effects of oil and chemically
dispersed oil in sediments on clams. In:
Proceedings of the 1985 Oil Spill Conference (prevention,
behavior, control, cleanup), February 25 28,
Los Angeles, CA.
Key words: chemically dispersed oil.

Anderson, Jack W., et al. Effects of Oil and Chemically
Dispersed Oil in Sediments on Clams. In
Proceedings of the 1985 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), February 25 28,
1985 in Los Angeles, CA Year.
oil, chemically, dispersed, sediments, clams

Anderson, Jack W., et al. 1987. Toxicity of dispersed and
undispersed Prudhoe Bay crude oil fractions to
shrimp and fish. In: Proceedings of the 1987 Oil Spill Conference
(prevention, behavior, control,
cleanup), April 6 9, Baltimore, MD.
Key words: Prudhoe Bay, oil.

Anderson, Roger D. 1975. Petroleum hydrocarbons and oyster
resources of Galveston Bay, Texas. In:
Proceedings of the 1975 Conference on Prevention and Control of
Oil Pollution, March 25 27, San
Francisco, CA.
Key words: Galveston Bay.

Andres, G.E., Dustman, J.E. (Leggette, Brashears and Graham,
Inc., St. Paul, MN (USA)). 1989.
Remedial investigation of hydrocarbon contamination in a complex
aquifer system along the Mississippi
River, Minneapolis, Minnesota. The proceedings of the third
national outdoor action conference on aquifer
restoration, ground water monitoring and geophysical methods.
National Water Well Association outdoor
action conference. 1611(p):645-658.
Key Words: Ground water contamination, oil spills environmental
effects, oil spills mitigation, soils

contamination, alluvial deposits, aquifers, fuel oils, hydraulic conductivity, hydrology, leaks, Minnesota, Mississippi, recreational areas, underground storage, water pollution, water pollution abatement, water wells, Federal Region IV, Federal Region V, geologic deposits, hydrogen compounds, liquid fuels, North America, organic compounds, other organic compounds, oxygen compounds, petroleum products, pollution abatement, USA.

Andrews, C. B., D. L. Hathaway and S. S. Papadopoulos. 1990. Modeling the migration and fate of polychlorinated biphenyls in the subsurface. In: Proceedings of the International Conference for the Remediation of PCB Contamination, April 2 3, Houston, TX. Penwell Books: Tulsa, OK, pp. 63 82.
Key words: Oil Spills, Groundwater, Biodegradation
Polychlorinated biphenyls (PCBs) generally are believed to be immobile in the subsurface. Even though PCBs have been extensively lost to the environment, in comparison to nearly all other priority pollutants, PCBs are infrequently detected in water supply wells or in monitoring wells. This is the case even for wells that are located in the vicinity of PCB spills or disposal areas. It is possible, though, that PCBs are present at concentrations below commonly used detection limits in a relatively large number of wells. The Federal Register reported in a survey conducted in 1976 1977 that PCBs were found in 6 percent of finished groundwater supplies at levels of 0.1 (mu) g/1, and that in one state PCBs were detected in samples from 32 out of 163 groundwater supplies at levels of less than 1.4 (mu) g/1. The purpose of this paper is to examine the processes by which PCBs migrate from the surface to the subsurface and to examine the range of PCB concentrations that can be expected in groundwater. For a case study, this paper examines the migration and fate of PCBs in the subsurface as a result of a surface spill of mineral oil containing about one percent PCBs.

Angelidake, I. 1992. Anaerobic thermophilic biogas process. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Bioteknologi. 155.
Investigations into several important aspects concerning thermophilic, anaerobic treatment of livestock wastes and other types of wastes in Denmark was carried out. Lipids, typically found in industrial organic waste, could be effectively degraded during anaerobic treatment with a high biogas yield. Long-chain fatty acids (LCFA) could also inhibit the biogas process at relatively low concentrations. Lipid-containing waste should be introduced gradually and fed continuously to the biogas process in order to permit adaptation.
Fed-bacth cultivation was shown to be a successful method for enriching bacteria which are exposed to substrate inhibition. The end product of the degradation were

methane and carbon dioxide. Ammonia concentrations at or above 4 g-N/l were shown to inhibit thermophilic digestion of cattle manure, but if the ammonia concentration was gradually increased, adaptation of the process occurred. It was found that addition of bentonite or the waste product bentonite-bound oil counteracted to some extent the inhibitory effect of ammonia. The effect was observed only when the ammonia concentration was increased gradually. When the ammonia load was high, reduction of the temperature below 55 Deg. C was shown to have a positive effect on process performance, while at ammonia non-inhibitory concentrations a temperature of 55 deg. C was found to be the optimal temperature. A mathematical model of the biogas process was formulated with main emphasis on free ammonia inhibition, pH simulation and temperature effects. (au) (140 refs.).
Key words: biomass conversion plants, ammonia, biomass conversion plants, lipids.

Angelvik, O. 1989. Alaska arctic offshore oil spill response technology. In: Proceedings of the U.S. Dep. Interior Minerals Manage. Serv. Alaska Arctic Offshore Oil Spill Response Technol. Workshop, November 29 December 1 1988, Anchorage, Alaska, (Nist Spec. Publication No. 762) pp. 185-195.
Key words: Abstracts, Boom, Economic Factor, Oil Waste, Petroleum Industry, Skimmer

Angles, M., M. Cessou, A. Derby. 1985. STOPOL: A recovery unit suited to exploration and production operations. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: STOPOL, recovery, exploration, production.

Annable, Michael, D., Wallace, Roger B. 1991. A laboratory investigation of ground water leachate characteristics during soil venting. Eos, Transactions, American Geophysical Union. 72(17):124.
Key Words: Pollution, experimental studies, effluents, laboratory studies, pollutants, decontamination, organic materials, vents, soils, volatiles, ground water, leaching, oil spills.

Annual environmental monitoring report for the Strategic Petroleum Reserve: 1988. June 1989. Boeing Petroleum Services, Inc., New Orleans, LA (USA). 111(p).
Key Words: Environment monitoring, strategic petroleum reserve monitoring, air quality, brines, environmental quality, ground water, oil spills, progress report, radioactivity, salinity, sampling, surface waters, waste water, water quality, document types, environmental quality, hydrogen compounds, liquid wastes, oxygen compounds.

Anonymous Officials from key US government agencies say oil spill cleanup technology is still rudimentary. Oil Spill Intelligence Report. 14(24).

Anonymous (Ed.) 1993. Symposium on bioremediation and bioprocessing presented at the 205th National Meeting of the American Chemical Society. Preprints Division of Petroleum Chemistry, American Chemical Society: Washington, D.C., pp. 236 307.
Key words: biodegradation, oil spills, soil pollution, bioremediation, in-situ, water pollution
This conference proceedings contains 27 papers from a symposium on the bioremediation of oil spills and petroleum sites and bioprocessing techniques for the fuels industry and for chemicals and liquid fuels.
Topics discussed include the biotreatment of oil spills with hydrocarbon-degrading microorganisms, measures of bioremediation effectiveness, oxidative biodegradation pathways of polynuclear aromatic hydrocarbons, bioremediation with oleophilic fertilizer, the bioremediation treatability of a Superfund site containing oily filter cake waste, the susceptibility of gasoline components to anaerobic biodegradation, the biodegradation of polychlorinated biphenyls, phytoremediation of contaminated soils, biological vapor-phase treatment, microbial enhanced oil recovery, fossil fuel biodesulfurization, microbial coal depyritization, biochemical coal modification, synthesis gas bioconversion, organic gas bioprocessing, bacterial ethanol production, microbial propanediol production using metabolic engineering, bacterial lactic acid production, and bioreactors for enhanced production of chemicals.

Anonymous. 1990. Oil prospects make the michigan grade. Northeast Oil World. 10(9):20-21.
Key words: Groundwater, Legal, Michigan, Regulation, Water Pollution, Oil Spill

Anonymous. 1989. Haztech Canada Toronto '89: Environmental Control/Hazardous Waste Management Conference Proceedings, May 16-18, 1989, Mississauga, 494 p. Haztech Canada, 4936-87th St., no. 26, Edmonton, AB, CAN T6E 5W3.
Key words: Biodegradation, Canada, Oil Spills, Transport, Waste Management

Anonymous. 1990. New concept in contaminated drill cuttings disposal. Ocean Industry (1990): 25
Key words: disposal, oil well, ofshore, oil field equipment
This article discusses a concept devised by the Oily Cuttings Clean-Up Co. to provide a cost-effective method to remove and transport drill cuttings for disposal on a well-to-well or term contract basis using inflatable towed 'barges' connected to the rig with a 360 degree mooring system and swivel operated

cutting loading hose.

Anonymous. 1986. Recycling metalworking fluids to reduce disposal and replacement costs. Practical Lubrication & Maintenance (1986 b): 9
Key words: EPA, oily wastes, Resource Conservation and Recovery Act, disposal
In January of 1986, the Environmental Protection Agency (EPA) announced that as of November, 1986, all oily wastes including waste cutting oils and coolants would be classified as hazardous wastes under the Resource Conservation and Recovery Act. This classification, along with existing regulations in about a dozen states then processed along with the crude in the central facility.

Anonymous. 1989. Oil re-refining - environmental protection plus resource conservation. Hong Kong Engineer (Nov 1989): 17
Key words: re-refining, waste oil, disposal
Both in terms of environmental protection and resource conservation, oil re-refining is beneficial to the society. As technology develops, oil re-refining processes become more sophisticated and are able to produce high quality lube oil. Though oil re-refining is widely practised overseas, it is still in the development stage locally. From both the environmental and economic viewpoint, it should be heavily promoted and actively developed in Hong Kong. The article briefly describes the process of waste oil disposal which includes: water removal, light ends removal, residue removal. 3 Refs.

Anonymous. Proceedings of the First International Conference on Health, Safety and Environment In Oil and Gas Exploration and Production. In Proceedings of the First International Conference on Health, Safety and Environment In Oil and Gas Exploration and Production Part 2 (of 2) in Hague, Neth Year.
Key words: disposal, oil, water, oil spills
This conference proceedings contain 95 papers. Topics covered include all aspects of environmental impact of oil and gas exploration and productivities. The papers presented discuss wastewater, drilling cuttings wastes, gaseous and fugitive emissions, and their disposal, characterizaton, treatment, analysis and prediction. The environmental impact of these wastes on marine ecology, society, soils and ecosystems, and techniques of minimizing them are also described. Environmental policies and legislation in the different countries around the world are presented. Produced water management, health and safety aspects, risk and environmental impact assessments and analysis are described. Also covered are instruments and techniques for monitoring pollution. Naturally occurring radioactive materials in oil and gas exploration and production are discussed along with results

of studies to measure their effect on health and safety. Company policies, strategies and plans to manage the environment, safety and health issues are given. The effect of seismic exploration are discussed. Environmental audits and their methodology is described. Corporate cultures for safety in design and operations are discussed, as also psychosocial effects of working on offshore platforms.

Anonymous. 1989. Bacteria transform and detoxify hydrocarbons and organophosphates.
GeneticTechnology News. December, p.4.
Keywords: hydrocarbons, biodegradation
The toluene monooxygenase system found in the bacterium Pseudomonas mendocina KR1 oxidizes toluene to p-cresol. The system has broad potential applications for biodegradation of toxic chemicals and for processes for biological conversions of organic intermediates into other compounds. Amgen researchers have used the system to completely degrade trichloroethylene. Many phenyl compounds, including acetanilide, 2-phenylethanol, fluorobenzene, and ethyl benzene can also be converted into phenolic compounds by the enzyme system. Amgen has also determined the nucleotide sequence for the gene in P. diminula MG that codes for parathion hydrolase. This enzyme hydrolyzes parathion, an extremely toxic organophosphate insecticide, reducing its toxicity by nearly 120-fold. Amgen has produced highly active parathion hydrolase in recombinant Escherichia coli.

Anonymous. 1989. Refiners share environmental-control skills. (NPRA Q&A, part 3). The Oil and Gas Journal. 87:108 113.
Keywords: petroleum, water, refineries, environmental policy, underground storage

Anonymous. 1993. Electrical soil cleaning process. Water Environment amp Technology (United States). 5(1):80.
Key words: Groundwater, Oil Spill, Soil Pollution, US DOE
A new technology that uses electricity to clean gasoline and other solvents from soil and groundwater has been tested successfully at Lawrence Livermore National Laboratory's site 300 experimental test facility near Tracy, Calif. Cleanup of soil and groundwater contaminants is enhanced by heating the soil electrically. In this process, electric currents flow through the soil, heating it up in much the same way as the heating element in a common household electric heater. When combined with a system for extracting vapors from the soil, the method shows promise for speeding up the cleanup process. The small-scale test conducted recently at Site 300 is the first demonstration of the technology at a contaminated site. The test showed that the vacuum-induced extraction removal rate of the common solvent trichloroethylene from soil

was more than doubled by the addition of electrical heating. A large-scale test was planned for late 1992 when electrical heating and vapor extraction were to be combined with steam injection for cleaning a gasoline spill from the soil and groundwater at the lab's main site in Livermore, Calif.

Anonymous. 1990. Celgene signs R&D agreement with General Electric on biodegradation of Hudson River PCB's. (polychlorinated biphenyls). PR Newswire.
Key words: biodegradation

Anonymous. 1990. Containment rule looks at spills. Northeast Oil World. 10(9):18-19.
Key words: Groundwater, Legal, Monitoring, Water Pollution, Disposal, Environmental Impact, Oil Spill, Soil Pollution

Anonymous. 1991. Directory of environmental products and services fall 1991. (Special Section) (Directory). The Oil Daily. pC1(14).
Key words: oil, petroleum, directory

Anonymous. 1989. Vinyl chloride omissions aired. (whistle blower reports vinyl chloride test omitted from Superfund site by contractor). Superfund. 3:4.
Keywords: government, law, environment, water, pollution

Anonymous. 1988. Scientific technology: 100 new products from the past year. (Research and Development's awards). Research & Development. 30:60 84.
Keywords: directory, apparatus

Anonymous. 1989. EPA will assess Hudson River PCBs under Superfund. (polychlorinated biphenyls). PR Newswire.
Keywords: Environmental Protection Agency, Hudson River, pollution

Anonymous. Facility-specific contingency planning under the oil SPCC program. 1989. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: contingency planning, oil, SPCC.

Anonymous. 1992. Reduce methylene chloride in line. Pollution Engineering. 24(2):17.
Key words: biodegradation, microorganism

Anonymous. 1973. In-situ measurements of oil barrier shape and loads due to current action. 1973. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: in-situ.

Anonymous. 1993. Hazardous chemicals: structure-activity relationships for environmental applications,

Alan Elzerman, ed., symposium proceedings contained in
Environmental Toxicology and Chemistry ,
11(7), July 1992, 885 991 (journal). Waste Information Digests.

Anonymous. 1991. Who's who among environmental groups. Chemical
Engineering. 98(10):35.

Anonymous. 1993. Plenty of opportunities for bioremediation.
Chemical Week. October 27, p.48.
Keywords: bioremediation, biodegradation
Bioremediation is still underused and 'is a technology whose
fullpotential has not yet been realized,'
according to the National Research Council (NRC: Washington). The
NRC committee offers
guidelines for testing the effectiveness of the cleanup
technique, including documenting evidence that
biodegradation is actually occurring.

Anonymous. 1992. Slurry process: A biological alternative to
sludge. Chemical Engineering (International
Edition). 99(5):23.
Key words: pollution control, biodegradation
A biological process to treat toxic chemical and petrochemical
sludges, containing high concentrations of
polyaromatic hydrocarbons (PAHs), to US Environmenta Protection
Agency standards, has been
developed. The PAHs,such as naphthalene, anthracene and
chrysene, are broken down in a stirred-tank
reactor by naturally-occuring sludge microbes. Degradation is
optimized by controlling pH, temperature,
dissolved oxygen and nutrient concentrations in the sludge;
decontamination will occur within 15 to 60
days. Treatment costs are said to be considerably lower than for
both thermal desorption and incineration.
A plant treating API-separator and flotation sludges has been in
operation at an undisclosed US refinery
since late 1991.

Anonymous. 1992. Koppers $77 million cleanup to be funded by
beazer east. BNA California
Environment Daily.
Key words: Cleanup, Soil, Ground Water, Oroville, Environmental
Protection Agency
Beazer East Inc. has agreed to conduct a $77 million cleanup of
contaminated soil and ground water at the
Koppers Superfund site in Oroville and pay $1 million in recovery
costs under terms of a settlement with
the U.S. Environmental Protection Agency announced (U.S. v.
Beazer, Inc., DC ECalif No. S-91-767
LKK, filed 2/7/92).

Anonymous. 1990. Hazardous label looming again for U.S. E&P
(Exploration & Production) wastes. Oil
Gas J. 88(51):18 22.
Keywords: waste material, disposal, drilling waste disposal,
legal consideration, Alaska, bacteria,
biodegradation, environmental impact, soil pollution, water

pollution

Anonymous. 1987. Fiscal year program report: Louisiana Water Resources Research Institute. REP. U.S. Geol. Surv. Water Resour. Div. 34 pp.
Water resources problems were addressed relating to flood technology, ground water, water resources planning, and hazardous waste contamination. Project 02 identified the effects of chlorinated hydrocarbons on the water transmission properties of cohesive deposits which are common to large portion of Louisiana's industrial area. Project 03 initiated biodegradation studies of hazardous chemical waste including PCB and Dioxin. Techniques, which had enhanced the degradation of chlorinated hydrocarbons, were not effective with dioxin. Project 04 involved using a thermal stratification model to evaluate the design and operation of a proposed flood control reservoir. Project 05 evaluated a groundwater model as a management aid in planning for lignite mining in northwestern Louisiana. The model was used to develop strategies which would enable lignite miners to minimize the adverse effects of their operations on groundwater quality. Project 06 utilized entropy to determine multivariate distributions of flood variables given limited data or information. These distributions were tested using real-world flood data. (Grant DI-14-08-0001-G-1020. See also report for Fiscal Year 1984, PB86-238920. Sponsored by Geological Survey, Reston, VA (USA). Water Resources Div.)

Anonymous.1986. Opportunities and obstacles. Practical Lubrication & Maintenance (1986 a): 9
Key words: used oil, disposal, reclamation
Utilizing the latest oil filtration/reclamation technology will not only reduce used oil disposal costs and environmental concerns but it can also reduce the cost of new oil purchases, extend critical component life and reduce unscheduled equipment downtime. After it is known how much of the used oil can be reclaimed from a technical standpoint, it is then necessary to determine how much of that oil should be reclaimed from an economic standpoint.

Antai, S.P., Mgbomo, E. 1989. Distribution of hydrocarbon-utilizing bacteria in oil-spill areas. Microbios Letters. 40(159): 137-143.
Key words: characterization, strain, microorganism culture, metabolism, degradation, hydrocarbon, substrate, petroleum, pipeline, fracture(mechanics), spill, bacteria, Nigeria.

Antinoro, J.E. Flexible oil spill containment boom, includes floating flexible barrier having elongated unitary tensioning member disposed from end to end and held in place by sleeves.
Patent No. US 626951_901212.

Key words: Boom, Containment, Crude Oil, Pollution Control

Antonopoulos, A.A., Emberton, J.R., Emberton, R.F. 1987. Current U.S. research in methanogenesis microbiology.
Energy from landfill gas. Proceedings of a conference jointly sponsored by the UK Department of Energy and the US Department of Energy held at Solihull, UK, 28-31 October 1986. United Kingdom/United States conference on energy from landfill gas. 164-175.
The United States Department of Energy (DOE) Energy from Municipal Waste Program (MSW) supports research to develop new technologies to effectively utilize MSW for methane and other fuels production.
The current research on bioconversion of MSW focuses on identifying methods to improve the effectiveness of microbial populations to enhance energy production from waste organic matter. Four of the DOE-supported projects directly related to methanogenesis microbiology are presented. These study the effect of molecular hydrogen on acetate degradation by methanogens, the effect of trace metals on methanogenesis and control of sulphate reducing bacteria, enzymatic and genetic studies of methanobacteria and the bioconversion of MSW and recovery of organic acids for liquid fuels production.
Key words: biogas process, sanitary landfills, methanogenic bacteria, enzymes, genetic engineering, hydrogen, metals, methane, municipal wastes, organic acids, recovery, renewable energy sources, trace amounts.

Apel, W.A., Duran, P.R., Wiebe, M.R., Johnson, E.G., Wolfram, J.H., Rogers, R.D. Bioprocessing of environmentally significant gases and vapors with gas-phase bioreactors. Methane, trichloroethylene ((TCE)), and xylene. ACS Industrial and Engineering Chemistry Division Symposium (Atlanta 10/1-3/91) ACS Symposium Series N.518 411-28 (1993).
Key words: air, air pollutant, association, biochemical reaction, biodegradation, byproduct, column packing, film, growth, gasification, column packing, flow rate, carbon dioxide, chlorohydrocarbon, bioremediation.

Apex Towing Co. 1990. Cleanup of oil spill off Galveston under way. Oil & Gas Journal. 88(32):27.
Key words: Accident, Boom, Economic Factor, Pollution Control, Skimming

API Health & Environment (Department) Water Program Group. 1992. In: Proceedings of the API 57th Midyear Refining Meeting Environmental Control Symposium, May 11 12 1992, Anaheim, CA, Paper N.J, 11 pp.
Key words: API, Business Operation, Clean Water Act, Economic Factor, Legal Consideration, Pollution

Control, Environmental Protection Agency

API. 1989. A guide to the assessment and remediation of underground petroleum releases. API Publication No., 81 pp.
Key words: Soil Remediation, Oil Spill, Soil Pollution, Underground Storage Facility, Bibliography, Bioremediation, Cleanup, Disposal, Groundwater, Water Pollution

Appelbee, Jane F. 1985. An environmental assessment and oil spill response plan for the Humber Estuary, United Kingdom. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: environment, oil spill, Humber Estuary.

Applications for Duty-Free Entry of Scientific Instruments; Massachusetts Institute of Technology et al. Wednesday, April 27, 1988. Notices. 53(81):88-92.

Applied and Environmental Microbiology. 1989. 55:2:372-379.
Pseudomonas sp. strain JS6 grows on chlorobenzene, p-dichlorobenzene, or toluene as a sole source of carbon and energy. It does not grow on p-chlorotoluene (p-CT). Growth on glucose in the presence of p-CT resulted in the accumulation of 4-chloro-2,3- dihydroxy-1-methyl benzene (3-chloro-6-methylcatechol), 4-chloro- 2,3-dihydroxy-1-methyl cyclohexa- 4,6-diene (p-CT dihydrodoil), and 2-methyl-4-carboxy methylenebut-2-en-4-olide (2-methyl dienelactone). Strain JS21, a spontaneous mutant capable of growth on p-CT, was isolated from cultures of strain JS6 after extended exposure to p-CT. In addition to growing on p-CT, JS21 grew on all of the substrates that supported growth of the parent strain, including p-dichlorobenzene, chlorobenzene, benzene, toluene, benzoate, p-hydroxybenzoate, phenol, and ethylbenzene. The pathway for degradation of p-CT by JS21 was investigated by respirometry, isolation of intermediates, and assay of enzymes in cell extracts. p-CT was converted to 3-chloro-6-methylcatechol by dioxygenase and dihydrodiol dehydrogenase enzymes. 3-Chloro-6-methylcatechol underwent ortho ring cleavage catalyzed by a catechol 1,2-dioxygenase to form 2-chloro-5-methyl-cis,cis-muconate, which was converted to 2-methyl dienelactone. A dienelactone hydrolase converted 2-methyl dienelactone to 2-methylmaleylacetic acid. Preliminary results indicate that a change in wild-type induction patterns allows JS21 to grow on p-CT.
Key words: organic chlorine compounds, biodegradation, pseudomonas, toluene, benzene, growth, mutants, microorganisms, hydrocarbons, alkylated aromatics, enzymes.

Aprill, W., Sims, R.C., Sims, J.L., Matthews, J.E. 1990. Assessing detoxification and degradation of

wood-preserving and petroleum wastes in contaminated soil. Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab. 23.
The study was undertaken to evaluate in-situ soil bioremediation processes, including degradation and detoxification, for wood preserving and petroleum refining wastes at high concentrations in an unacclimated soil. The soil solid phase, water soluble fractions of soil, and column leachates were evaluated. A mutagenic potential assay (Ames assay) and an aqueous toxicity assay (Microtox(TM) assay) were used to evaluate detoxification; high performance liquid chromatography was used to evaluate chemical concentration and degradation for eight polynuclear aromatic hydrocarbons (PAHs). The group of noncarcinogenic PAHs studied demonstrated greater degradation, ranging from 54-90% of mass added for the wastes; the carcinogenic group of PAHs studied exhibited degradation ranging from 24-53% of mass added. Although no mutagenicity was observed in waste/soil mixtures after one year, Microtox(TM) toxicity was observed in water soluble fractions and in leachate samples. Integration of information concerning degradation of hazardous constituents with bioassay information represents an approach for designing treatability studies and for evaluating effectiveness of in-situ soil bioremediation. When combined with information from waste, site, and soil characterization studies, data generated in treatability studies may be used in predictive models to: evaluate effectiveness of on-site soil bioremediation; develop appropriate containment structures to prevent unacceptable waste transport from the treatment zone; and design performance monitoring strategies.
Key words: petroleum products, biodegradation, soils, decontamination, environmental, liquid column chromatography, salmonella typhimurium, site characterization, site surveys, aromatics, bacteria, chemical reactions.

Aravamudan, Krishna S., P. Km Raj, Lt. G. Marsh. 1981. Simplified models to predict the breakup of oil on rough seas. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: oil, sea.

Arcangeli, J.P., Arvin, E. 1992. Toluene biodegradation and biofilm growth in an aerobic fixed-film reactor. Applied Microbiology and Biotechnology (Germany). 37:4:510-517.
Aerobic biodegradation of toluene in a biofilm system was investigated. Toluene is easily biodegradable, like several other aromatic compounds. The degradation was first order at bulk concentrations lower than 0.14 mg/l and zero order above 6-8 mg/l. An average yield coefficient of 1 mg biomass/mg toluene

degraded was found. A chemical oxygen demand balance relative to three biofilm growth scenarios showed that only a minor fraction of the carbon in the influent accumulated as biomass in the reactor. Of this accumulated biomass only a small fraction was active biomass, about 5% protein. A characterization of the carbon fractions leaving the reactor showed a significant production of soluble polymers and formation of suspended biomass. The latter was probably due to the detachment of filamentous bacteria. A decrease in toluene degradation was observed when the oxygen concentration was increased from 5 to about 20 mg/l. Future studies must show if this effect was due to inhibition. (orig.).
Key words: toluene, biodegradation, aerobic conditions, bench-scale experiments, biochemical oxygen.

Arcangeli, J.P., Arvin, E. Modelling of toluene biodegradation and biofilm growth in a fixed biofilm reactor. Water Science & Technology, 26(3/4) 617-626 (1992) Aqualine Abstracts (ISSN 0748-2531) ABSTR. NO. 93-0419 V9 N.3 (2/2/93).
Key words: abstract, activity, aerobic microorganisms, biochemical reaction, biodegradation, concentration, composition, biomass, C7.

Archer, D.B., Robertson, J.A, Emberton, J.R., Emberton, R.F. 1987. Fundamentals of landfill microbiology. Energy from landfill gas. Proceedings of a conference jointly sponsored by the UK Department of Energy and the US Department of Energy held at Solihull, UK, 28-31 October 1986. United Kingdom/United States conference on energy from landfill gas. 116-122.
The microbiology of waste degradation to produce methane in landfills has been little studied. The degradation steps, catalysed by bacteria, are assumed to be analogous to those in better studied environments such as sediments, the gastrointestinal tract and anaerobic digesters. Nonetheless, from present knowledge of landfill microbiology of related environments an input to landfill management practices can be made. Successful landfill management should lead to rapid initiation of methane production, high rates of production of methane-rich gas, stable long term gas production and prevention of pollution by acidic leachates. Achieving all these objectives is dependant upon the microbiology of landfill.
Key words: biogas process, landfills, methane, methanogenic bacteria, renewable energy sources, anaerobic digestion, bacteria, bioconversion, hydrocarbons, energy sources, alkanes, waste processing.

Archer, D.B. 1989. The microbiology of waste degradation in landfills. Svensson, B. 1989. The biogas process in the Nordic countries. Research and Application.

Conference on the biogas process in the Nordic countries: research and application. 206.
A significant proportion of the U.K.'s projected energy needs could be met through landfill methane production. In order to realise this potential, account must be taken in landfill management of the microbiology and biochemistry involved in waste degradation in a heterogeneous environment of high solids content. Detailed biochemical pathways of refuse degradation under landfill conditions are difficult to study and are consequently poorly understood. Similarly, little is known of the microbiology of landfill, although a picture of the degradative events occurring in landfill can be tentatively constructed from the limited studies so far conducted, and by analogy with other methanogenic ecosystems. The rates and extent of methane production from landfills vary and the opportunity to exert the most effective control over refuse degradation has already been lost once the refuse has been landfilled. On the other hand, landfill leachate is amenable to anaerobic digestion in purpose-built bioreactors. The impact of a microbiological approach to optimise methane production from refuse is likely to be greatest in purpose-built reactors or in the controlled deposition of refuse in biofills. These environments allow scope for manipulation of the physical conditions, nutrient status, microbial activities and degradative pathways involved in methane production from waste.
Key words: bioreactors, design, municipal wastes, biodegradation, sanitary landfills, microorganisms, hydrocarbons, waste disposals, management.

Arctic Petroleum Review. 1990. Task mastered. Arctic Petroleum Review. 13(2):9-10.
Key words: Oil Spill Pollution Abatement, Research Programs
In 1989, there was a large offshore oil spill in Alaska and another near Vancouver Island prompting the Canadian Petroleum Association (CPA) and the Independent Petroleum Association of Canada (IPAC) to investigate the industry's preparedness to handle spills. This joint working group, the Task Force On Oil Splill Preparedness (TFOSP) used realistic scenarios to assess the upstream industry's ability to respond to offshore spills from blow-outs and onshore spills from a variety of sources including pipeline leaks and trucking accidents. The task force made 33 recommendations divided into five major areas noted as planning, prevention, equipment, training, and research and development. The cost would be $13 million over a five-year period. Nine million dollars would go to offshore areas in the Beaufort, the Arctic Islands and the east coast. Key rcommendations for offshore include increased spending of $2.4 million on research and development, dispersants, in-situ burners, improved recovery for heavy oil, and the purchase of $6.2 million worth of oil spill equipment. A well organized

system for documenting industry
achievements was also stressed. It is concluded that by setting
clear goals the task force will keep industry
in an increased state of preparedness for oil spills. 3 figs.

Ardito, Cynthia Paula, Billings, Jeffrey F. 1990. Alternative
remediation strategies; the surface
volatilization and ventilation system. Ground Water Management.
4:281-296.
Key Words: Reclamation, pollution, methods, volatilization, oil
spills, ventilation, in situ, unsaturated
zone, wells, biodegradation, ground water, New Mexico,
Southwestern U.S., United States, underground
storage.

Ariman, T. 1990. Seismic vulnerability of crude oil pipelines.
Pipeline Gas J 217(7):22 24.

Ariman, T. 1989. Seismic vulnerability and serviceability
analysis of crude oil transportation systems in
the eastern United States. In: Proceedings of the API Pipeline
Conf, April 17 18, Dallas, Texas. Pp.
104 113.
Key words: Oil Spill, Transport

Arizona Univ., Tucson. Optical Sciences Center. 1992. Combustive
management of oil spills. Final
report. Report No. DOE/ER/12102-1, 151 pp.
Key words: Incinerators, Oil Spills, Petroleum
Extensive experiments with in situ incineration were performed on
a desert site at the University of
Arizona with very striking results. The largest incinerator, 6
feet in diameter with a 30 foot chimney,
developed combustion temperatures of 3000, F, and attendant soot
production approximately 1000 times
less than that produced by conventional in situ burning. This
soot production, in fact, is approximately 30
times less than current allowable EPA standards for incinerators
and internal combustion engines.
Furthermore, as a consequence of the high temperature combustion,
the bum rate was established at a very
high 3400 gallons per hour for this particular 6 foot diameter
structure. The rudimentary design studies we
have carried out relative to a seagoing 8 foot diameter
incinerator have predicted that a continuous burn
rate of 7000 gallons per hour is realistic. This structure was
taken as a basis for operational design because
it is compatible with C130 flyability, and will be inexpensive
enough ($120,000 per copy) to be stored at
those seaside depots throughout the US coast line in which the
requisite ancillary equipments (booms,
service tugs, etc.) are already deployed. The LOX experiments
verified our expectations with respect to
combustion of debris and various
highly weathered or emulsified oils. We have concluded, however,
that the use of liquid oxygen in actual
beach clean up is not promising because the very high

temperatures associated with this combustion are almost certain to produce environmentally deleterious effects on the beach surface and its immediately sublying structures. However, the use of liquid oxygen augmentation for shore based and flyable incinerators may still play an important role in handing the problem of accumulated debris.

Armstrong, J.M., W. Korreck, L.E. Leach, J.T. Wilson, R.M. Powell, and S.V. Vandergrift. 1988. Bioremediation of a fuel spill : evaluation of techniques for preliminary site characterization. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:931-948.
Key words: Soil Pollution, Oil Spill, Water Pollution, Bacteria, Bioremdiation, Groundwater

Armstrong, A.Q., R.E. Hodson, H-M Hwang, and D.L. Lewis. 1991. Environmental factors affecting toluene degradation in ground water at a hazardous waste site. Environmental Toxicology and Chemistry. 10(2):147 158.
Key words: biodegradation, microorganisms, disposal, water pollution, soil pollution
The microbial ecology of pristine and contaminated ground water at a chemical waste disposal site was investigated. Recently, it was determined that ground water downslope from the disposal site contained elevated levels of toxic pollutants, including benzene, toluene, xylene and methylene chloride, as well as iron and manganese. Microbial mineralization and uptake of radiolabeled glucose and amino acids indicated a metabolically active microflora in both pristine (upslope from the contamination) and contaminated groundwater samples collected from monitoring wells at the site. However, microbial uptake and mineralization of glucose and amino acids were up to fourfold slower in the contaminated well but were negligible in water from the pristine well, suggesting that the subsurface microflora in the contaminated region had adapted to degrade toluene. Additions of the inorganic nutrients N, K, and P enhanced toluene mineralization in water from the contaminated well, with the addition of K and P enhancing mineralization twofold. The addition of these inorganic nutrients, therefore, presents an opportunity for biorestoration of the site. An increase in the incubation temperature also enhanced toluene mineralization; however, manipulations of pH and dissolved oxygen concentration had no measurable effects.

Armstrong, L.J., et al. 1993. A simple oil spill trajectory model for use in contingency planning. In Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1,

Tampa, FL.
Key words: oil spill.

Army, U.S. Investigating waste oil disposal by combustion. In U.S. dep commer natl tech inf serv ad n.772 991, 13. JAN 1974.
Key words: waste oil, disposal, combustion

Arnold, Ken, Marurice Stewart Jr. Designing oil and gas production systems. World Oil (1985): 200
Environmental regulations prohibit disposal of produced water without primary and, in some instances, secondary treatment. Corrugated-plate interceptors, cross-flow separators, flotation units and other specialized equipment are required to reduce hydrocarbon content to acceptable levels. The authors discuss sizing and selection of produced-water treating equipment. 2 refs.

Arnold, W.R., G.R. Biddinger, R.B. Harley. 1991. Exxon's 1990 Arthur Kill natural resource injury assessment studies. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.

Arscott, R. L. New directions in environmental protection on oil and gas operations. In Proceedings: International Meeting on Petroleum Engineering. in Tianjin, China. Year.
Key words: toxicity, wildlife, fisheries, environmental impact, disposal, biomonitoring
A description is given of the current activities and new directions in disposal of drilling fluids, produced water and other oil field wastes to protect human health and the environment. Special attention will be paid to the protection of wildlife and fisheries resources and progress in cooperative agreements between the oil and gas industry, the fishing industry, native groups, government agencies and environmental groups.
Since the passage of the National Environmental Protection Act in 1970, the U.S. oil and gas industry has made tremendous progress in developing techniques and practices to improve the protection of human health and the environment. Tests for toxicity of drilling fluids are conducted routinely, and many exploration and production operations are modified to protect valuable wildlife and fisheries resources. 10 Refs.

Arseneault, E., and H. Tremblay. Use of Pre-cooked and Puffed Cereals as Oil Spill Sorbents. Patent No. US 4969774, c 11/13/90, F 10/5/89 (Appl 417339) (b01d-015/00) (3 pp; 20 claims)
1990
Key words: oil spill, adsorbent, adsorption, cereal, contamination, environmental pollution, oil water separation, physical separation, solid adsorbent, sorbent,

sorption, water pollution, (p) USA, business operation, cellulose, change, cleaning, coalescing, collecting agent, compound, control, data, decontaminating, density, ecology, environment, expansion, floating, lake, Le Groupe Cegerco Inc., manufacturing, material handling, natural resin, ocean, ocean environment, oil waste, organic matter, physical property, pollution control, removal, sea, starch, stream, table (data), waste material, ecology & pollution

Arvin, E., B. Jensen, J. Aamand, and C. Jorgensen. 1988. The potential of free-living ground water bacteria to degrade aromatic hydrocarbons and heterocyclic compounds. Water Science and Technology. 20(3):109.
Key words: Groundwater, Bacteria, Degradation

Arvin, E., Jensen, B.K., Gundersen, A.T. 1989. Substrate interactions during aerobic biodegradation of benzene. Applied and Environmental Microbiology (USA). 55:12:3221-3225.
This study dealt with the interactions with benzene degradation of the following aromatic compounds in a mixed substrate: toluene, o-xylene, naphthalene, 1,4-dimethylnaphthalene, phenanthrene, and pyrrole. The experiment was performed as a factorial experiment with simple batch cultures. The effect of two different types of inocula was tested. One type of inoculum was grown on a mixture of aromatic hydrocarbons; the other was grown on a mixture of aromatic hydrocarbons and nitrogen-, sulfur-, and oxygen-containing aromatic compounds (NSO compounds), similar to some of the compounds identified in creosote waste.
The culture grown on the aromatic hydrocarbons and NSO compounds was much less efficient in degrading benzene than the culture grown on only aromatic hydrocarbons. The experiments indicated that toluene- and o-xylene-degrading bacteria are also able to degrade benzene, whereas naphthalene-, 1,,4-dimethylnaphthalene-, and phenanthrene-degrading bacteria have no or very little benzene-degrading ability. Surprisingly, the stimulating effect of toluene and o-xylene was true only if the two compounds were present alone. In combination an antagonistic effect was observed, i.e., the combined effect was smaller than the sum from each of the compounds. The reason for this behavior has not been identified.
Pyrrole strongly inhibited benzene degradation even at concentrations of about 100 to 200 micrograms/liter. Future studies will investigate the generality of these findings.
Key words: benzene, biodegradation, culture media, water pollution, decomposition, dispersions, pollution, organic compounds, microorganisms, nucleotides, hydrocarbons.

Arya, P.K., Saroj, K.K., Thakur, D.N., Banerjee, S.P. 1989.
Bacterial degasification of coal seams.
Today's technology for the mining and metallurgical industries.
MMIJ/IMM joint symposium on today's
technology for the mining and metallurgical industries.
443-451:631.
Control of methane emission in development headings in gassy coal seams has remained a major problem
in Indian coal mines. A method which shows great promise is bacterial degasification of coal seams where
methane utilisers are used to consume the methane in the coal seam before its liberation. Methane utilisers
have only recently been utilised for degradation of methane in mines. The tiny bacteria which belong to the
group of methanotrophs are obligate, gram-negative, single polar flagellated some pigmented, and are rod
shaped organisms measuring 1.0 x 3.0 micron in size. Strains of methane utilisers capable of thriving in
100 percent methane atmosphere have been successfully isolated. These bacteria have been utilised in six
highly gassy coal mines of India under eleven different geomining conditions. The results of some of the
in-situ investigations and the relation between bacterial population and methane and carbon dioxide
emission rates are presented in this paper. 4 refs., 13 figs., 2 tabs.
Key words: coal mines, degassing, aerobic digestion, underground mining, bioconversion, mining,
organic, resources, digestion, methane, geologic deposits.

Ash, C., Garret, C., Gray, S. 1987. The key to preventing contamination of groundwater by petroleum
products - Florida's SUPER Act. National Water Well Assoc., Dublin, OH. 3-10.
Key Words: Drinking water monitoring, Florida petroleum industry, ground water contamination, ground
water oil spills, oil spills environmental effects, petroleum industry legislation, cost, government policies,
health hazards, public health, site characterization, underground storage, water quality, environmental
quality, Federal Region IV, hydrogen compounds, North America, oxygen compounds, USA.

Ashland Oil Co. Battelle Memorial Institute Columbus. June 8, 1988.
The Cause of Ashland's Diesel Fuel Spill (has been) Pinpointed.
Oil & Gas Journal, The Chemical Week.
86(23):16.
Key Words: Ashland oil, brittleness, collapse, diesel fuel, District 1, District 2, economic factor,
engineering, ground water, Kentucky, material handling, mechanical property, motor fuel, North
America, Number 2 Diesel fuel, Ohio, operating condition, operating cost, Pennsylvania, physical
property, pollution control, pollution source, potable water, storage facility, temperature 20 to 40C, USA,
waste material, water pollutant.

Ashtary, P.N. 1990. A ship-mounted oil spill recovery apparatus. In: Proceedings of the API 1990
Alternative Tank Vessel Design Forum, June 5 1990, Washington, D.C., Proceedings N.21, 30 pp.
Key words: Boom, Cargo, Oil waste, Pollution Control, Spill, Storage Facility, Water Pollution

Ashtary, P.H. Ship-mounted oil spill recovery appts. includes spill barrier, in form of floating boom
placed around oil carrying vessel and recovery lines connected to on-board oil recovery system with
storage tanks. Patent No. US 448074_891208.
Key words: Accident, Arrangement, Boom, Oil Waste, Pollution Control, Storage Facility, Waste
Material

Asker, J. R. 1992. Commercial Remote Sensing Faces Challenges on Three Fronts. Aviation Week &
Space Technology 137(2):53.
Key words: Landsat TM, Synthetic Aperture Radar
Photograph: Eosat false color image of the Moroccan coast was taken in three spectral bands. Landsat's
Thematic Mapper offers fine spectral resolution with 30-meter spatial resolution. Photograph: St.
Petersburg, Russia, is shown in Landsat false color image (top). Lighter blue areas in Gulf of Finland
show shallow water and sediment and help identify point sources of pollution. Soyuzkarta's photographic
film, ejected by Russian spacecraft, offers 5 meter (below). Nizhnevartovsk along Russia's Ob River can
be seen. Oil wells are seen as dots. Photograph: Synthetic Aperture Radar image from Russian Almaz-1
reveals geological structure under heavily forested mountains in Paraguay. It can resolve objects as small
as 15-meter square.

Asper, J.J, P. Bolli. 1973. New device for removing oil slicks from the surface of water. In: Proceedings
of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.

Association, National Petroleum Refiners. NPRA (National Petroleum Refiners Association) Maintenance
Q+A...Conclusion--8. environmental sessoin covers waste, noise. In Oil gas J, 135 36, 138. 73.
10/27/75.
refining, health, legal consideration, spill, waste, disposal, water pollutant

Astin, M.S., Edwards, D. June 25-30, 1989. In-situ application of vapor extraction systems ((VES)) to
volatile organic and petroleum hydrocarbon soil remediation. 82nd Air Waste Manage. Assoc. Annu.
Meet. (Anaheim 6/25-30/89) Pap. 89(98):5-12.
Key Words: Air pollution, aquifer, cargo, case history, depth, diesel fuel, economic factor, ground water,

heating fuel, hydrocarbon, in situ, injection well, meeting papter, motor fuel, motor gasoline, motor vehicle, oil waste, petroelum fraction, physical property, physical separation, pollution ocntrol, pollution control equipment, service staton, soil (earth), soil pollutant, soil pollution, stripping, subsurface, thermodynamic property, unleaded gasoline, vapor pressure, volatile organic compounds, waste material, water pollutant.

Atkeson, T.B., Dower, R.C. May 1987. Unrealized potential of SARA: mobilizing new protection for natural resources. Environment(United States). 29(4):6-11,43.
Key Words: Birds injuries, fishes injuries, ground water pollution, hazardous materials spills economic impact, hazardous materials spills environmental effects, legislation implementation, legislation pollution, nature reserves values, oil spills economic impact, oil spills environmental effects, plants injuries, resources values, surface waters pollution, aquatic organisms, hydrogen compounds, oxygen compounds, vertebrates.

Atlantic Richfield Co. Combined mechanical and hydraulic oil spill recovery appts. using tractor plough to scarify oleaginous substances from bottom sediment for flotation and conventional recovery. Patent No. US 155406_880212.
Key words: Agitating, Beach, Boom, Composition, Concentration, Crude Oil, Petroleum, Physical Property, Pollution Control, Shallow Water

Atlantic Richfield Co. Oil boom for contg. floating oil spills, comprises floating hose with mounted tubing members fitted with nozzles at bent free ends to direct air at floating oil. Patent No. US 803832_911209.
Key words: Air Blowing, Boom, Halohydrocarbon, Oil Waste, Pollution Control

Atlantic Richfield Co. Recovering crude oil spills in coarse bootom sediments using crawler tractor with array of ripper teeth and hydraulic jets to agitate the sediment. Patent No. US 5_870102.
Key words: Accumulating, Beach, Boom, Crude Oil, Waste Material, Pollution Control

Atlantic Richfield. Oil containment boom for oil spills into water_comprises weighted foam sections coupled by polymeric pins and flexible polymeric sheet. Patent No. US 546812_900702.

Atlas, R.M. Petroleum biodegradation and oil spill bioremediation. ACS 205th National Meeting (Denver, CO 3/28-4/2/93) ACS Division of Petroleum Chemistry, Inc. Preprints (ISSN 0569-3799) V38 N.2 236-37 (March 1993).
Key words: accident, ammonium, nitrate, bacteria, phosphate,

association, beach, biochemical, coastal
area, concentration, crude oil, commercial, fertilizer, hydrogen,
calcium, emulsion, bulk carrier.

Atlas, R.M. 1993. Bacteria and bioremediation of marine oil
spills.
Oceanus (United States) 36:2: 71-73.
Virtually all marine ecosystems harbor indigenous hydrocarbon
-degrading bacteria. These hydrocarbon degraders comprise less
than one percent of the bacterial
community in unpolluted environments, but generally increase to
one to ten percent following petroleum
contamination. Various hydrocarbons are degraded by these
microorganisms at different rates, so there is
an evolution in the residual hydrocarbon mixture, and some
hydrocarbons and asphaltic petroleum
hydrocarbons remain undegraded. Fortunately, these persistent
petroleum pollutants are, for the most part,
insoluble or are bound to solids; hence they are not biologically
available and therefore not toxic to marine
organisms. Carbon dioxide, water, and cellular biomass produced
by the microorganisms from the
degradable hydrocarbons may be consumed by detrital feeders and
comprise the end products of the
natural biological degradation process. Bioremediation attempts
to accelerate the natural hydrocarbon
degradation rates by overcoming factors that limit bacterial
hydrocarbon degrading activities.
Key words: bacteria, growth, petroleum, biodegradation, aquatic
ecosystems, detritus, oil spills.

Atlas, R.M. 1991. Microbial hydrocarbon degradation -
bioremediation of oil spills. J Chem Technol
Biotechnol. 52(2):149-156.
Key words: Bioremediation, Biodegradation, Microorganism,
Research, Bacteria, Hydrocarbon, Soil
Pollution, Water Pollution

Audet, A. 1993. Response to the Rio Orinoco incident: A small-
scale incident that lasted a whole year. In:
Proceedings of the 13th Bien API et al oil spill (Prev,
Preparedness, Response & Coop) INT conf, March
29 April 1 1993, Tampa, FL, pp. 209 212.
Key words: Oil Spill, Atlantic Ocean, Contamination,
Environmental Pollution, Marine Transportation

Audunson, T., et al. 1987. Injection of oil spill chemicals into
a blowing well. In: Proceedings of the 1987
Oil Spill Conference (prevention, behavior, control, cleanup),
April 6 9, Baltimore, MD.
Key words: oil spill, chemical.

Augenfeld, John M. 1983. Exposure of Abarenicola pacifica to
oiled sediment: effects of glycogen content
and Alterations in sediment-bound hydrocarbons. In: Proceedings
of the 1983 Oil Spill Conference
(prevention, behavior, control, cleanup), February 28 March 3,

San Antonio, TX.
Key words: Abarenicola pacifica, oil, sediment, hydrocarbons.

Austin, J., Collins, M. (Photovac International Inc., Huntington, NY (USA)). 1989. Characterization of environmental contamination by petroleum products. Haztech Canada Edmonton 89: environmental control/hazardous waste management conference. 435(p):34-48.
Key Words: Land pollution monitoring, oil spills land pollution, detection, environment, gas chromatography, ground water, liquid contamination monitors, petroleum products, photoionization, sampling, chromatography, hydrogen compounds, ionization, measuring instruments, oxygen compounds, radiation monitors, separation processes.

Averting an oil slick disaster in the gulf, opec bull v 22, no 9, pp 22-33, oct 1991 (issn 04746279)
Key words: containment^disposal^oil spreading^oil waste^oil waste fate^waste disposal^waste material

Ayers, R. R.,A. V. Barnett. 1977. SOCK: An oil skimming kit for vessels of convenience. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil.

Ayers, R. R., J. P. Fraser, L. J. Kazmierczak. 1975. Developing an open-seas skimmer. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA. Year.
Key words: seas.

Ayyachamy, J. S., A. Atalay and M. Zaman. 1992. Soil washing for brine removal. In: Proceedings of Special Symposuim on Emerging Technologies for Hazardous Waste Management, Sept. 21 23, Atlanta, GA. American Chemical Society (ACS): Washington DC, p. 194.
Key words: Brines, Water Pollution, Remedial Action, Oil Spills, Soil Washing
During the exploration for oil and thereafter, brine transfer lines get ruptured releasing the brine which contaminates the surrounding soil. The salinity level in brine is very high, sometimes approaching or exceeding that of sea water. Soils contaminated with brine are unproductive and unsuitable for plant growth. Several investigators have documented the pollution of surface water and groundwater due to brine disposal from oil and needed to clean up such sites. The objective of this study is to develop a soil washing technique that can be used to remove brine sites were collected and used in the study. This paper reports on results which indicate that soil washing using varous surface active agents is effective in removing the brine.

Babb, J., and R. Laferriere. 1993. Responding to the underground oil spill: A case study of the city gas and transmission site in wilmington, North Carolina. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 155-158.
Key words: Oil Spill, Contamination, Crude Oil, Environmental Pollution

Baca, Bart J., Charles D. Getter, June Lindstedt-Siva. 1983. MIRG environmental element: an oil spill response tool for the Gulf of Mexico. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil spill, Gulf of Mexico.

Baca, Bart J., et al. 1985. A method for site-specific planning for dispersant use. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: dispersant.

Baca, Bart J., Charles D. Getter, June Linstedt-Siva. 1985. Freshwater oil spill considerations: protection and cleanup. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: oil spill.

Baca, Bart J., et al. 1983. Cape Fear River oil spill (North Carolina): determining oil quantity from marsh surface area. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil spill, marsh.

Bachmann, F., H. Sonnen, H.J. Kutzner. Microbiological and biochemical characterization of bacterial soil communities. Soil Decontamination Using Biological Processes. (1992): 6 9 December 1992.
Key words: bacteria, degradation, hydrocarbon
The microbiology of a soil profile and an oil contaminated soil are analyzed for number of heterotrophic bacteria by plate counts and MPN determinations, number of mineral oil degrading bacteria, reduction of DMSO, hydrolysis of fluoresceine diacetate, and dehydrogenase activity. Laboratory tests with an autochthonous population show complete oil degradation within 28 days. Paper given at Int. Symp. Soil Decontamination using Biological Processes, Karlesruhe, D, 6 9.12.92. (Knauf)

Backlund, Lars, Lars Holmstrom. 1983.Second generation oil spill and maritime surveillance systems now operational in Sweden. In: Proceedings of the 1983 Oil Spill

Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil spill, maritime.

Backlund, Lars. 1979. Airborne oil spill surveillance systems in Sweden. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: bacteria, hydrocarbons, degradation
A substrate containing aromatic and aliphatic hydrocarbons is contacted with Pseudomonas putida NRRL-B-18117 containing fused plasmids encoding camphor and toluene degradation.

Badard, D.L., Wagner, R.E., Brennan, M.J., Haberl, M.L., Brown, J.F., Jr. 1987. Extensive degradation of aroclors and environmentally transformed polychlorinated biphenyls by Alcaligenes eutrophus H850. Appl. Environ. Microbiol.(United States). 53:5:1094-1102.
The authors have isolated and characterized a strain of Alcaligenes eutrophus, designated H850, that rapidly degrades a broad and unusual spectrum of polychlorinated biphenyls (PCBs) including many tetra- and pentachlorobiphenyls and several hexachlorobiphenyls. This strains, which was isolated from PCB-containing dredge spoils by enrichment on biphenyl, grows well on biphenyl and 2-chlorobiphenyl but poorly on 3- and 4-chlorobiphenyl. Capillary gas-chromatographic analysis showed that biphenyl-grown resting cells of H850 degraded the components of 38 of the 41 largest peaks of Aroclor 1242 and 15 of the 44 largest peaks of Aroclor 1254, resulting in an overall reduction of PCBs by 81% for Aroclor 1242 (10 ppm) and 35% for the Aroclor 1254 (10 ppm) in 2 days. Furthermore, H850 metabolized the predominantly ortho-substituted PCB congeners that the resulted from the environmental transformation of the more highly chlorinated congeners of Aroclor 1242 by the upper Hudson River anaerobic meta-, and para-dechlorination agent system. The congener selectivity patterns indicate that a two-step process consisting of anaerobic dechlorination followed by oxidation by H850 can effectively degrade all to congeners in Aroclor 1242 and possibly all those in Aroclor 1254.
Key words: bacteria, growth, chlorinated aromatic hydrocarbons, metabolism, gas chromatography,halogenated aromatic hydrocarbons, organic halogen compounds, separtation processes, microorganisms, toxicology.

Badesha, S.S., J. Hunt, E. Wenck. 1993. Structural analysis of oil containment booms. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill, containment.

Baedecker, M. J. 1991. Partitioning and transport of hydrocarbons from crude oil in a sand and gravel aquifer. In: Proceedings of the American Chemical Society (ACS) National Meeting, April 14 19, Atlanta, GA. American Chemical Society: Washington DC, pp. 23 24.
Key words: Groundwater, Oil Spills, Solubility, Minnesota
Hydrocarbons in crude oil are partitioned in water and sediment based on the solubilities and sorptive properties of individual compounds. Crude oil from a pipeline break accumulated as an oil body at the water table, 6 m below land surface, in a glacial outwash aquifer near Bemidji, Minnesota. The crude oil was a paraffinic oil composed of about 60% saturated hydrocarbons, 33% aromatic hydrocarbons, and 6% resins and asphaltenes. The aromatic hydrocarbons from C(sub 6) to C(sub 10) are soluble in water and are transported downgradient farther than other organic compounds. The higher molecular-weight hydrocarbons are predominantly normal alkanes in the C(sub 11) to C(sub 33) range and the isoprenoid hydrocarbons, pristane and phytane. These hydrocarbons are insoluble and occured in groundwater only near the soil source, and not downgradient. However, normal alkanes were found on sediment 30 m downgradient, which suggests that they are transported as an oil film at the saturated/ unsaturated zone interface.

Baedecker, Mary Jo, Cozzarelli, Isabelle M. 1991. Geochemical modeling of organic degradation reactions in an aquifer contaminated with crude oil. Water-Resources Investigations. 627-632.
Key Words: Minnesota, pollution, ground water, environmental geology, oil spills, reactions, USGS, Midwest, United States, North-Central Minnesota, Bemidji, Minnesota, Beltrami County, Minnesota, aquifers, organic materials, alteration, degradation, aerobic environment, anaerobic environment, hydrochemistry.

Baehr, A.L., and M.Y. Corapcioglu. 1987. A compositional multiphase model for groundwater contamination by petroleum products : PT.2 : numerical solution. Water Resources Res. 23(1):201-213.
Key words: Soil Pollution, Groundwater, Biodegradation, Oil Spill

Baehr, Arthur L., Hult, Marc F. 1989. Determination of the air-phase permeability tensor of an unsaturated zone at the Bemidji, Minnesota, research site. Water-Resources Investigations. 55-62.
Key Words: Minnesota, ground water, environmental geology, pollution, surveys, Beltrami County Minnesota, USGS, Midwest, United States, north-central Minnesota, Bemidji Minnesota, oil spills, crude oil, polluted water, outwash, clastic sediments, aquifers, unsaturated zone, permeability.

Baehr, Arthur L., Fischer, Jeffrey M., Lahvis, Matthew A., Baker, Ronald J., Smith, Nicholas P. 1991.
Method for estimating rates of microbial degradation of hydrocarbons based on gas transport in the unsaturated zone at a gasoline-spill site in Galloway Township, New Jersey. Water-Resources Investigations. 250-255.
Key Words: New Jersey, pollution, environmental geology, oil spills, biodegradation, USGS, Eastern U.S., United States, southeastern New Jersey, Atlantic County New Jersey, Galloway New Jersey, ground water, volatile organic compounds, Atlantic Coastal Plain, North America, unsaturated zone.

Baek, Nam H., and Peter R. Jaffe. 1989. The degradation of trichloroethylene in mixed methanogenic cultures. J env quality. 18(4):515-518.
Key words: Biodegradation, Microorganism, Hydrocarbons, Water Pollution, Degradation, Bacteria
The purpose of this study was to investigate nonmethanogenic fermenter and methanogen microbial communities and their effects on anaerobic degradation of trichloroethylene (TCE). The chance of degrading TCE to inorganic carbon is improved when fermenters are present and methanogenic conditions exist, since the chlorinated ethene double bond can be hydrogenated to form the saturated chloroethane under these conditions. In the TCE degradation, the production of methane is significantly correlated with the production of TCE degradation products. Since chloroethane rapidly degrades to organic carbon, these results may provide a mechanism for complete TCE degradation under anaerobic conditions.

Baillie, L.A. 1993. Oil Boom. Atlantic Richfield, Co. 5.
Key Words: Floating barrier, air flow, fluid flow, gas flow, oil spill, pollution control, tubular goods, USA, air injection, Atlantic Richfield

Baily, Cdr. John L. 1979. Difficulties in unloading heavy oil from damaged barges during extremely cold weather and ice conditions. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil, barges.

Bair, Thomas Irvin, and Dimitri Peter Zafiroglu. 1988. Article for absorbing liquids. Patent No. EP 278476_A2, 9 pp.
Key words: Acids, Hydrocarbon Oils

Baker, G L. Australian developments in oil shale processing. In 14th Colo Sch Mines & U.S. Dep Energy Oil Shale Symp (Golden, Colo, 4/22 24/81) Proc in Year.
Key words: recovery, Australia, oil, disposal

Baker, J.M., R.B. Clark, P.F. Kingston, R.H. Jenkins. 1990. A

review of natural recovery of cold water
marine environments after an oil spill. In: Proceedings of the
13th Annual Arctic and Marine Oilspill
Program Technical Seminar Proceedings (June 1990), 111 pp.
Key words: Animal, Biochemical Reactions, Biodegradation,
Biology, Bird, Coastal Area, Ecosystem,
Environmental Impact, Pollution Control

Baker, Jenifer M. 1973. Biological effects of refinery effluents.
In: Proceedings of Joint Conference on
Prevention and Control of Oil Spills, March 13 15, Washington,
D.C.
Key words: oil spills, prevention.

Baker, B., G. Duffin, R. Flores and T. Lynch. 1990. Evaluation of
water resources in part of central
Texas. Unpublished final report prepared for the U.S. Department
of Energy. Austin, TX:Texas Water
Development Board. 67 pp.
Key words: Oil Spills, Water Pollution
Water resources in the Brazos, Red, Colorado, and Trinity River
basins, in central Texas, were evaluated.
In 1985 there was a little less that 81,000 acre-ft of
groundwater pumped from all aquifers in the study
area, with a little less than 77,000 acre-ft of groundwater
pumped from the Trinity Group aquifer.
Irrigation accounted for about 56% of all groundwater pumped. A
serious problem associated with the
development of groundwater from the Trinity Group aquifer is the
decline of artesian pressure in areas of
large groundwater withdrawals. Degradation of groundwater within
the Antlers and Travis Peak
Formations from oil-field brines and organic material are
problems in several counties. The deterioration
of water quality for the City of Blum has occureed over a 26-year
period and is associated with water level
declines in the Hensell Member of the Travis Peak Formation. The
Woodbine Group yields good quality
water at or near the outcrop; however, the residual sodium
carbonate and percent sodium limits its use for
irrigation, while high iron and fluoride content restricts its
use for public supply. Existing surface
reservoirs in the study area alone can supply 296,400 acre-ft of
water under 2010 conditions. Nearly all of
this water is either currently owned or under contract to supply
current and future needs. An additional
176,000 acre-ft of surface water could become available with the
development of the proposed Lake
Bosque and Paluxy Reservoir projecets and with reallocation of
storage in existing Lakes Waco and
Whitney. The amount of groundwater currently pumped exceeds the
estimated annual effective recharge to
the Trinity Group aquifer; the groundwater supply for the area
will continue to be drawn from storage
within the aquifer.

Baker, J.M., D.I. Little, E.H. Owens. 1993. A review of

experimental shoreline oil spills. In:
Proceedings of the 1993 Oil Spill Conference (prevention,
preparedness, response), March 29 April 1,
Tampa, FL.

Baker, R.N. 1991. Environmental remote sensing for the petroleum
industry: A practical approach. In:
Proceedings of the eighth thematic conference on geologic remote
sensing: exploration,
engineering and environment, April 29 May 2 1991, Denver, CO, pp.
229-238.
Key words: Environment, Remote Sensing, Oil Spills, Petroleum
Industry
Remote sensing techniques developed for exploration programs can
often be used to address environmental
issues facing the petroleum industry. While this industry becomes
increasingly more environmentally
conscious, budgets remain tight, requiring any technology used in
environmental applications to be cost
effective, widely available and reliable. In this paper a
three-fold analysis of environmental issues facing
the petroleum industry concludes: major areas of concern included
environmental mapping natural
habitats, surface cover, change through time, pollution
monitoring (hazardous wastes, oil seeps and spills
on and offshore), earth hazards assessment, baseline studies,
facilities sitting and crisis response. options
matrices were developed plotting current and near future RS
technology vs environmental concerns, and
each sensor/platform combination subjectively evaluated to
determine which combination could best
address the problem. While presently available RS technology
(both airborne and spaceborne) has
significant capability toward environmental mapping, hazards
detection and other concerns, the anticipated
launches of ERS-1, JERS-1, Landsat-6 and other systems will
provide environmentally useful data
available today only from relatively expensive and local airborne
surveys. Low altitude airborne surveys
and ground/sea truth will continue to be critical to any
quantitative studies.

Baker, J.M., D.I. Little, and E.H. Owens. 1993. A review of
experimental shoreline oil spills. In:
Proceedings of the 13th Bien API et al Oil Spill (Prev,
Preparedness, Response & Coop) Int Conf, March
29 April 1 1993, Tampa, FL, pp. 583-590.
Key words: Oil Spill, Bioremediation, Pollution Control,
Bibliography, Crude Oil, Petroleum, Pollutionn
Control Equipment

Baker, P.L. 1991. Fluid, lithology, geometry, and permeability
information from ground-penetrating radar
for some petroleum industry applications. In: Proceedings of the
SPE Asia Pacific Conf, November 4 7
1991, Perth, W Australia, pp. 277-287.
Key words: Radar, Environmental Pollution, Hydrocarbon Potential,

Petroleum, Pipeline Construction

Baker, W.T. 1991. An airborne bispectral imager configured to map oil spills. In: Proceedings of the Mar. Technol. Soc. et al. Conf. (Mts 91), November 10 14 1991, New Orleans, LA, 2:972-976.
Key words: Environment, Water Pollution Control, Monitoring

Baker, J.M., M.L. Guzman, P.D. Bartlett, D.I. Little, C.M. Wilson. 1993. Long-Term fate and effects of untreated thick oil deposits on salt marshes. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, Tampa, FL, pp. 395-399.
Key words: Oil Waste Fate, Natural Remediation, Oil Spill, Crude Oil

Baker, J.M., R.B. Clark, and P.F. Kingston. 1990. (A discussion of) environmental recovery in Prince William Sound and the Gulf of Alaska. Institute of Offshore Engineering (UK) Publication 12 pp.
Key words: Accident, Alaska, Animal, Beach, Bulk Carrier, Crude Oil

Baker J. M., Clark R. B., Kingston P. F. 1990. Environmental recovery in prince william sound and the gulf of alaska. Inst offshore engineering. Inst offshore eng rep june 1990 (12 pp). Key words: natural remediation, alaska, environment, inspecting, north america, ocean environment, oil spill, prince william sound area, remediation, reproductive behavior, testing, united states.

Baker, Ronald J., Fischer, Jeffrey M., Smith, Nicholas P., Koehnlein, Susan A., Baehr, Arthur L. 1991. Gas-chromatographic methods for determining the composition of the vapor phase in gasoline-contaminated soils. Water Resources Investigations. 280-286.
Key Words: Soils, chemical analysis, pollution, analysis, methods, gas chromatography, oil spills, USGS, New Jersey, Eastern U.S., United States, southeastern New Jersey, Atlantic County New Jersey, Galloway New Jersey, ground water, volatile organic compounds, Atlantic Coastal Plain, North America, gaseous phase.

Baker, W.T. 1991. An airborne bispectral imager configured to map oil spills. Mar Technol Soc et al Conf (MTS 91), November 10 14 1991, New Orleans, LA, 2:972-976.
Key words: Oil Spills, Remote Sensing

Baker, J. M., D. I. Little, and E. H. Owens. A Review of Experimental Shoreline Oil Spills. In Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993 in Tampa, Florida Year.
experimental, shoreline, oil spills

Baker, J.M., D.I. Little, and E.H. Owens. 1993. A review of experimental shoreline oil spills. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, Fl, pp. 583-590.
Key words: Oil Spill, Bioremediation, Cleaning, Pollution Control, Crude Oil, Environmental Pollution

Baker, B., G. Duffin, R. Flores and T. Lynch. 1990. Evaluation of water resources in part of north-central Texas. Unpublished report prepared for U.S. Department of Energy. Austin, TX: Texas Water Development Board. 67 pp.
Key words: Water Pollution, Oil Spills
Water resources within the North-Central Texas Region which lies in the Brazos, Red, Sulphur, Sabine, and Trinity River basins, were evaluated. The geologic formations underlying the study area range in age from Paleozoic to recent. The principal water-bearing formations are the Antlers, Twin Mountains, and Paluxy Formations of the Trinity Group, and the Woodbine Group, all of Cretaceous age. Extensive cones of depression have developed in the piezometric surface of each of the region's principal aquifers, coinciding with areas of large groundwater withdrawals. During the 13-year period 1976 to 1989, water level declines of 25 feet were common in the aquifers studied. The study identified a number of existing and potential water quality problems. Some of these are naturally occurring and are related to geologic structure. Elevated levels of some chemical constituents suggest contamination related to oil-field activities and other industrial sources. The projected water demands for the study area by the year 2010 total over 1.4 million acre-ft. Existing surface-water reservoirs can supply 1.6 million acre ft of water under 2010 conditions. The amount of groundwater currently pumped exceeds the estimated annual effective recharge to the area's aquifers; a portion of the water pumped is drawn from aquifer storage resulting in water level declines. Even though the study area has sufficient surface water to meet projected needs through 2010, rural areas that depend on a groundwater supply could face shortages before 2010 due to the limited availability of groundwater and the high cost of converting to a surface water supply.

Baker, J.M., J.A. Bayley, S.E. Howells, J. Oldham, and M. Wilson. 1987. Oil in wetlands. Dicks, B. Ecological impacts of the oil industry. In: Proceedings of the International meeting on ecological impacts of the oil industry, November 4 5 1987, London, pp. 37-59.
Key words: Oil Spills, Environmental Impacts
Wetlands include a variety of bog, fen, reed-swamp and saltmarsh communities. Within this variety, a number of oil-pollution case histories have been investigated,

and field experiments have been carried out with clean-up and rehabilitation in mind. The behaviour of oil in wetlands is described in relationship to tidal and water-table movements. Substrate penetration may occur, for example along channels left by drying roots, to depths of 50 cm and more. Clean-up techniques including dispersant treatment, cutting and burning are discussed. Some species can grow in sediments with high concentrations of weathered oil and have been successfully used in the rehabilitation of old spill sites. (author).

Bakke, Torgeir, Torbjorn M. Johnsen. 1979. Response of a subtidal sediment community to low levels of oil hydrocarbons in a Norwegian fjord. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: subtidal, oil.

Balba, M. T., A. C. Ying and T. G. McNeice. 1991. Bioremediation of contaminated soil: strategy and case histories. In: Proceedings of the HMC-South 91: Hazardous Waste, Hazardous Materials/Hazardous Materials Control (HWHM/HMC) Conference, April 24 26, 1991, Houston, TX, pp. 235 241.
Key words: Bacteria, Biodegradation, Groundwater, In-Situ, Petroleum, Soil Pollution
Microorganisms are capable of degrading many kinds of xenobiotic compounds and toxic chemicals. These microorganisms are ubiquitous in nature and there are numerous cases in which long-term contamination of soil and groundwater has been observed. The persistence of the contamination is usually caused by the inability of micro-organisms to metabolize these compounds under the prevailing environmental conditions.
Two general reasons account for the failure of microbes to degrade pollutants in any environment: (1) inherent molecular recalcitrance of the contaminants and (2) environmental factors. The inherent molecular recalcitrance is usually associated with zenobiotic compounds where the chemical structure of the molecule is such that microbes and enzymes required for its catabolism have not evolved yet in nature.
The environmental factors include a range of physicochemical conditions which influence microbial growth and activity. Biological remediation of contaminated sites can be accomplished using naturally-occurring microorganisms to treat the contaminants. Only particular groups of microorganisms are capable of decomposing specific compounds. The development of a bioremediation program for a specific contaminated soil system usually includes: thorough site/soil/waste characterization; treatability studies; and design and implementation of the bioremdiation plan. The results of in-situ and ex-situ treatment programs involving the cleanup of petroleum hydrocarbon-contaminated soil will be discussed in detail.

The paper will address key issues affecting the success of the bioremediation process such as nutrient transport, metal precipitation and potential soil clogging, microbial inoculation, etc.

Baldi, F. 1991. New method for detecting methylmercury by its enzymatic conversion to methane. Environmental Science and Technology (United States). 25:2:302-305.
A new method is suggested for determining methylmercury in biological samples. The determination is based on the use of whole cells of a broad-spectrum mercury-resistant bacterium, Pseudomonas putida, strain FB1, which is induced to produce the enzymes organomercurial lyase and mercuric reductase. These biocatalysts convert organomercurials to elemental mercury and their derivative hydrocarbons. The extraction procedure for methylmercury in biological samples follows the conventional toluene extraction method, which is retained until methylmercury is concentrated in an aqueous phase containing 0.01 M Na{sub 2}S{sub 2}O{sub 3}. This solution is mixed with bacterial cells in exponential growth phase and then incubated in microreaction vessels. A complete biological degradation of methylmercury to methane occurs. The efficiency of derivatization depends on the organomercurial concentration, the incubation time, and the cell density. The detection limit is 15 ng of methylmercury in 1 g of biological tissue and the coefficient of variation is 1.9% in 10 replicate samples with 100 ng/mL.
Key words: Methylmercury, quantitative chemical analysis, biological materials, experimental data, measuring.

Balfanz, J., Rehm, H.J. 1991. Biodegradation of 4-chlorophenol by adsorptive immobilized Alcaligenes sp. A 7-2 in soil. Applied Microbiology and Biotechnology (Germany). 35:5:662-668.
Alcaligenes sp. A 7-2 immobilized on granular clay has been applied in a percolator to degrade 4-chlorophenol in sandy soil. Good adsorption rates on granular clay were achieved using cell suspensions with high titres and media at pH 8.0. The influence of various parameters such as aeration rate, pH, temperature, concentration of 4-chlorophenol and size of inoculum on the degradation rate were investigated. During fedbatch fermentations under optimal culture conditions, concentrations of 4-chlorophenol up to 160 mg.l{sup -1} could be degraded. Semicontinuous culture experiments demonstrated that the degradation potential in soil could be well established and enhanced by the addition of immobilized bacteria. Continuous fermentation was performed with varying 4-chlorophenol concentrations in the feed and different input levels. The maximum degradation rate was 1.64

g.l{sup-1}.day{sup -1}.
Key words: chlorinated aromatic, hydrocarbons, biodegradation, immobilized cells, soils.

Ball, Harold A., Martin Reinhard, and Perry L. McCarty. 1991. Biotransformation of monoaromatic hydrocarbons under anoxic conditions. Battelle In Situ Bioreclamation Symp, San Diego, CA, pp. 458-463.
Key words: Hydrocarbons, Groundwater, Bacteria, Microorganism, Degradation
Groundwater environments are susceptible to contamination from aromatic hydrocarbons contained in gasoline. To allow for aerobic remediation methods, oxygen is often supplied to aquifers, but this greatly increases costs. An alternative is the development of microbes that can transform hydrocarbon contaminants under anoxic, nitrate-reducing conditions. Microcosm experiments with denitrifying bacteria resulted in degradation of the aromatic compounds toluene, phenol, ethylbenzene, and xylene. Toluene was very readily transformed. Microorganisms capable of degrading aromatic compounds are not ubiquitous, and microbial medium composition clearly affects aromatic biotransformation.

Ballestero, T. P. 1990. Fiscal year 1990 program report: New Hampshire Water Resources Research Center. Unpublished report prepared for New Hampshire University, Water Resources Research Center.
Reston, VA: Geological Survey, Water Resources Div. 49 p.
Key words: Groundwater, Oil Spills, Separation Processes
The report covers the activities of the New Hampshire Water Resource Research Center for the period of July 1, 1990, through June 30, 1991. The projects include: effects of the forest land application of municipal wastewater treatment plant sludge, the analysis of how contaminants attach to lake sediments, oil spill response plans on the Piscataqua River, literature review of motor boat and personal water craft on environmental quality, performance evaluation of point-of-entry treatment units for gasoline-contaminated groundwaters and automation of a portable filtration system for community water supplies.

Ballou, Thomas G., et al. 1985. Oil spill response planning in tropical coastal environments. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.

Ballou, Thomas G., et al. 1989. Effects of untreated and chemically dispersed oil on tropical marine communities: a long-term field experiment. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: chemical dispersants, oil, marine.

Ballou, Thomas G., Roy R. Lewis III. 1989. Environmental assessment and restoration recommendations for a mangrove forest affected by jet fuel. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: environmental, restoration, forest.

Ballou, Thomas G. 1987. Final results of the API tropics oil spill and dispersant use experiments in Panama. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: results, API, oil spill, dispersant, Panama.

Bao-Kang, Pu. 1976. Analysis of significant oil spill incidents from ships, 1976 1985. In Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil spill.

Baokang, Pu. 1989. Combating oil pollution in China. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil spill, China.

Baokang, Pu, Yu Chengguo. 1991. Oil spill contingency planning in Shanghai. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: oil spill contingency, Shanghai.

Barber, F.G. 1971. Containment of oil by sea ice: some qualitative aspects. In: Proceedings of Joint Conference on prevention and control of oil spills, June 15 17, Washington, D.C.
Key words: oil, sea.

Barenschee, E.R., P. Bochem, O. Helmling, and P. Weppen. 1991. Effectiveness and kinetics of hydrogen peroxide and nitrate-enhanced biodegradation of hydrocarbons. Battelle In Situ Bioreclamation Symp, San Diego, CA, 103-124.
Key words: Soil Contamination, Biodegradation, Microorganism, Hydrocarbon, Oil Spills, Bacteria
Two experiments were conducted to evaluate and compare two techniques applied to in situ biodegradation of contaminated sites underground. Electron acceptors are known to enhance underground biodegradation, and the two methods tested focused on hydrogen peroxide and nitrate, the most commonly applied electron acceptors. Hydrogen peroxide was more effective than nitrate, resulting in degradation of diesel fuel at four to seven times higher rates, greater heterotrophic bacterial activity, larger counts of hydrocarbon oxidizing bacteria in the soil, much higher formation rates of

carbon dioxide and rates of oxygen
consumption, and total mineralization of eliminated hydrocarbons.

Barenschee, E.R., et al. Kinetic studies on the hydrogen peroxide-enhanced in-situ biodegradation of hydrocarbons in water-saturated ground zone. DECHEMA Biotechnology Conferences. (1990): 4.
Key words: bacteria, degradation, biodegradation, hydrocarbon, soil
The development of a bioreactor system is described that allows consideration of the effects of mass transportation and evaluation of the correct kinetics for in-situ biodegradation processes. It consists of two parallel and continuously operated lysimeter installations. Technical data and reaction parameters are reported.

Barger, William R. 1973. Laboratory and field testing of surface-film forming chemicals for use as oil collecting agents. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: chemicals, oil.

Barik, S., Tiemens, K., Harding, R., Hawley, B., Isbister, J. 1990. Biological conversions of coals to methane| Proceedings: 1990 first international symposium on the biological processing of coal.
5.21-5.32:501.
An update on ARCTECH's current Biogasification of Coal research projects is presented. Significant progress has been made on biogasification process development (METC), direct biogasification of Texas lignite (Houston Lighting and Power), intermediate identification and/or degradation of soluble coal products (GRI), acetogenic populations and their roles in biogasification (EPRI). Anaerobic biodegradation of several low-rank coals was evaluated using enriched bacterial cultures. These cultures, obtained from natural sources, were developed in the laboratory and demonstrated direct conversion of coals to methane. Unique bacterial consortia derived from the guts of several species of termites were studied for conversion of Texas lignite to methane. Two of these termite-derived cultures were capable of producing significant quantities of methane (up to 272 cc of methane/g of coal) from untreated Texas lignite. A bacterial consortium developed at ARCTECH also produced methane from an untreated Beulah premium coal sample. Microbial culture/coal specificity with respect to biogasification of coal has been demonstrated. Three coals were biosolubilized and the soluble coal-derived products were separated into seven fractions based on nominal molecular weight. These coal fractions are being evaluated as substrates for biogasification. Studies using batch, semi-continuous, and bio-disc reactors indicate that the bacterial

cultures can be adapted and improved to increase the rate and efficiency of coal carbon conversion to methane. Preliminary calculations of coal carbon conversion by the best consortium indicate a coal carbon conversion of more than 80%. The effects of pH, temperature, agitation, solids loadings and reactor size are being studied with respect to optimizing coal carbon conversions.
Key words: coal gasification, biochemical reaction, liquids, biodegradation.

Barinaga, M. 1989. Alaskan oil spill: Health risks uncovered. Science. 245(4917):463.
Key words: Acute, Alaska, Bone, Boom, Economic Factor, Oil Waste, Pollution Control

Barker, David. 1983. State of Texas spill response mapping project. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: spill response.

Barker, J.F., and C.I. Mayfield. 1988. The persistence of aromatic hydrocarbons in various ground water environments. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:649-667.
Key words: Water Pollution, Biodegradation, Groundwater, Oil Spill, Bacteria

Barnard, S. M. and D. R. Walt. 1991. Fiber-optic organic vapor sensor. Environmental Science and Technology 25(7):1301 1304.
Key words: Fiber Optics, Oil Spills, Groundwater, In-Situ
Fiber-optic sensors and supporting field-portable instrumentation have been developed that are capable of in-situ, continuous measurements of volatile organic compounds in groundwater and soil samples. The sensors are based on the polymer absorption of organic vapor and result in fluorescence enhancement of an immobilized fluorophor. Laboratory tests have characterized the effects of various volatile organic compounds and temperature on sensor performance. Preliminary in-situ field data are presented from a jet fuel contamination site. The lowest detection limit is 10 ppm with a response time of 2.5 min with 7.5% signal change.

Barrett, R. MCD. 1992. Oil Spillage Boom. 10.
Key Words: Floating barrier, ballast, foamed plastic, oil spill, pollution control equipment, polymer, Great Britain, BIP Chemicals, Ltd., buoyancy, casings, construction material, coupling (mechanical), elastomer, engineering drawing, environmental pollution, mechanical property, ocean environment, physical property, pollution control, sleeve, synthetic resin,

tubular goods, urea formaldehyde polymer,
water pollution.

Barrilaut, D., Sylvestre, M. 1993. Factors affecting PCB [polychlorinated biphenyl] degradation by an implanted bacterial strain in soil microcosms. Canadian Journal of Microbiology (Canada). 39:0008-4166.
A study was conducted to evaluate the capabilities of Pseudomonas testosteroni B-356 to degrade polychlorinated biphenyls (PCBs) in soil microcosms and to identify some of the factors likely to favor the degradative performance of the implanted bacteria. The presence of biphenyl as cosubstrate was the most important factor affecting PCB degradation in soil. However, because biphenyl was rapidly depleted in soil microcosms, repeated addition of small amounts of biphenyl to maintain a constant level of the cosubstrate allowed the achievement of a higher degree of degradation of the tetrachlorinated components of Aroclor 1242 than was achieved with a single addition at the time of inoculation. Degradation of di- and tri-chlorinated PCB congeners was less affected by repeated addition of biphenyls because these congeners were degraded very fast and complete degradation was achieved before biphenyl was depleted in the soil. Biodegradation was also related to bioavailability of the substrate. The proportion of each congener degraded was higher in the microcosms receiving both the producer of the surface-active agent, Alcaligenes faecalis B-556, and strain B-356. Under the best conditions (presence of a constant level of biphenyl and strain of B-556) P. testosteroni B-356 was able to degrade ca 30% of the Aroclor 1242 added to soil microcosms; some other factors reducing the PCB degradation capabilities of the implanted bacteria are also discussed. 42 refs., 2 figs., 5 tabs.
Key words: polychlorinated, biphenyls, biodegradation, bench scale experiments, microcosms, pseudomonas, soils.

Barsdate, Robert J. , Vera Alexander, and Robert E. Benoit. 1973. Natural oil seeps at Cape Simpson, Alaska: Aquatic Effects. In: Proceedings of the 23rd AAAS Alaska Sci. Conf., University of Alaska, Fairbanks, August 17, 1972. Symposium on the Impact of Oil Resour Dev on North Plant Communities. Inst of Arct Biol (Occas Publ on North Life n 1), pp. 91 95.
Key words: Oil seeps, Petroleum Pipelines, Phytotoxicity
In ponds at the natural oil seeps of Cape Simpson, Alaska, phytoplankton productivity and abundance, as well as numbers of bacteria, were high in waters in contact with old tars and asphalts. Both oil-free ponds and ponds containing much fresh, low viscosity oil were substantially less productive. The ionic composition of the water was little influenced by the seeps. Phytotoxicity may limit primary productivity in waters in contact with relatively fresh oil, but at lower levels

of hydrocarbon stress productivity is
high,possibly because of reduced grazing pressure. 8 refs.|

Bart J. Baca, et al. Recovery of Brittany Coastal Marshes in the
Eight Years Following the AMOCO
CADIZ Incident. In Proceedings of the 1987 Oil Spill
Conference(Prevention, Behavior, Control,
Cleanup), April 6 9, 1987 in Baltimore, MD Year.
Key words: recovery, Brittany, coastal, marshes, AMOCO CADIZ

Bartell, S.M. 1987. Structure-activity relationships in a model
of the fates and effects of PAH's in aquatic
ecosystems. Proceedings of the symposia of the division of
environmental chemistry of the American
Chemical Society. 323-324.
Structure-activity relationships are frequently used in
environmental toxicology to estimate the equilibrium
concentrations of chemicals of concern in water, sediments, and
organisms. For example, the
accumulation of nonpolar aromatic hydrocarbons by planktonic
invertebrates and fishes has been routinely
estimated from the octanol:water partition coefficients (Kow)
measured or calculated for these compounds.
Similarly, the accumulation of these chemicals in suspended
particulate matter and sediments has been
estimated as a function of the Kow of the particular hydrocarbon
and the organic matter content of the
particulates or the sediments. To the extent that the
equilibrium assumptions are valid in particular
applications, these relations may provide useful estimates of the
expected concentration of potential
toxicants in important components of aquatic systems. The
purpose of work reported here was to develop
a model for forecasting the fate and effects of polycyclic
aromatic hydrocarbons (PAHs) under
nonequilibrium conditions in aquatic systems. The model follows
the dissolution of a PAH from a surface
oil slick and simulates the time-varying concentration of the
compound in water, sediments, suspended
particulates, and populations of rooted vegetation,
phytoplankton, zooplankton, attached algae, bacteria,
benthic invertebrates, omnivorous fish, and benthic
detritus-feeding fish. The modeled transport and fate
processes include photolytic degradation, volatilization,
sorption, and bioaccumulation of dissolved PAH.|
Key words: aquatic ecosystems, biological accumulations,
ecosystems, environmental exposure pathway,
ecological concentration, polycyclic aromatic hydrocarbons,
mathematical models, plankton, sediments,
water pollutions, environmental transport, fishes,
microorganisms.

Bartha, J. Cleaning up petroleum oil spills, by spraying molten
paraffin wax to solidify and entrain the oil.
Patent No. US 588791_900927.
Key words: Automatic, Boom, Coastal Area, Crude Oil, Oil Waste,
Petroleum Wax, Pollution Control,

Separation Equipment

Bartsch, Norbert, Konrad Gruner, Wolfgang Keydel, and Franz Witte. 1987. Contributions to oil-spill detection and analysis with radar and microwave radiometry: results of the archimedes II campaign. IEEE Transactions on Geoscience and Remote Sensing. GE-25(6):677-690.
Key words: Water Pollution, Oil Spills, Remote Sensing
During the Archimedes II European measurement campaign in November 1985 different DFVLR instruments were flown, an X-band SLAR (side-looking aperture radar), an elementary L-band SAR, and microwave radiometers at 32 and 90 GHz. The objective of these measurements was to evaluate the possibility of detection, localization, and qualification of oil pollution with microwave sensors. Examples of measurement results obtained were presented. As a main result, it can be stated that all of these microwave instruments are valuable and necessary tools for oil pollution detection and oil collection systems. 9 refs.

Baruah, K.C. November 2, 1991. Environmental evaluation of oil drilling and collection system: A case study from India. 1st US Environ. Protect. Agency et al. Oil & Gas Explor. & Prod. Waste Manage. Pract. Int. Symp. (New Orleans, 9/10-13/90) Proc. 357-373 (1990) Petroleum Abstracts (ISSN 0031-6423) ABSTR. NO. 512,800 V31 N.44. 31(44):357-373.
Key Words: Abstract, accumulating, air pollution, case history, conservation, crude oil, crude oil (well), drilling (well), economic factor, effluent water treating plant, energy conservation, environmental impact, Far East, flare gas, ground water, incineration, India, industrial plant, meeting paper, natural gas, oil waste, pollution control, pollution source, separation equipment, settling pond, soil pollutant, surface water, US Environmental Protection Agency, venting, waste disposal, waste material, water pollutant, water pollution, water treating plant.
Welch, J., Stolls, A.M., Etkin, D.S. 1991. Oil Spill Intelligence Report: Worldwide oil spill trends. USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference (San Diego 3/4-7/91) (Condensation) API Publication N.4529. 720-22.

Basco, David R. 1971. Pneumatic barriers for oil containment under wind, wave and current conditions. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.

Basseres, A., Eyraud, P., Tramier, B. 1993. Enhancement of spilled oil biodegradation by nutrients of natural origin. 1993 International oil spill conference: Prevention, preparedness,response. 495-501,931.
Ten years ago, Elf Aquitaine began developing the technologies

for the acceleration of hydrocarbon biodegradation. The continuation of this work has involved the study of new additives to complement the oleophilic nutrient, INIPOL EAP 22. In particular, it has been shown in both laboratory and in situ tests that hydrocarbon degradation can be accelerated by animal meals, which are natural products. Preliminary laboratory studies carried out under batch conditions have shown that the use of these products has resulted in considerable growth of the bacteria, coupled with a notable increase in the biological degradation kinetics of the hydrocarbons. These results are comparable with the performance of the nutrient INIPOL EAP 22. In situ experiments undertaken on soils polluted by hydrocarbons have shown that by using animal meals, 50 percent biodegradation was obtained after six weeks and this increased to 80 percent when mechanical aeration was also employed. Under nutrient-free control conditions, 25 percent biodegradation was obtained with no aeration and 35 percent with mechanical aeration. In trials using coastal sandy sediments, the use of these nutrients has resulted in an increase of both the number of hydrocarbon specific bacteria and the hydrocarbon degradation. It can be concluded from these pilot experiments that in the development of bioremediation as an operational tool in the response to accidental oil spills, these nutrients of natural origin represent an interesting advance.
Key words: bacteria, cell, proliferation, biodegradation, acceleration, remedial action.

Basseres, A., Ladousse, A. Bioremediation with oleophilic fertilizer. ACS 205th National Meeting (Denver, CO 3/28-4/2/93) ACS Division of Petroleum Chemistry, Inc. Preprints (ISSN 0569-3799) V38 N.2 246-53 (March 1993).
Key words: accident, animal, association, bacteria, biodegradability, bioremediation, biodegradation, isomer, coating, crude oil, demulsifying, aquitaine.

Bates, D.W., Jr., K.G. Mitchell, and E.L. Schrader.1992. First Response Remediation of Marine Oil Spills : pt.1 : Procedure for Determining the Efficiency and Comparison of Polypropylene and Cellulosic Sorbent Fabrics. Millsaps Coll. 41ST Annu GSA Southeast sect et al mtg (Winston-Salem, NC, 3/18-20/92) pap no 8592; abstr with programs (gsa) v 24, no 2, p 3, March 1992 (issn 00167592; abstract only) (ao).
Key words: pollution control, control, oil spill, pollution control equipmnt, remediation, ecology & pollution

Battelle. 1991. Process promises to ease sludge disposal. Chemical Engineering Progress. 87(5):11-12.
Key words: Containment, Crude Oil, Economic Factor, Oil Refinery,

Pollution Control

Batutis, Edward P., Lt. (jg) Robert L. Skewes. 1977. Development and test of a shipboard, continuous, on-line oil-in-water content monitor using forward (laser) light scattering techniques. In Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: monitor.

Baud-Grasset, F., S. Baud-Grasset, and S.I. Safferman. 1993. Evaluation of the bioremediation of a contaminated soil with phytotoxicity tests. Chemosphere. 26(7):1365 1374
Keywords: hydrocarbons, biodegradation, fungi, soils, hydrocarbons, monitoring, transport
The fungal remediation of polycyclic aromatic hydrocarbons in a contaminated soil from a hazardous waste site was evaluated in a pilot-scale treatability study. Because toxic chemicals may not be measured accurately in chemical analysis and disappearance of parent compounds may not indicate detoxification of the soil, higher plants were selected to evaluate the overall reduction in toxicity in the soil after fungal treatment. Seed germination tests using soil samples and root elongation tests using soil eluates were conducted with three different species (lettuce, oat and millet) before and after treatment. Phytotoxicity tests revealed significant detoxification of soil after treatment with a good correlation with parent compound depletion. The seed germination test appeared to be more sensitive than the root elongation test, suggesting that the toxic compounds were not easily extracted from the soil to the aqueous solution. The study indicates that phytotoxicity tests have good potential to be used as an environmental tool to assess the efficacy of a remediation technology for site clean-up.

Bauer, J.E., D.G. Capone. Effects of co-occurring aromatic hydrocarbons on degradation of individual polycyclic aromatic hydrocarbons in marine sediment slurries. Appl. Environ. Microbiol. (1988): 54.
Key words: marine environment, biodegradation, hydrocarbons, sediment, pollution
Rates of polycyclic aromatic hydrocarbon (PAH) degradation and mineralization were influenced by preexposure to alternate PAHs and a monoaromatic hydrocarbon at relatively high (100 ppm) concentrations in organic-rich aerobic marine sediments. Prior exposure to three PAHs and benzene resulted in enhanced 14Cnaphthalene mineralization, while 14Canthracene mineralization was stimulated only by benzene and anthracene preexposure. Preexposure of sediment slurries to phenanthrene stimulated the initial degradation of anthracene. Prior exposure to naphthalene stimulated the initial degradation of phenanthrene but had no effect on either the initial degradation

or mineralization of anthracene. For those compounds which stimulated 14Canthracene or 14Cnaphthalene mineralization, longer preexposures (2 weeks) to alternative aromatic hydrocarbons resulted in an even greater stimulation response.

Bauman, B.J. (American Petroleum Inst., Washington, DC (USA)). 1989. Soils contaminated by motor fuels: Research activities and perspectives of the American Petroleum Institute.
Kostecki, P.T.,Calabrese, E.J. (Massachusetts Univ., Amherst, MA (USA)). 1989. Petroleum contaminated soils: <Original Series/Collective> Remediation techniques environmental fate risk assessment. National conference on environmental and public health effects of soils contaminated with petroleum products. 357(p):3-20.
Key Words: Environment pollution regulations, oil spills health hazards, petroleum products land pollution, environmental exposure pathway, ground water, petroleum industry, pollution control, remedial action, risk assessment, hydrogen compounds, oxygen compounds.

Bauman, B. 1991. Current and recent research of the American Petroleum Institute. In: Proceedings of the First Annual Groundwater and Soil Remediation Research, Development, and Demonstration Symposium, Jan. 30, Ottawa, Canada. pp. 1 17, paper 3.
Key words: Oil Spills, Groundwater, In-Situ Biodegradation, Venting
Current research projects on various aspects of groundwater contamination by petroleum and related products are summarized. Under each project, the research objective, scope, current status and results, and initiation/completion dates are given. The topics of these projects include the chemical fate of oxygenates and oxygenated fuels in groundwater and soil, evaluation of techniques for delineating subsurface hydrocarbon plumes, leak detection systems for crude oil tanks, soil analyses, impacts of residual hydrocarbons in soils over groundwater, measurement of fuel-contaminated soil leachate, in-situ biodegradation of aromatics, venting of gasoline-range hydrocarbons in soils, groundwater modelling, soil remediation, and assessment of site-specific cleanup levels.

Bausum, H.T., W.R. Mitchell, and M.A. Major. 1992. Biodegradation of 2,4- and 2,6-dinitrotoluene by freshwater microorganisms. J. Environ. Sci. Health Part A. 27(3):663 695.
Key words: Biodegradation, Rivers, Maryland, Bacteria
The microbial degradation of 2,4- and 2,6-dinitrotoluene was complete or nearly complete in surface water from two locations downstream from the Radford Army Ammunition Plant. No degradation was detected in surface water from 4 local (Frederick, MD, USA area) sites. Either isomer could serve as a sole carbon and energy source, with about 60 percent of substrate carbon

appearing as CO2, and with an increase in the population of degrading organisms. In both the rate of mineralization in percent degraded per day increased with increasing substrate concentration. At 10 mg/L, degradation rates of 32 and 14.5 percent/day were observed for the 2,4 and 2,6 isomers, respectively. At very low concentrations of the 2,6 isomer a degrading population did not develop, and significant degradation did not occur. The rate of substrate utilization was far greater, and the lag time shorter, for the 2,4 isomer, consistent with a far greater density of 2,4-DNT degraders.

Bavister, Richard, Jon Wonham. 1993. Contingency planning for oil spill response: a program of joint IMO/Oil industry regional seminars. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill.

Baxter, R.M. 1989. Reductive dehalogenation of environmental contaminants: A critical review. Water Pollution Research Journal of Canada (Canada). 24:2:0197-9140.
It is generally recognized that reductive processes are more important than oxidative ones in transforming, degrading and mineralizing many environmental contaminants. One process of particular importance in reductive dehalogenation, i.e., the replacement of a halogen atom (most commonly a chlorine atom) by a hydrogen atom. A number of different mechanisms are involved in these reactions. Photochemical reactions probably play a role in some instances. Aliphatic compounds such as chloroethanes, partly aliphatic compounds such as DDT, and alicyclic compounds such as hexachlorocyclohexane are readily dechlorinated in the laboratory by reaction with reduced ion porphyrins such as hematin. Many of these are also dechlorinated by cultures of certain microorganisms, probably by the same mechanism. Such compounds, with a few exceptions, have been found to undergo reductive dechlorination in the environment. Aromatic compounds such as halobenzenes, halophenols and halobenzoic acids appear not to react with reduced iron porphyrins. Some of these however undergo reductive dechlorination both in the environment and in the laboratory. The reaction is generally associated with methanogenic bacteria. There is evidence for the existence of a number of different dechlorinating enzymes specific for different isomers. Recently it has been found that many components of polychlorinated biphenyls (PCBs), long considered to be virtually totally resistant to environmental degradation, may be reductively dechlorinated both in the laboratory and in nature. These findings suggest that many environmental contaminants may prove to be less persistent than was previously feared. 145 refs.
Key words: pollutants, dehalogenation, chlorinated aromatic

hydrocarbons.

Bayliss, Randolph, Capt. Raymond Spoltman. 1981. The Wreck of the Lee Wang Zin. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.

Bayliss, R., E. Gundlach, J.H. Janssen, A. Kegler, M. Kendziorek, and D. Lawn. 1991. Initial state of Alaska response to the Exxon Valdez oil spill. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp. 321 23.
Key words: Accident, Alaska, Animal, Boom, Bulk, Crude Oil, Environmental Protection, Pollution Control, Spill, Supertanker

Bazylinski, D.A., Wirsen, C.O., Jannasch, H.W. 1989. Microbial utilization of naturally occurring hydrocarbons at the Guaymas Basin hydrothermal vent site. Applied and Environmental Microbiology (USA). 55:11:0099-2240.
The Guaymas Basin (Gulf of California; depth, 2,000 m) is a site of hydrothermal activity in which petroliferous materials is formed by thermal alteration of deposited planktonic and terrestrial organic matter. We investigated certain components of these naturally occurring hydrocarbons as potential carbon sources for a specific microflora at these deep-sea vent sites. Respiratory conversion of (1-{sup 14}C)hexadecane and (1(4,5,8)-{sup 14}C)naphthalene to {sup 14}CO{sub 2} was observed at 4{degree}C and 25{degree}C, and some was observed at 55{degree}C, but none was observed at 80{degree}C.
Bacterial isolates were capable of growing on both substrates as the sole carbon source. All isolates were aerobic and mesophilic with respect to growth on hydrocarbons but also grew at low temperatures (4 to 5{degree}C). These results correlate well with previous geochemical analyses, indicating microbial hydrocarbon degradation, and show that at least some of the thermally produced hydrocarbons at Guaymas Basin are significant carbon sources to vent microbiota.
Key words: bacteria, ecology, fumaroles, carbon 14, carbon oxides, chalcogenides, isotope.

Beach, Robert L., William T. Lewis. 1983. Testing of a prototype waste oil flaring system. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.

Beach, Robert L., Kenneth R. Goldman. 1981. Development of a flaring burner oil disposal system. In Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5,

Atlanta, GA.

Beaty, P.S., McInerney, M.J., Wofford, N.Q. 1987. Energetics of H sub 2 -producing syntrophic
bacteria. Biotechnological advances in processing municipal wastes for fuels and chemicals. 1987.
Antonopoulos, A.A. (ed.). 1. symposium on biotechnological advances in processing municipal waste for
fuels and chemicals. 67-83:488.
The complete anaerobic degradation of organic matter to CO{sub 2} and CH{sub 4} requires the concerted
actions of four major metabolic groups of bacteria. Fermentative bacteria hydrolyze the substrate polymers
and ferment the products to volatile acids, CO{sub 2} and H{sub 2}. The H{sub 2} (-) and acetate
producing syntrophic bacteria degrade propionate and longer-chain fatty acids and some aromatic acids to
acetate, CO{sub 2} and H{sub 2}. The acetogenic bacteria produce acetate and sometimes butyrate from
H{sub 2} CO{sub 2}, CO, CH{sub 3}OH and methoxy moieties of aromatic compounds. Finally, the
methanogens use the H{sub 2} produced by the other groups to reduce CO{sub 2} and CH{sub 4} and
some species cleave acetate to CH{sub 4} and CO{sub 2}. Little is known about the physiology of the
H{sub 2}(-) and acetate-producing syntrophs. These bacteria grow very slowly and only grow in coculture
with H{sub 2}(-) using bacteria. Methods have been developed to mass-culture Syntrophomonas wolfei in
coculture with Methanospirillum hungatei and to obtain cell-free extracts of S. wolfei with minimal
contamination from cellular components of the methanogen by lysozyme treatment. S. wolfei extracts
contained high specific activities of the B-oxidation enzymes indicating that fatty acids are degraded by this
pathway. Theoretical calculations indicate that end-product excretion may be an important route for energy
production in this organism. 26 refs., 4 figs., 2 tabs.
Key words: methane, biosynthesis, metabolism, propionic acid, hydrogen, alkanes, bacteria.

Bech, C., P. Sveum, and I. Buist. 1992. In-situ burning of emulsions: The effects of varying water content
and degree of evaporation. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical
seminar, June 10 12 1992, Edmonton, Alberta, pp. 547-559.
Key words: Oil Spill, Combustion, Thermochemical Processes
In-situ burning of oil is considered to be one of the most promising techniques for rapid removal of large
quantities of oil at sea, particularly in ice-infested waters. A series of field experiments was conducted in
Spitsbergen, circular basins cut in sea ice, to study the effect of water content, evaporation, thickness of
the emulsion layer, and environmental factors on the burn efficiency of Statfjord crude oil and emulsions.
Results from the experiments are presented along with preliminary results concerning the dynamics of

burning emulsions and the efficiency of conventional and novel igniters. Water-in-oil emulsions with 40% water content could be burned. However, for oils evaporated more than 18% and with a water content of over 20%, conventional gelled gasoline was not a very effective igniter. Ignition success was improved when gelled crude oil was used as the igniter. The results imply that for practical in-situ burning, the igniter technology needs to be improved. 5 refs., 11 figs., 3 tabs.

Bechtel Corp. 1991. Bechtel (Corp): Kuwaiti restoration cost overstated. Oil & Gas Journal. 89(16):33-34.
Key words: Buoyancy, Business Operation, Diaster Control, Economic Factor, Legal Consideration, Oil Waste, Pollution Control Equipment

Beck, Donald A., Lt. Paul J. Moeller. 1979. Implementation of the offshore oil pollution fund. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: offshore oil pollution.

Becker, K.W., et al. A New laboratory method for evaluating oil spill dispersants. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill dispersants.

Becker, Donald A. Used lube oil: hazardous waste vs. valuable resource. In Trace Substances in Environmental Health 16, Proceedings of University of Missouri's 16th Annual Conference. in Columbia, Mo,U.S.A. Year.
Key words: motor oil, EPA regulations, recycled oil, used oil, disposal

Becker, Kenneth W.,Gordon P. Lindblom. 1983. Performance evaluation of a new versatile oil spill dispersant. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil spill, dispersants.

Beckett, Capt. C.J. 1979. The Grounding of the Imperial St. Clair: A case history of contending with oil in ice. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil.

Beckstrom, B.D. 1989. Destruction of hazardous waste and clean-up of contaminated soils. In: Proceedings of the PETRO-SAFE '89: international exhibition and conference for environmental and safety concerns of the energy industries, October 3 5 1989,

Houston, TX, pp. 585-602.
Key words: Hazardous Materials, Waste Management, Soil Contamination, Polycyclic Aromatic Hydrocarbons
This paper reports the destruction of hazardous waste and clean-up of contaminated soils by pyrolysis in an indirectly heated rotary kiln system, followed by combustion of the volatiles in a secondary combustion chamber, tested in a pilot plant and demonstrated in an industrial scale plant. Soils and other materials to be treated are heated in the kiln to 500-600{degrees}C., with a maximum temperature of 750{degrees}C.
The residence time of solids in the kiln is approximately 1 hour. Data from the tests, including destruction efficiencies for various polycyclic aromatic compounds and percent organics remaining in the ash, are presented. In general, the destruction efficiency exceeds 99%.

Bedard, D.L., Haberl, M.L., May, R.J., Brennan, M.J. 1987. Evidence for novel mechanisms of polychlorinated biphenyl metabolism in Alcaligenes eutrophus H850. Appl. Environ. Microbiol.(United States). 53:5:1103-1105.
Previous studies indicated that Alcaligenes eutrophus H850 attacks a different spectrum of polychlorinated biphenyl (PCB) congeners than do most PCB-degrading bacteria and that novel mechanisms of PCB degradation might be involved. To delineate this, the authors have investigated the differences in congener selectivity and metabolite production between H850 and Corynebacterium sp. strain MB1, an organism that apparently degrades PCBs via a 2,3-dioxygenase. H850 exhibited a superior ability to degrade congeners via attack on 2-, 2,4-, 2,5-, or 2,4,5-chlorophenyl rings in PCBs but an inferior ability to degrade congeners via attack on a 4-chlorophenyl ring. Reactivity preferences were also reflected in the products formed from unsymmetrical PCBs; thus, MB1 attacked the 2,3-chlorophenyl ring of 2,3,2',5'-tetrachlorobiphenyl to yield 2,5-dichlorobenzoic acid, while H850 attacked the 2,5-chlorophenyl ring to yield 2,3-dichlorobenzoic acid and a novel metabolite, 2',3'-dichloroacetophenone. Furthermore, H850 oxidized 2,4,5,2',4',5'-hexachlorobiphenyl, a congener with no adjacent unsubstituted carbons, to 2',4',5'-trichloroacetophenone. The atypical congener selectivity pattern and novel metabolites produced suggest that A. eutrophus H850 may degrade certain PCB congeners by a new route beginning with attack by some enzyme other than the usual 2,3-dioxygenase.
Key words: bacteria, growth, chlorinated aromatic hydrocarbons, metabolism, biological pathways, biological variability, comparative evaluations, metabolites, oxygenases, enzymes, halogenated aromatic hydrocarbons, organic compounds, oxidoreductases, microorganisms.

Bedient, P. B., Rifai, H. S. December 1992. Ground water

contaminant modeling for bioremediation: A
review. Journal of Hazardous Materials. 32(2-3):225-243.
Key Words: Groundwater pollution, impurities, biodegradation,
mathematical models, oil spills,
microorganisms, decontamination.

Beech, Eric. 1991. Military aircraft of the world. Flight
International. 140:29 59.

Beer, G.L., Y.H. Li. 1988. Method for Treating Crude Oil Sludges
and the Like. Patent No. US
4775457, c 10/4/88, f 8/12/87 (Appl 84596) (5 pp; 6 claims).
Key words: waste disposal, adsorbent, burner, combustion,
control, disposal, pollution control, sludge,
solid adsorbent, sorbent, waste material, p) USA, adsorption,
Atlantic Richfield Co., blending, block
diagram, chart, combustion product, contamination, crude oil,
decontaminating, diagram, diatomite,
ecology, environment, equipment layout, flow chart, gas solid
separation, igneous rock, mixer, mixing, oil
spill, oil waste, perlite, petroleum, physical separation,
product, purifying, recycling, rock, scrubber,
sedimentary rock, separation equipment, silica rock, soil
pollution, sorption, volcanic glass, volcanic
rock, water pollution, ecology & pollution

Begley, David, Bonnie J. O'Connell, Dawn Prior, and Tony Vitolo.
1992. 30 years. (of radio electronics
history). Microwaves & RF. 31:76 94.

Belen, M.S., William J. Lehr, Huseyin M. Cekirge. 1981.
Spreading, dispersion, and evaporation of oil
slicks in the Arabian Gulf. In: Proceedings of the 1981 Oil Spill
Conference (prevention, behavior,
control, cleanup), March 2 5, Atlanta, GA.
Key words: oil, gulf.

Belk, John L., Deborah J. Elliott, L. Michael Flaherty. 1989. The
Comparative effectiveness of
dispersants in fresh and low salinity waters. In: Proceedings of
the 1989 Oil Spill Conference (prevention,
behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: waters.

Bell, Victor A. 1981. Protection strategies for vulnerable
coastal features. In: Proceedings of the 1981 Oil
Spill Conference (prevention, behavior, control, cleanup), March
2 5, Atlanta, GA.
Key words: coastal.

Bell, P. R. F. Evaluation of rundle spent shale as an adsorbent
for the treatment of retort water. In 17th
Oil Shale Symposium Proceedings. in Golden, Colo, U.S.A. Year.
oil, adsorbent

Bell, John M. (Ed.). Proceedings of the 40th industrial waste
conference. In Proceedings of the 40th

Industrial Waste Conference. in West Lafayette, IN, U.S.A. Year.
Key words: disposal, oil
This conference contains 94 papers, presented in 18 sections covering coal, coke, and power plant wastes; brewery and distillery wastes; meat packing and rendering wastes; mining wastes; steel and foundry wastes; animal wastes; paint, ink, and dye wastes; land disposal, oil and gas field wastes; sludge conditioning; pulp and paper mill wastes; dairy wastes; plating wastes; refinery wastes; metal wastes; hazardous and toxic wastes; and biological systems.

Bell, J.F., Barber, W.H. 1991. Oil Containment Boom. Atlantic Richfield Co. 4(pp).
Key Words: Floating barrier, containment, contamination, environmental pollution, oil spill, pollution control, water pollution, USA, articulated, Atlantic Richfield Co., buoyancy, chloroethylene homopolymer, connector, coupling

Bellantoni, John F., Mary Ann Froehlich. 1981. Oil spill rates in four U. S. coastal regions. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: oil spill.

Beller, H.R., Edwards, E.A., Grbic-Galic, D., Reinhard, M. 1991. Microbial degradation of alkylbenzenes under sulfate-reducing and methanogenic conditions. Final report, May 89-Apr 91. 74.
Aquifer solids and soils obtained from various hydrocarbon-contaminated sites were used to investigate the ability of indigenous microorganisms to degrade monoaromatic hydrocarbons under strictly anaerobic conditions. In anaerobic microcosms inoculated with fuel-contaminated soil from the Patuxent River site, toluene degradation occurred concomitantly with sulfate reduction and ferric iron reduction. Similar results were obtained with suspended enrichments derived from the microcosms. Stoichiometric data and other observations suggested that sulfate reduction was closely linked to toluene degradation, whereas iron reduction was a secondary, potentially abiotic, reaction between ferric iron and biogenic hydrogen sulfide.
The presence of millimolar concentrations of amorphous Fe(OH)3 in Patuxent River.
Key words: aromatics, bacteria, chemical reaction, decomposition, elements.4

Beller, H.R., Grbic-Galic, D., Reinhard, M. 1992. Microbial degradation of toluene under sulfate-reducing conditions and the influence of iron on the process. Applied and Environmental Microbiology (United States).
58:3:0099-2240.
Toluene degradation occurred concomitantly with sulfate reduction

in anaerobic microcosms inoculated
with contaminated subsurface soil from an aviation fuel storage
facility near the Patuxent River (Md.).
Similar results were obtained for enrichment cultures in which
toluene was the sole carbon source. Several
lines of evidence suggest that toluene degradation was directly
coupled to sulfate reduction in Patuxent
River microcosms and enrichment cultures: (1) the two processes
were synchronous and highly correlated,
(2) the observed stoichiometric ratios of moles of sulfate
consumed per mole of toluene consumed were
consistent with the theoretical ratio for the oxidation of
toluene to CO{sub 2} coupled with the reduction of
sulfate to hydrogen sulfide, and (3) toluene degradation ceased
when sulfate was depleted, and conversely,
sulfate reduction ceased when toluene was depleted.
Mineralization of toluene was confirmed in
experiments with (ring-U-{sup 14}C)toluene. The addition of
millimolar concentrations of amorphous
Fe(OH){sub 3} to Patuxent River microcosms and enrichment
cultures either greatly facilitated the onset
of toluene degradation or accelerated the rate once degradation
had begun. In iron-amended microcosms
and enrichment cultures, ferric iron reduction proceeded
concurrently with toluene degradation and sulfate
reduction. Stoichiometric data and other observations indicate
that ferric iron reduction was not directly
coupled to toluene oxidation but was a secondary, presumably
abiotic, reaction between ferric iron and
biogenic hydrogen sulfide.
Key words: aviation fuels, biodegradation, catalytic effects,
carbon dioxide, correlations, geochemistry.

Beller, H.R., Grbic-Galic, D., Reinhard, M. 1993. The influence
of iron on anaerobic toluene degradation
by sulfate-reducing enrichment cultures. Abstracts of the Annual
Meeting of the American Society for
Microbiology. 356.
Short communication.
Key words: ground water, contamination, iron response modifying
factors, sulfate-reducing, bacteria,
metabolism, toluene, biodegradation, aviation fuels, gasoline,
alkylated.

Bellier, Pierre, Georges Massart. 1979. The AMOCO CADIZ oil spill
cleanup operations: an overview of
the organization, control, and evaluation of the cleanup
techniques employed. In: Proceedings of the 1979
Oil Spill Conference (prevention, behavior, control, cleanup),
March 19 22, Los Angeles, CA.
Key words: oil spill, cleanup.

Belore, R. C., B. K. Trudel, B. J. Jessiman, and S. L. Ross.
1990. An automated oil spill impact
assessment system using a microcomputer based GIS. In: GIS for
the 1990s. Proc. national conference,
Ottawa,1990. CISM), pp. 87-102

Key words: Oil Spills, Water Pollution, Real Time, Gulf of Mexico
A microcomputer-based spill impact assessment system has been developed and applied to the problem of making oil spill impact predictions and real-time dispersant-use decisions in the US Gulf of Mexico and the Atlantic coast of Florida. The system predicts the effects of chemically-dispersed and untreated spills on 70 important resources. Impact is estimated by means of a model that integrates the effects of such variables as spill conditions, oil properties, environmental conditions, oil toxicity, and resource vulnerability. An in-house oil fate prediction model has been directly linked with GIS software as a user function to allow access by the oil fate model to spatially mapped data. The real-time impact assessment system automatically calculates the oil's trajectory, distribution and oil properties; overlays the resulting map onto the resources in the vicinity of the spill; then calculates the percent of each resource at risk from the oil spill. Because the GIS handles all of the spatial requirements the impact assessment tool can be implemented in any geographic location by simply mapping the new coastline and resource base of interest.

Belore, R., C. Seeley, S.L. Ross. 1990. Air jet atomization and burning of oil slicks. In: Proceedings of the Thirteenth Arctic and Marine Oil Program technical seminar, June 6 8 1990, Edmonton, AB, pp. 289-304.
Key words: oil spills, combustion, petroleum, atomization, bench-scale experiments
Laboratory scale evaluations were carried out on the air jet atomization of oil slicks, and a full scale burner was tested. The small scale testing of air jet atomizers revealed that the air jets must operate at or above the water-oil interface to eliminate excessive water uptake. The nozzle type (blunt or conical) had little effect on the oil atomization rate. Maximum oil uptake was achieved using the larger nozzle diameter.
A total of 27 full scale burn tests were completed which evaluated the effect of air pressure, nozzle position and oil type on burn rates and cleanliness. The results indicate that a clean burn is possible only if the air nozzles are placed at or above the water-oil interface. Burn rate was not affected by the nozzle pressure or air flow rate but the burns were clean only at the highest air flow used. The burner could be placed at the apex of a fireproof boom for clean burning of collected oil at a burn rate of 5 l/min. 1 ref., 5 figs., 4 tabs.

Belore, R. 1987. Laboratory tests of the use of high-pressure water mixing for ship-based oil spill dispersing. In: Proceedings of the API - EPA - U.S. Coast Guard oil spill prev. behavior control cleanup conf., April 6 9 1987, Baltimore, MD, API PUBL. N.4452, pp.

297-302.
Key words: Additive, Boom, Crude Oil, Economic Factor, Pollution Control

Bender K., Ostergard J., Jensen S. K. 1993. Nogbou oil spill contingency planning in the Ivory Coast. In: 13th biennial api et al oil spill (prev, preparedness, response & coop) int conf Tampa, FL, March 29-April 1
Key words: Africa, business operation, Ivory Coast, logistics, management, material handling, oil spill, organization, planning, water pollution.

Bender, Klavs, Robert Taylor. 1987. Oil spill contingency planning in Thailand. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.

Bender, K., P. Ostfeldt, H. Bach. 1991. Baseline studies and risk analyses in the Baltic Sea. In Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, 1991 in San Diego, CA. Year.
Key words: sea.

Bender, M.E., et al. 1977. Ecological effects of experimental oil spills on eastern coastal plain estuarine ecosystems. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.

Bender, K., P. Ostfeldt, P. Kronberg. 1989. Oil spill contingency planning in the Baltic Sea. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.

Benkert, R. Adm. W.M., et al. 1979. Oil pollution by tankers: issues and progress. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil pollution, tankers.

Benner, Bruce A., Nelson P. Bryner, Stephen A. Wise, George W. Mulholland, Robert C. Lao, and Mervin F. Fingas. 1990. Polycyclic aromatic hydrocarbon emissions from the combustion of crude oil on water. Env Science & Technology. 24(9):1418 1428.
Key words: Polycyclic Aromatic Hydrocarbons, Oil Spills
Factors required to measure the environmental impact of the in situ combustion of crude oil on water were investigated. Those factors include the fraction of an oil layer that can be burned, the quantity of smoke produced, and the concentrations of 18 PAHs in the smoke, crude oil, and burn residue. Alberta Sweet crude oil, in layers of different thickness, was burned on water. Smoke samples were collected at elevated

and ambient temperatures and analyzed by two independent laboratories. Burning the crude oil produced less total PAHs than were present originally in the crude oil, but concentrations of PAHs with five or more rings were 10-20 times greater in the smoke than in the oil. The organic carbon fraction of the smoke was approximately 14-21%. The smoke yield increased from 0.035-0.080 g smoke/g fuel, and the oil residue percentage decreased from 46-21% as the fuel layer thickness was increased from 2 to 10 mm. In situ burning can mitigate the local environmental impact of an oil spill by consuming much of the oil spill and reducing the amount of PAHs in the water and by dispersing the combustion products over a larger area. In situ burning might be the most workable cleanup method in remote areas like the Arctic ice fields.

Benner, B.A. Jr., N.P. Bryner, S.A. Wise, G.W. Mulholland, D.D. Evans, M.F. Fingas, and K. Li. Emissions of polycyclic aromatic hydrocarbons from the combustion of crude oil on water. Spill Technology Newsletter (Canada). 16(3):1-16.
Key words: Oil Spills, Polycyclic Aromatic Hydrocarbons, Petroleum, Air Pollution
A study was conducted to examine some of the factors necessary to assess the environmental impact of an in-situ burn of an oil spill on water. These factors include the fraction of an oil layer which can be burned, the quantity of smoke emitted, and the concentrations of 18 polycyclic aromatic hydrocarbons (PAHs) in the smoke, crude oil, and burn residue. Alberta sweet mixed blend crude in 1, 3, 5, 10, and 30 mm layers on water was burned in the laboratory and smoke samples were collected at elevated and ambient temperatures and analyzed by two independent laboratories. While burning the crude oil produced less total PAHs than was in the original crude, the concentrations of PAHs with 5 or more rings were 10-20 times greater in the smoke than in the oil. The organic carbon fraction of the smoke was in the 14-21% range. As the fuel layer thickness was increased from 2 to 10 mm, the smoke yield increased from 0.035 g smoke/g fuel and the percentage of oil residue decreased from 46% to 17%. By consuming much of the oil spill and reducing the amount of PAHs in the water, and by dispersing the combustion products over a larger area, in-situ burning can mitigate the local environmental impact of an oil spill. There appears to be a range of situations, such as in Arctic ice fields, where in-situ burning might be the most viable cleanup method. 25 refs., 6 figs., 6 tabs.

Bennett, Lt. Vance, Lt. Don Noviello. 1993. Response to the grounding of the F/V EI JYU MARU NO. 21. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.

Bennett, G.F. 1989. Impact of toxic chemicals on local wastewater treatment plant and the environment.
Environ. Geol. Water Sci. 13(3):201 212.
Key words: environmental impact, pollutants, biodegradation, wastewater
Pretreatment regulations limit industrial discharges to municipal sewers of heavy metals, oil and grease,
acids and bases, and toxic organic chemicals. This paper discusses the evolution of these regulations, the
basis for them, the types of regulations (categorical and local), and the rationale for their promulgation
based on the impacts of toxics chemicals on the treatment plant and receiving system. Finally, the expected
results of these regulations in reducing industrial discharges to toxic chemicals is discussed.

Bennett, Phillip C. 1991. The chemistry of silica-organic complexation in a petroleum-contaminated
aquifer. Water-Resources Investigations. 638-640.
Key Words: Minnesota, pollution, organic materials, ground water, environmental geology, oil spills,
reactions, geochemistry, complexing, USGS, Midwest, United States, North-Central Minnesota,
Bemidji, Minnesota, Beltrami County, Minnesota, aquifers, silica, organic acids.

Benson, D.A., D. Huntley, and P.C. Johnson, 1993. Modeling vapor extraction and general transport in
the presence of NAPL mixtures and nonideal conditions. Ground Water (United States). 31(3):437-445.
Key words: Transport, Groundwater, Oil Spill, Water Pollution, Monitoring
The design of vapor-extraction remedial systems and the analysis of their performance can be improved by
using models that can simulate the chemical and physical processes affecting the occurrence and movement
of multiple-compound vapor-phase chemical mixtures. Previous models fall into two categories: (1)
multiple-compound phase distribution models which are either nondimensional (no transport) or
one-dimensional (column experiments); and (2) multidimensional single-compound transport models. In
this paper, a model is presented that couples the steady-state vapor flow equation, the advection-diffusion
transport equation, and a multiple-compound, multiphase chemical partitioning model. The numerical
implementation allows spatially variable fields of permeability, confining layer permeability, and initial
contaminant concentrations. Based on the concentrations of each chemical compound, the model calculates
whether a nonaqueous phase liquid (NAPL) is present, and calculates the chemical phase distribution by
the appropriate equilibrium partitioning formulation (Henry's Law or Raoult's Law). The user can specify
the location and discharge rates of any number of extraction or injection wells, including zero wells, in

which case the simulation will solve transport by diffusion only. The remediation, by vapor extraction, of hypothetical fuel hydrocarbon spills was simulated to investigate the error introduced by failing to account for natural conditions. The nonideal conditions include inhomogeneous soil permeability, leakage of atmospheric air into the subsurface and irregular contaminant distribution. The model was also run in the pure diffusion mode to simulate the transport of benzene to the ground surface, and to show the limitations of single-compound vapor flux models when a multicompound NAPL (such as gasoline) represents the source of benzene.

Benson, R.L., R.S. LeGore, Cdr. D. Pascoe. 1993. A mechanized approach to beach cleanup in Saudi Arabia. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: beach cleanup.

Benton, J.B. Overflow of environmental monitoring data developed at four synthetic fuels facilities. In Commonwealth Kentucky Et Al East Oil Shale Symp (Lexington, Ky, 11/18 20/87) in Year.
Key words: oil, disposal, in-situ, legal, petroleum, oil recovery

Benton, J.B. Highlights of environmental monitoring and health surveillance activities at Parachute Creek shale oil project, 1986 1990. In Kentucky Univ & U.S. DOE East Oil Shale Symp (Lexington, Ky, 11/6 8/90) in Year.
Key words: oil, disposal

Benton, J.B. Environmental monitoring and health surveillance activities at Parachute Creek shale oil project, 1986 1990. Fuel (1992): 71
Key words: oil, disposal

Bentz, Alan P., Stanley L. Smith, Jr. 1979. The Legal aspects of oil spill fingerprinting. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: legal aspects, oil spill.

Beraud, Jean-Francois, Jean Ducreux, Claude Gatellier. 1989. Use of soil-aquifer treatment in oil pollution control of underground waters. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.

Beraud, Capt. Alain, Jean-Claude Sainlos. 1985. Accidental marine oil pollution: French policy and response. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.

Key words: marine, pollution, French.

Bergmann, Pamela Ann. 1989. Development of wildlifae protection guidelines for Alaska's federal
on-scene coordinators. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control,
cleanup), February 13 16, San Antonio, TX.
Key words: wildlife.

Bergmann, P.A. 1991. Implementation and revision of the wildlife protection guidelines for Alaska's
Federal On-Scene Coordinators. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention,
Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp.
137 39.
Key words: Accident, Alaska, Biology, Boom, Cleaning, Crude Oil, Pollution Control

Berkner, Alice B., David C. Smith, Anne Stairs Williams. 1977. Cleaning agents for oiled wildlife. In:
Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New
Orleans, LA.
Key words: cleaning agents, wildlife.

Berkowitz, J.B., et al. Land treatment field studies. volume 1. petroleum wastewater pond bottoms. In
REP NO EPA-600/2-83-057A, 1983.
Key words: disposal, oil

Bern, T.I., T. Wahl, T. Andersen, and R. Olsen. 1993. Oil spill detection using satellite based SAR -
Experience from a field experiment. Photogrammetric Engineering and Remote Sensing (United States).
59(3):423-428.
Key words: Oil Spills, Synthetic Aperature Radar, Aquatic Ecosystems, Data Analysis
During the commissioning phase of the ERS-1, C-band, synthetic aperture radar (SAR) images were
obtained regularly over international waters for a range of operational, real-time uses. Among other
capabilities, SAR is expected to be able to detect oil slicks on the sea surface. A project was defined with
the aim of developing and demonstrating a system for early oil spill detection using satellite based SAR.
During the Dedicated Oil Spill Experiment August 1991 (DOSE-91) three slicks, each 20 metric tons of
stabilized crude oil, were released in phase with the passages of the ERS-1 satellite. The experiment
included sea truthing, oil slick tracking using drifting buoys, and aircraft surveillance using various remote
sensing techniques to compare and verify satellite observations. This paper presents the observations
gathered during the experiment with emphasis on the SAR imagery of oil slicks under certain
environmental conditions. Image enhancements techniques used to

process the imagery are also discussed.
7 refs.

Bernard, Harold. 1971. Embroiled in oil. In: Proceedings of Joint Conference on Prevention and Control
of Oil Spills, June 15 17, Washington, D.C.

Bernasconi, R., Tacher, L. 1990. Modelisation mathematique d'une pollution, par hydrocarbures dissous
de l'aquifere d'Oberriet (SG).
<TRANSLATED> Mathematical modelling of pollution using dissolved hydrocarbons in the Oberriet
Aquifer, Saint Gall. Bulletin de Centre d'Hydrogeologie. 9:1-13.
Key Words: Aquifers, Central Europe, dissolved materials, Europe, ground water, hydrocarbons,
hydrodynamics, mathematical models, Molasse Basin, Northern Switzerland, Oberriet Aquifer, oil spills,
organic materials, pollution, Saint Gall Switzerland, sollution, Swiss Molasse Basin, Switzerland.

Bernhardt, B. 1992. Arrangement for driving out of volatile impurities from ground water using
vibrations. Patent No. US 5147535920915.
Key words: Groundwater, Oil Spill, Pollution Control, Soil Pollution, Environment, Water Pollution

Berry, W.L., J.M. Wolfe. 1975. Clean gulf associates unveils a new generation of oil-spill cleanup
equipment. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March
25 27, San Francisco, CA.

Berry-Spark, K., Barker, J.F. 1987. Nitrate remediation of gasoline contaminated ground waters: Results
of a controlled field experiment. Proceedings of the NWWA/API conference on petroleum hydrocarbons
and organic chemicals in ground water: Prevention, detection and restoration. 127-144.
Key Words: Gasoline environmental effects, gasoline plumes, ground water dedifrication, ground water
nitrogen additions, ground water pollutants, ground water remedial action, ground water water pollution,
aquifers, benzene, Canada, chemical reaction kinetics, experimental data, oil spills, thre-dimensional
calculations, toluene, xylenes, alkylated aromatics, alloys, chemical reactions, hydrogen compounds,
kinetics, liquid fuels, North America, numerical data, organic compounds, oxygen compounds, petroleum
products, reaction kinetics.

Bertrand, P, and E. Lallier-Verges. 1993. Past sedimentary organic matter accumulation and degradation
controlled by productivity. Nature. 364(6440):786-788.
Key words: Bacteria, Degradation, Hydrocarbon

Bertrand J.C., Almallah M., Acquaviva M., Mille G. 1990. Biodegradation of hydrocarbons by an

extremely halophilic
archaebacterium. Letters in applied microbiology. 11(5): 260-263.
Key words: hydrocarbon, archaeobacteria, halophily, isolation, biodegradation, electron microscopy, bacteria.

Bertrand, J.C., M. Bianchi, M. Al Mallah, M. Acquaviva, and G. Mille. 1993. Hydrocarbon biodegradation and hydrocarbonoclastic bacterial communities composition grown in seawater as a function of sodium chloride concentration. Journal of experimental marine biology and ecology. 168(1):125-138.
Key words: Hydrocarbon, Bacteria, Biodegradation
Bacterial strains have been enriched and isolated from marine sediment of an oil-contaminated area and grown in a culture medium prepared with synthetic seawater (0.4 M NaCl) and containing crude oil (EH1 community) or an hydrocarbon mixture (EH2 community) as sole energy and carbon source. The strains isolated from crude oil were code named EH1 community; those from the mixture EH2 community.
Hydrocarbon biodegradation in enrichment culture was maximum for 0.4 M NaCl and decreased for NaCl concentrations above or below this value. However, the effect of NaCl concentration depended somewhat on the nature of the substrate supplied for growth. With 2 M NaCl, the saturated fraction of crude oil was the only one significantly biodegraded (27 %)...

Betts, W.E., H.I. Fuller, H. Jagger. 1971. An integrated program for oil spill cleanup. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.

Betts, W.E. 1973. Cleanup of inland oil spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.

Beunink, J., Rehm, H.J. 1988. Synchronous anaerobic and aerobic degradation of DDT by an immobilized mixed culture system. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 29:1:72-80.
For the investigation of a mixed anaerobic and aerobic degradation of xenobiotics the reductive dechlorination of 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane (DDT) to 1,1-dichloro-2,2-bis(4-chlorophenyl)ethane (DDD) and the oxidative degradation of the DDT-conversion product 4,4'-dichlorodiphenylmethane (DDM) were studied. Enrichments from digested sewage sludge led to the isolation of an Enterobacter cloacae-strain which is able to reductive dechlorination of DDT during the fermentation of lactose. From fresh sewage sludge 11 bacterial strains were isolated in batch-culture and in continuous culture utilizing diphenylmethane, a non chlorinated structural analogon of DDM, as sole

source of carbon and energy. One of these isolates, Alcaligenes sp. cometabolizes DDM during the aerobic growth with diphenylmethane. By coimmobilization of Alcaligenes sp. and Enterobacter cloacae in Ca-alginate a system could be established, in which the reductive dechlorination of DDT and the oxidative degradation of DDM and diphenylmethane proceeds simultaneously in one reactor vessel.
Key words: chlorinated aliphatic hydrocarbons, anaerobic conditions, immobilized cells, organic compounds, media, halogenated aliphatic hydrocarbons, microorganisms, plants, yeasts, chemical analysis.

Bevinakatti, B.G., Ninnekar, H.Z. 1992. Degradation of biphenyl by a Micrococcus species. Applied Microbiology and Biotechnology (Germany). 38:2:273-275.
A bacterium capable of utilizing biphenyl as the sole source of carbon was isolated from soil and identified as a Micrococcus species. The organism also utilized 4-chlorobiphenyl and several other aromatic compounds as growth substrates. 2,3-Dihydroxybiphenyl and benzoic acid were identified as intermediates by physico-chemical methods. The bacterium degraded biphenyl to 2,3-diphydroxybiphenyl followed by its metaring cleavage to yield 2-hydroxy-6-oxo-6-phenylhexa-2,4-dienoic acid, which was then hydrolysed to give benzoic acid. Benzoate was further metabolised via a catechol meta-cleavage pathway by a Micrococcus sp. (orig.).
Key words: biphenyl, biodegradation, biochemical reaction kinetics, culture media.

Beyaert, Bruce. 1975. Analysis of oil spill accidents for environmental imapct statements. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil spill, environmental impact.

Beyer, A.H., L.J. Painter. 1977. Estimating the potential for future oil spills from tankers, offshore development, and onshore pipelines. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil spills, tankers, offshore, pipelines.

Beyer, R. Environmental aspects related to the use of natural gas advantages and limitations. In Saga Petrol AS, Statoil Et Al Natur Gas Europe Appl Res Conf (Eurogas 90) (Trondheim, Norw, 5/28 30/90) in Year.
Key words: environment, petroleum, oil, disposal, hydrocarbon, pipeline

Beynon, L.R., et al. 1975. Planning and developing a company oil spill contingency plan. In: Proceedings of the 1975 Conference on Prevention and Control of Oil

Pollution, March 25 27, 1975 in San Francisco, CA.

Beynon, L. R. 1973. Codes of practice for dealing with oil spills at sea and shore: a European view. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil spills, sea, European.

Beynon, L.R. 1969. Evaluation of dispersants. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: dispersants.

Beyrouty, L. 1993. On-Board Oil Spill Prevention and Recovery System. World 93/256, P 1/7/93, F 6/21/91 (Appl 91/4425) (B63B-043/16) PCT GAZ V 1993, NO 2, P 352, 1/7/93 (ISSN 02507757; Abstract only) (AO) 1993
Key words: oil spill, adsorbent, barrier, floating barrier, marine transportation, pollution control equipment, prevention, ship, sorbent, spill, tanker, transportation, world, adsorption, adsorption capacity, chart, collecting agent, container

Beyrouty, L. Oil spill recovery system on transporting vessel, which prevents escape of oil from ruptured tank and recovering any oil that does escape. Patent No. US 484977_900226.
Key words: Boom, Containment, Oil Waste, Pollution Control

Beyrouty, L. On-board emergency oil disposal and recovery system has wheeled oil disposal bladders, with bladder supports positioned about deck edges, connected to oil transfer system.
Key words: on-board, oil, disposal, recovery, environment, oil waste, pollution control, water pollutant

Bhattacharya, S.K., Parkin, G.F. 1986. Toxicity of nickel in methane fermentation systems: Fate and effect on process kinetics. Biotechnology for degradation of toxic chemicals in hazardous wastes. Scholze, R.J., Smith, E.D., Bandy, J.T., Wu, Y.C., Basilico, J.V. (eds.) Conference on biotechnology for degradation of toxic chemicals in hazardous wastes. 82-101:697.
The objectives of the research were to study the kinetic effects of nickel on anaerobic utilization of acetate and propionate and to determine its fate in these systems. Nickel was added both as slug and continuous doses. With the shock of a slug addition, there should be minimal chance of a slug addition, there should be minimal chance for acclimation to nickel by the bacteria. With continuous addition, however, the concentration of nickel can be increased gradually and the bacteria will have a chance to acclimate. The following conclusions are drawn from this study: (1)

Acetate-utilizing methanogens are more severely affected than propionate utilizers by nickel; (2) massive slug doses of nickel immediately stop bacterial activity - smaller slug doses give lower hydraulic retention time systems a better chance to recovery; (3) response to nickel toxicity is similar to uncompetitive inhibition; the competitive-inhibition-coefficient model worked well for continuous addition of nickel. Best-fit inhibition coefficient (K sub I) values varied between 80 and 150 mg/L depending on SRT; the observed increase in K sub I with increasing SRT indicates acclimation; (4) the uncompetitive-inhibition-coefficient model did not adequately describe the fate of systems exposed to slug doses of nickel; (5) without acclimation to nickel, total soluble nickel concentrations above 6 mg/L caused failure; total soluble nickel concentrations as high as 31 mg/L could be tolerated with acclimation. 21 refs., 7 figs., 7 tabs.
Key words: methane, fermentation, toxicity, sensitivitiy, hydrocarbons, carboxylic, elements, bioconversion.

Bhattacharya, A. 1991. Some aspects of offshore environmental impact assessment using expert system.
In: Proceedings of the 6th Deep Offshore Technol (DOT) INT Conf, November 4 6 1991, Monte Carlo, Monaco, 1(SESS NO B3):135-146.
Key words: Environmental Impact, Contamination, Pollution, Models, Oil Spills, Petroleum Industry

Bhattacharyya, D., Aleem, M.I.H., Kermode, R.I., Khalid, A.M., Hsieh, M., Francis, H. 1988. Coal desulfurization by bioprocessing. Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988--July 31, 1988. Huffman, G.P., Sendlein, L.V.A.
1988. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY, (USA). 4-13.
Dibenzothiophene (DBT) one of the forms of organic sulfur which occurs in coals is transformed by myriads of soil microorganisms, predominant of which are aerobic, gram negative rods. Pseudomonas and other related types of microorganisms are well known for their DBT degradative activities. Pseudomonas most commonly associated with DBT degradation are Pseudomonas putida, Pseudomonas alcaligenes, and Pseudomonas stutzeri. Both Pseudomonas putida and Pseudomonas alcaligenes have been found to contain a 55 megadalton plasmid which enables these strains to oxidize naphthalene and slaicylate, and induction of DBT oxidizing capability to these bacteria have also been demonstrated by addition of DBT, benzene, naphthalene and anthracene to the microbial cultures. A novel desulfurization pathway has been reported for DBT where it is oxidized to DBT-5-oxide by a soil isolate

(Pseudomonas putida) which oxidizes it further to sulfate and 2-2'-dihydroxy biphenyl. The oxidative ability of Pseudomonas putida was found to be dependent upon the addition of sodium benzoate, which probably induces enzymes necessary for this transformation. In the light of the above facts, it seemed logical to assume that bacteria capable of growing on sodium benzoate should be capable of removing organic sulfur from the coals. Therefore, bacterial cultures were first adapted to grow on benzoic acid and then these cells were used for desulfurization studies of coal samples. Results from these studies are given and discussed.
Key words: coal desulfurization, pseudomonas, batch culture, benzoic acid, biodegradation, pyrite, sodium compounds, heterocycles, progress report, sodium compounds, sulfur-oxidizing, bacteria.

Bianchi, R. A., E. E. Johanson, and J. H. Farrell. Use of the Massachusetts dip oil skimmer on free slicks in the Casco Bay (Portland) spill. In Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973 in Washington, D.C. Year.
Key words: oil, skimmer, Casco Bay, Portland

Bianchi, Ralph A. The impact of regulations on the development of oil spill recovery vessels. Proceedings of the 1993 Oil Spill conference(prevention, preparedness, response), March 29 April 1, 1993. In in Tampa, Florida Year.
Key words: regulations, development, oil, spill, recovery, vessels

Biedenbender, P.L., and J. Michel. 1989. Response strategies in a high tidal range estuarine system: The Savannah River oil spill. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 95 97 .
Key words: Adhesion, Adsorbent, Carrier, Decomposition, Fresh Water, Oil Waste

Biederbeck, V.O. Using oily waste sludge disposal to conserve and improve sandy cultivated soils. In 1st U.S. Environ Protect Agency Et Al Oil & Gas Explor & Prod Waste Manage Pract Int Symp (New Orleans, 9/10 13/90) in Year.
Key words: soil remediation, bioremediation, oil, disposal, petroleum

Bieri, Rudolph H., Vassilios C. Stamoudis, and M. Kent Cueman. Chemical investigations of two experimental oil spills in an estuarine ecosystem. In Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977 in New Orleans, LA Year.
Keywords: chemical, oil spills, estuarine, ecosystems

Bieri, Rudolf H., Vassilis C. Stamoudis, and M. Kent Cuemen. Chemical investigations of two experimental oil spills in an estuarine ecosystem, part II. In Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979 in Los Angeles, CA. Year.
Keywords: chemical, oil spills, estuarine, ecosystem

Biggers, Rebecca L. Oil spill contingency planning at Navy shore activities. In Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987 in Baltimore, MD Year.
Keywords: oil spill, contingency, planning, Navy

Biglane, K. E. A history of major oil spill incidents. In Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, 1969 in New York, NY Year.
Keywords: history, oil spill

Biglane, K. E. and R. H. Wyer. Oil pollution control legislation and The Water Quality Improvement Act of 1970: the federal viewpoint. In Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971 in Washington, D.C. Year.
Keywords: oil, pollution, legislation, water, improvement, federal

Bilbo, C.M., Arvin E. Holst H. Spilid H. 1992. Modelling the growth of methane-oxidizing bacteria in a fixed biofilm. Water research. 26(3): 301-309. United Kingdom.
Methane-oxidizing bacteria were grown in a fixed biofilm reactor in order to study their ability to degrade chlorinated aliphatic hydrocarbons. Focus is on the growth behaviour of the mixed culture. The growth is described by a model that includes methanotrophic bacteria in the active biomass fraction. The inactive biomass fraction consists of exocellular polymers and biodegradable and inert particulate biomass. The model describes the oxygen respiration in detail. Yield coefficients, decay constants and hydrolysis constants are estimated based on the oxygen respiration.
Key words: modeling, microorganism growth, biofilm, performance evaluation, biodegradation, chlorocarbon, mathematical model, cell respiration.

Biles, R.W., D.A. Edwards, R.H. McKee, and G.F. Egan. 1990. Assessment of the potential human health consequences related to incineration of Alaskan oil spill wastes. In: Proceedings of the 29. annual meeting of the Society of Toxicology, Feburary 12 16 1990, Miami Beach, FL, p. 315.
Key words: oil spills, health hazards, polycyclic aromatic hydrocarbons, Alaska
Polychlorinated dibenzodioxins (PCDD's) and polychlorinated dibenzofurans (PCDF's) are generated by various industrial

processes. This paper addresses the potential for adverse human health consequences related to PCDD/PCDF which might be produced by incinerating oil wastes from the cleanup of an Alaskan oil spill. Solid wastes from the cleanup operation of the Exxon Valdez included approximately 10,000 tons of sorbent booms, pads, rags, clothes, mats and oiled logs. These materials were soaked in seawater, a potential source of chlorine which could be available for PCDD/PCDF generation at the elevated temperatures achieved during waste incineration. Based on published data available on PCDD/PCDF and risk assessments from municipal waste incinerators, we concluded that (a) PCDD/PCDF would be formed by the incineration process, but that the excess chlorine contributed by seawater would not lead to excessively increased levels, (b) the total amount of PCDD/PCDF produced ranges from a worst case level of 10 g to 5 mg, (c) the levels of PCDD/PCDF in this single episode are insignificant by comparison to current and ongoing levels of PCDD/PCDF production in Alaska, and (d) an estimated total human exposure for the period of months required to incinerate the wastes would result in an excess cancer risk substantially less than 1 {times} 10{sup {minus}6}. Therefore, we conclude that the PCDD/PCDF likely to be formed by incineration of oil spill waste from the cleanup of the Exxon Valdez would be low and that the potential human health hazards would be negligible.

Billings L. D. 1992. Method of cleaning oil slicks and chemical spills. Us 5135578, c 8/4/92, f 5/12/90 (appl 522671) (b08b-007/04) (11 pp; 34 claims).
Key words: solid adsorbent, adsorbent, business operation, float, mounting, oil spill, salvaging, sorbent, suspension device, waste oil recovery, wood.

Bills, Cdr. Charles E. and Lt. Daniel C. Whiting. Major oil spills caused by hurricane Hugo, St. Croix, US Virgin Islands. In Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991 in San Diego, CA. Year.
Key words: Oil Spills, Hurricane Hugo, St.Croix

Bingham, A. 1992. Gulf War pollution leaves long-term legacy. Pollution Prevention. 2(4):19-23.
Key words: Animal, Biochemical Reaction, Biodegradation, Bioremediation, Containment, Crude Oil, Economic Factor

Binkley, P.E. 1987. Ground water monitoring experience at a refinery land treatment unit. Proceedings of the NWWA/API conference on petroleum hydrocarbons and organic chemicals in ground water: Prevention, detection and restoration. 271-278.
Key Words: Ground water monitoring, ground water oil spills,

gournd water pollution control, oil wells
site characterization, petroleum refineries environmental
effects, drill cores, geologic formations,
hydrology, Oklahoma, stainless steels, teflon, corrosion
resistant alloys, Federal Region VI, fluorinated
aliphatic hydrocarbons, hydrogen compounds, industrial plants,
iron alloys, iron base alloys, North
America, organic compounds, organic fluorine compounds, organic
halogen compounds, organic
polymers, oxygen compounds, petrochemicals, petroleum products,
polyethylenes, polymers, polyolefins,
polytetraflu oroethylene, synthetic materials, USA.

BioVersal USA Inc. 1990. Oil cleaning agent nontoxic. Oil & Gas
Journal. 88(25):71.
Key words: Beach, Biochemical Reaction, Biodegradation, Chemical
Cleaning, Crude Oil, Oil Waste,
Recycling, Soap

Birdwell, S.R., and C.L. McConnell. 1988. Theoretical model of
in-situ bioreclamation process. In:
Proceedings of the API et al. Petrol Hydrocarbons & Org Chem in
Ground Water (Prev, Detection &
Restoration Conf) November 9 11, 1988, Houston, TX. 2:687 714.
Keywords: biodegradation, water pollution, bacteria, in-situ,
inground tank, oil spill, pipeline leak, soil
pollution, tank

Birkett, H. Oil spillage recovery vacuum trawl, has tubular
floating boom with oil-water separator supplied
by it. Patent No. GB 912786_910209.
Key words: Aspirating, Boom, Oil Waste, Pipe, Pollution Control,
Recycling, Separation

Birns, Karl F. 1975. Determination of an oil effluent guideline
for industrial discharges in the state of New
Jersey: is 1 P.M. realistic and obtainable?. In: Proceedings of
the 1975 Conference on Prevention and
Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil, effluent, discharges.

Biscoito, M.S., and F.J. Zino. 1990. Report from Madeira (after
the recent oil spill). Marine Pollution
Bulletin. 21(3):104-5.
Key words: Accident, Africa, Bird, Crude Oil, Oil Waste

Bishop, P.L. and J. DeWaters. 1988. Heavy metal removal by
aquatic macrophytes in a temperate climate
aquatic treatment system. In: Proceedings of the Conference on
Biotechnology for Degradation of Toxic
Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp.
102-119.
Key words: Bacteria, Biodegradation, Monitoring, Wastewater
Research was begun in 1982 to examine and assess the feasibility
of using aquatic macrophytes and their
associated bacteria in temperate regions as a combined secondary
and tertiary wastewater treatment

process. The results indicate that an Elodea-based aquatic treatment system can operate on a seasonal basis at loading rates and hydraulic detention times similar to hyacinth-based systems while providing good secondary and tertiary treatment of domestic primary effluent and maintaining good plant productivity.
One phase of this research effort concerned the removal of heavy metals from the wastewater by the aquatic macrophytes. This paper discusses that phase of the research. These studies suggest that the heavy metal removal efficiencies of various aquatic macrophytes treatment systems varies depending on the metal considered, but that the underlying removal mechanisms are probably the same. In essentially all cases, metal removals in the macrophyte-containing reactors were better than in the control reactors. Copper was almost entirely removed from the waste streams in aquatic treatment systems containing the temperate climate macrophytes Elodea nuttali and Myriophyllum heterophyllum; substantial quantities of lead and zinc were also removed. Removal rates for cadmium and nickel were much lower, but this may have been due to the low concentrations present in the raw wastewater.

Bishop, D.F. and N.A. Jaworski. 1988. Biological treatment of toxins in wastewater: The problems and opportunities. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 1-24.
Key word: Biodegradation
The toxicity impact on receiving water ecosystems, bio-accumulative uptake of toxins into the food chain, and effects of toxic discharges in wastewater effluents on the water quality of drinking water are strong factors driving the demand for improved technology for control of toxins. Ongoing EPA research should soon provide the scientific tools to support regulatory action by defining the environmental fates and effects and the health risk of toxins, by identifying the presence of toxins and toxicity in water and wastewater, and by tracing the toxins or toxicity to their sources. Effective toxins risk management through risk reduction, however, will require successful improvement of control technology. The EPA is thus addressing 3 major approaches to improve control technology for managing toxins in wastewater - partitioning on solids and biomass, volatilization and biodegradation. The costs for satisfactory control of the toxins will drive the EPA and the researchers in control technology to search for increasingly efficient and innovative technology. Systems engineering techniques will evolve to provide the tools for selection of technically effective and least costly combinations of control technology in industrial and municipal wastewater treatment and pretreatment and water treatment to meet the water quality and food chain requirements.

Black, W., Zamora, J. 1992. Using microorganisms to aid in hydrocarbon degradation. Journal of the Tennessee Academy of Science (United States).
Aliphatic hydrocarbons are threatening the potable water supply and the aquatic ecosystem. Given the right microbial inhabitant(s), a large portion of these aliphatic hydrocarbons could be biodegraded before reaching the water supply. The authors' purpose is to isolate possible oil-degrading organisms. Soil samples were taken from hydrocarbon -laden soils at petroleum terminals, a petroleum refinery waste-treatment facility, a sewage-treatment plant grease collector, a site of previous bioremediation, and various other places. Some isolates known to be good degraders were obtained from culture collection services. These samples were plated on a 10w-30 multigrade motor oil solid medium to screen for aliphatic hydrocarbon degraders. The degrading organisms were isolated, identified, and tested (CO[sub 2] evolution, BOD, and COD) to determine the most efficient degrader(s). Thirty-seven organisms were tested, and the most efficient degraders were Serratia marcescens, Escherichia coli, and Enterobacter agglomerans.
Key words: bacteria, detection, hydrocarbons, biodegradation, hydrocarbons, water pollution, abatement, petroleum, biodegradation.

Blackall, Peter J. and Gary A. Sergy. The BIOS project: an update. In Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983 in San Antonio, TX Year.
Keywords: BIOS

Blackall, Peter J. and Gary A. Sergey. The BIOS project: frontier oil spill countermeasures research. In Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981 in Atlanta, GA Year.
Keywords: BIOS, oil spill, countermeasures, research

Blackburn, J.W., Jain, R.K., Sayler, G.S. 1987. Molecular microbial ecology of a naphthalene-degrading genotype in activated sludge. Environ. Sci. Technol.(United States). 21:9:884-890.
The concentration of cells in an activated sludge system containing a gene known to participate in degradation of naphthalene was experimentally related to the biotransformation and mineralization of naphthalene. The gene probe analysis for the naphthalene catabolic genotype was more sensitive in this system than other naphthalene degrader microbial analysis methods for naphthalene catabolic cells. Other live cells present were 1000-10,000-fold more numerous than the genotype. Naphthalene biotransformation

and mineralization rates fell when the mean value of genotype replicates dropped below 10/sup 7/
genotypically positive cells/mL. The ability to enumerate a critical genotype and relate it to enzymatic
activity in a mixed culture suggests an improved capability for system understanding at the ecological level
and the potential for process control at the genotype level.
Key words: bacteria, genotype, biodegradation, mineralizat, activated sludge process, municipal wastes,
sewage sludge, aromatics, chemical reactions.

Blacklaw, J. R., Strand, J.A., and P. C. Walkup. Assessment of oil spill treating agent test methods. In
Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971 in Washington,
D.C. Year.
Keywords: assessment, oil spill, treating

Blaikley, Dr. R., et al. 1977. SLIKTRAK: a computer simulation of offshore oil spills cleanup, effects,
and associated costs. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control,
cleanup), March 8 10, New Orleans, LA.
Key words: offshore, oil spill.

Blair, R.M., Tedeschi, E.T. 1993. Dual-Chamber Inflatable Oil Boom. Petroleum Abstracts. 7.
Key Words: USA, adjustability, alloy, articulated, ballast, bladder, bouyancy, chart, collapsible,
compartment, compressed gas, connector, construction material, contamination, coupling (mechanical,
ecology, engineering drawing, environmental pollution, fastener, ferrous alloy, flexibility, inflatable,
latch, marine stablization, mechanical property, ocean environment, physical property, pollution control
equipment, polymer, reinforcing agent, sleeve, stabilization, suspension device, water pollution.

Blake, Torgeir and Kai Sorenson. Experimental long-term oil exposure on rocky shore mesocosms. In
Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28,
1985 in Los Angeles, CA Year.
Keywords: oil, exposure, rocky, shore, mesocosms

Blanc, P., Valisolalao, J., Albrecht, P., Kohut, J.P., Muller, J.F., Duchene, J.M. 1991. Comparative
geochemical study of three maceral groups from a high-volatile bituminous coal. Energy and Fuels (United
States). 5:6:0887-0624.
Three maceral concentrates (vitrinite, fusinite, and sporinite, over 90% pure) from the same high-volatile
bituminous coal (Vouters, Lorraine Basin, France; 0.84% R{sub o}) have been analyzed for their organic
solvent soluble (bitumen) and insoluble (macromolecular network) fractions in the scope of a comparative
geochemical study. Molecular marker distributions in the

saturated and aromatic hydrocarbon fractions
from the bitumen of vitrinite and fusinite were almost identical,
whereas they were rather different for
sporinite, probably due to a difference of origin. Hopanoid
compounds were much more abundant in
fusinite than in vitrinite, giving evidence for a major bacterial
input in the former. The macromolecular
networks have been oxidized with ruthenium tetroxide. Both
oxidative degradation and Rock-Eval
pyrolysis showed sporinite to be easily degradable and fusinite
very resistant, at this level of maturity.
Covalently bound hopanes are present in the matrix of sporinite;
they appear less mature than the free
hopanes in the bitumen, probably due to a protection of the
macromolecular network. Hopanoids seem to
have been incorporated in the matrix of fusinite. New coal rank
parameters based on oxidation products of
aromatic structural entities belonging to the macromolecular
network have been proven to be more
discriminating than rank parameters from the bitumen. They
enabled the quantification of the level of
condensation of the polyaromatic subunits of the macerals
(fusinite {gt} vitrinite {gt} sporinite). Moreover,
fusinite seems to behave like a 2% R{sub o} vitrinite-rich coal.
These new parameters could find useful
applications in the coking industry since they are able to
differentiate between inert and reactive inertinites.
70 refs., 14 figs., 6 tabs.
Key words: bituminous coal, macerals, biological.

Blanchard, M.S., and L.E. Dunlap. 1991. Vapor extraction
monitoring for hydrocarbon impacted soils.
In: Proceedings of the Nat Water Well Ass & API Petrol
Hydrocarbons & Org Chem in Ground Water:
Prev, Detection, & Restoration Conf, November 20-22, 1991,
Houston, TX, pp. 175-189.
Key words: Gas Analysis, Groundwater, Soil Pollution, Vadose
Water, Oil Spill, Tank

Blankenship, M.L. Polymer process cuts water coning. Amer Oil Gas
Reporter (1989): 32
disposal, oil

Blaylock, William M. and Jonathan P. Houghton. Infaunal recovery
at Ediz Hook following the ARCO
Anchorage oil spill. In Proceedings of the 1989 Oil Spill
Conference(Prevention, Behavior, Control,
Cleanup), February 13 16, 1989 in San Antonio, TX Year.
Keywords: infaunal, recovery, Ediz Hook, ARCO Anchorage, oil
spill

Blaylock, J.W., et al. 1973. Determination of n-alkane and
methylnaphthalene compounds in shellfish. In:
Proceedings of Joint Conference on Prevention and Control of Oil
Spills, March 13 15, 1973 in
Washington, D.C.
Key words: shellfish.

Blevins, H.J., S.D. Loftin, and W.R. Leek. 1981. It is time to redefine a harmful quantity of oil. In:
Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5,
Atlanta, GA.
Key words: oil.

Bloch, H.P. The results of a plant-wide turbine lubricating oil reconditioning and analysis program. In
38th ASLE (Am. Soc. Lubr. Eng.) Annu. Meet. (Houston 4/24 28/83) Prepr. N.83-AM-1B-2 in Year.
equipment, petroleum, refining, separation, reclamation, used oil

Blomberg, E. 1988. Arrangement for Positioning an Oil Boom or Similar Alongside a Ship. Pct Gaz.
1988(11):2226.
Key Words: Floating barrier, collector, containment, marine transporation, oil spill, positioning,
transportation, world, cable, chart, cleaning, connection, contamination, diagram, effieciency, extension,
hull (marine), navigation, oil spreading, pollution control, sealing, sweep efficiency, troilboom systems
AB, water pollution.

Blomberg, Capt. Erling and Ove Terling. Experiences gained from deployment of booms and skimmers
in various oil recovery applications. In Proceedings of the 1981 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), March 2 5, 1981 in Atlanta, GA Year.
booms, skimmers, oil, recovery

Blomberg, Capt. Erling. Combating oil with side-fitted sweeping booms. In Proceedings of the 1987 Oil
Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987 in Baltimore, MD Year.
Keywords: oil, side-fitted, sweeping, booms

Blotvogel, K.H. 1990. The behaviour of nitroaromatic compounds under methanogenic conditions.
Biochemical engineering, environmental biotechnology, recovery of bio-products, safety in biotechnology.
Lectures. Behrens, D., Driesel, A.J. 1990. <Original Series/Collective> DECHEMA biotechnology
conferences. 7. DECHEMA annual meeting on biotechnology and 58. meeting of the European
Biotechnology Federations, and joint meeting of Society for Industry Microbiology (SIM). 3:883-887,578.
Metabolically stable enrichment cultures of an anaerobic bacteria obtained of sewage sludge samples from
an industrial wastewater treatment plant have been used to study the degradation of nitrophenols under
methanogenic conditions. During incubation of the stable mixed culture with 4-nitrophenol as the sole
carbon source the following intermediates were detected in the culture fluid: 4-aminophenol, phenol,

cyclohexanone, cyclohexanol and traces of cylcohexane. The only methanogenic intermediate found so far
was actetate, which served as the sole carbon source for Methanosarcina spec. So, for example,
4-nitrophenol was completely mineralized to ammonia, carbon dioxide and methane under methanogenic
conditions.
Key words: nitrophenol, biodegradation, carbon dioxide, industrial plants, methane.

Blystra, Calvin D. 1992. Recovery of organic liquid spills. Patent No. EP 518336_A1, 21 pp.
Key words: Soil Pollution, Oil Spill, Removal

BMT Abstracts. 1991. Oil skimmers VALDEZ STAR and SHEARWATER. Sea Technology, 32(9):63
Key words: Health, Environment, Water Pollution Control, Equipment, Boom, Waste Material

BMT Abstracts. 1990. Guidelines for the preparation of shipboard oil spill contingency plans. Oil
Companies Intl. Marine Forum and The Intl. Tanker Owners Pollution Federation Ltd. 27p. BMT
Abstracts, ABSTR. NO. 91030591. 46(3)
Key words: Abstract, Boom, Environmental Protection, Legal Considerations, Oil Waste, Pollution
Control, Skimmer, Spill

Bobra, Mark. 1991. Water-in-oil emulsification: a physiochemical study. In: Proceedings of the 1991 Oil
Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: emulsification, physiochemical.

Bocard, Christian, Jean-Jacques Quinquis, and Christian Such. A mobile plant prototype for the restoration
of polluted beaches by washing oily sand. In In proceedings of the 1987 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), April 6 9, 1987. 61 66. Baltimore, MD: Washington, D.C.: American
Petroleum Institute. 1987.
Keywords: mobile, prototype, restoration, beaches, oily, sand.

Bocard, Christian, Claude Gatellier. 1981. Breaking of fresh and weathered emulsions by chemicals. In:
Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5,
Atlanta, GA.
Key words: emulsions, chemical.

Bocard, Christian, Renault, Philippe, and Jean Croquette. Cleaning products used in operations after the
AMOCO CADIZ disaster. In Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior,
Control, Cleanup), March 19 22, 1979 in Los Angeles, CA Year.
Keywords: cleaning, AMOCO CADIZ.

Bocard, C., et al. 1977. New concept of oil dispersion in view of clean-up by degradation. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: dispersion, degradation.

Bocard, C., et al. 1987. Protectmar: the French experience from a seven-year dispersant offshore trials program. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: Protectmar, French, offshore.

Bock, J., Canevari, G.P., Fiocco, R.J. Oil shoreline chemical cleaner. Exxon Research and Engineering Co. 7.
Key words: waters, ocean, oil spill, removal, surface, surfactant mixt. for removal, dispersion, collection of removed oil, beaches, droplets without dispersion.

Bockle, R. 1992. Method and apparatus for removing a liquid phase floating on a surface of groundwater. Patent No. US 5154538921013, 5pp.
Key words: Decontaminating, Contamination, Environmental Pollution, Ground Water, Pollution Control, Remote Sensing

Bodennec, G., Desmarquest, J.P., Jensen, B., Kantin R. 1987. Evolution of hydrocarbons and of bacteriological activity in sea sediments contaminated with curde and treated oil. International Journal of environmental analytical Chemistry. 29(3): 153-178.
Key words: soil pollution, marine environment, sand, sediments, pollutant behavior, hydrocarbon, biological activity, bacteria, crude oil, land disposal, sediment water interaction, dissolved oxygen, temperature, chemical degradation, treatment, comparative study.

Boehm, Paul D., et al. 1981. Physical-chemical weathering of petroleum hydrocarbons from the IXTOC I blowout: chemical measurements and a weathering model. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: petroleum, chemical, weathering.

Boehm, Paul D. 1985. Comparative fate of chemically dispersed and untreated oil in the Arctic: Baffin Island oil spill studies 1980 1983. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: dispersed, oil, Arctic, oil spill.

Boehm, Paul D. 1979. A chemical assessment of the present levels and sources of hydrocarbon pollutants in the Georges Bank region. In: Proceedings of the 1979 Oil Spill

Conference (prevention, behavior,
control, cleanup), March 19 22, Los Angeles, CA.
Key words: chemical, hydrocarbons.

Boehm, Paul D. 1983. A natural resources damage assessment study:
the IXTOC I blowout. In:
Proceedings of the 1983 Oil Spill Conference (prevention,
behavior, control, cleanup), February 28 March
3, San Antonio, TX.
Key words: assessment, blowout.

Bogardt, A.H., and B.B. Hemmingsen. 1992. Enumeration of
phenanthrene-degrading bacteria by an
overlayer technique and its use in evaluation of
petroleum-contaminated sites. Applied and environmental
microbiology. 58(8):2579-2582.
Key words: Biodegradation, Bacteria, Hydrocarbons, Soils, Water
Bacteria that are capable of degrading polycyclic aromatic
hydrocarbons were enumerated by
incorporating soil and water dilutions together with fine
particles of phenanthrene, a polycyclic aromatic
hydrocarbon, into an agarose overlayer and pouring the mixture
over a mineral salts underlayer. The
phenanthrene-degrading bacteria embedded in the overlayer were
recognized by a halo of clearing in the
opaque phenanthrene layer.

Bohme, V.E. and E.R. Brushett. 1977. Oil spill control in
Alberta. In: Proceedings of the 1977 Oil Spill
Conference (prevention, behavior, control, cleanup), March 8 10,
New Orleans, LA.
Key words: oil spill control.

Bokn, Tor. 1985. Effects of diesel oil on commercial benthic
algae in Norway. In: Proceedings of the
1985 Oil Spill Conference (prevention, behavior, control,
cleanup), February 25 28, Los Angeles, CA.
Key words: diesel, algae, Norway.

Bolakas, J. F. and R. A. Brown. 1991. Site closure through
integrated site remediation. In: Proceedings of
Hazmat '91 International: the Ninth Annual Hazardous Materials
Management Conference, June 12 14,
Atlantic City, NJ. Tower Conference Management Company: Wheaton,
IL, pp. 580 598.
Key words: Oil Spills, Groundwater Extraction, Underground
Storage, Bioremediation, Soil Vapor
Extraction
In October 1988, an apparent act of vandalism caused a large
gasoline spill at a bulk petroleum storage
facility in southern New Jersey. The facility is underlain by the
Cohansey Aquifer, a sole source drinking
water aquifer. Approximately 8,400 gallons of premium unleaded
gasoline was spilled onto the ground
around four underground storage tanks. It was estimated that
approximately 6,000 yd (sup 3) of soil was
contaminated by the spill over an area of approximately 100 feet

by 80 feet. Approximately 7,700 gallons of gasoline was adsorbed in the soil of the spill area. An additional 700 gallons of gasoline was adsorbed in soil which was excavated and stockpiled immediately following the spill. Because of the significant depth of groundwater (18 to 20 feet) and the emergency response actions, it was estimated that less than 100 gallons of gasoline reached the groundwater under the spill area. This paper describes the site remediation, which included groundwater extraction, soil vaper extraction, and bioremediation.

Boldrin, B., A. Tiehm, and C. Fritzsche. 1993. Degradation of phenanthrene, fluorine, fluoranthene, and pyrene by a mycobacterium sp. Appl Environ Microbiol. 59(6):1927 1930.
Keywords: biodegradation, hydrocarbon, monitoring, soil pollution

Bonazountas, M. 1991. Fate of hydrocarbons in solids. In: Proceedings of Annual West Coast Conference on Hydrocarbon Contaminated Soils and Groundwater, Feb. 1990, Newport Beach, CA. Lewis Publishers: Chelsea, MI, pp.167 186.
Key words: Oil Spills, Groundwater Pollution, Biodegradation
This paper describes concepts, uses, and limitations of state-of-the-art mathematical environment pollutant fate modeling for use in hydrocarbon fate studies and analyses of environmental quality. Terrestrial chemicals fate modeling has traditionally been performed for three distinct sub-compartments: the land surface (of watershed); the unsaturated soil (or soil) zone; and the saturated (or groundwater) zone of the region. An evaluation of the fate of inorganic compounds in soil and groundwater requires a detailed consideration of the physical, chemical, and biological processes and reactions involved, such as complexation, absorption, precipitation, oxidation-reduction, chemical speciation, and biological reactions to determine the free metal concentration in soil solutions. These processes can affect such characteristics as species solubility, availability for biological uptake, physical transport, and corrosion potential.

Booker, Fitzgerald. 1987. Fuel oil effects on membrane permeability in Spartina alterniflora roots. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: alterniflora.

Boone, D.R., Mah, R.A. 1987. Effects of molecular hydrogen on acetate degradation by methanogens. Biofuels and municipal waste technology research program summary: FY 1986. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Biofuels and Municipal Waste Technology Div. 155-156.

Work has centered on acetate-degrading Methanosarcina strains under various concentrations of hydrogen and co-cultures with other synergistic anaerobic bacteria. Efforts are focusing on the determination of the optimum levels of the concentrations, nutrient requirements, and synergism between bacteria to enhance methane production. It was found that low (ca. 0.2 ..mu..M of H/sub 2/) concentrations had no discernible effect on the degradation of acetate by M. barkeri, but the cultures were unable to utilize hydrogen as a catabolic substrate at such low concentrations. Higher levels (ca. 50 ..mu..M) of hydrogen usually did not significantly affect acetate degradation, and at these levels M. barkeri was able to convert the hydrogen to methane. Higher levels of hydrogen, added directly to the cultures by bubbling gas, did inhibit aceticlastic methanogenesis. Furthermore, it was found that hydrogen-grown cultures of M. barkeri are unable to utilize acetate except after a prolonged lag-phase. It was also noted that if acetate is present when hydrogen is exhausted, no inhibition results. That is, inhibition occurs only when stationary-phase cultures are used for inoculum.
Key words: acetates, biodegradation, biochemical reaction kinetics, biosynthesis, methane, carboxylic acid salts, chemical reactions, decomposition, elements, organic compounds, kinetics, decomposition, methane, inhibition, quantity ratio, alkanes.

Boone, D.R., Menaia, J.A.G.F., Boone, J.E., Mah, R.A. 1987. Effects of hydrogen pressure during growth and effects of pregrowth with hydrogen on acetate degradation by Methanosarcina species. Appl. Environ. Microbiol.(United States). 53:1:83-87.
Methanosarcina barkeri 227 and Methanosarcina mazei S-6 grew with acetate as the substrate; little effect of H/sub 2/ on the rate of aceticlastic growth was found in the presence of various H/sub 2 pressures between 2/ and 810 Pa. Physical (H/sub 2/ addition or flushing the headspace to remove H/sub 2/) and biological (H/sub 2/-producing or -utilizing bacteria in cocultures) methods were used for controlling H/sub 2/ pressure in Methanosarcina cultures growing on acetate. Added H/sub 2/ (ca. 100 Pa) was removed rapidly (a few hours) by M. barkeri and slowly (within a day) by M. mazei. When the H/sub 2/ produced by the aceticlastic methanogens was removed by coculturing with an H/sub 2/-using Desulfovibrio sp., the H/sub 2/ pressure was about 2.2 Pa. Under these conditions the stoichiometry of aceticlastic methanogenesis did not change. H/sub 2/-grown inocula of M. barkeri grew with acetate as the sole catabolic substrate if the inoculum culture was transferred during logarithmic growth to acetate-containing medium or if the transfer was accomplished with 1 or 2 days after exhaustion of H/sub 2/. H/sub 2/-grown cultures incubated for 4 or more days after

exhaustion of H/sub 2/ were able to grow
with H/sub 2/ but not with acetate as the sole catabolic
substrate. Addition of small quantities of H/sub 2/
to acetate-containing medium permitted these cultures to initiate
growth on acetate.
Key words: acetates, biodegradation, hydrogen, catabolism,
methanogenic bacteria, growth, pressure
effects, stoichiometry, alkanes, carboxylic acid, bacteria,
chemical reactions, decomposition, nonmetals,
organic compounds, sulfate-reducing, synthesis, microorganisms,
elements, hydrocarbons.

Boone, D., Mah, R., Chynoweth, D.P., Isaacson, R. 1987.
Transitional bacteria. Anaerobic digestion of
biomass. 35-48.
Transitional bacteria convert the soluble organic matter produced
by hydrolytic bacteria into methanogenic
substrates. Soluble organic matter enters the anaerobic
degradation process at a number of different
points. For instance, acetate in the influent may be metabolized
directly by methanogens independent of
catabolic interactions with other bacteria. Fatty acids, the
major hydrolysis products of fats, are
catabolized primarily by the obligate proton-reducing acetogens
and converted to methanogenic substrates.
Peptides, the hydrolysis products of protein, are taken up by
bacteria and hydrolyzed to amino acids that
may be used as carbon and energy sources via fermentative
reactions. Oligosaccharides, the major
hydrolysis products of carbohydrate polymers, are taken up by
bacteria and catabolized by various
fermentative pathways. Traditionally, anaerobic digestion has
been described as a two-phase process with
the products of the first or acidogenic phase serving as
intermediate substrates for the second or
methanogenic phase.
Key words: bacteria, biogas process, hydrogen transfer, anaerobic
digestion, energy sources,
hydrocarbons, renewable energy sources, organic compounds,
processing, digestion, alkanes, methane,
biomass.

Boortz, M.J. 1993. The API petroassist network. In: Proceedings
of the 1993 Oil Spill Conference
(prevention, preparedness, response), March 29 April 1, Tampa,
FL.

Boortz, Marielle J. 1991. Chevron worldwide exposures project.
In: Proceedings of the 1991 Oil Spill
Conference (prevention, behavior, control, cleanup), March 4 7,
San Diego, CA.

Booth, G.T. Jr. The oil company's partner in proper
service-station waste oil disposal. The collector and
rerefiner. In Natl pet refiners assoc natl fuels & lubr meet (NY
9/14 15/72) in Year.
petroleum refining, control, legal

Borden, Robert C., Kao, Chih-Ming. 1989. Water flushing of trapped residual hydrocarbon; mathematical model development and laboratory validation. Natl. Water Well. Assoc., Dublin, OH, United States. 473-486.
Key Words: Ground water, pollution, waste disposal, liquid waste, mathematical models, oil spills, aromatic hydrocarbons, organic materials, solution, mass transfer, xylene, benzene, toluene, ethylbenzene, organic carbon, laboratory studies, Raoult's law, finite difference analysis, statistical analysis, simulation, leaching.

Borow, Harlan S., Thomas Maziarz, William R. Mahaffey, and Tanni M. Whitlock. 1990. Development of Bioremediation Strategy for Contaminated Soils, Surface and Groundwater. In: Proceedings of the TAPPI Environ Conf, April 9 11, 1990, Seattle, WA.1:285 304.
Keywords: biodegradation, waste site remediation, groundwater, water pollution
Strategies to carry out the biological degradation of toxic chemicals successfully are identified and demonstrated through actual field experiences. The treatment technologies fall into four main categories: solid-phase biotreatment, slurry-phase biotreatment, in-situ biotreatment, and combined technologies with chemical or physical treatment. The pros and cons of each technology type are identified. The application of each of these technologies requires strategic integration of scientific, engineering, and operational principles.

Borst, M, R.J. Cocherell, H.W. Lichte. OHMSETT (Oil and Hazardous Materials Simulated Environmental Test Tank) pump tests. In 8th Bien API, EPA & U.S. Coast Guard Oil Spill (Prev, Behav, Contr, Cleanup) Conf (San Antonio, 2/28/83 3/3/83) Proc in Year.
disposal, oil, recovery

Borst, M. and H. W. Lichte. Standardizing boom test procedures. In In proceedings of the 1985 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 41 46. Los Angeles, CA : Washington, D.C.: American Petroleum Institute. 1985.
Keywords: boom

Bort, R.M.| Pyles, D.G.| Ricketts, H.M.| Connor, G.R. (Roy F. Weston,Inc., Bannockburn, IL (USA)).Oil spill remedial actions: Two case histories.

Bosich, J.F. Leakage Containment and Detection Systems US 4922232, c 5/1/90, f 10/21/88 (Appl 261173) (g08b-021/00) (14 pp; 51 claims)
1990
leak detector, absorbent, containment, detector, electrical equipment, electrode, fluid loss, instrument,

leak, oil spill, pipeline leak, sorbent, (p) USA, absorption, buried pipeline, casings, chart, circuit, compressive strength, constructio material, container, contamination, control, direct current, ecology, electric circuit, electric current, electric potential, electrical insulation, electricity, electrochemical potential, electrolytic cell, engineering drawing, environment, foam, foamed plastic, indicator, inground tank, insulating material, mechanical property, mechanical strength, mixture, oil solubility, physical property, pipeline, plastic, pollution control, polymer, seepage, signal, soil pollution, solubility, sorption, storage facility, tank, terrestrial environment, ecology & pollution

Bossert, Ingelborg, R. Bartha. Fate of petroleum in soil ecosystems. In Pet Microbiol , 435 473. New York, NY: Macmillan Publ Co. 1984.
bibliography, disposal, hydrocarbons, biodegradation, soil pollution, environmental impact, bacteriology.
The impact of oil spills on land is reviewed. In terrestrial environments the lateral spread of spilled oil is relatively easy to control and the consequent ecological damage is typically localized. Special problems arise due to the movement of spilled oil into the soil water table. These problems are discussed in the context of the biodegradation of petroleum in soils. Petroleum prospecting, accidental petroleum spills on land, and intentional waste oil disposal on land are reviewed. 146 refs.

Botts, J.A., J.W. Braswell, E.C. Sullivan, W. Goodfellow and B.D. Sklar. 1988. Patapsco wastewater treatment plant toxicity reduction evaluation. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 601-621.
Key words: Biodegradation, Maryland, Monitoring, Waste Management, Wastewater
The US EPA has established a policy to develop water quality based permit limitations to control the discharge of toxic materials through the nation's wastewater treatment systems. A toxins management process is evolving to support this policy and one step in this process involves conducting Toxicity Reduction Evaluations (TREs) at wastewater treatment facilities identified as having toxic influence wastewaters. The objectives of these TREs are to assess the sources of toxicity, the impact of treatment, and the pass-through following treatment of wastewater toxicity. The EPA and the city of Baltimore are conducting a TRE at the City's Patapsco Wastewater Treatment Plant (Patapsco WWTP). The Patapsco TRE was initiated in April 1986 and will provide the first case history of a toxins management program at a municipal wastewater treatment plant. The overall approach and specific tasks that have been developed

since the TRE was proposed are described in this paper. Initial results of the study are also presented and discussed. To date, Ceriodaphmia dubia has been the most sensitive indicator of acute toxicity for both the primary effluent and the secondary effluent wastewaters. The acute responses for Mysidopsis bahia and Microtox have been considerably less sensitive than C. dubia.

Bourquin, Al W. 1989. Bioremediation of Hazardous Waste. Hazardous Materials Control. 2(5):16 34.
Keywords: petroleum, hydrocarbons, waste site remediation, biodegradation
Principles of bioremediation, which is the controlled use of biodegradation for removal of toxic chemicals from soil and groundwater, and field experiences to illustrate its effectiveness are presented. Biological destruction of hazardous organic chemicals results in recycling carbon from the organic state to carbon dioxide, the inorganic state. Microbial metabolism can be useful in remediation of petroleum hydrocarbons, pesticides, chlorinated solvents, and halogenated aromatic hydrocarbons. Treatment technologies include solid-phase biotreatment (land farming), slurry-phase biotreatment, in-situ biotreatment, and combined technologies with chemical or physical treatment. Case histories are presented.

Bovet, David M., Charles R. Corbett. 1991. The Oil Pollution Act of 1990: key provisions and implications. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: pollution.

Bovet, David M. 1993. OPA 90 and the shipowner. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: ship.

Bowlds, L.S. 1992. Potential new bioremediation technique of PCBs.
Water Environment amp Technology (United States). 4:2:1044-9493.
University of Michigan environmental engineers may have found a way to destroy toxic PCBs in contaminated riverbed sediments using sequential treatments with anaerobic and aerobic bacteria.
According to the researchers, the process is the first to breakdown successfully PCBs in contaminated sediments. First anaerobic organisms remove chlorine atoms from PCBs, making them less toxic. Then aerobic bacteria chemically convert PCBs to carbon dioxide and water. The trick is putting oxygen into the system to create the switch from anaerobic to aerobic degradation. To date concentrations have been reduced from 300 mg/L to about 50 mg/L and work continues to

attempt to perfect the process. EPA has
been requested to test the sequential anaerobic-aerobic process
on PBC-contaminated Superfund sites near
Sheboygan, WI.
Key words: biodegradation, aerobic, digestion, anaerobic
digestion.

Boxer, Baruch. 1979. Mediterranean oil pollution monitoring and
control: technical and policy issues. In:
Proceedings of the 1979 Oil Spill Conference (prevention,
behavior, control, cleanup), March 19 22, Los
Angeles, CA.
Key words: oil, monitoring.

Bozzo, W. 1989. Oil/hazardous substance response training for the
strategic petroleum reserve. In:
Proceedings of the 1989 Oil Spill Conference (prevention,
behavior, control, cleanup), February 13 16,
San Antonio, TX. Year.
Key words: petroleum.

Brabrand, A., B. Faafeng, and J.P.M. Nilssen. 1987. Pelagic
predators and interfering algae stabilizing
factors in temperate eutrophic lakes. Arch Hydrobiol.
110(4):533-552.
Key words: Phytoplankton, Zooplankton
Two large pelagic limnocorrals were installed in Lake Gjersjoen,
SE Norway, in 1979 (diam. 10 m, depth
12 m) and 1980 (diam. 10 m, depth 20 m). The walls consisted of
transparent polyethylene foil (thickness
0.15 mm) and the bottom was covered by netting of mesh size 7.9
mm. The corrals were supported by
oil-spill booms and surrounded by wodden docks. Temperature,
oxygen and pH stratifications in the
corrals generally mimicked the conditions in the lake in 1979 and
1980, although the thermocline in the
corrals was situated slightly closer to the surface. The effect
of fish removal on zooplankton community
structure and interfering algae (Oscillatoria) was investigated
during 1979 and 1980. Juvenile roach
(Rutilus rutilus) (mostly of age 2+) equivalent to approx. 230 kg
ha-1 were added to one of the enclosures
in 1979 and 1000 kg ha-1 in 1980, while there were no fish in the
other corral. The absence of fish had
apparently no major effect on water chemistry, phytoplankton and
zooplankton, and the enclosures closely
resembled the lake during autumn 1979. The experiments in 1980,
initiated during the spring
phytoplankton peak, gave high abundance of carnivorous cyclopoid
copepods in the enclosure without fish.
This was followed by even lower numbers of efficient
filter-feeders than in the lake, in which fish were the
main zooplankton predator. As a result, filter-feeders were
unable to influence successional patterns and
species composition of phytoplankton, even when roach were
absent.

Bradley, J. and B. Axline. 1993. Monitoring oil spills with radar. Energy Environ. 24(4):4 5.
Key words: Synthetic Aperture Radar, Oil Spills, Pollution Monitoring, Coast Guard
Recent flight tests show great promise for using SAR (synthetic aperture radar) as an oil spill monitor. Sandia has delivered flight test data and a PC based workstation to the Coast Guard and is developing the conceptual design of a SAR system for wide swath monitoring of oil spills. Sandia and the Coast Guard R&D Center will jointly assess the cost effectiveness of SAR in fulfilling the Coast Guard's requirements for detecting and monitoring oil spills.

Braga, C. Z. F. and A. W. Setzer. 1991. Modeling suspended solids concentrations based on TM/Landsat-5 images at Guanabara Bay, RJ, Brazil. In: Proceedings of the 24th International Symposium on Remote Sensing of Environment, May 27 31, Rio de Janeiro, Brazil. Erim: Ann Arbor, MI. 3(1):59.
Key words: Landsat TM, Remote Sensing, Oil Pollution, Guanabara Bay, Brazil
Guanabara Bay, Rio de Janeiro, Brazil, is the most urbanized and industrialized estuary of the country and its polluted waters have many uses, ranging from recreation to traffic of oil tankers. Remote sensing techniques have not been tried in this region with limited water quality analysis; those techniques could provide a general picture of pollution patterns. This paper presents a distribution of Total Suspended Solids (TSS) for the bay obtained through the expansion of a stepwise regression resulting model from in-situ and TM/Landsat-5 data.

Bragg, J.R., et al. 1993. Bioremediation effectiveness following the Exxon Valdez spill. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 - April 1, Tampa, FL.
Key words: bioremediation, Exxon Valdez.

Breisford, J.A. 1989. Process of cleaning oil spills and the like. 1 Jun 1993. Patent and Trademark Office, Box 9, Washington, DC 20232 (United States)ETD (Energy Technology Data Exchange), INS (US Atomindex input) IMS (DOE contractor), 10pp.
A process of cleaning spills of toxic or hazardous materials such as oil, antifreeze, gasoline, and the like from bodies of water, garage floors, roadways and the like, comprising spraying unbonded shredded fiberglass blowing wool composition particles onto the spill, absorbing the spill into the shredded fiberglass blowing wool composition particles, and removing the soaked shredded fiberglass blowing wool composition particles and the spill absorbed therein. An absorbent composition for absorbing spills of toxic or hazardous materials such as oil, antifreeze, gasoline, and

like, comprising shredded fiberglass blowing wool particles, and means for absorbing the spill and for stiffening the co-position so that the composition fights against being compressed so that less of the absorbed spill escapes from the composition when it is being removed from the spill, said means including cork particles dispersed in with the fiberglass blowing wool particles. An absorbent sock for absorbing or containing a spill of toxic or hazardous materials such as oil, antifreeze, gasoline, and thelike, comprising a hollow tube, said tube being permeable to the toxic or hazardous materials and being made of nylon or polypropylene, and unbonded, shredded fiberglass blowing wool composition particles enclosed in the tube. Apparatus for controlling an oil slick on the surface of water, comprising a craft for traversing the slick, a supply of fiberglass blowing wool composition particles stored on the craft in position for being dispersed, shredding means on the craft for shredding the fiberglass blowing wool particles to form unbonded, shredded fiberglass blowing wool particles, and dispensing means on the craft for dispensing the unbonded, shredded fiberglass blowing wool particles onto the slick.
Key words: antifreeze, materials recovery, gasoline

Brelsford, J.A. 1993. Process of Cleaning Oil spills and the like. Patent No. US 5215407, c 6/1/93, f 10/5/89 (Appl 417740) (e02b-015/04; C02b-009/02) (8 pp; 23 claims).
Key words: collecting agent, contamination, decontaminating, environmental pollution

Brendel, Judith. 1985. Revegetation of Arctic tundra after an oil spill: a case history. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: revegetation, oil spill.

Breslin, M.K. 1988. Apparatus for controlling the removal of liquid hydrocarbons from groundwater. Patent No. US 4761225880802, 11p.
Key words: Oil Water Separator, Groundwater, Oil Spill, Soil Polution, Water Pollution

Breslin, M.K. 1988. Apparatus for recovery of liquid hydrocarbons from groundwater. Patent No. CA 1239868880802, 19p.
Key words: Oil Water Separator, Oil Spill, Groundwater, Soil Pollution, Water Pollution

Breslin, Michael K. 1983. Method for conducting oil pollution liability insurance survey. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil, pollution, liability.

Breure, A.M., F. Volkering, J.G.van Andel. Biodegradation of polycyclic aromatic hydrocarbons.
DECHEMA Biotechnology Conferences (1990): 4
Key words: hydrocarbon, bacteria, cyanobacteria, degradation
The biodegradation of naphthalene, phenanthrene, and anthracene by bacterial pure and mixed cultures in batch and chemostat cultures is described. Microbial growth kinetics are studied in detail and product formation is investigated.

Bridges, R.L. 1990. Anaerobic decomposition of benzoic acid during methane fermentation: Specific activity of fatty acid intermediates and postion of radioactive label. Kansas State Univ., Manhattan, KS (United States). 86.
A study of the pathway of anaerobic decomposition of benzoic acid by a mixed methanogenic culture of bacteria was conducted. Specific activities of the possible fatty acid intermediates cyclohexanecarboxylic acid, propanoic acid, and acetic acid were determined. In the case of propanoic acid, the position of the radioactive label was also determined by isotropic trapping and Phares-Schmidt degradation of the intermediate. The specific activities of cyclohexanecarboxylic acid and propanoic acid are the same as the benzoate substrate fed to the mixed methanogenic cultures. These fatty acids must be direct breakdown products from the aromatic ring. When (4{minus}{sup 14}C) benzoate is the substrate, the propanoic acid produced is labeled exclusively in the carboxyl position. This supports the pathway proposed by Keith et al. (1978), but would be unlikely for the pathway proposed by Evans (1977). The specific activity of the acetic acid isolated from a culture fed (4{minus}{sup 14}C) benzoate is 42% of the specific activity of the substrate. This is possible only if the methylmalonyl-CoA pathway for the conversion of propanoate to acetate is not being utilized. The amount of various intermediates found indicates that at least three syntrophically linked organisms are present in the mixed methanogenic culture. One is responsible for the production of cyclohexanecarboxylic acid, one for the production of acetate from propanoate, and one for the production of methane.
Key words: benzoic acid, anaerobic digestion, biochemical reaction, acetic acid.

Bright, Donald B. 1979. West Coast oil spills: a probability analysis keyed to Southern California. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil spills.

Brinkley, H.E. 1993. Method of Recovering Oil-based Fluid and Apparatus. 15 pp; 23 Claims

Key words: collecting agent, adsorbent, contamination, decontaminating, environmental, pollution, fabric, oil, spill, solid adsorbent, sorbent

Brinkley H. E. 1993. Method of recovering oil-based fluid, 10 pp; 29 claims.
Key words: collecting agent, adsorbent,adsorption, business operation, decontaminating, oil spill

British Petroleum Plc. Destabilisation method for oil in water emulsions_using amino-alkyl (meth)acrylate polymers with amine gps. opt. blocked by alkyl-carbonate gp. followed by unblocking. Patent No. GB 9016061_900721.
Key words: Crude Oil, Demulsifier, Pollution Control

Brocksen, Robert W., Howard T. Bailey. 1973. Respiratory response of juvenile chinook salmon and striped bass exposed to benzene, a water-soluble component of crude oil. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: salmon, bass, oil.

Brodersen, C.C. 1977. Sensitivity of larval and adult Alaskan shrimp and crabs to acute exposures of the water-soluble fraction of Cook Inlet crude oil. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: sensitivity, oil.

Brodie, D. 1991. Preparation of marine pollution contingency plans for small island nations. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp. 25 28.
Key words: Activity, Adsorbent, Animal, Boom, Diaster Control, Oil Waste, Pollution Control, Waste Material

Brodie, Donald. 1991. Preparation of marine pollution contingency plans for small island nations. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: marine, pollution.

Brodie, D. 1987. Oil pollution response arrangements in Australia: the government view (Including an update on dispersant testing). In: Proceedings of the 10th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Conf, April 6 9 1987, Baltimore, MD, pp. 181-188.
Key words: Oil Spill, Administration, Pollution Control, Remote Sensing, Contamination, Waste Material

Brodie, Donald. 1993. The KIRKI incident. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.

Broholm, Kim, Thomas H. Christensen, and Bjorn K. Jensen. 1991. Laboratory feasibility studies on biological in-situ treatment of a sandy soil contaminated with chlorinated aliphatics. Env Technology. 12(3):279-289.
Key words: In-situ, Hydrocarbons, Bacteria, Microorganism
The potential for obtaining in situ biodegradation of chlorinated aliphatics in unsaturated soil by in-situ injection of methane and air for stimulation of methane-oxidizing bacteria was the focus of laboratory batch and column trials. Biodegradation of trichloroethylene and 1,1,1-trichloroethane was achieved, but tetrachloroethylene did not biodegrade. One soil contained inhibitory concentrations of chlorinated aliphatics, resulting in long lag-phases and retarded methane degradation rates. The degree of biodegradation is so modest for this soil, when compared with stripping and leaching, that bioremediation does not seem attractive.

Bronchart, R.D.E. 1985. A New approach in enhanced biodegradation of spilled oil: development of an oil dispersant containing oleophilic nutrients. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: biodegradation, spilled oil, dispersant.

Brook, K. D., J.O. Carte, T.J. Danaher, G.M. McKeon, N.R. Flood, and A. Peacock. 1992. The use of spatial modelling and remote Ssnsing for monitoring and forecasting of drought-related land degradation events in Queensland. In: Proceedings of the Australasian Remote Sensing 6th Conf Proc, Wellington, NZ. 1(10):1-140.
Key words: Rangelands, Mathematic Models, Land Misuse
The effects of rangeland management, climate, and vegetation on land degradation is studied in Queensland, Australia. The GRASP spatial model of pasture growth and utilization is being developed to help monitor and predict degradation events on rangeland. Soil class, pasture type, tree cover, herbivore density, and daily meteorological data are input to the model. Predicted El Nino phenomena are used to construct future climate scenarios. Animated spatial and temporal visualizations of model outputs are generated. When other remote sensing, geographic information systems, and other technologies are integrated, model output will assist in issuing feed deficit and rangeland condition alerts in near real time.

Brookner, P.L., F.E. Farley, and W.K. Lederman. 1988. A cost effective alternative for diesel contaminated soil disposal :biological degradation using land

farming techniques. In: Proceedings of the
API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf,
November 9-11, 1988, Houston, TX, 2:613-625.
Key words: Biodegradation, Bioremediation, Soil Pollution, Hydrocarbon, Bacteria, Disposal, Florida

Brooks, K., and Guy F. Atkinson. 1987. Cleaning up groundwater. Chemical Week. 140(11):13,16.
Key words: soil pollution, water pollution, biodegradation

Brooks, K. 1987. Learning to deal with chemical spills. Chemicalweek. 140(3):33-34.
Key words: Business Operation, Diaster Control, Economic Factor, Legal Consideration, Pollution
Control, Environmental Protection Agency

Brouns, T. M., S. S. Koegler and J. K. Fredrickson. 1990. Biological treatment of Hanford groundwater.
In Proceedings of the international meeting of nuclear and hazardous waste management, September
30 October 4, 1990, Knoxville, TN, pp.451 456.
Key words: Biodegradation, Disposal, Groundwater, Handford, Waste, Water Pollution
Liquid wastes containing radioactive, hazardous, and regulated chemicals have been generated throughout
the 40 years of operations on the Hanford Site. Some of these wastes were discharged to the soil column,
and many of the waste components, including nitrate (NO3-1) and carbon tetrachloride (CCl4) have been
detected in the Hanford groundwater. This paper describes a biological process developed by researchers
at Pacific Northwest Laboratory (PNL) for remediation of contaminated groundwater. For this work,
laboratory screening tests were used to select an indigenous microbial consortium from Hanford
groundwater that is capable of both NO3-1 and CCl4 degradation. Reaction rates were obtained from the
results of bench-scale kinetics tests. A pilot-scale treatment system was designed, constructed, and tested
with simulated groundwater to ensure operability and confirm rates of degradation. A treatment
demonstration with actual groundwater from the Hanford Site is scheduled for Fiscal Year (FY) 1990 and
FY 1991.

Brown, W.A., and D.G. Cooper. 1992. Hydrocarbon degradation by Acinetobacter calcoaceticus RAG-1
using the self-cycling fermentation technique. Biotechnology and bioengineering. 40(7):797-805.
Key words: Biodegradation, Hydrocarbon, Degradation
The use of self-cycling fermentations (SCFs) as a method for dealing with insoluble carbon substrates was
examined. The emulsan-producing Acinetobacter calcoaceticus RAG-1 was used as the test organism.
Limiting concentrations of hexadecane, 1-hexadecene, or 1-chlorohexadecane were used as the carbon

substrate. The parameters monitored were residual hydrocarbon concentration, cycle time (doubling time), biomass concentration and emulsan concentration. Cycle-to-cycle variations of the measured parameters were found to be small. In all cases, no residual hydrocarbon was detected.

Brown, Richard A._Groundwater Technology Inc, Mercerville, NJ|Dey, Jeffrey C.|McFarland, Wayne E., Integrated Site Remediation Combining Groundwater Treatment, Soil Vapor Extraction, and Bioremediation; Battelle +i In Situ +r Bioreclamation Symp, San Diego, CA; An act of vandalism resulted in a large gasoline spill at a New Jersey bulk petroleum storage plant in 1988. A sole source drinking water aquifer under the spill area was only moderately contaminated because of immediate excavation of affected soil. Two remedial alternatives for spill cleanup were compared: excavation and replacement of all contaminated soil, coupled with groundwater treatment and on-site treatment of contaminated soil, using bioremediation and soil extraction. The high cost of the excavation alternative made it infeasible, while the less expensive +i in situ +r system allowed the plant to continue operations and eliminated off-site liability associated with migrating contaminants. The system has effectively removed gasoline and reduced groundwater contamination.

Brown, J. May 1990. Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989. 19(p).
Key Words: Environment monitoring, environmental policy compliance, Naval Petroleum Reserve Waste Management, accidents, air quality, containment, ground water, land use, oil spills, permits, Radium 226, site characterization, state government, US EPA, well drilling, Wyoming, administrative procedures, alkaline earth isotopes, alpha decay

Brown, M. 1993. Innovative, fast Sea Spray oil spill response catamarans. Work Boat World. 12(3):16.
Key Words:

Brown, Richard A., Johnson, John, Oppenheim, James, Harper, Cliff. 1990. Application of in-situ bioreclamation to a low-permeable heterogeneous formation; evolution of a system in response to regulatory and technical issues. Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:829-843.
Key Words: Vermont, environmental geology, reclamation, biodegration, in situ, methods, heterogeneous materials, permeability, New England, Eastern U.S., United States, northwestern Vermont, Champlain Valley, ground water, oil spills, volatiles.

Brown, H.M., Goodman, R.H., Nicholson, P. (Imperial Oil Ltd., Calgary, AB (Canada)). June 10-12, 1992. The containment of heavy oil in flowing water. Fifteenth Arctic and Marine Oilspill Program technical seminar. 457-465.
Key Words: Oil retention booms performance, oil spills-oil pollution containment, bitumens, field tests, organic compounds, other organic compounds, pollution control, pollution control equipment, tar, testing.

Brown, V.M. 1991. Radical environmentalism, the new approach: The removal of oil as a primary goal of oil spill clean up. In: Proceedings of the 7th Amer. Soc. Civil Eng. et al. Coastal & Ocean Manage. Symp. (Coastal Zone 91), July 8 12 1991, Long Beach, Calif., pp. 301-314.
Key words: health, environment, water pollution control

Brown, J.R., M. Bianchini, M. Ligthart, C.N. Du Payrat, and J.B. Whitmore. 1987. Methods to detect and control spillages in European oil lines: Pt.2. Pipe Line Ind, 67(6):30-32.
Key words: Pipeline Leak, Oil Spill, Contamination, Crude Oil

Brown, James D. Successful natural resource damage claim for a coastal oil spill. In In proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. 293 296. San Antonio, TX : Washington, D.C.: American Petroleum Institute. 1989. b.
Keywords: natural resource, damage, coastal, oil spill.

Brown, G. A., S. Bartlett, and W. Lamb. In-situ measurements of oil barrier shape and loads due to current action. In In proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973. 409 420. Washington, D.C. : Washington, D.C.: American Petroleum Institute. 1973.
Keywords: in-situ, oil, barrier.

Brown, H.M., and R.H. Goodman. 1987. In situ burning of oil in experimental ice leads. Environmental studies revolving funds, No.064. Report No. ER/C-8702, 123 pp.
Key words: Oil Pollution Containment, Oil Spill Removal, Petroleum Residues
Oil-spill cleanup in Arctic waters poses unique problems because of the presence of ice and the remoteness of potential spill sites. This work investigates the removal by burning of spilled oil in leads. Twenty-five burns of weathered Norman Wells crude were carried out under varying wind conditions in leads cut in an ice sheet. It was found that burning efficiencies of up to 90% were possible if moderate winds (similar to average Beaufort winds) herded the oil into long narrow leads. For leads of other geometries with similar winds,

efficiencies might be as low as 70%. Winds of up to 4 m/s across a narrow lead caused no oil herding and resulted in low efficiency burns. Brash ice impeded wind herding of the oil and resulted in lower burning efficiencies. Wind herded oil could be ignited at either the upwind or downwind edge with similar burning results. Weathering of oil of up to 20% did not significantly affect the burn efficiency in moderate winds. 6 refs., 3 tabs., 9 figs.

Brown, R.A. 1973. Distribution of heavy hydrocarbons in some Atlantic Ocean waters. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: hydrocarbons, water.

Brown, Dennis F., John A. Arway. 1987. Biological impacts of oil and gas development in Northwest Pennsylvania. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.

Brown, H.M., R.H. Goodman. 1989. The Recovery of spilled heavy oil with fish netting. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: recovery, oil.

Brown, James D. 1989. Successful natural resource damage claim for a coastal oil spill. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, 1989 in San Antonio, TX.
Key words: damage claim, coastal.

Brown, John S., Paul D. Boehm. 1993. The Use of double ratio plots of polynuclear aromatic hydrocarbon (PAH) alkyl homologues for petroleum source identification. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: petroleum source identification.

Brown, L.R. 1981. Oil-degrading potential of surficial sediments near oil-producing platforms. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: sediments.

Brown C.E., Fruhwirth M., Lambert P., Fingas M.F.Recent activities of the Emergencies Science Division's Remote Sensing Working Group. Environment Canada 16th Arctic and Marine Oil Spill Technical Seminar (Calgary 6/7-9/93) Proceedings V2 1073-82 (1993).

Key words: acoustics, adsorbent, aerial, Alberta, CZ, monomer, Canada, commercial, crude oil, depth, emergency, equipment testing, fuel oil scale, functional fluid, heating, homopolymer, hydraulic fluid.

Brown, H.M. 1988. Recovery of spilled heavy oil with skimmers. Prairie Regional Oil Spill Containment and Recovery Advisory Committee, Calgary (Alberta), 12 pp.
Key words: Oil Spills, Cleanup
Experiments were conducted in 1988 in the Esso Resources wave basin to test various suggested methods of containing and recovering spilled heavy oil from water. Oil from the Cold Lake plant was used in these tests. No spill containment and recovery equipment has been specifically designed to combat spills of this oil but equipment used on spills of Bunker C oil or heavily weathered oil may be applicable. One approach is to use nets as containment devices and to remove the oil from the water by some type of skimmer. The most heavily tested skimmer is one developed by British Petroleum, and this design was chosen for tests in the Esso wave basin at low water temperature. It was also suggested that a rope skimmer might work for these oils at low temperatures and this was also tested. This report describes the equipment used and evaluates the two types of skimmers.

Brown, F.G. 1992. (Using naturally occurring) microbes: The practical and environmental safe solution to production problems, enhanced production, and enhanced oil recovery. In: Proceedings of SPE 1992 Permian Basin Oil & Gas Recovery Conference, March 18 20, Midland TX, pp. 251 259.
Key words: bacteria, biodegradation, microorganism, oil, petroleum, texas

Brown, M. 1989. Clean-up technology. The fate and effects of oil in freshwater.PP 215-226. Essex, Engl: Elsevier Science Publishing LTD.
Keywords: bioremediation, oil spill, oil water separation, biodegradation, dispersant, disposal, environmental impact, floating barrier, waste disposal, water pollution

Brown, J.D. 1989. Successful natural resource damage claim for a coastal oil spill. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 293 96.
Key words: Accident, Boom, Economic Factor, Pollution Control Equipment, Transportation

Brown, A. 1992. Method for Removing Oil Spills Using a Natural, Recyclable Absorbent. World 92/22501, p 12/23/92, f 6/9/92.
Key words: absorbent, adsorbent, energy source, flora, oil spill, oil waste, solid adsorbent, sorbent,

spill, vegetation, waste material, (p) world, chart, contamination, control, diagram, environmental pollution, fuel, pollution control, solid, water pollution, ecology & pollution

Brown., P. Bernard Ryan, Derek J.S. 1987. Oil pollution control and spill response capability in the Ropme Sea Area. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil pollution control, spill response, Ropme Sea.

Brubaker, Gaylen R. 1991. In situ bioremediation of PAH-contaminated aquifers. Ground Water Management. 8:377-391.
Key Words: Pollution, ground water, organic materials, hydrocarbons, polycyclic aromatic hydrocarbons, in situ, bioremediation, aquifers, oil spills, DNAPLs, dense non-aqueous phase liquid, aromatic hydrocarbons.

Bruce, D. A., G. A. Yoshioka, and A. Condie. A review of federal and state law concerning reportable discharges of oil. In In proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 165 170. Los Angeles, CA : Washington, D.C.: American Petroleum Institute. 1985.
Keywords: review, federal, state, law, discharges, oil.

Bruce., Sutherland. G. The value of natural resource protection plans under actual spill conditions. In Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. Los Angeles, CA. 93 96. Washington, D.C.: American Petroleum Institute. 1985.
Keywords: natural resource, protection.

Bruch, Barrett. Lockheed oil spill recovery device. In In proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971. 339 356. Washington, D.C.: Washington, D.C.: American Petroleum Institute. 1971.
Keywords: lockheed, oil spill, recovery.

Bruderly, D.E. 1990. Hydrogen: The clean fuel of tomorrow is available today. In: Proceedings of the AWMA 83rd Annual Meeting, June 24 29 1990, Pittsburgh, PA, Paper N.90-141.1, 27 pp.
Key words: Crude Oil, Economic Factor, Natural Gas

Bruell, Clifford J. ,Gilbert, Craig D., Baehr, Arthur L. 1991. Non-Fickian vapor transport in sand columns contaminated with volatile organic compounds. Water Resources Investigations. 294-300.
Key Words: Soils, pollution, transport, USGS, New Jersey, Eastern U.S., United States, southeastern

New Jersey, Atlantic County New Jersey, Galloway New Jersey, oil spills, ground water, volatile organic compounds, Atlantic Coastal Plain, North America, theoretical studies, equations, non-Fickian behavior, experimental studies, physical models.

Brulle, Lt. Cdr. Robert J. and Lt. Clayton W. Evans. Evaluating the effectiveness of marine environmental protection programs: directions for development. In In proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987. 632. Baltimore, MD : Washington, D.C.: American Petroleum Institute. 1987.
Keywords: evaluating, marine, environmental, protection.

Bruney, J.M., and D.L. Trimm. 1993. Marsh recovery following an oil spill and in-situ burning. In: Proceedings of the ASLO and SWS 1993 Annu. Meet., May 30 June 3 1993, Edmonton, Albertam.
Key words: Salt Marsh, Reclamation, Oil Spills
This study examines the recovery of marsh vegetation affected by a crude oil spill and subsequent treatment by in-situ burning in a coastal marsh in the western Gulf of Mexico. Measures such as species presence, percent cover by species, biomass and weight percent oil in the sediment were used to assess the effects of varying degrees of oiling and burning on marsh vegetation. Results from the first year of monitoring show that burned areas have less oil in the sediments than unburned areas, and that although oil loss from the sediment occurs more rapidly in unburned areas, total oil in these areas remains elevated relative to burned sections. Marsh vegetation cover and biomass were reduced in oil impacted areas when compared to controls, and this impact was greatest within the burned sections. In impacted areas that retained cover, species diversity did not vary significantly from controls. Partial recovery, in terms of increased cover, was observed during the first year. It may be concluded that in-situ burning is an effective method of reducing oil loading to a marsh, that burning will significantly reduce vegetative cover in the short term, and that recovery can begin to occur within the first year following an oil spill and in-situ burn. Monitoring of the site will be continued for another year in order to more fully document recovery.

Brunhoff, F.P., Lian, E.P., Lian, L.B. 1992. Detachable Boom and Method for Its Use. 24(pp).
Key Words: Floating barrier, contamination, disconnecting, environmental pollution, oil spill, water pollution, USA, adjustability, anchoring, articulated, ballast, buoyancy, coupling (mechanical), engineering drawing, marine ecology, marine stabilization, mechanical property, ocean environment, offshore equipment, offshore technology, physical property, pollution control equipment, stabilizer

(mechanical), suspension device.

Brunk, Peter A. Use of dracone barges: a case history. In In proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. 573. San Antonio, TX : Washington, D.C.: American Petroleum Institute. 1983.
Keywords: dracone, barges.

Brunner, D. E., J. J. Der, and D. Hall. An offshore mechanized sorbent oil recovery system using vessels of opportunity. In In proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977. 251 254. New Orleans, LA : Washington, D.C.: American Petroleum Institute. 1977.
Keywords: offshore, sorbent, oil, recovery, vessels.

Bryk, M.T., and M. Yakovenko. 1987. Magnetic adsorbent based on iron-containing clay for removal of petroleum from water. Soviet Journal of Water Chemistry and Technology. 9(2):126-128.
Key words: Water Treatment, Water Pollution, Oil Spills
Treating water with oil spills necessitates the use of an oleophilic adsorbent, which must have magnetic properties to permit ready collection. Fuel oil and clay with a high content of iron oxides underwent thermal oxidation destruction to produce a uniform, black, powdery, porous hydrophobic product whose capacity for petroleum adsorption is 3. 5-4. 0 g/g. The iron oxides were reduced to ferromagnetic forms, and the magnetic susceptibility of the thermally treated composition reached a maximum after 90 min of treatment at 380 degree C. Complete restoration of the magnetic and sorption properties of the adsorbent is achievable at 350 degree C for 2 hr. 8 refs.

Bryniok, D., Troesch, W. 1989.ELISA techniques for the determination of methanogenic bacteria. Applied Microbiology and Biotechnology (F.R. Germany). 32:2:235-242. Easy-to-handle enzyme-linked immunosorbent assay (ELISA) techniques have been developed suitable for quantitative species-specific determination of very low numbers of methanogens in complex bacterial populations. The amount and the distribution of different species of methanogens in anaerobic digestors is a reflection of the functional status of the degradation process; this can be recognized with these tests and hence may be used for process control.
Key words: bioreactors, process control, anaerobic digestion, biosynthesis, control, waste management, methane.

Bubar, B.G., and J.R. Czarnecki. 1991. Response to the January 1990 Arthur Kill heating oil spill. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention,

Behavior, Control, Cleanup
Conference, March 4 7 1991, San Diego, CA, API Publication
N.4529, pp. 259 61.
Key words: Adsorbent, Animal, Boom, Containment, Pollution
Control, Skimming, Spill

Buckley, Joseph, David R. Green, and Blair Humphrey. Oil spill
cleanup with dispersants: a boomed oil
spill experiment. In In proceedings of the 1981 Oil Spill
Conference(Prevention, Behavior, Control,
Cleanup), March 2 5, 1981. 263 268. Atlanta, GA : Washington,
D.C.: American Petroleum Institute.
1981.
Keywords: oil spill, cleanup, dispersants, boomed.

Buettgenbach, L, Weiland, P. 1989. Application of different
fluidized-bed reactors and support materials
for anaerobic treatment of high strength effluents. 7. DECHEMA
annual meeting on biotechnology and
58. meeting of the European Biotechnology Federations, and joint
meeting of Society for Industry
Microbiology (SIM). 725-728.
In order to achieve efficient anaerobic degradation rates and
high methane productivities coupled with a
good process stability, a large concentration of active biomass
must be kept in the reactor even at high
liquid throughputs. In fluidized-bed reactors biomass retention
is achieved by attachment of the bacteria on
small fluidized support particles, which are retained in the
reactor due to their high settling velocity. The
large specific surface area and the fluidized state of the
support media result in high biomass
concentrations and consequently large degradation rates without
any risk for reactor clogging. Experiments
with natural and synthetic support materials in the different
reactor systems have demonstrated the
favourable fluidization properties of polyurethane (PUR)
carriers. Hence, in further studies on anaerobic
digestion only PUR carriers were used.
Key words: agricultural wastes, anaerobic digestion, bioreactors,
methane, optimization, production,
hydrocarbons, processing, management, organic compounds, organic
wastes, production.

Bugbee, Stephen L., Carl M. Walter. 1973. The Response of
macroinvertebrates to gasoline pollution in a
mountain stream. In: Proceedings of Joint Conference on
Prevention and Control of Oil Spills, March
13 15, Washington, D.C.
Key words: macroinvertebrates.

Buhite, Tom R. Cleanup of a cold weather terrestrial pipeline
spill. In In proceedings of the 1979 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup), March 19 22,
1979. 367 370. Los Angeles, CA :
Washington, D.C.: American Petroleum Institute. 1979.
Keywords: cleanup, pipeline, spill.

Buist, I., D. Mackay, S. Potter, M. Charles. 1989. Laboratory studies on the behavior and cleanup of waxy crude oil spills. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 105 13.
Key words: Additive, Boom, Crude Oil, Oil Waste, Pollution Control Equipment, Solidification, Water Pollution

Buist, I.A., and S.G. Potter. 1988. Offshore testing of booms and skimmers. In: Proceedings of the eleventh Arctic and marine oil spill program technical seminar, June 7 1988, Vancouver, Canada, pp. 229 265.
Key words: oil retention booms, performance testing, oil spills, pollution control equipment, skimmers
This paper describes offshore trials of oil spill containment and recovery equipment in conditions representative of the Grand Banks. A prime objective of the study was to find out whether the oil spill equipment currently stockpiled by the Canadian Coast Guard was suitable for use on spills of oils typical of those discovered on the Grand Banks; such oils show atypical spill behavior. Specific objectives were to investigate the sea-keeping and waxy oil containment capabilities of the Vikoma Ocean Pack and RO-BOOM, and the waxy oil recovery capabilities of the Framo ACW-400 type skimmer and the experimental Heavy Oil Skimmer. North Sea Brent crude, modified by addition of wax, was used to simulate a typical Grand Banks crude. Equipment performance was recorded on videotape and still photographs. Due to delays, weather conditions and the addition of Elastol to the slick between skimmer tests, it was not possible to draw quantitative conclusions regarding the capability of the skimmers to recover waxy crude oil spills in seas representative of Grand Banks conditions. Qualitatively, skimmers working on the oleophilic principle were ineffective in the untreated waxy oil. Both the RO-BOOM and Vikoma Ocean Pack are suited to the containment of waxy oil spills in seas representative of Grand Banks conditions, up to sea state 3-4 and at relative currents less than 0.5 m/s. Both booms were judged to be equal in terms of sea-keeping and oil retention capabilities. 7 refs., 22 figs., 2 tabs.

Buist, Ian A., et al. The development and testing of a fireproof boom. In In proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. 43 52. San Antonio, TX : Washington, D.C.: American Petroleum Institute. 1983.
Key words: development, fireproof, boom.

Buist, I.A. 1989. Disposal of spilled Hibernia crude oils and emulsions: In-situ burning and the swirlfire burner. In: Proceedings of the twelfth Arctic and marine oil spill program, June 7 9 1989, Vancouver, Canada, pp. 245-278.
Key words: Oil Burners Performance, Oil Spill Combustion, Petroleum
A study was conducted on combustion techniques for the disposal of recovered oily materials from oil spill cleanups. Small-scale tests were performed to simulate in-situ burning of Hibernia crude oils and emulsions. The oil samples were weathered by air sparging to simulate evaporative loss when spilled. The effect of weathering and emulsion water content on the ignitability, removal efficiency and removal rate of the spill was determined. In the case of the unemulsified oils, the degree of weathering had little effect on burn efficiency. Emulsion and oil removal efficiency was adversely affected by weathering and by the emulsion water content. In the second part of this study, a prototype Swirlfire oil-spill disposal burner was designed, constructed, and tested. Five oil types were used in the tests, including 2 crudes with various emulsion water content, fuel oil, and waste engine oil. The unique features of the burner include the ability to deliver 140-150% of the stoichiometric air required for combusiton, the use of 2 fuel atomization processes, and a combustion chamber that incorporates a recirculation system and swirling motion to extend retention times and encourage complete, smokeless combustion. The burner combusted water-free crude at rates of 12-13 bbl/d with no smoke, and oil/water emulsions of up to 66% water content. The other types of oil were also burned satisfactorily. A number of modifications are suggested to improve performance. 7 refs., 37 figs., 4 tabs.

Buist, I. A., W. M. Pistruzak, and D. F. Dickins. Dome petroleum's oil and gas under sea ice study. In In proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981. 183 190. Atlanta, GA : Washington, D.C.: American Petroleum Institute. 1981.
Keywords: dome petroleum, oil, gas, sea, ice.

Buist, I.A., and D.F. Dickins. 1987. Experimental spills of (Alberta Sweet Mixed Blend) crude oil in pack ice. In: Proceedings of the 1987 API - EPA U.S. Coast Guard Oil Spill Prev. Behavior Control Cleanup Conf., April 6 9 1987, Baltimore, MD, API Publ. N.4452, pp. 373-81.
Key words: Aircraft, Alberta, Canada, Concentration, Crude Oil, Monitoring, Pollution Control

Buist, I. A. and S. L. Ross. Emulsion inhibitors: a new concept in oil spill treatment. In In proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control,

Cleanup), April 6 9, 1987. 217 222.
Baltimore, MD: Washington, D.C.: American Petroleum Institute.
1987. c.
Keywords: emulsion, oil spill, treatment.

Buist, I.A. 1987. A preliminary feasibility study of in-situ burning of spreading oil slicks. In: Proceedings of the 10th Bien API et al Oil Spill, Prev, Behav, Contr, Cleanup, Conf, April 6 9 1987, Baltimore, MD, pp. 359-367.
Key words: Combustion, Crude Oil, Petroleum, Pollution Control

Buist, I.A. 1992. The application of burning to marine oil spills. In: Proceedings of the MTS '92: Global Ocean Partnership, October 19 21 1992, Washington, DC, pp. 147-152.
Key words: Pollution Control, Oil Spills, Oil Slicks
This paper presents a summary of the use of burning in response to marine oil spills. The principles, capabilities and limitations of in-situ burning are discussed as are the incentives and disincentives for its use. The technology available to use combustion to dispose of oily materials and shoreline cleanup debris is also summarized. The paper concludes that a better understanding of the environmental trade-offs involved in the application of burning to marine oil spills is the next step in advancing its use.

Bullock, P.W. 1992. Wellbore liquid recovery apparatus and method. Patent No. US 5128052920707, 9p.
Key words: Groundwater, Oil Spill, Water Pollution, Recovery

Bunkin, A.F., A.L. Surovegin. 1992. Laser remote sensing of pollution on water surfaces. In: Proceedings of the Sixteenth International Laser Radar Conference, Part 1, July 20 24 1992, Cambridge, MA, pp. 229-232.
Key words: Hydrocarbons, Remote Sensing, Oil Spills
One of the most important problems of modern environmental science is the detection and identification of various impurities in the ocean. Sources of impurities in sea water are diverse. The most common of them are accidental transport, agricultural, and oil industry spills. Once the ecological balance is disturbed, biological processes in sea water become affected, resulting in changes in chlorophyll concentrations, water turbidity, and temperature. During the last few years, the authors have created new types of lidars and arranged nearly ten aircraft and shipboard expeditions. Some aircraft expeditions dealt with terrestrial investigations. Others were devoted to oceanological research, the results of which are discussed here.
Emphasis is on the detection of phytoplankton chlorophyll and hydrocarbon in sea water.

Burback, B.L., Perry, J.J. 1993. Biodegradation and biotransformation of groundwater pollutant mixtures

by Mycobacterium vaccae. Appl. Environ. Microbiol. 59(4). pp. 1025-1029 (April 1993).
Key words: 1,2-dichloroethylene, 6 member ring, bacteria, biochemical reaction, carbon 14, composition, chromatography, benzene, concentration, dioxane, ether, halogen organic, heterocyclic, water, group.

Burger, J., and M. Gochfeld. 1992. Effects of washing fiddler crabs (Uca pugnax) following an oil spill. Environmental Pollution. 77(1):15-22.
Key words: Animal, Biomedical Technique, Chemical Cleaning

Burke, M.R. 1987. Cleanup and abatement procedures. In: Proceedings of the API Pipeline Conf, Mar 23-24, 1987, Dallas, TX, pp. 177-199.
Key words: Pipeline Leak, Environmental Impact, Soil Pollution, Water Pollution, Groundwater, Oil Spill

Burke, R.A. 1993. Possible influence of hydrogen concentration on microbial methane stable hydrogen isotopic composition. Pub. in Chemosphere, Vol. 29, No. 1-4, 55-67(Apr 1993).
Factors affecting the stable hydrogen isotopic composition (delta D) of important sources of microbial methane to the atmosphere include oxidation, methanogenic precursor (e.g., acetate vs. CO2/H2), and the delta D of the environmental water. Variations in hydrogen gas concentrations or rates of interspecies hydrogen transfer resulting from variations in organic matter degradation rates may also affect delta D-CH4. Methane produced via CO2 reduction by laboratory cultures was more D-depleted than methane produced in shallow marine sediments from CO2/H2. The dissolved hydrogen gas concentration in that laboratory culture was about 1mM; whereas, hydrogen concentrations in methane-zone sediments typically range between 10 and 100 nM. The relatively greater hydrogen isotope fractionation in the culture appears to result from the incorporation into methane of protons that are produced intracellularly from the hydrogenase-catalyzed oxidation of hydrogen gas.
Key words: hydrogen isotopes, atmospheric chemistry, hydrogen, isotopes, ratio.

Burkhardt, R., and H.Hass. 1987. Method for the isolation of pollutants in soil strata. Patent No. US 4645382870224, 6p.
Key words: Soil Pollution, Groundwater, Oil Spill, Water Pollution

Burlage, R.S., Heitzer, A., DiGrazia, P.M. 1991. Regulated bioluminescence as a tool for bioremediation process monitoring and control of bacterial cultures. Oak Ridge National Lab., TN (United States). 11.
An effective on-line monitoring technique for toxic waste bioremediation using bioluminescent

microorganisms has demonstrated great potential for the description and optimization of biological processes. The lux genes of the bacterium Vibrio Fascheri are used by this species to produce visible light. The lux genes can be genetically fused to the control region of a catabolic gene, with the result that bioluminescence is produced whenever the catabolic gene is induced. Thus the detection of light from a sample (monoculture, consortium, or bioreactor) indicates that genetic expression from a specific gene is occurring. We have used this technique to monitor biodegradation of specific contaminants from waste sites. For these studies, fusions between the lux genes and the operons for naphthalene (nah) and toluene/xylene (xyl) degradation were constructed. Strains carrying one of these fusions respond sensitively and specifically to target substrates. Bioluminescence from these cultures can be rapidly measured in a non-destructive and non-invasive manner. The potential for this technique in this and other biological systems is discussed. 7 refs., 3 figs.
Key words: bioluminescence, bioreactors, monitoring, pseudomonas, genetic engineering.

Burn, Timothy. 1993. Study shows bioremedial method works in Michigan's groundwater. Northeast Oil World. 13(4):17-18.
Key Words: Aromatic hydrocarbons, benzene, bioremediation, ethylbenzene, ground water, Michigan, oil spills, organic materials, petroleum, remediation, research, soils, toluene, United States, xylene.

Burns, D. J. 1992. QRA (quantitative risk assessment) of rigid riser systems for a tension leg platform. In: Proceedings of the 2nd Isope et al. Int Offshore & Polar Eng Conf., June 14-19, San Francisco, CA. Vol. 2, pp. 296-299.
Key words: Risk Assessment, Offshore, Oil Spills, Engineering

Verwoerd, M. 1991. Reliability data for use in offshore formal safety assessment studies. In: Proceedings of the 11th Annu Safety & Rel Soc et al. Symp, Sept 18-19, Sutton Coldfield, Engl. Pp. 90-104.
Key words: Reliability Data, Offshore Safety Assessments, Oil Spills

Burns, K. A. 1993. Evidence for the importance of including hydrocarbon oxidation products in environmental assessment studies. Marine Pollution Bulletin. 26(2):77-85.
Key words: Oil Spill, Hydrocarbon, Prince William Sound
Samples of bivalve tissue from Prince William Sound, collected as part of the assessment of the 1989 Valdez Oil Spill were extracted and separated into fractions based on polarity, by normal phase high performance liquid chromatography (HPLC). Each fraction was analysed by ultraviolet fluorescence

spectroscopy (UVF) and examined for evidence of the presence of oxidation products of aromatic
hydrocarbons (O-PAHs). Results support the contention that photo and bacterial degradation processes
create a complex assemblage of intermediate oxidation products of hydrocarbons that are bioaccumulated
in marine organisms. -from Author.

Burns, Capt. Bobby G. and Cdr. A. G. Campbell. Coast Guard environmental mission fulfilled by Navy
salvage, French frigate shoals. In In proceedings of the 1981 Oil Spill Conference(Prevention, Behavior,
Control, Cleanup), March 2 5, 1981. 233 242. Atlanta, GA : Washington, DC: American Petroleum
Institute. 1981.
Keywords: Coast Guard, environmental, Navy, salvage, French.

Burns, K., et al. Sediment chemistry studies related to the 1986 Bahia Las Minas (Panama) oil spill. In In
proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991.
701 704. San Diego, CA: Washington, D.C.: American Petroleum Institute. 1991.
Key words: sediment, chemistry, Bahia Las Minas, Panama, oil spill.

Burns, R. C., Ontario Ministry of Env, Canada. June 7-9, 1990. Cleanup and Containment of a Diesel
Fuel Spill to a Sensitive Water Body at a Remote Site Under Extreme Winter Conditions. Env Canada
Arctic & Marine Oilspill 11th Technical Sym, Vancouver. 209(12).
Key Words: Oil spill cleanup, Ontario, lakes, oil spills-refined, diesel fuel, oil booms, controlled burning,
cold environments, oil spill incidents, rural areas, Canada.

Burris, D.R., and C.P. Antworth. 1990. Potential for subsurface in-situ sorbent systems. In: Proceedings
of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection, & Restoration
Conf, October 31 November 2, 1990, Houston, TX. Ground Water Manage No:4527 538.
Keywords: sorption, soil remediation, biodegradation, in-situ, laboratory equipment, microbiology,
Mississippi, soil pollution, sorbent, water pollution

Bury, S.J., and C.A. Miller. 1993. Effect of micellar solubilization on biodegradation rates of
hydrocarbons. Environmental Science & Technology. 27(1):104-110.
Key words: Bacteria, Hydrocarbon, Biodegradation
Batch experiments were conducted with a strain of Pseudomonas aeuroginsa and a strain of Ochrobactrum
antropi, both Gram-negative bacteria, growing on aqueous solutions containing straight-chain hydrocarbons
solubilized in small micelles (2-4 nm) of nonionic surfactants. Measurements of optical density, a quantity
proportional to bacterial cell concentration, and hydrocarbon content were made as a function of time. The

results provided confirmation that solubilization greatly enhances rates of hydrocarbon degradation in these systems compared to rates observed with bulk liquid hydrocarbon in the absence of surfactants. -from Authors.

Butcher, J.C. 1992. Oil Decontamination Method and Structure. Patent No. Gr Brit 2255772a, 11pp.
Key words: solid adsorbent, adsorbent, adsorption, contamination, decontaminating, environmental pollution, float, oil spill sorbent, sorption, water pollution|, (p) Great Britain, absorption, beach, buoyancy

Butler, Brian K., Metzger, William C., Urquhart, Joanne. 1991. Fate and transport of low-concentration AVGAS plumes in a sand and gravel aquifer. Ground Water Management. 7:837-848.
Key Words: Massachusetts, pollution, ground water, environmental geology, monitoring, Barnstable County Massachusetts, New England, Eastern U.S., United States, Cape Cod, Eastern United States, AVGAS, plumes, hydrogeology, movement, aquifers, oil spills.

Butler, James N. Using oil spill dispersants on the sea. In In proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. 343 346. San Antonio, TX : Washington, D.C.: American Petroleum Institute. 1989.
Keywords: oil spill, dispersants, sea.

Butterworth Publishers. 1985. Proceedings of the 40th industrial waste conference. In: Proceedings of the annual Purdue industrial waste conference, West Lafayette, IN, USA. 40: Stoneham, MA: Butterworth Publishers. 1985.
Keywords: disposal, oil, management, biodegradation.
A total of 94 papers were presented under the following headings: coal, coke and power plant wastes; brewery and distillery wastes; meat packing and rendering wastes; mining wastes; animal wastes; paint, ink and dye wastes; land disposal; oil and gas field wastes; sludge conditioning; food wastes; pulp and paper mill wastes; dairy wastes; plating wastes; refinery wastes; metal wastes; hazardous/toxic wastes and biological systems. 7 papers have been abstracted separately.

Buttner, W. J., G. Maclay, J. R. Jordan Stetter. 1990. An integrated amperometric microsensor. Sens. Actuators B1(1 6):303 307.
Key words: Sensors

Cahill, E. J., L. R. Smith, and G. P. Haley. 1979. Penalties on oil spills with unquantified damage: the hidden tax and economic deterrent concept. In: proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979. pp. 95 98. Los

Angeles, CA:. Washington, D.C.:
American Petroleum Institute.
Keywords: penalties, oil spills, damages, tax, economic.

Cain, R.E., Jones, N.B. 1993. Lightweight, Rapid Deployment Oil Spill Containment Boom. 10.
Key Words: Floating barrier, oil spill, USA, aerial transportation, automatic control, ballast, chemical resistance, collapsible, compressed gas, contruction material, coupling (mechanical), engineering drawing, environmental pollution

Calabrese, E.J. , Kostecki, P.T. 1990. Petroleum contaminated soils. Volume 2. national conference on the environmental and public health effects of soils contaminated with petroleum products. 515(p).
Key Words: Ground water pollutants, petroleum ecological concentration, soils pollutants, health hazards, land pollution control, leading abstract, legal aspects, oil spills, pollution regulations undergrounds storage, waste disposal

Callaway, J.R., J.W. Burkholder, P.F. Olsen. 1985. An Inland oil spill control course: a need perceived and met. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, 627 - 630. Los Angeles, CA. American Petroleum Institute: Washington, D.C., pp.627 630.
Key words: oil spill, control.

Calmbacher, C.W. 1989. Occupational Safety and Health Administration (OSHA) hazardous waste operations and emergency response requirements for refineries (29 CFR 1910.120). In: Proceedings of the PETRO-SAFE '89: international exhibition and conference for environmental and safety concerns of the energy industries, October 3 5 1989, Houston, TX, pp. 661-668.
Key words: Hazardous Materials, Occupational Safety, Waste Management, Oil Spills, Regulations
The final requirements for safety procedures to be used during hazardous waste operations and emergency response actions to hazardous materials incidents were issued by the Occupational Safety and Health Administration of March 6, 1989. The criteria for coverage outlined by these regulations broadly encompasses a large group of industries and industrial activities. This paper reports that refinery activities may be covered by one or more of the activities that are cited by OSHA. Most refineries maintain an emergency response team. This team is expected to respond to hazardous material spills as well as fires. Such teams are included in the requirements of the OSHA 1910.120 regulations. Other refineries have become RCRA permitted TSD facilities or are involved in cleaning up RCRA, State, or local government defined hazardous waste sites resulting from past disposal

activities at the sites.

Camagni, Paolo, Angelo Colombo, Claudio Koechler, Nicolo Omenetto, Pan Qi, and Guglielmo Rossi.
1991. Fluorescence response of mineral oils: spectral yield vs absorption and decay time. Appl. Opt.
30(1):26-35.
Key words: Petroleum, Oil Spills, Remote Sensing

Campbell, R.P. 1990. Method and Apparatus for Remediating Contaminated Soil. Patent No. US
4927293,10 pp.
Key words: soil pollution, chemical process, chemical reaction, contamination, control, decontaminating,
oil spill, pollution control, redox reaction, soil (earth), p) USA, absorbent, air, air injection, belt, block
diagram, byproduct

Campbell, L.S. 1992. Method for Removing Oil or Hydrocarbons from Water. Patent No. US 5118425,6
pp.
Key words: oil water separation, adsorbent, asphalt, bitumen, compound, contamination, control,
environmental pollution, gilsonite, hydrocarbon compound, oil spill, physical separation, pollution
control, solid adsorbent, solid hydrocarbon

Campbell, J., J. Seif, and J. Heinz. 1988. An oil spill may spur new storage rules. Chemicalweek.
142(5):28-29.
Key words: Economic Factor, Environmental Protection, Legal Consideration

Campbell, H.W., T.R. Bridle. Sludge management by thermal conversion to fuels. Canadian Journal of
Civil Engineering. (Oct 1986): 13
disposal, oil, recovery
Low-temperature conversion of sludge to fuel appears to have considerable potential as a viable new
technology. Experimental work carried out at Environment Canada's Wastewater Technology Centre used
batch and continuous reactors to evaluate this technology at bench scale. Tests on a number of mixed raw
sludges (primary PLUS waste activated) resulted in the following yields: oil, 22 25%, char, 50 60%,
noncondensable gas, 10 12%, and reaction water, 5 12%. The impact of a number of sludge treatment
alternatives, including the conversion of sludge to oil, are discussed with respect to energy efficiency,
flexibility, and public acceptance. The future plans of Environment Canada for the development and
demonstration of sludge-to-oil technology are also discussed. (Edited author abstract) 10 refs.

Campbell., Lt. Jack A. Kemerer; MK1 Terrence McGuigan; DC1 Douglas. Cleanup and Effects of
Crude Oil and Fuel Oil Spills in Osito Canyon: A Comparison. In

Proceedings of the 1987 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup), April 6 9,
1987. in Baltimore, MD Year.
Key words: cleanup, oil spill, Osito Canyon

Canadian Coast Guard. 1989. Marine oil pollution response. Report
No. MICROLOG--90-04031, 14p.
Key words: Canada, oil spills, emergency plans, oil pollution
containment, equipment
This document outlines the responsibilities of the Canadian Coast
Guard in dealing with oil spills on the
coasts of Canada. A brief description of legislation concerning
oil spills and spill clean up is presented.
The behaviour of oil at sea is discussed, including its movement
on the surface, 'weathering' effects,
evaporation of its 'light ends' (components with a low boiling
point), dissolution of its toxic constituents,
emulsificaton, and oxidation of hydrocarbons. Canada's response
capability is outlined. Equipment is
purchased for three basic areas of operation. In order of
priority they are equipment to transfer cargos
from damaged vessels, shoreline protection and/or restoration,
and open water recovery. The document
concludes with a description of the equipment used and measures
taken in dealing with an open water spill.
Equipment includes portable inflatable booms, the FRAMO ACW-400
disc skimmer, transfer pumps, and
oil dispersants.

Canadian Petroleum Association. 1987. A field guide to muskeg
spill response. Canadian Petroleum
Association, Calgary, AB, Report No. CPA-CE03002, 77 pp.
Key words: Land Pollution, Oil Spills
This manual is intended to assist field personnel in determining
appropriate strategies for containment,
recovery and disposal of oil and salt water spills on muskeg.
Reclamation in a muskeg area could differ
from that of an upland site because of the wet cool condition of
peat soils, different plant community in the
peat, and the high acidity and low nutrient level of the soil.
The objective in selecting a response strategy
following a spill, is to select the most effective action so as
to minimize environmental impact without
compromising safety and economic considerations. The spill site
must be assessed to determine the type of
muskeg that is involved, its drainage patterns, and location of
any surface water in the area. The next step
is to contain the spill immediately to stop further oil
migration, reduce the amount of containment
equipment required, and minimize recovery and cleanup costs. One
of the major cleanup problems in
muskeg results from the fact that oil becomes trapped in voids or
between organic layers, and can be
difficult to remove and recover. It may be necessary to employ
methods such as stripping, burning and
manual removal. Salt water, or brine spills are becoming more
frequent in forested areas. Brine spreads

more, both horizontally and vertically, in muskeg than does oil. It mixes with water and being heavier than fresh water tends to sink quickly. The faster the spill recovery, the lower the risk of tree loss and loss of ground cover. A prompt spill response and recovery also means less contaminated water for disposal. Brine pumped from the muskeg can be placed in the storage pit to allow solids to settle, and to remove floating organic debris by skimming. 18 figs., 5 tabs.

Canadian Petroleum Association. 1990. Canadian firms to improve oil spill response. Oil & Gas Journal 88(51):22.
Key words: Association, Business Operation, Containment, Economic Factor, Environmental Protection, Pollutoin Control

Canelas, L. D., and J. D. CAlejo Monteiro. 1977. Some studies of an oil spillage due to the Jacob Maersk Accident. In: proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, pp. 281 288. New Orleans, LA: Washington, D.C.: American Petroleum Institute.
Keywords: oil spillage, Jacob Maersk.

Canevari, Gerard P., Jan Bock, and Max Robbins. 1989. Improved dispersant based on microemulsion technology. In: proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. pp. 317 320. San Antonio, TX: Washington, D.C.: American Petroleum Institute.
Key words: dispersant, microemulsion.

Canevari, Gerard P. 1985. The effect of crude oil composition on dispersant performance. In: proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. pp. 441 444. Los Angeles, CA : Washington, D.C.: American Petroleum Institute. 1985.
Keywords: oil, dispersant, performance.

Canevari, Gerard P. The restoration of oiled shorelines by the proper use of chemical dispersants. In In proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979. 443 446. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1979.
Keywords: restoration, oiled, shorelines, chemical, dispersants.

Canevari, Gerard P. A review of the utility of self-mixing dispersants in recent years. In In proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975. 337 342. San Francisco, CA : Washington, D.C.: American Petroleum Institute. 1975.
Keywords: review, dispersants.

Canevari, Gerard P. General Dispersant Theory. In In proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, 1969. 171 178. New York, NY: Washington, D.C.: American Petroleum Institute. 1969.
Keywords - dispersant.

Canevari, Gerard P. Development of the Next Generation Chemical Dispersants. In In proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973. 231 240. Washington, D.C. : Washington, D.C.: American Petroleum Institute. 1973.
Keywords: chemical, dispersant.

Canevari, Gerard P. Oil spill dispersants: current status and future outlook. In In proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971. 263 270. Washington, D.C.: Washington, D.C.: American Petroleum Institute. 1971.
Keywords: oil spill, dispersant.

Canevari, Gerard P. Some recent observations regarding the unique characteristics and effectiveness of self-mix chemical dispersants. In In proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977. 387 390. New Orleans, LA : Washington, D.C.: American Petroleum Institute. 1977.
Keywords: chemical, dispersants.

Canevari, Gerard P. 1987. Basic study reveals how different crude oils influence dispersant performance. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), Baltimore, MD. American Petroleum Institute: Washington, D.C. pp. 293 296.
Key words: oils, dispersants.

Canevari., H. M., R.H. Brown; Gerard P. Goodman. 1987. Where Has All The Oil Gone? Dispersed Oil Detection in the Wave Basin and at Sea. In Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, MD
Key words: dispersed, oil, detection, wave basin, sea

Canning, S.P. 1990. (ASTM) American Society for testing and Materials Standards on hazardous substances and oil spill response. Canning, S.P. ASTM (American Society for Testing and Materials) Standards on Hazardous substances and oil spill response. 0(0).
Key words: Water Pollution
Emergency response personnel, federal and local government officials, oil company representatives, shippers and transporters, manufacturers and suppliers of equipment and chemicals for response action, and environmentalists will find this book to be an outstanding technical resource. It provides thirty-three

standards such as methods for testing full-scale advancing oil spill removal devices, spill control barrier membrane materials and spill control barrier tension members, and methods for testing sorbent performance. Seventeen of the guides outline uses of chemical dispersants, while others cover oil water separation systems, the incineration of oil spill wastes, skimmer performance, and the use of aqueous foams to control the vapor hazard. The ASTM Committee F-20 on Hazardous Substances and Oil Spill Response has created this manual. Technical illustrations, tables, additional references, and maps are included.

Canutt, F.G. 1992. Adjustable floating pumping system. Patent No. US 5078213920107, 6p.
Key words: Pollution Control Equipment, Groundwater, Oil Spill, Environmental Pollution, Soil Pollution, Water Pollution

Caplan, J.A., E.K. Schmitt, and D.R. Malone. 1992. Apparatus for bioremediation of sites contaminated with hazardous substances. Patent No. US 5080782920114, 12 pp.
Keywords: biodegradation, bioremediation, oil recovery, oil spill, pollution control, recycling, soil pollution, tank

Cappel, F., D. Hankel, H. Meiler, and F. Rosenstock. 1990. Process of dressing contaminates soils. Patent US 4969775901113.
Keywords: soil remediation, bacteria, biodegradation, disposal, oil spill, waste disposal

Capt. David Zawadski, Lt. Jeffrey D. Steib, Cdr. Stewart McGee, Jr. 1987. Considerations for dispersant use: tank vessel Puerto Rican incident. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: dispersant, tank vessel.

Capuano, R.M., and C.W. Kreitler. 1989. Chemical controls on subsurface degradation of wastes disposed of by deep well injection. In: Proceedings of the U.S. Environ Protect Agency et al class I & II Injection Well Technol Int Symp, May 8 11, 1989, Dallas, TX. pp. 345 355.
Keywords: waste disposal, biodegradation, disposal, bacteria, soil pollution, Texas, water pollution

Capuzzo, J.M. 1987. Ecological and human health concerns in ocean disposal of wastes. Mar. Pollut. Bull. 18(3):107 109.
Key words: ocean, biodegradation, water pollution
Environmental and human health concerns with waste disposal in the ocean include: 1. uptake and accumulation of pathogenic organisms and chemical contaminants in marine resources destined for human

consumption; 2. toxic effects of chemical contaminants on the survival and reproduction of marine organisms and the resulting impact on marine ecosystems; and 3. the release of biodegradable organic matter and nutrients, which under quiescent conditions may result in localized eutrophication, organic enrichment, and oxygen depletion.

Carbeneau, R. J. and J. W. Weaver. 1992. Modeling contaminant transport through subsurface systems, 1992. Journal of Hazardous Materials 32:293-311.
Key words: Pollutants, Oil Spills, Subsurface Transport, Waste Disposal
Modeling of contaminant transport through soil to groundwater to a receptor requires that consideration be given to the many processes which control the transport and fate of chemical constituents in the subsurface environment. These processes include volatilization, degradation, sorption and multiphase partitioning, leaching, advection and dispersion. Mathematical models for simulation of these processes may require significant data inputs. The paper reviews the important factors involved in modeling of subsurface transport as well as the data requerements and uncertainties. An application of a hydrocarbon spill screening model is presented.

Carberry, T.K. 1990. Soil and groundwater remediation system. Patent No. US 4966654901030, 8p.
Key words: Groundwater, Oil Spill, Pollution Control, Water Pollution, Soil Pollution

Carberry, J.B., and T.M. Benzing. 1991. Peroxide pre-oxidation of recalcitrant toxic waste to enhance biodegradation. Water Science and Technology. 23(1-3):367 376.
Key words: soil pollution, biodegradation, water pollution, disposal
Land disposal is required for industrial chemicals which are not readily biodegraded. Such compounds lead to adverse effects on the environment if they escape containment. Recalcitrant and persistent hydrocarbons and chlorinated chemicals are inherently resistant to any degree of biodegradation and cause a growing threat to underground aquifer quality. Hydrogen peroxide is a potentially economical method of pre-oxidation utilized to enhance the biodegradation of persistent and recalcitrant organics in contaminated soil systems. This pre-oxidation technology was examined in a laboratory respirometer using three model toxic organic chemicals: toluene, trichloroethylene and pentachlorophenol. Microbial cultures were selected from contaminated sites for the degradation of each model organic chemical. The rate at which the microbes degraded the organic chemicals in unoxidized aqueous systems was compared to the rate of degradation in peroxide pre-oxidized aqueous systems. Results indicated that pre-oxidation enhanced the

biodegradation of trichloroethylene and pentachlorophenol. Toluene, in contrast, was not significantly oxidized by pretreatment with hydrogen peroxide, and its biodegradation rate was not enhanced by the oxidation pre-treatment process. (Author abstract) 33 refs.

Card, J.C., and J.A. Meehan. 1991. Response to the American Trader oil spill. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp. 305 11.
Key words: Adsorbent, Alaska, Arctic, Crude Oil, Environmental Protection, Oil Waste, Pollution Control

Card, Lt. Cdr. J. C., P. V. Ponce, and Lt. Cdr. W. D. Snider. 1975. Tankship accidents and resulting oil outflows, 1969 1973. In: proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA. pp. 205 214. Washington, D.C.: American Petroleum Institute.
Keywords: tankship, oil, outflows.

Carpenter, A. D., R. G. Dragnich, and M. T. Smith. 1991. Marine operations and logistics during the Exxon Valdez oil spill cleanup. In proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991., San Diego, CA, pp. 205 212. Washington, D.C.: American Petroleum Institute.
Keywords: Marine, Exxon Valdez, oil spill, cleanup.

Carr, R.E., and D. Michaelis. 1993. Pollutant Containment Boom. Pct. Gaz. 1993(4):1558.
Key Words: Floating barrier, containment, contamination, environmental pollution, inflatable, oil spill, pollution control equipment, water pollution, buoy, membrane, mounting offshore structure, suspension device.

Carr, J.E., E.B. Chase, R.W. Paulson, D.W. Moody. 1990. National Water Summary 1987: Hydrologic events and water supply and use. Annual report. Geological Survey, Reston, VA (USA). Water Resources Div. 568 (p).
Key Words: USA water resources, agriculture, floods, forecasting, hydrology, industry, meteorology, oils spills, population dynamics, progress report, Puerto Rico, regulations, seasons, Trust Territory of the Pacific Islands

Carr, R.E., and D. Michaelis. Sea deployed oil-pollutant inflatable containment boom, includes floating boom, tubular member with one-way valves, cable members, and membrane member. Patent No. GB 9115948_910724.
Key words: Boom, Pollution Control, Saline Water

Carr, Robert Scott, Jerry M. Neff, and Paul D. Boehm. 1985. Large-scale continuous flow exposure systems for studying the fate and effects of chemically and physically dispersed oil on benthic marine communities. In: proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, pp. 64, . Los Angeles, CA . Washington, D.C.: American Petroleum Institute.
Keywords: exposure, chemically, dispersed, oil, benthic, marine.

Carrier, G., F. Fendell, and J. Mitchell. 1992. In situ burning via towed boom of oil spilled at sea.
Combustion & Flame. 90(3/4):295-306.
Key words: Combustion, Oil Spills
Operational guidance for the efficient use of combustion in the cleanup of a surface oil film, formed as a result of a spill at sea, is sought by approximate analysis. In remediation by burning, the spilled oil itself provides the energy for its cleanup. Attention is focused on situations holding relatively far from the source of the spill and/or relatively long after the spill: the oil is taken to have so dispersed that the thickness of the film is on the order of a few millimeters. Under such conditions, the oil film is unlikely to burn without the use of multiple towed booms, each boom spreading its already-ignited, localized fire to continuously collected, previously unignited portions of the oil film. A simple, quasisteady, two-dimensional analysis suggests efficient values of the two speed and the tow-line length as functions of such parameters as the oil density, oil-film thickness, oil burn/evaporation rate, etc. The analysis leads to specific suggestions for apparently unreported laboratory experiments that may be informative prior to at-sea operation. (A)

Carter, J.A., and C.D.R. Macgregor. 1989. An evaluation of the methodology used for shipboard monitoring of oil spills. Oil Chem Pollut. 5(1):47-63.
Key words: Oil Spill, Contamination, Oil Waste

Carter., R. Glenn Ford, Gary W. Page, Harry R. 1987. Estimating mortality of seabirds from oil spills.
In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: estimating, mortality, seabirds, oil spills.

Carven, Christopher J. Oil spill liability and compensation. In: proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979. 7 10. Los Angeles, CA:
Washington, D.C.: American Petroleum Institute. 1979.
Keywords: oil spill, liability, compensation.

Case, C.W. Update on aboveground and underground storage tank regulations. In Pennwell Conf &

Exhibit Co Petro-safe 92 Conf (Houston, 1/27 29/92) in Year.
Key words: oil, disposal, tank, oil spill

Cassaday, J.W. 1992. Inflatable Anti-Pollution Boom. 7(pp).
Key Words: Floating barrier, ballast, barrier, contamination, environmental pollution, oil spill, water pollution, Great Britain

Castellucci, Robert E. 1981. The Naval facilities engineering command's oil spill response program. In proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981. 99 102, Atlanta, GA. Washington, D.C.: American Petroleum Institute.
Keywords: Naval, oil spill, response.

Castle, R.W., E.H. Owens, and J.D. Sartor. 1991. Oil spill contingency planning in tropical areas. In: Proceedings of the SPE Asia Pacific conference, November 4 7 1991. Tokyo, Japan, pp. 685-692.
Key words: Oil Spill Planning, Tropical Regions
This paper reports that oil spills can result in significant environmental damages, particularly in highly sensitive and poorly accessible tropical regions. The overall effects of spills can, however, be significantly reduced through proper prespill planning. In addition to facilitating effective response prior to the incident becoming too large to manage, such planning reduces the potential for misapplication of technologies and resultant unnecessary damage. Planning concepts discussed include development of realistic planning objectives (probable spill scenarios), spill trajectory and fate modeling, identification of sensitive areas, interpretation of persistence and impacts, and identification of environmentally acceptable response technologies. procedures for environmental data collection and information handling are also addressed.

Castle, R. W., C. R. Foget, and M. A. Cramer. 1983. Underground gasoline spill recovery: a blending of science and engineering. In: proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. 575pp. San Antonio, TX. Washington, D.C.: American Petroleum Institute.
Keywords: gasoline, spill, recovery, engineering.

Castle, Robert W. and Eric Schrier. 1979. Decision criteria for the chemical dispersion of oil spills. In: proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, pp. 459 464, Los Angeles, CA. Washington, D.C.: American Petroleum Institute.
Keywords: criteria, chemical, dispersion, oil spills.

Catoe, Clarence E. 1971. Remote sensing of controlled oil spills. In: proceedings of Joint Conference on

Prevention and Control of Oil Spills, June 15 17, pp. 71 84, Washington, D.C.. Washington, D.C.:
American Petroleum Institute.
Keywords: remote sensing, oil spills.

Catt, Pauline. 1992. Digitised air photography for high resolution studies on coral reefs. Australasian Remote Sensing 6th Conf Proc, Wellington, NZ. 1:1-366(4).
Key words: Remote Sensing, Coral Reefs, Australia, Satellite
Remote sensing can provide critical information on biophysical and environmental stresses on the Great Barrier Reef off the coast of Australia. Satellite imagery gives wide coverage but lacks good spatial and temporal resolution. Aerial photos are widely used but cannot be processed using digital image processing techniques. The use of digitized, large-scale air photos to detect and map small area changes in reef features is proving successful. The importance of scanning resolution to maximize the data obtained is emphasized. The dynamic range can be increased by careful consideration of scale and output resolution required.

Cava, F. M. 1989. Information technology: A key to effective marine sanctuary management. In: Proceedings of the 6th Amer. Soc. Civil Eng. et al. Coastal & Ocean Manage. Symp. (Coastal Zone '89), July 7 11, Charleston, SC, Proc. 4.
Key words: Oil Spills, Water Pollution, Contingency Planning, Channel Island

Ceaser, A.V. 1988. Oil spill absorbent material US Patent-4780518. October 25 1988.
Official Gazette of the United States Patent and Trademark Office Patents.

Cecamore, P., A. Ciappa and V. Perusini. 1992. Monitoring the oil spill following the wreck of the tanker Haven in the Gulf of Genoa through satellite remote sensing techniques.In: Proceedings of the 1st Thematic Conference on Remote Sensing for Marine and Coastal Environments, June 15 17, New Orleans, LA. Proc. Spie. International Society for Optical Engineering. 1930(1):183 189.
Key words: Monitoring, Oil Spills, Water Pollution, Landsat TM, Mediterranean Sea
In recent years several efforts have been spent in order to apply remote sensing techniques in the monitoring of hazardous events occurring in the marine environment. This paper is focused upon the oil spill event that occurred in the Mediterranean Sea (Gulf of Genoa), in April, 1991. Satellite remote sensed data supplied by Landsat TM, SPOT-HRV sensors allowed to indentificate and locate the oil spilled and the sequence of the sea surface thermal structures from NOAA-AVHRR furnished further information to indentificate the transient circulation during the event. These

indications, along with ancillary data (meterolological data, climatological currents, in-situ observations) were collected and integrated in a GIS to supply an overview of the event. Furthermore an on-scene oil spill model (by courtesy of NOAA/HAZMAT, Seattle) was used to forecast the movement of the oil in the emergency phase, and to hindcast the evolution of the event with a better accuracty during the post-analysis phase.

Cecamore, P., A. Ciappa, and V. Perusini. 1992. Remote sensing monitoring and hindcasting of the accident occurred to the tanker haven in the gulf of Genoa (Italy). In: Esa, Environment Observation and Climate Modelling Through International Space Projects. Volume 2: Remote Sensing for Environmental Monitoring and Resource Management pp. 715 718.

Cerkirge, H.M., A.H. Al-Rabeh, and N. Gunay. 1992. Use of three generations of oil spill models during the Gulf War oil spills. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar, June 10 12 1992, Edmonton, Canada, pp. 93-105.
Key words: Persian Gulf, Oil Spill Simulation
During the January-May 1991 Gulf War, an estimated 6 million bbl of oil was spilled into the Arabian Gulf, mostly around Mina Al-Ahmadi in southern Kuwait. Three models were used to analyze the fate and transport of the spills originating at Al-Ahmadi. The first generation model, GULFSLIK I, was developed in the late 1970s and predicts the movements of a spill by considering that the center of the slick advects with a velocity equal to 3% of the wind speed. This model is best for the initial forecasting of oil spill movement. The second generation GULFSLIK II Model predicts the trajectory of spills at 24 h intervals, requiring as input the average daily wind velocity. Surface currents are obtained for the model from a reliable 3-dimensional hydrodynamic model of the Gulf coupled with an appropriate interpolation scheme. Comparisons between predicted spill trajectories and actual sightings show GULFSLIK II to be reasonably accurate. The third generation model, called OILPOL, consists of a set of algorithms describing the processes of advection, turbulent diffusion, surface spreading, vertical mechanical dispersion, emulsification, and evaporation. After 80 days, results show under 8% of the initial oil volume remains on the sea surface while 15% is suspended in the water column or sedimented on the sea bed. Comparisons of simulation results and actual sightings show excellent agreement. 4 refs., 7 figs., 2 tabs.

Cerniglia, Carl E. 1992. Biodegradation of polycyclic aromatic hydrocarbons. Biodegradation. 3(2-3):351-368.
Key words: Degradation, Hydrocarbon, Biodegradation,

Microorganism, Bacteria
Recent information is presented and reviewed on the general principles involved in the microbial degradation of PAHs. Generally, the rate of degradation of PAHs is inversely proportional to the number of rings in the PAH molecule: lower weight PAHs are biodegraded more readily than the higher weight compounds. Data are presented on the PAHs oxidized by various bacterial species; PAHs oxidized by various fungal and algal species; the pathways for the microbial catabolism of PAHs; and the various metabolites produced from PAHs by fungi, bacteria, and algae. Futher research is needed to isolate and characterize microorganisms capable of mineralizing more recalcitrant PAHs and complex PAH mixtures.

Cerniglia, C.E., Heitkamp, M.A. 1990. Polycyclic aromatic hydrocarbon degradation by Mycobacterium. Methods in Enzymology. 188: 148-153.
Key words: Polycyclic aromatic compound, pyrene, mineralization, enzymatic reaction, oxidation, mycobacterium, characterization, isolation, biodegradation, metabolism, microorganism culture, hydrocarbon.

Cerniglia, Carl E. 1993. Oxidative biodegradation pathways of PAHs. In: Proceedings of the Symposium on Bioremediation and Bioprocessing presented at the 205th National Meeting of the American Chemical Society, Denver, CO, p. 245.
Key words: hydrocarbons, biodegradation, bacteria
Polycyclic aromatic hydrocarbons (PAHs) constitute a class of hazardous organic chemical consisting of three or more fused benzene rings in linear, angular and cluster arrangements. PAHs mostly occur as a result of fossil fuel combustion, as by-products of industrial processing, and during the cooking of foods. A catabolically diverse microbial community, consisting of bacteria, fungi and algae, metabolizes aromatic compounds. Molecular oxygen is essential for the initial hydroxylation of polycyclic aromatic hydrocarbons by microorganisms. In contrast to bacteria, filamentous fungi use hydroxylation as a prelude to detoxification rather than to catabolism and assimilation. The biochemical principles underlying the degradation of polycyclic aromatic hydrocarbons will be presented in some detail. The oxidative pathways of polycyclic aromatic hydrocarbon catabolism will be discussed. Studies will be presented on the relationship between the chemical structure of the polycyclic aromatic hydrocarbon and the rate of polycyclic aromatic hydrocarbon biodegradation in aquatic and terrestrial ecosystems. (Author abstract).

Cerniglia, C.E., Heitkamp, M.A. 1991. Microbial degradation of polycyclic aromatic hydrocarbons (PAH) in the aquatic environment. Varanasi, U. 1991. Metabolism

of polycyclic aromatic hydrocarbons
in the aquatic environment. CRC Press, Inc. 41-68:341.
Due to their hydrophobic properties and limited water solubility,
PAH tend to adsorb to particulates and
eventually migrate to the sediments in river, lake, estuarine,
and marine waters. The PAH levels ranged
from 5 parts per billion (ppb) for an undeveloped area in Alaska
to 1,790,000 ppb for an oil refinery
outfall in Southampton, England. Sediments from other
industrialized areas ranged from 198 to 232,000
ppb. A variety of processes including volatilization, adsorption,
chemical oxidation, photodecomposition,
and biodegradation are important mechanisms for environmental
loss of PAH. In reviewing the literature,
some general statements can be made about the present knowledge
of the microbial degradation of PAH:
(1) a wide variety of bacteria, fungi, and algae have the ability
to metabolize PAH; (2) hydroxylation of
unsubstituted PAH always involves the incorporation of molecular
oxygen; (3) PAH with more than three
condensed benzene rings do not serve as substrates for microbial
growth; (4) fungi hydroxylate PAH as a
prelude to detoxification, whereas bacteria oxidize PAH as a
prelude to ring fission and assimilation; (5)
lower weight PAH such as naphthalene degrade rapidly, while
higher weight PAH such as
benz(a)anthracene or benzo(a)pyrene are quite resistant to
microbial attack; (6) most rapid biodegradation
of PAH occurs at the water/sediment interface and degradation
rates can be influenced by environmental
factors; and (7) microbial adaptations can occur from chronic
exposure to PAH. 114 refs., 11 figs., 3 tabs.
Key words: polycyclic aromatic hydrocarbons, biodegradation,
contamination, algae, sediment, molecular
weight, bacteria.

CH2M Hill Inc. 1988. Electric utilities can assess exposure
levels associated with chemical spills. Environ.
Sci. Technol. 22(5):479.
Key words: Benzene Ring, Chlorohydrocarbon, Pollution Control

Chaconas, J.D.J., S.S Huismann, and R.W. Hunter. 1993. A lesson
in site management and cleanup: the
Bishop tank farm remediation. In: Proceedings of the SPE West Reg
Mtg, May 26 28, 1993, Anchorage,
AK, pp. 47 57.
Keywords: biodegradation, bioremediation, California,
environmental impact, legal consideration, soil
remediation tank

Challenor, P.G. 1988. The future role of satellites. In:
Proceedings of the INST Petrol Remote Sensing of
Oil Slicks Mtg, May 17 18 1988, London, England, Pap; Quart J
Tech Pap (INST Petrol), pp. 31-40.
Key words: Man Made Satellite, Oil Spill, Remote Sensing

Chamberlain, Gary. 1989. Technology Tackles the Oil Spill. Design

News. June 1989:90-96.
Several systems deployed in response to the 10 million gal of oil spilled off the coast of Valdez, AK, by the Exxon Valdez tanker on March 24, 1989, helped officials keep track of the spill's spread. In addition, oil containment equipment and absorbent materials, some used for the first time, were tested under real spill conditions. A USCG aircraft provided the daily surveillance of the spill, using a side-looking airborne radar; these images became the primary tools for monitoring the extent of the spill. A computer mapping system combined data from the flyovers, sampling station instruments, and individual sitings to document the movement and location of polluted waters. A new containment boom developed by Minnesota Mining & Mfg. Co. survived several days of continuous booms, while others performing the same task were destroyed. Full text available from Congressional Information Service.
1 diagram(s), 1 map(s), 6 photo(s).
Key words: oil spill incidents, oil spill cleanu, oil spill detection, oil spill analysis, oil spills-tanker, Alaska, marine pollution equipment, computer applications, radar, aerial surveillance, controlled burning, oil booms

Chamberlain, D.W., J. Lindstedt-Siva, E.R. Mancini, R.A. Levine, and J.A. Miller. 1987. The ARCO Anchorage oil spill: a review. In: Proceedings of the tenth Arctic and Marine Oil spill Program Technical Seminar, June 9, 1987, Edmonton, Canada, pp. 385 396.
Key words: oil pollution containment, oil spills, biological effects, environmental effects
On 21 December 1985 the oil tanker ARCO Anchorage grounded in Port Angeles Harbor, Washington, USA, spilling 5,690 barrels of Prudhoe bay crude oil. Oil eventually spread east and west of Port Angeles Harbor. The heaviest occurred on the outer edge of Dungeness Spit, a National Wildlife Refuge. About 2,000 seabirds were oiled. Spill response included setting up oiled bird collection stations, an oiled bird cleaning and rehabilitation center, the use of conventional skimmers, booms and sorbents, etc., inshore and open water cleanup. Unique problems encountered included cleaning of bundles of oiled logs and contaminated shore sediments involving the invention of special cleaning methods and equipment. A filed screening procedure for the analysis of crude oil in beach sediments was developed. Monitoring the fate and effects of the spilled oil began immediatley following the spill and is continuing. Results of beach sediment agitation for crude oil removal demonstate a significant reduction of oil concentrations in affected sediments. Elevated tissue levels of hydrocarbons in affected inverterbrates oiled by the spill also show a decrease since the event. Elevated levels of petrogenic hydrocarbons in captive fish exposed to the spill

were not observed. 8 refs., 4 figs.

Chambers, Lt. Barry E. and LCDR Hugh D. Williams. 1975. Utilization of diving and salvage expertise in the prevention of oil pollution. In: proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, pp. 369 372, San Francisco, CA. Washington, D.C.: American Petroleum Institute.
Keywords: salvage, prevention, oil, pollution.

Chan, Elaine I. 1977. Oil pollution and tropical littoral communities: biological effects of the 1975 Florida Keys oil spill. In proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, pp. 539 542. New Orleans, LA. Washington, D.C.: American Petroleum Institute.
Keywords: oil, pollution, tropical, littoral, biological, Florida Keys, oil spill.

Chan, Gordon L. 1973. A study of the effects of the San Francisco oil spill on marine organisms. In: proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C. , pp. 741 782. Washington, D.C.: American Petroleum Institute.
Keywords: San Francisco, oil spill, marine.

Chan, Gordon L. 1975. A study of the effects of the San Francisco oil spill on marine life, Part II: recruitment. In: proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, pp. 457 462, San Francisco, CA. Washington, D.C.: American Petroleum Institute.
Keywords: San Fransico, oil spill, marine life.

Chan, Gordon L. 1977. The five-year recruitment of marine life after the 1971 San Francisco oil spill. In proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, pp. 543 546, New Orleans, LA. Washington, D.C.: American Petroleum Institute.
Keywords: marine life, San Francisco, oil spill.

Chang, C.C., and P.B. Bedient. 1991. Multiphase unsaturated zone flow and transport model for ground water contamination by hydrocarbon. In: Proceedings of the Nat Water Well Ass & API Petrol Hydrocarbons & Org Chem in Ground Water: Prev, Detection, & Restoration Conf, November 20-22, 1991, Houston, TX, pp. 515-529.
Key words: Water Pollution, Contamination, Groundwater, Oil Spill

Chang, Fu-Hsian, Hai Wang, Brenda Denzin,and Julie Buller. 1991. Kinetics of crude-oil biodegradation by bacteria indigenous to sediment and ground water. Water-Resources Investigations. pp. 646-649.

Key Words: Minnesota, pollution, ground water, environmental geology, oil spills, biodegradation, USGS, Midwest, United States, North-Central Minnesota, Bemidji, Minnesota, Beltrami County, Minnesota, aquifers, sediments, microorganisms, bacteria, kinetics, rates, theoretical studies.

Chang, Chi-Chung, Wise, William R., Klopp, Rick A., Bedient, Philip B. 1990. In-situ source release mechanism study at an aviation gasoline spill site; Traverse City, Michigan. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:459-473.
Key Words: Michigan, ground water, environmental geology, pollution, surveys, Grand Traverse County Michigan, Midwest, United States, Traverse City Michigan, Michigan Lower Peninsula, central Michigan, oil spills, in situ, sampling, infiltration, experimental studies.

Chang, Fu-Hsian, Nancy N. Noben, Danny Brand, Marc F. Hult. 1988. Microbial degradation of crude oil and some model hydrocarbons. Open-File Report (United States Geological Survey. 1978). C33-C42.
Key Words: Pollution, experimental studies, decontamination, Beltrami County Minnesota, USGS, Minnesota, Midwest, United States, northwestern Minnesota, Bemidji Minnesota, oil spills, ground water, aquifers, crude oil, hydrocarbons, organic materials, biodegradation, microorganisms, carbon, carbon dioxide

Chang, Myungkeun, Voice, T.C., Criddle, C.S. 1993. Kinetics of competitive inhibition and cometabolism in the biodegradation of benzene, toluene, and p-xylene by two Pseudomonas isolates. Biotechnology and Bioengineering (United States). 41:11:1057-1065.
Two Pseudomonas species (designated strains B1 and X1) were isolated from an aerobic pilot-scale fluidized-bed reactor treating groundwater containing benzene, toluene, and p-xylene (BTX). Strain B1 grew with benzene and toluene as the sole sources of carbon and energy, and it cometabolized p-xylene in the presence of toluene. Strain X1 grew on toluene and p-xylene, but not benzene. In single substrate experiments, the appearance of biomass lagged the consumption of growth substrates, suggesting that substrate uptake may not be growth-rate limiting for these substrates. Batch tests using paired substrates (BT, TX, or BX) revealed competitive inhibition and cometabolic degradation patterns. Competitive inhibition was modeled by adding a competitive inhibition term to the Monod expression. Cometabolic transformation of nongrowth substrate (p-xylene) by strain B1 was quantified by coupling xylene

transformation to consumption of growth substrate (toluene) during growth and to loss of biomass during the decay phase. Coupling was achieved by defining two transformation capacity terms for the cometabolizing culture: one that relates consumption of biomass to the consumption of nongrowth substrate. Cometabolism increased decay rates, and the observed yield for strain B1 decreased in the presence of p-xylene.
Key words: benzene, biodegradation, pseudomonas, growth, toluene, xylenes, aerobic condition, bioreactors.

Chang, Chi-Chung. 1991. Multiphase unsaturated zone contaminant transport model for source term definition in ground water. Thesis, Rice University, Houston, TX.
Key Words: Pollution, ground water, unsaturated zone, movement, models, simulation, equations, finite difference analysis, statistical analysis, solutes, advection, dispersion, one-dimensional models, MUCT, OILENS, Michigan, Midwest, United States, Traverse City, Michigan, oil spills, organic materials, infiltration.

Chansky, Steven, et al. Waste Automotive Lubricating Oil Reuse as a Fuel. In Washington Environmental Research Center, D.C., 218p. Sep 74.Socioeconomic environmental studies series.
Key words: waste oil, disposal, environmental impacts
This study evaluates the technical, economic and environmental feasibility of automotive waste oil reuse as a fuel. The supply and potential marketability of waste oil fuel is considered in relationship to existing and projected fossil fuel usage in the United States. Moreover, its use will alleviate a serious waste oil disposal problem. The physical and chemical properties of waste oil are presented and serve as the basis for subsequent assessment of waste oil usage options. Options considered are the use of untreated waste oil as a blended fuel oil or as a supplement to coal combustion and the use of waste oil following treatment to alleviate technical and environmental impacts. Various treatment methods are discussed and their cost and effectiveness assessed. The reduction of environmental impacts by the use of particulate emission control system and industrial utilization of fuel and control equipment.

Chapatwala, K.D., G.R.V. Babu, and M.S. Nawaz. 1992. Degradation of acetonitrile and biphenyl compounds by a mixed microbial culture. Environ. Toxicol. Chem. 11(8):1145 1151.
Key words: biodegradation, microorganisms, pollution, PCB
A mixed microbial culture was isolated from an environment contaminated with organic cyanides and polychlorinated biphenyls (PCBs). This mixed culture could utilize acetonitrile as the sole source of carbon and nitrogen, and biphenyl as the sole source of carbon. This

mixed culture also utilized nitriles, their respective amides, and several PCBs as growth substrates. Studies involving the radiolabeled compounds indicated that nearly 70% of C14 acetonitrile and 51% of C14 biphenyl were recovered as $^{14}CO_2$. The end products resulted during the degradation of acetonitrile and biphenyl were identified as ammonia and benzoate, respectively. The mixed culture that can degrade biphenyl loses its capability when transferred repeated into a medium supplemented with acetonitrile as growth substrate. The application of mixed rather than pure microbial culture is more effective in bioremediation of toxic chemicals.

Chapman, Brian R. 1981. Effects of the IXTOC I oil spill on the Texas shorebird population. In: proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981, Atlanta, GA, pp. 461 466. Washington, D.C.: American Petroleum Institute.
Keywords: IXTOC I, oil spill, Texas, shorebird.

Chapman, P.J., Omenn, G.S. 1988. Constructing microbial strains for degradation of halogenated aromatic hydrocarbons. Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. pp. 81-95.
Studies of the biodegradation of organic compounds have gained increased interest in the last few years as their relevance to environmental pollution and the treatment of chemical wastes has acquired a wider appreciation. This area of research, once described in some microbial physiology texts as peripheral metabolism, has become central to the author concerns about the persistence of noxious organic chemicals in the environment and to the development of rational biological approaches for their removal. Among those chemicals that prompt concern are a variety of halogenated hydrocarbons, of which the halogenated aromatic hydrocarbons represent a subcategory. In recent years it has been possible to isolate or construct in the laboratory bacteria capable of growth with some of the simpler members of this series of chemicals which have a reputation for both toxicity and persistence. This chapter will examine some of the methods that have been used to isolate and to construct bacteria capable of growing aerobically with chlorinated aromatic compounds, including hydrocarbons. They will also describe some recent work in this area of research.
Key words: genetic engineering, biodegradation, halogenated aromatic hydrocarbons, microorganisms, decomposition, organic compounds, growth, cleaning, decontamination.

Charbeneau, R. J. and J. W. Weaver. Modeling contaminant transport through subsurface systems. In:

Proceedings of the 4th Annual Symposium on Ground Water: The Problem and Some Solutions, April 2 3, Beaumont, TX. 26 pp.
Key words: Groundwater, Oil Spills
Modeling of contaminant transport through soil to groundwater to a receptor requires that consideration be given to the many processes which control the transport and fate of chemical constituents in the subsurface environment. These processes include volatilization, degradation, sorption and multiphase partitioning, leaching, advection, and dispersion. Mathematical models for simulation of these processes may require significant data inputs. The paper reviews the important factors involved in modeling of subsurface transport as well as the data requirements and uncertainties. An application of a hydrocarbon spill screening model is presented.

Charbeneau, R.J. , C.Y. Chiang, J.P. Nevin, and C.L. Klein. 1989. A two-layer model to simulate floating free product recovery: Formulation and applications. National Water Well Association, Dublin, OH (US). 698(p):333-346.
Key Words: Ground water contamination, ground water flow models, oil spills water pollution abatement, aquifers, California, computerized simulation, fluid flow, hydraulic conductivity, petroleum, energy sources, Federal Region IX

Charbeneau, R.J., C.Y. Chiang, and J.P. Nevin. 1990. Optimal free hydrocarbon recovery from a single pumping well. In: Proceedings of petroleum hydrocarbons and organic chemicals in ground water: Prevention, detection, and restoration. 664(p):161-178.
Key Words: Ground water flow models, ground water-water pollution, oil spills, water pollution abatement, California, drawdown, hydrocarbons, petroleum, water wells, energy sources, Federal Region IX, fossil fuels, hydrogen compounds, mathematical models, North America, organic compounds, oxygen compounds, pollution abatement, USA.

Charlton, Thomas J. and John M. Cunningham. 1975. Spill prevention: the SPCC approach. In: proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 187 188. Washington, D.C.: American Petroleum Institute.
Keywords: spill, prevention, SPCC.

Charter, Jr., Cdr. Daniel B. 1971. National contingency planning. In proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971, Washington, D.C., pp. 17 26. Washington, D.C.: American Petroleum Institute.
Keywords: national, contingency, planning.

Chemical Engineering. 1989. Cleaning up contaminated waste sites. <Subheading> Remediation's goal:
'Protect human health and the environment'. Chemical Engineering. 96(8):94.

Chemical Engineering. 1992. Chementator/(A survey of new CPI processes). Chemical Engineering.
99(5):17,19...27.
Key words: Aluminum Silicates, Aromatic Hydrocarbons, Biochemical Reactions, Biodegradation,
Bioremediation, Environmental Protection

Chemical Engineering. 1992. A more effective way of cutting wastewater hydrocarbons. Chemical
Engineering (International Edition). (1992): 99.
Key words: hydrocarbon, bacteria, degradation
Soluble and insoluble hydrocarbon contaminants and fine suspended solids, including viruses and bacteria,
can be removed from wastewater by a membrane adsorption process from Separation Dynamics
International Ltd. Hydrocarbon levels in wastewater can be cut to as little as 15 ppm. The key component
is Extran, a membrane module consisting of thousands of 400-.mu.m-diameter hollow cellulosic fibres,
which are resistant to degradation and can remove more than 99% of insoluble oils and 50% of soluble
hydrocarbons from wastewater.

Chen, C. T. 1992. Understanding the fate of petroleum hydrocarbons in the subsurface environment.
Journal of Chemical Education 69(5):357 361.
Key words: Groundwater Pollution, Hydrocarbons, Oil Spills, Underground Storage, Remediation
To achieve effective remediaton of subsurface petroleum hydrocarbon contamination, definite scientific
and technical knowledge of their fate after they are spilled onto the ground surface or leaked from
underground storage tanks is essential. The paper provides extensive details of the parameters that affect
the fate of petroleum products in the underground environment. These include: the character of the
subsurface environment; the composition, physical, and chemical properties of petroleum products; and the
mechanisms of their mobilization, immobilization, and transformation in the subsurface. Data on the
physical and chemical properties of soil, groundwater, and petroleum hydrocarbons are identified. The
mechanisms that affect the fate of these contaminants in the subsurface include vaporization and
condensation, diffusion, advection, dispersion, dissolution, adsoprtion, biodegradation, and abiotic
reactions, the relation between these mechanisms and the properties of soil, groundwater, and petroleum
hydrocarbons is described. The distribution of the contaminated petroleum products in the subsurface as
effected by these parameters and principles is also described.

Chen, M., C.S. Hong, B. Bush, G-Y. Rhee. 1988. Anaerobic biodegradation of polychlorinated biphenyls by bacteria from Hudson River sediments. Ecotoxicology & Env Safety. 16(2):95-105.
Key words: Biodegradation, Bacteria, Hydrocarbons, Degradation
While investigations have focused intensively on aerobic biodegradaton of PCBs, little information is available regarding the fate of these pollutants in anaerobic environments. To elucidate this fate, the biodegredation of Aroclor 1221, monochlorobiphenyls, 2,4,2,4-tetrachlorobiphenyl, and sediment PCBs by mixed, obligately anaerobic bacterial populations enriched from Hudson River sediments were studied under laboratory conditions. Degradation of PCB congeners was observed when mixed bacterial cultures were anaerobically incubated with radiolabelled monochlorobiphenyls for Aroclor 1221. With the radiolabelled monochlorobiphenyls, a significant amount of radioactivity was detected in the cell material and in the aqueous phase.

Cheremisinoff, P.N. 1989. Oil spills and oily wastes. Pollut. Eng. 21(5):88-91.
Key words: Alaska, Boom, Combustion, Flame Propagation, Oil waste, Pollution Control, Equipment, Skimmer, Oil Spill

Chianelli, R. R. 1991. Bioremediation technology development and application to the Alaskan spill. In proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991, San Diego, Ca, pp. 549 558. Washington, D.C.: American Petroleum Institute. 1991.
Keywords: bioremediation, development, application, Alaskan spill.

Chiang, C.Y., K.R. Loos, and M.C. Beltz. 1989. A real-time determination of geological/chemical properties of an aquifer by penetration testing. National Water Well Association, Dublin, OH (US). 698(p):175-189.
Key Words: Ground water chemical analysis, ground water contamination, ground water sampling, oil spills environmental transport, penetrometers field tests, aquifers, comparative evaluations, fluid flow, gas chromatography, hydraulic conductivity, petroleum, portable equipment, water pollution, chromatography, energy sources, fossil fuels, hydrogen compounds, mass transfer, measuring instruments, oxygen compounds, separation processes.

Chiang, C.Y., C.C. Stanley, L. Hekma, and G.F. Boehm. 1989. Characterization of ground water and soil conditions. National Water Well Association, Dublin, OH (US). 698(p):141-157.
Key Words: Ground water contamination, oil spills detection, soils contamination, soils pore pressure,

soils stratigraphy, California, cost benefit analysis, hydraulic conductivity, penetrometers, petroleum, site characterization, water wells, well logging, energy sources, Federal Region IX, fossil fuels, geology, hydrogen compounds measuring instruments, North America, oxygen compounds, USA.

Chikhliwala, E.D., and Y.C. Yortsos. 1988. Investigations on viscous fingering by linear and weakly nonlinear stability analysis. SPE (Society of Petroleum Engineers) Reserv. Eng.(United States). 3(4):1268-1278.
Key Words: Displacement fluids supercritical state, oil fields rock-fluid interactions, rock-fluid interactions nonlinear problems, rock-fluid interactions supercritical state, capillaries, computer calculations, distrubances, interstitial water, numerical solution, oil spills phase stability, water saturation, blood vessels, cardiovascular system, geologic deposits

Childers, Gary W. 1981. Effect of crude oil on microbial processes in marine sediments. In proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981, Atlanta, GA, pp. 731 735. Washington, D.C.: American Petroleum Institute.
Keywords: oil, microbial, marine, sediments.

Cho, J.S. 1993. Three-Dimensional Air Flow Model for Soil Venting: Superposition of Analytical Functions. Journal of Hazardous Materials. 35:31-51.
Key Words: Air flow, computerized simulation, land pollution control, water pollution abatement, three-dimensional calculations, volatile organic compounds, oil spills, fossil fuels, storage tanks, underground storage, ground water, reprints.

Cho, J. S., D.H. Kampbell, J.T. Wilson, D.C. DiGiulio. 1990. Soil Bioventing Demonstration Project.
Pub. in New Jersey Institute of Technology, Division of Continuing Education, November 1990.
Sponsored by Robert S. Kerr Environmental Research Lab., Ada, OK. 16(p).
Key Words: Biodeterioration, land pollution control, water pollution control, remedial action, volatile organic compounds, oil pollution control, aquifers, ground water, vadose wate, oil spills, leakage, site characterization, environmental transport, microorganisms, biochemistry, hydrocarbons, oxidation, soil gases, nutrients, reaction kinetics, aeration, reprints.

Cho, B.N. 1989. Isolation and characterization of naturally occurring bacteria carried TOL plasmid.
Korean Journal of Applied Microbiology and Bioengineering. 17(4).
Key words: bacteria, hydrocarbons, degradation.
Eighty-two bacterial strains have been isolated from five different soils and sewage samples by selective enrichment culture on m-toluate minimal medium. Two of these were

identified as Pseudomonas cepacia,
one as P. putida, one as Yersinia intermedia, and one as
Flavobacterium odoratum. P. cepacia37 appeared
to carry plasmid superficially similar to TOL plasmid previously
described in P. putida mt-2 and other two
plasmids from Flavobacterium odoratum and Y. intermedia larger
than that of P. putida mt-2. P. cepacia37
was sensitive to streptomycin but resistant to rifampicin. P.
cepacia37 carrying plasmid metabolizes the
hydrocarbons to benzoate and toluates via the corresponding
alcohols and aldehydes. By the curing
experiment, it appears that P. cepacia37 carries TOL plasmid
encoding for the enzymes responsible for the
catabolism of toluene and xylene via benzoate and the toluates
and then by meta pathway in the process of
degradation of aromatic hydrocarbons. P. cepacia37 degraded
m-toluate rapidly to be very low level when
it was fully grown.

Choate, D., R. Blake and N. Revis. 1991. Chemical transformation
of toxic metals by a Psuedomonas
strain from a toxic waste site. Federation of American Societies
for Experimental Biology (FASEB)
Journal. 5(4):A466.
Key words: Bacteria, Biodegradation, Disposal, Waste
Pseudomonas maltophilia, 0 2, isolated from soil at a toxic waste
site in Oak Ridge, TN, catalyzed the
transformation and precipitation of numerous toxic metal cations
and oxyanions. When a viable inoculum
(1%) of 0 2 was introduced into LB broth containing 0.2 mM Hg
(II), 1 mM Cr , 40 mM Se (IV), 3 mM
Pb (II), 3 mM Au (III), 3 mM Cd (II), 10 mM Te (IV), or 4 mM Ag
(I), effective removal of the toxic
metal was complete within 1,1,2,2,2,4,5, and 7 days,
respectively. The NADPH-dependent reduction pf
Hg (II) was catalyzed by an inducible mercuric reductase. The
reduction of selenite and tellurite to their
insoluble elemental forms appeared to be mediated by an
intracellular glutathione reductase that utilized the
spontaneously-formed bis(glutathio)Se or bis(glutathio)Te,
respectively, as pseudosubstrates. The
biomolecules responsible for the remaining metal transformations
are currently under investigation. This
project could provide useful information toward the eventual
exploitation of p. maltophilia and related
organisms for the removal of toxic metal wastes from selected,
heavily polluted sites.

Choi H. M., Cloud R. M. 1992. Natural sorbents in oil spill
cleanup. LSU, Baton Rouge, va polytech inst
st univ. Environ sci technol v 26, no 4, pp 772-776, april 1992
(issn 0013936x; 16 refs).
Key words: sorbent, control, fiber, oil recovery, oil spill,
pollution control, sea water, water.

Choi, Hyung-Min Kwon, Hyo-Jung. 1993. Cotton nonwovens as oil
spill cleanup sorbents. Louisiana State

Univ, Baton Rouge, LA, Textile Research Journal. 63(4):211-218.
Key words: Cotton Fibers, Oil Spills
We examined partial or complete replacement of synthetic sorbents by cotton-containing nonwovens for use in oil spill cleanup. The results indicate that with light crude oil, oil sorption capacities of the needlepunched cotton-containing sorbents were slightly greater than those of sorbents made from 100% polypropylene fibers. If necessary, a small portion of polypropylene fiber could be incorporated into nonwovens to increase mechanical strength properties and to maintain fabric integrity. The cotton-containing sorbents were reusable after a simple mechanical compression to remove oil. They also floated in an artificial seawater bath for a long period of time. We found that oil sorption of cotton fiber was controlled by adsorption on the fiber surface and capillary action through its lumen. Contrarily, the main mechanism for polypropylene was through capillary bridges between fibers. Detailed evaluation using an environmental scanning electron microscope confirmed this mechanism. Individual bundles of both cotton and polypropylene fibers sorbed more oil than did the needlepunched nonwoven fabrics prepared from the respective fibers. In addition, sorption decreased as needling density increased. This study provides preliminary data for investigating other cotton nonwoven constructions with improved oil sorption properties. (Author abstract) 13 Refs.

Choquet, M., R. Heon, G. Vaudreuil, J.P. Monchalin, C. Padioleau, and R.H. Goodman. 1993. Remote thickness measurement of oil slicks on water by laser-ultrasonics. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf , March 29 April 1 1993, Tampa, FL, pp. 531-536.
Key words: Oil Spill, Contamination, Environmental Pollution, Remote Sensing, Water Pollution

Chosson, P., C. Lanau, J. Connan, and D. Dessort. 1991. Biodegradation of refractory hydrocarbon biomarkers from petroleum under laboratory conditions. Nature. 351(6328):640-642.
Key words: Bacteria, Biodegradation, Microorganisms, Oil Spills
The capacity of 73 aerobic bacteria to degrade steranes in Rozel Point (Utah) oil is investigated. Seven Gram-positive strains were found to be active and using Nocardia sp. SEBR 16, which caused the most extensive alteration, biodegradation rates for several isomers of steranes and methyl-steranes were determined. The degradation intermediates may be useful as indicators of the degree of biodegradation of oil, and these microorganisms also may be effective in biodegrading oil spills. - R.K.H.

Christensen, L., and B. Wolferstan. 1989. Threat of spill looms.

Oilweek, (Calgary, Alberta).
40(15):7-8,10,12,14.
Key words: Accident, Alaska, Boom, Bulk, Crude Oil, Distribution, Equipment, Pollution Control, Risk
Assessment, Safety

Christodoulou, Marios S. and John T. Turner. 1987. Experimental study and improvement of the rotating
disc skimmer. In: proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup),
April 6 9, 1987, Baltimore, MD, pp. 101 108. Washington, D.C.:
American Petroleum Institute. 1987.
Keywords: skimmer.

Christopher L. Quina. 1987. Containment and cleanup of a major oil well blowout in Texas. In:
Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9,
Baltimore, MD.
Key words: containment, cleanup, oil, blowout.

Christopherson, Sharon K. and Lt. Paul M. Slyman. 1993. Oil spill response planning on the Columbia
River estuary. In: proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response),
March 29 April 1, 1993, Tampa, FL, pp. 63 66. Washington, D.C.:
American Petroleum Institute.
Keywords: oil spill, response, Columbia River.

Chromecek, R.C., and W.L. Klein. 1992. Method of Recovering Oil from the Surface of Water. Patent
No. US 5135660, c 8/4/92, f 1/7/91 (Appl 637730) (e02b-015/04) (9 pp; 1 claim).
Key words: solid adsorbent, adsorbent, business operation, chemical process, copolymer, methacrylate,
oil, spill, polymer, regeneration, salvaging, sorbent, waste oil recovery, p) USA, absorbent,
absorption, adsorption, applying, chemical formula, chemical reaction, cleaning, comonomer,
compression, contamination, control

Chuba, LCDR Thomas J. and Elizabeth Dimmick. 1993. A coordinated state/federal volunteer training
program. In: proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March
29 April 1, 1993, Tampa, FL, pp. 775 777. Washington, D.C.:
American Petroleum Institute.
Keywords: state/federal, volunteer, program.

Chung, J. S., G. R. Cunningham, and J. M. Evon. 1973. Design parameter study of an oil-spill boom. In:
proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973,
Washington, D.C., pp. 427 440. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, boom.

Churchill, R. J. 1975. Photomicrograph techniques for characterization and monitoring oil waste streams. In: proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 79 86. Washington, D.C.: American Petroleum Institute.
Keywords: photomicrograph, monitoring, oily, waste.

Chynoweth, D.P., M.W. Peck, J.C. Yang, S.E. Coleman, and C.E. Turick. 1989. Biogasification of woody biomass. Annual report, March 1988-February 1989. Florida Univ., Gainesville, FL (United States). Inst. of Food and Agricultural Sciences. 64.
The objectives of the research are to characterize the principal bacteria, interactions, and factors limiting depolymerization, yields and rates during the methanogenic fermentation of woody biomass, and to develop and evaluate an efficient biological process for conversion of woody biomass to methane and other resources. Methane yields in excess of 4.0 SCF/1b VS added have been obtained with three of the willow clones included in samples received from the State University of New York and the University of Toronto.
A bi-phasic curve of methane production noted in many cases may have led to underestimates previously.
Methane production from hybrid poplar is inhibited by high concentrations of bark. The inhibitory agent(s) are partially extracted with hot water and appear to be active against methanogens. Pore volume measurements of woody biomass samples have been conducted.
Cellulolytic, xylanolytic and pectinolytic organisms isolated from a mesophilic hybrid poplar reactor have been partially characterized. A predominant cellulolytic organism is Clostridium P-1, which is a new species with novel properties. A highly sensitive and specific polyclonal antibody probe raised to Clostridium P-1 has been used in an ELISA procedure to quantify Clostridium P-1 in pure and mixed cultures and anaerobic digesters. Details of bacterial entry into wood and wood degradation have been obtained in an ultrastructural study.
Key words: bacteria, interactions, biomass, gasification, methane, bioconversion, bark, cellulose, clostridium, conversion.

Ciancaglini, R. Adm. D. E. 1991. The federal on-scene coordinator's role in the Exxon Valdez oil spill. In: proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991, San Diego, CA, pp. 325 332. Washington, D.C.: American Petroleum Institute.
Keywords: Exxon Valdez, oil spill.

CIM. 1991. CIM [Canadian Institute of Mining and Metallurgy] fifth district five meeting. A conference held in northern Alberta focused on matters of interest to the mining of oil sands and coal. Papers were

presented on such subjects as open pit mining methods, mine geology and exploration, mine haulage, waste handling and disposal, oil sand upgrading, geotechnical and geochemical monitoring, mine design and personnel management, environmental effects and reclamation, water management, training, and mining equipment. Separate abstracts have been prepared for 46 papers from this conference. Canadian Inst. of Mining and Metallurgy, Montreal, PQ (Canada), 1991a.
Keywords: monitoring, oil sand, Canada, oil shales & tar sands.

Cimberg, Robert L. and Daniel P. Costa. 1985. North Aleutian Shelf sea otters and their vulnerability to oil. In: proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 211 218. Washington, D.C.: American Petroleum Institute.
Keywords: North Aleutian, otters, oil.

Cimberg, Robert, Steven Mann, and Dale Straughan. 1973. A reinvestigation of southern California rocky intertidal beaches three and one-half years after the 1969 Santa Barbara oil spill: a preliminary report. In: proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington D.C., pp. 697 702. Washington, D.C.: American Petroleum Institute.
Keywords: California, intertidal, beaches, Santa Barbara, oil spill.

Claff, R.E. 1991. An evaluation of soil gas and geophysical techniques for detection of hydrocarbons. API Publication No.4509, 106 pp.

Clark, B., S. Slenicks, J. Glynn Henry and D. MacKay. 1987. The fate of toxic organic chemicals in sewage treatment plants. In: Proceedings of the Technology Transfer Conference. Part B: Water Quality Research, December 8, 1986, Toronto, Ontario, pp. 176-191.
A predictive model based on the fugacity modelling system, which describes the steady-state fate of organic chemicals in a water pollution control plant, has been developed. By estimating a prevailing fugacity in each of the primary, aeration, and secondary settling tanks, chemical concentrations in the water streams, air streams, and sludge streams can be calculated, fluxes can be estimated and a mass balance assembled. Comparison of the fugacity model with the predictive fate models or sub-models developed by other workers show good agreement. The fugacity model was also subjected to tests of validity by conducting laboratory-scale experiments for chemical stripping, stripping-sorption, and stripping-sorption-biodegradation processes, and comparing the model predictions with data obtained from the literature, from pilot plant studies, and from full-scale water pollution control plants. The model

predicted the fate of organic chemicals with fair accuracy based on reasonable estimates of biodegradation rate constants. It is suggested that when adequately calibrated, the model can be used to give a relatively simple description of the fate of organic chemicals in treatment systems.

Clark, Thomas P., and John H. Holck. 1987. Development of a petroleum-tank release cleanup fund for Minnesota. Midwest Ground Water Conference. 32.
Key Words: Minnesota, environmental geology, pollution, oil spills, Midwest, United States, ground water, water treatment, water quality, protection.

Clark, C.D. 1993. Satellite remote sensing for marine pollution investigations. Mar Pollut Bull. 26(7):357-368.
Key words: Remote Sensing, Contamination, Environmental Pollution, Pollution Control

Clark, A.M., A.N. Kalvaitis, and F. Busby. 1990. Evaluation of a heavy-work ROV (Remotely Operated Vehicle) for Science and Submersible Rescue. In: Proceedings of the 8th Annu Mar Technol Soc Rov '90 Conf, June 25 27 1990, Vancouver, Canada, pp. 152-160.
Key words: Unmanned Vehicle, Remote Sensing, Contamination

Clark, David A. 1977. SPCC planning: good management practice. In: proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, New Orleans, LA, pp. 55 56. Washington, D.C.: American Petroleum Institute.
Keywords: SPCC, management.

Clark, Jr., Robert C., 1973. Interagency investigations of a persistent oil spill on the Washington coast. In Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C., pp. 793 808. Washington, D.C.: American Petroleum Institute.
Keywords: investigations, oil spill, Washington, coast.

Clark, Jr., Robert C. and John S. Finley. 1973. Techniques for analysis of paraffin hydrocarbons and for interpretation of data to assess oil spill effects in aquatic organisms. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C., pp. 161 172. Washington, D.C.: American Petroleum Institute.
Keywords: analysis, paraffin, hydrocarbon, assess, oil spill, aquatic, organisms.

Clark, Jr., Robert C. 1975. Long-term chemical and biological effects of persistent oil spill following the grounding of the General M.C. Meigs. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 479

488. Washington, D.C.: American
Petroleum Institute.
Keywords: chemical, biological, effects, oil spill, General M.C.
Meigs.

Clark, Robert C. and John S. Finley. 1971. Puget Sound fisheries
and oil pollution: a status report. In:
Proceedings of Joint Conference on Prevention and Control of Oil
Spills, June 15 17, 1971, Washington,
D.C., pp. 139 146. Washington, D.C.: American Petroleum
Institute.
Keywords: Puget Sound, fisheries, oil.

Clark, R.M., A.H. Vicory, and J.A. Goodrich. 1990. The Ohio
River oil spill. A case study. Journal of
the American Water Works Association (USA). 82(3):39-44.
Key Words: Ground water pollution, Ohio River, oil spills,
petroleum tanks, tanks regulations, gas
chromatography, on-line measurement systems, parametric analysis,
storage facilities, water pollution
control, water quality, chromatography

Clarke, R.H. 1992. Methods and sensor systems for sensing
hydrocarbon- containing fluids based on
fluorescence detection. PCT GAZ, 1992(10):4657. Patent No. WO
9207249920430.
Key words: Leak Detection, Hydrocarbon, Soil Pollution, Oil
Spill, Petroleum, Pollution Control, Remote
Sensing

Clauss, G. F. and W. L. Kuhnlein. 1991. Efficiency of selected
oil skimming systems in irregular seas. In
Proceedings of the 1991 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), March 4 7, 1991,
San Diego, CA, pp. 115 124. American Petroleum Institute.
Keywords: oil, skimming, seas.

Clay, Lt. Cdr. John S. 1985. Trends in stranded tanker salvage.
In Proceedings of the 1985 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup), February 25
28, 1985, Los Angeles, CA, pp.
177 182. Washington, D.C.: American Petroleum Institute.
Keywords: tanker, salvage.

Clodfelter, C.L. 1992. Conceptual design of air sparge/soil vent
systems for in situ remediation of
petroleum hydrocarbons. In: Proceedings of the Pennwell Conf &
Exhibit co Petro-Safe 92 Conf, January
27-29, 1992, Houston,TX, pp. 899-907.
Key words: Soil Pollution, Water Pollution,, Biodegradation,
Bioremediation, Groundwater, Monitoring,
Oil Spill, Vadose Water

Clodfelter, Chris L. 1990. A method for evaluation of the
effectiveness of vacuum enhanced ground water
recovery systems. In: Proceedings of the National Outdoor Action
Conference on Aquifer Restoration,

Ground Water Monitoring and Geophysical Methods. 4:73-82.
Key Words: Ground water, pollution, reclamation, natural resources, drawdown, pore pressure, vacuum-enhanced methods, Blue Ridge Mountains

Clow, Lt. James C. 1977. The Coast Guard's forensic oil identification system. In Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, New Orleans, LA, pp. 189 192. Washington, D.C.: American Petroleum Institute.
Keywords: Coast Guard, forensic, oil, identification.

Clumpner, Curtiss Jay. 1993. Rehabilitation of oiled magellanic penguins (Spheniscus magellanicus) in Patagonia, Argentina. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 896. Washington, D.C.: American Petroleum Institute.
Keywords: rehabilitation, oiled, penguins.

Clumpner, Curtiss J. 1991. Bird cleaning trailers used in oil spill response. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991, San Diego, CA, p. 712.
San Diego, CA: American Petroleum Institute.
Keywords: bird, cleaning, oil spill, response.

Clyde R. 1993. A discussion covers the use of wastes for fuels and chemicals. ACS 206th National Meeting (Chicago 8/22-26/93) ACS Division of Fuel Chemistry Preprints (ISSN 0569-3772) V38 N.3 901-5 (1993).
Key words: aerobic microorganism, air association, biodegradation, container, corrugated, pollution, bioremediation, oil waste, paperboard, pollutant, immobilization.

Clyde, R.A. 1990. Biotechnology for clean fuels. In: Proceedings of the 200. American Chemical Society national meeting, August 26 31 1990, Washington, DC, p. 15, Paper FUEL 44.
Key words: Coal, Desulfurization, Biotechnology, Chemical Reactions
Two genera of Thiobacillus can oxidize pyrite in coal and genera of Pseudomonas remove organic sulfur.
Both of these organisms can be immobilized on fibers and remove metals from wastewater as described in patent 4,530,763. Species of Phanerochaete chrysosporium also grow on fibers and convert coal to a water soluble form. Oil spills and wastes from oil drilling also cause death and disease. By converting sugar to alcohol for gasohol this pollution could be decreased. Independent investigators have confirmed that sugar can be converted to alcohol in 15 minutes by immobilizing organisms on rotating fibers. The CO{sub 2} produced can be used in a paint spray or to grow plants or algae.

Clymer, A.B., and T.B. Judge. 1987. Desktop simulation of plant emergencies. In: Proceedings of the AICHE 1987 summer natl. meet., August 16 19 1987, Minneapolis, MN, PREPR. N.53E, 25pp.
Key words: Accident, Boom, Computer Programing, Computer Simulation, Legal Consideration

Coakley, William A. 1973. Comparative identification of oil spills by fluorescence spectroscopy fingerprinting. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C., pp. 215 222. Washington, D.C.: American Petroleum Institute.
Keywords: identification, oil spills, spectroscopy, fingerprinting.

Cobet, Andre B. and Harold E. Guard. 1973. Effects of bunker fuel on the beach bacterial Flora. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C., pp. 815 820. Washington, D.C.: American Petroleum Institute.
Keywords: fuel, beach, bacterial, Flora.

Cochran, J.W., M.V. Yates, and J.M. Henson. 1988. Modified purge-and-trap/gas-chromatography method for analysis of volatile halocarbons in microbiological degradation studies (journal version). Pub. in Jnl. of Microbiological Methods, Vol. 8, No. 6, 347-354(Nov 1988).
A modification of a purge-and-trap unit is described for use in microbiological studies concerning degradation of aliphatic halogenated hydrocarbons (halocarbons). Sealed serum tubes containing bacteria, aqueous medium, headspace, and volatile halocarbons are used as purge vessels to monitor the disappearance of the halocarbons. Data are presented to show the loss of volatile halocarbons that occurred when these systems were analyzed by standard purge-and-trap. An application of this method is shown with methane-utilizing bacteria. The modified purge-and-trap method resulted in a total measurement of halocarbons in the sample without making a transfer to a separate purge vessel.
Key words: biodegradation, gas chromatography, volatile matter, biodegradation, methane, decomposition, hydrogen compounds, organic halogen compounds, oxygen compounds.

Cochran, R. A., G. A. Manney, and J. P. Fraser. 1975. Computer simulation of offshore oil-spill cleanup operations. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 293 300. Washington, D.C.: American Petroleum Institute.
Keywords: computer, offshore, oil spill, cleanup.

Cohen, Steven and Stephen Dalton. 1983. Self-contained oil recovery system for use in protected waters. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983, San Antonio, TX, pp. 73 80. Washington, D.C.: American Petroleum Institute.
Keywords: oil, recovery, waters.

Cohen, Steven H., William T. Lindemuth, and John S. Farlow. 1979. Development of tests of an air-jet oil boom. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Los Angeles, CA, pp. 483 488. Washington, D.C.: American Petroleum Institute.
Keywords: development, oil, boom.

Cohn, R. E., W. A. Wallace, and J. R. Harrald. 1991. Organizing for response: the unresolved problem. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991, San Diego, CA, pp. 29 34. Washington, D.C.: American Petroleum Institute.
Keywords: response.

Collier, T. K. 1993. Oil exposure and effects in subtidal fish following the Exxon Valdez oil spill. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 301 305. Washington, D.C.: American Petroleum Institute.
Keywords: oil, exposure, fish, Exxon Valdez, oil, spill.

Collins, P. A., K. C. Garrity, C. J. Peiper, R. P. Siegel, P. J. Smith and G. E. Tesch. 1992. Aboveground storage tanks. In: Proceedings of the Second International Symposium on Aboveground Storage Tanks, Jan. 14 16, Houston, TX. Materials Technology Institute of the Chemical Process Industry, Inc.: St. Louis, MO, pp. 1 2.
Key words: Oil Spills, Underground Storage, Groundwater
With the 1988 promulgation of the comprehensive Resource Conservation and Recovery Act (RCRA) regulations for underground storage of petroleum and hazardous substances, many existing underground storage tank (UST) owners have been considering making the move to aboveground stroage. While on the surface, this may appear to be the cure-all to avoiding the underground leakage dilemma, there are many other new and different issues to consider with aboveground storage. The greatest misconception is that by storing materials above ground, there is no risk of subsurface environmental problems. It should be noted that with the aboveground storage tank (AGST) systems, there is still considerable risk of environmental contamination, either by the failure of onground tank bottoms or the spillage of product onto the ground surface where it subsequently finds its way to the groundwater.

In addition, there are added safety concerns that must be addressed. So what are the other specific areas of concern besides environmental to be addressed when making the decision between underground and aboveground tanks? The primary issues that will be addressed in this paper are: Safety, Product Losses, Cost Comparison of USTs vs AGSTs, Space Availability/Accessibility, Precipitation Handling, Aesthetics and Security, Pending and Existing Regulations.

Colman, R., and R. Fitzsimmons. 1991. The application of spatial analysis systems in planning oil spill response strategies. In: Proceedings of the 1st Victorian Dep Manufacturing IND Developmental Offshore Australia Conf, November 25 27 1991, Melbourne, Australia, 2:X-27 - X-31.
Key words: Oil Spill, Geographic Information Systems, Pollution Control, Contingency Planning, Remote Sensing

Colwell, R.R., D. Jenkins, and B.H. Olson (eds.). 1988. Plenary address - The need for interaction between microbiologists and engineers. Water and Wastewater Microbiology. 20(11 12):1 4
Key words: in-situ, microbiology, biodegradation
The immediate tasks can be defined and include development of methods for treating very large volumes of water. Chemical and biological water quality standards must be changed to meet the conditions.
Drinking water organisms unheard of a decade ago, e.g. Legionella, Campylobacter, thermal resistant Escherichia coli , and viable but nonculturable bacteria, the latter including many potential pathogens, have been detected in drinking water. Detection of pathogenic microorganisms can be significantly improved using the new tools of biotechnology which include DNA probes and monoclonal antibodies. In situ biodegradation, employing genetically engineered indigenous organisms, i.e. naturally occurring organisms at the site under study, into which genes have been cloned that code for enzymes degradating toxic chemicals at low concentrations under in situ conditions holds great promise.

Colwell, R.R. 1988. Engineering marine microorganisms for biodegradation and waste control in the sea. J. Shellfish Res. 7(3):552 553.
Key words: biodegradation, pollution control, water pollution, bacteria
Recent developments in genetic engineering and biotechnology have opened up new opportunities for waste control and toxic waste degradation in situ. Marine bacteria have been employed for treatment of oil spills occurring in coastal and ocean waters with reasonable success. Isolation of oil-degrading microorganisms has been effective and can be accomplished with relative ease.

New approaches have been taken to amplify and enhance strain capability for biodegradation of hydrocarbons, employing the techniques of genetic engineering. Furthermore, marine bacteria have been isolated which are capable of degrading a variety of toxic chemicals. The genetics of these organisms is being studied, and engineering organisms for rapid clean-up of toxic chemical spills in the marine environment now appears possible. The potential of biotechnology, applied to marine and fresh water systems for bioremediation, waste control, and targeted biodegradation is significant. However, careful microcosm and mesocosm testing, as well as ample containment trials should be done, before large scale field application can be done.

Comer, P. J., F. Clements, and G. Van Der Graf. 1991. Assessing the risk of riser and pipeline failures on offshore installations. In: Proceedings of the 1st SPE et al. Health, Safety & Environ in Oil & Gas Explor & Prod Int Conf, November 11-14, The Hague, Netherlands. V 1, pp, 657-665.
Key words: Pipeline, Risk Assessment, Oil Spills

Commander, J. C. 1971. Nonradioactive Waste Oil Disposal Study. In Idaho Nuclear Corp., Idaho Falls., 53p.
Key words: oils

Compton, J.S., L.B. Williams, and R.E. Ferrell Jr. 1992. Mineralization of organogenic ammonium in the Monterey Formation, Santa Maria and San Joaquin basins, California, USA. Geochimica et Cosmochimica Acta. 56(5):1979-1991.
Key words: Hydrocarbon, Bacteria, Biodegradation, California
The increase in the organic (C/N) ratio with burial depth most likely reflects the preferential release of N compared to C and suggests that NH SUB 4 release is greatest during shallow burial bacterial degradation and deep burial catagenesis (oil generation). The results of this study support the suggestion of WILLIAMS et al. (1989) that high fixed-NH SUB 4 contents may provide a long-term geologic record of low-temperature (<150 degreesC) NH SUB 4 mineralization associated with hydrocarbon generation and migration. -from Authors.

Compton, E. 1988. Fate and Transport of Petroleum Released from Leaking Underground Storage Tanks in Areas of Karst Topography. Technical rept. 43.
Key Words: Water pollution abatement, aquifers, water pollution control, petroleum products, underground storage, storage tanks, regulations, fuel storage, leakage, drinking water, geologic surveys, ground water, hydrology, Karst, permiability, carbonates.

Conaway, Lt. Brian. 1989. Rolling mills complex, Fore River,

Portland, Maine. In: Proceedings of the
1989 Oil Spill Conference(Prevention, Behavior, Control,
Cleanup), February 13 16, 1989, San
Antonio,TX, pp. 575. Washington, D.C.: American Petroleum
Institute.

CONCAW. May 1991. 1990 annual report (on CONCAWE activities).
Stichting CONCAWE (Report)
1(91):17.
Key Words: Air pollutant, aromatic, benzens content, business
operation, carbon monoxide, carbon
oxide, diesel fuel, economic factor, employee relations,
environmental impact, fuel performance, full
scale, ground water, Group IVA, Group VA, Group, VIA,
health/disease

Concawe. 1974. An inland oil spill cleanup manual. In Sticht
Concawe Rep N.4/74., p.107.
Key words: dispersant, separation, pollution, control, soil,
spill, tank

CONCAWE. 1992. Catalogue of CONCAWE special interest reports.
CONCAWE (Report) N.92/57, 39
pp.
Key words: Absorption Process, Air Pollution, Crude Oil,
Petroleum, Pollution Control

Conche, M., and J.L. Fages. 1992. Technique for the Removal of
Petroleum-based Pollutants and a
Material for That Purpose. Patent No. US 5078890, c 1/7/92, f
4/24/90 (6 pp; 5 claims) see related patent
abstract # 509656.
Key words: solid adsorbent, adsorbent, collecting agent,
contamination, environmental pollution, oil
spill, oil water separation, physical separation, rock wool
sorbent, water pollution, (p) USA,
absorption, adsorption, applying

Conditt, M.K., S.B. Hawthorne, R.M. Barkley, R.E. Sievers.
1982. Characterization and treatment of
wastewater from oil shale processing in Colorado. Rep No
DOE/EV/10298--4, Pp XI1-XI40, 1982 ($27
00) (Oil Shale Environmental Research and Coordination
Progress Report, 1981 1982).
Key words: disposal, oil, recovery

Connan, J.1987. Biodegradation of crude oils in reservoirs.
Proc. Inst. Pet., London .

Connell, Des W. 1987. Ecotoxicology: a Framework for
Investigations of Hazardous Chemicals in the
Environment. Ambio. 16(1):47 50.
Keywords: water pollution effects, biodegradation
Hazardous chemicals have become a major focus for the
environmental management activities within the
OECD. Recommendations have been made for a set of physical,
chemical, and biological tests and for an

evaluation procedure which will form the basis for predicting the possible environmental impacts of new chemicals. The evaluation procedure attempts to trace the fate of a chemical from discharge and dispersal to subsequent effects on biota. The scheme offers a conceptual framework for the development of a new scientific discipline referred to as ecotoxicology.

Connor, S.R. 1992. Environmental issues and the oil and gas operator : PT.2 : Level II environmental assessments. Petrol Eng Int. 64(3):77-78.
Key words: Oil Spill, Groundwater, Soil Pollution, Underground, Water Pollution

Conrad, S.H., J.L. Wilson, W.R. Mason, and W.J. Peplinski. 1992. Visualization of residual organic liquid trapped in aquifers. Water Resources Res. 28(2):467 478.
Keywords: biodegradation, equipment, morphology, photomicrograph, pollution control, remediation, water pollution

Conway, Cdr. Michael A. 1987. A History of the development of oil dispersant guidelines for Alaska. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: dispersants, Alaska.

Cook, George E., Oberdorfer, June A., Orloff, Stephen P. 1991. Remediation of a gasoline spill by soil vapor extraction; Lawrence Livermore National Laboratory, Livermore, California. Ground Water Management. 8:583-599.
Key Words: California, pollution, soils, environmental geology, oil spills, vapor extration, Lawrence Livermore National Laboratory, Livermore California, Pacific Coast, Western U.S., United States, underground storage, unsaturated zone, monitoring, aromatic hydrocarbons, organic materials.

Cook, David O., Gary R. Davis, Ronald A. Franklin. 1982. Use of aerial photography with loran c positioning to map offshore surface currents. Photogrammetric Engineering and Remote Sensing (1982): 48
Key words: disposal, oil spill, transport
Techniques have been developed for mapping surface currents in the offshore zone using aerial photography. Dye-emitting tracers, resembling spar buoys with color-coded arms and a radio transmitter, are used to track surface currents in the upper meter of the water column. The tracers are relocated by homing on the radio signal and looking for the dye patch, then are photographed using Loran C as the aircraft position reference. Photographic tracer data are digitized and computer-processed to make photogrammetric corrections and display tracer locations in

tabular and graphic formats. The total error of tracer locations determined by these techniques i PLUS OR MINUS 114 m. The method has been used to study both large- and small-scale Lagrangian circulation phenomena on the outer continental shelf. This work is pertinent to waste disposal, oil spill transport, and oil and gas deposits. 12 refs.

Cooper, D., and I. Gausemel. 1993. Oil spill sorbents: testing protocol and certification listing program. In: Proceedings of the 8th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1, Tampa, FL, pp. 549-551.
Key words: Sorbent, Oil Spill Removal, Business Operation, Cleaning, Contamination, Crude Oil

Cooper, L.I. 1991. Law--1. Clean Water Act, Coastal Zone Management Act, and the Safe Drinking Water Act. Research Journal of the Water Pollution Control Federation. 63(4):302-10.
Key words: Accident, Alaska, Business Operation, Crude Oil, Economic Factor, Legal Consideration, Oil Refinery

Corapcioglu M. Y., Lingam R., and Kambham K. K. R. 1992. Development of screening tools to estimate the performance of free product recovery. In: api et al petrol hydrocarbons & org chem in ground water : prev, detection, & restoration conf, March 4, Houston, TX.
Key words: ground water, liquid level, oil spill remediation, spill,water, water level, water pollution, water table

Corapcioglu, M.Y., and A.L. Baehr. 1987. A compositional multiphase model for groundwater contamination by petroleum products : PT.1 : theoretical considerations. Water Resources Res. 23(1):191-200.
Key words: Soil Pollution, Groundwater, Pipeline, Underground Storage Facility

Corbett, Capt. Charles R. 1987. United States progress towards enactment of comprehensive oil spill liability and compensation legislation. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, MD, pp. 559 564. Washington, D.C.: American Petroleum Institute.
Keywords: United States, oil spill, liability, compensation.

Corbett, Cdr. C. R. and Capt. C. J. Beckett.. 1977. A dynamic international contingency plan. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, New Orleans, LA, pp. 79 80. Washington, D.C.: American Petroleum Institute.

Keywords: international, contingency plan.

Corbett, Charles R. 1993. Vessel response plan requirements: observations by intertanko. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 259 262. Washington, D.C.: American Petroleum Institute.
Keywords: vessel, response, intertanko.

Corbett, Charles R. and David M. Bovet. 1989. Comprehensive oil spill liability and compensation legislation. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, pp. 513 514. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, liability, compensation.

Corbin, Lt.(jg) Robert F. and Gary L. Ott. 1985. Federal region II regional contingency planning for a dispersant decision process. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 417 420. Washington, D.C.: American Petroleum Institute.
Keywords: federal, contingency, planning, dispersant.

Corey, J.C., B.B. Looney, and D.S. Kaback. 1989. In-Situ Remediation system and method for contaminated groundwater. Patent No. US 4832122890523, 7p.
Key words: Oil Spill, Disposal, In-situ

Corey, D., R. W. Neal, and G. R. Schimke. 1971. A joint state-industry program for oil pollution control. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971, Washington, D.C., pp. 147 156. Washington, D.C.: American Petroleum Institute.
Keywords: state-industry, pollution, control, oil.

Cormack, Douglas. Review of United Kingdom oil spill response techniques and equipment. In Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983, San Antonio, TX, pp. 15 18. Washington, D.C.: American Petroleum Institute.
Keywords: United Kingdom, oil spill, response.

Cormack, D., N. Hurford, and D. Tookey. 1987. Remote sensing techniques for detecting oil slicks at sea - a review of work carried out in the United Kingdom. In: Proceedings of the 10th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Conf, April 6 9 1987, Baltimore, MD, pp. 95-100.
Key words: Oil Spill, Remote Sensing, Crude Oil, Petroleum

Cormack, D. and Hugh Parker. 1979. The use of aircraft for the clearance of oil spills at sea. In:

Proceedings of the 1979 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), March 19 22,
1979, Los Angeles, CA, pp. 469 474. Washington, D.C.: American
Petroleum Institute.
Keywords: aircraft, clearance, oil spills, sea.

Cormack, D. and J. A. Nichols. 1977. The concentrations of oil
in sea water resulting from natural and
chemically induced dispersion of oil slicks. In: Proceedings of
the 1977 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), March 8 10, 1977, New Orleans, LA,
pp. 381 386. Washington, D.C.:
American Petroleum Institute.
Keywords: oil, sea, chemically, dispersion, oil slicks.

Cormack, D. and P. G. Jeffrey. 1975. An oil pollution control
officer training course. In: Proceedings of
the 1975 Conference on Prevention and Control of Oil Pollution,
March 25 27, 1975, San Francisco, CA,
pp. 69 72. Washington, D.C.: American Petroleum Institute.
Keywords: oil, pollution, control.

Cornillon, Peter C., Malcolm L. Spaulding, and Kurt Hansen. 1979.
Oil spill treatment strategy modeling
for Georges Bank. In: Proceedings of the 1979 Oil Spill
Conference(Prevention, Behavior, Control,
Cleanup), March 19 22, 1979, Los Angeles, CA, pp. 685 692.
Washington, D.C.: American Petroleum
Institute.
Keywords: oil spill, Georges Bank.

Corrie, C. L., and A. J. Guzman. 1991. National contingency plan
for control and combat of major oil
spills in water. In: Proceedings of the 23rd Annu SPE et al
Offshore Technol Conf (OTC 91), May 6 9,
Houston, Texas. Vol. 1, pp. 27-54.
Key words: Oil Spill, Contingency Planning, Water Pollution

Corseuil, H.X. 1992. Enhanced degradation of monoaromatic
hydrocarbons in sandy aquifer materials by
microbial inoculation using biologically active carbon reactors.
Michigan Univ, Dissertation. Diss Abstr
Int, SECT B 53(10):5133-B April, 1993.
Key words: Bioremediation, Hydrocarbon, Biodegradation,
Microorganism, Bacteria, Environmental
Impact, Soil Pollution, Water Pollution

Cortelyou, C. G. and H. A. Bernard. 1969. Conference summary. In:
Proceedings of Joint Conference
on Prevention and Control of Oil Spills, December 15 17, 1969,
New York, NY, pp. 343 344.
Washington, D.C.: American Petroleum Institute.
Keywords: conference.

Costanzo, Donald. 1991. A Computerized Equipment and Personnel
Management System Specific to Oil
Spill Response. In: Proceedings of the Environ Canada Arctic &

Marine Oil Spill Program 14th Technical
Semin, Vancouver, BC. 223(14).
Key Words: Computer applications, oil spill cleanup, emergency planning, Alaska, information systems-
env, marine pollution equiment, oil booms.

Costello, V. Adm. John D. The metamorphosis of PIRO into MSRC. In: Proceedings of the 1991 Oil
Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991, San Diego, CA, pp. 65 70.
Washington, D.C.: American Petroleum Institute.
Keywords: PIRO, MSRC.

Costello, J.D. 1993. Oil spill response: Countdown to readiness. Sea Technology. 34(4):54-58.
Key words: Oil Pollution Containment, Petroleum Industry
In the wake of the Exxon Valdez oil spill, a task force representing America's oil industry set about
studying the existing resources across the nation for responding to catastrophic oil spills. In June 1989 the
task force reported that the capability did not exist in either government or industry to respond to a spill the
magnitude of the one in Alaska. As a result of task force recommendations, 20 companies began the
process that led to the creation of both the Marine Preservation Association (MPA) and the Marine Spill
Response Corp. (MS-RC). The latter is headquartered in Washington, D.C., with 5 regional response
centers around the US. Under the direction of the US Coast Guard, each of MSRC's five regions will
provide a best-effort response to cleaning up spill of persistent (crude) oils that are beyond the capabilities
of local spill response organizations. MSRC will work closely with both cooperatives and independent,
commercial responders to maximize spill response effectiveness. The MPA and its member companies
have committed more than $400 million for the acquisition of capital equipment for MSRC, an
unprecedented record in American business history. MSRC is also involved in research programs
concerning remote sensing, in-situ burning, dispersants, handling of recovered material, and shoreline
countermeasures.

Cote, B. 1984. Optimization of offshore platform layouts. In: Proceedings of the 13th Annual Indon Petrol
Ass Conv., May 29-30, Jakarta, Indon. V 2, pp. 301-316.
Key words: Oil Spills, Offshore Platforms

Cotton, Ernest. Oil spill cooperative program. In: Proceedings of Joint Conference on Prevention and
Control of Oil Spills, December 15 17, 1969, New York, NY, pp. 141 144. Washington, D.C.: American
Petroleum Institute.
Keywords: oil spill.

Couch, G.R. 1987. Biotechnology and coal. IEA Coal Research,

London (UK). 56.
A wide-ranging review of the possible applications of biotechnology to coal use is presented. The review includes a brief introduction to biochemical processes and discusses the possible applications of biotechnology to coal utilization. Coal is not seen as an easy material for microbial attack. Work has been done in many countries on the microbial desulphurization of coal, to remove both pyrite and organic sulphur. The work on pyrite removal has been more extensive. Microbes which attack and use the sulphur contained in coal have been identified, and it is possible to propose processes and define conditions that would achieve a significant reduction in the sulphur content of some coals prior to use. Development work has been undertaken in the US, in the Netherlands and in a number of other member countries including the FRG and the UK. Up to 90% removal of pyritic sulphur can be achieved. At this stage, reaction rates are too slow for a process to look economically competitive, and there may be significant costs associated with effluent treatment. Work is, however, continuing to improve the process economics.
Biodesulphurization may be applicable where small tonnages are involved, where the use of coal-water slurries are considered, or for treatment fines. Bioprocesses based on the products of a preliminary chemical degradation of lignite are being considered. This approach has a number of attractions, and involves the identification of microorganisms to effect the various transformations at an adequate rate.
Work is going on in the US and in the FRG to find microorganisms which directly attack or degrade coals, and both fungi and bacteria have been identified. Studies are in the very early stages, and little has yet been done to identify the degradation products or to measure reaction rates. The reaction rates observed have been extremely slow. 100 refs., 27 figs., 19 tabs.
Key words: bioreactors, configuration, design, biotechnology reviews, configuration, desulfurization, coal, chemical reaction, microorganisms, kinetics, biodegradation, anaerobic conditions, dissolution, methane.

Cowdery, Craig, and Paco Aram. 1990. The application of multiple stage diffused aeration in the treatment of petroleum contaminated ground water. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:57-71.
Key Words: Pollution, reclamation, ground water, oil spills, natural resources, hydrocarbons, aeration, Florida, Southeastern U.S., Eastern U.S., United States, Alabama, Southern U.S., methods.

Cowell, E. B. 1971. Some effects of oil pollution in Milford Haven, United Kingdom. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15

17, 1971, Washington, D.C., pp.
429 436. Washington, D.C.: American Petroleum Institute.
Keywords: oil pollution, United Kingdom.

Cowell, Eric B., Geraldine V. Cox, and George M. Dunnett. 1979.
Applications of ecosystem analysis to
oil spill impact. In: Proceedings of the 1979 Oil Spill
Conference(Prevention, Behavior, Control,
Cleanup), March 19 22, 1979, Los Angeles, CA, pp. 517 520.
Washington, D.C.: American Petroleum
Institute.
Keywords: ecosystem, oil spill, impact.

Cowell, E. B. and D. C. Monk. 1979. Problems in ecological
monitoring in Port Valdez, Alaska. In:
Proceedings of the 1979 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), March 19 22,
1979, Los Angeles, CA, pp. 713 718. Washington, D.C.: American
Petroleum Institute.
Keywords: ecological, monitoring, Port Valdez.

Cox, Bruce A., Jack W. Anderson and Jack C. Parker. 1975. An
experimental oil spill: the distribution
of aromatic hydrocarbons in the water, sediment, and animal
tissues within a shrimp pond. In: Proceedings
of the 1975 Conference on Prevention and Control of Oil
Pollution, March 25 27, 1975, San Francisco,
CA, pp. 607 612. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, hydrocarbons, water, sediment, animal,
shrimp.

Cox, Jack C. and Lawrence A. Schultz. 1981. The containment of
oil spilled under rough ice. In:
Proceedings of the 1981 Oil Spill Conference(Prevention,
Behavior, Control, Cleanup), March 2 5, 1981,
Atlanta, GA, pp. 203 210. Washington, D.C.: American Petroleum
Institute.
Keywords: oil, ice.

Cozzarelli, Isabelle M., Mary Jo Baedecker, and Jessica A.
Hopple. 1991. Geochemical gradients in
shallow ground water caused by the microbial degradation of
hydrocarbons at Galloway Township, New
Jersey. Water-Resources Investigations. 256-262.
Key Words: New Jersey, pollution, ground water, environmental
spills, biodegradation, USGS, Eastern
U.S., United States, southeastern New Jersey, Atlantic County New
Jersey, volatible organic compounds,
Atlantic Coastal Plain, North America, hydrochemistry,
geochemistry.

Craik, W. 1991. Oil spills in the Great Barrier Reef region. In:
Proceedings of the API - EPA - USCG
1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference,
March 4 7 1991, San Diego, CA, API
Publication N.4529, pp. 55 60.
Key words: Accident, Boom, Bulk, Offshore Oil Waste, Pollution

Control Equipment, Spill, Supertanker

Cram, R.S., M. Phillips, J. Iddon, and A. Craig. 1991. Information technology applications in the emergency response centre. In: Proceedings of the INST Mar Eng Offshore Oper Post Piper Alpha Conf, February 6 8 1991, London, England, Preprints Pap No. 16, 5 pp.
Key words: Information Retrieval Systems, Contingency Planning, Alaska, Atlantic Ocean, Oil Spill, Remote Sensing

Cramer, M.A., E.H. Owens, D.E. Howes, and G.A. Sergy. 1991. Spill response manuals for the coasts of British Columbia. In: Proceedings of the 14th Environ Can Arctic & Mar Oil Spill Program Tech Seminar June 12 14 1991, Vancouver, Canada, pp. 551-577.
Key words: Contingency Planning, Oil Spill, Pollution Control, Remote Sensing

Crawford, R.L., and D.R. Ralston. 1993. Stabilization of microorganisms for in situ degradation of toxic chemicals. Final report. Department of Energy, Washington, D.C. Report No. DOE/ER/60847-T1, 6 pp.
Key words: bacteria, hydrocarbons, biodegradation, groundwater, Idaho
Methods for large-scale microencapsulation of bacteria and nutrients into microbeads with small enough diameters to travel through aquifers have been developed at the University of Idaho. Both free and immobilized cells of Flavobacterium ATCC 39723, a gram-negative aerobe that degrades various chlorinated phenols, into aquifer microcosms, through which pentachlorophenol (PCP)-contaminated groundwater flowed at in situ flow rates. Aquifer samples were collected with an auger from three wells at the University of Idaho Ground Water Research Site, and packed into 24 columns. Some sterile columns were also prepared, by irradiation at the Washington State University Radiation Center. In some of the columns the free Flavobacterium cells were mixed with the aquifer material before packing the columns. In others, agarose-microimmobilized Flavobacterium were mixed into the aquifer material. The effluent from each column was collected daily for 170 days and analyzed by UV spectroscopy or HPLC for remaining PCP. There were no statistically significant differences between the degradation rates of free or encapsulated Flavobacterium in sterile or native aquifer material as tested in these experiments. This work has shown at the lab scale that encapsulated PCP-degrading Flavobacterium were able to survive under conditions of starvation, predation, and lack of water.

Crawford, R.L., and K. Stormo. 1990. Stabilization of microorganisms for in situ degradation of toxic chemicals. Progress report. Department of Energy, Washington, DC. Report No. DOE/ER/60847-1,

11pp.
Key words: in-situ, bacteria, biodegradation, water pollution, soil pollution
In our initial work, we have developed methods to microencapsulate cells within beads of 5 100,(mu)m diameter, and we have examined these entrapped cells for their abilities to mineralize specific chemicals in the presence of subsurface soils and waters obtained from the University of Idaho Groundwater Research Site (GRS). We have employed a pentachlorophenol (PCP)-degrading Flavobacterium and a toluene-degrading Pseudomonas. Cells were immobilized within one of three polymeric matrixes: alginate, agarose, or polyurethane.

Crawford, R.L., and K. Stormo. 1991. Stabilization of microorganisms for in situ degradation of toxic chemicals. Progress report, Year two. Department of Energy, Washington, D.C. Report No. DOE/ER/60847-2, 14 pp.
Key words: in-situ, biodegradation, soil pollution, PCP
We have developed methods to microencapsulate a petachlorophenol (PCP)-degrading Flavobacterium and a p-cresol (PCR)-degrading Pseudomonas within beads of 5 100 am diameter, and we examined these entrapped cells for their abilities to mineralize PCP and PCR in the presence of subsurface soils and waters obtained from the University of Idaho (UI) Groundwater Research Site (GRS). Matrixes employed to make beads included alginate, agarose, polyurethane, agarose coated. by polyurethane, and novel polyurethanes containing cross-linked sources of supplemental carbon and/or nitrogen sources. A low-pressure-nozzle apparatus was developed for the production of microspheres. We found that microencapsulated cells survived better and were catabolically more active than free cells in the presence of aquifer materials. Microcosm studies reported here confirmed that microbeads containing long-lived pollutant-degrading bacterial cells can be readily prepared in sizes that will travel through subsurface sand/gravel aquifer matrixes. Microencapsulated bacteria at PCP concentrations up to 275 ppM and free cells at PCP concentrations < 150 ppM can remain active for extended periods under simulated aquifer conditions. Periods of several months are certainly attainable. This should be sufficient time to effect significant environmental restoration through biodegradation of specific targeted pollutants.

Crawford, Ronald L., Kirk T. O'Reilly, and Hong-Lei Tao. 1989. Microorganism Stabilization for In-situ Degradation of Toxic Chemicals. In: Proceedings of the Biotechnology & Biodegradation Int Workshop, Lisbon, Portugal. Gulf Publishing. 203 211. 1989.
Keywords: in-situ, biodegradation, waste site
Pure cultures of bacteria introduced into natural environments

often do not persist, because they are not competitive with indigenous populations or because the environments are too toxic to support growth. To enhance the potential for successful +i in situ +r bioremediation of aquifers polluted with toxic chemicals, methods are needed to stabilize microbial cells and to assure their survival in hostile environments. Immobilization of pollutant-degrading bacteria in polymeric matrices, such as alginate, has been found to stabilize the microbiota for introduction into surface soils or waters. The ability of immobilized cells to degrade pentachlorophenol in soil was demonstrated.

Cresswell, L. W. 1977. The fate of petroleum in a soil environment. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, New Orleans, LA, pp. 479 482. Washington, D.C.: American Petroleum Institute.
Keywords: petroleum, soil.

Cretney, Walter J. 1981. Biodegradation of a chemically dispersed crude oil. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981, Atlanta, GA, pp. 37 46. Washington, D.C.: American Petroleum Institute.
Keywords: biodegradation, chemically, dispersed, oil.

Crews, B., E. Malachosky, and L.D. Hinman 1993. The effect of pH on microbial degradation of oil-based drilling mud in a slurry-phase bioreactor. In: Proceedings of the SPE - EPA Exploration & Production Environmental Conference (San Antonio, TX 3/7-10/93) pp. 477-84.
Key words: acideic, acidity, ammonia, analytical method, association, bacteria, biochemical, concentration, grease, deteriorat ion, drilling, element, hydrogen, biodegradation, anion, association, calcium, industrial oil, laboratory, hydrogen ide, ion, scale.

Crickard, Lt. Alvin M. and Capt. Donald S. Jensen. 1993. Post-OPA 90 national strike force. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 273 275. Washington, D.C.: American Petroleum Institute.
Keywords: OPA 90, national strike force.

Crisafi, E. 1989. Effect of hydrocarbons and decontaminating substances on bacterial flora of coastal sediments. Marine Ecology. (1989): 10(4).
Key words: hydrocarbons, bacterial, coastal sediments, degradation, dispersant, oil spill, cleanup, Italy
Seventy-six samples of coastal sediments collected in the Straits of Messina [Italy] were studied in order to evaluate the effects of an oil spill and the consequent clean-up operations on heterotrophic aerobic bacteria. In addition, in vitro tests were carried out to estimate the

effects of five dispersants on the growth and oil degrading capacity of marine strains isolated from the same sediments.

Crocker, Marshall J. 1985. Design considerations for a large sweep width skimming system. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 47 50. Washington, D.C.: American Petroleum Institute.
Keywords: design, skimming.

Crocker, M.E., and M.P. Madden. 1989. Degradation, interaction, and fate of wastes disposed by deep-well injection. In: Proceedings of the U.S. Environ Protect Agency et al class I & II Injection Well Technol Int Symp, May 8 11, 1989, Dallas, TX. pp. 333 343.
Keywords: waste disposal, disposal, biodegradation, laboratory equipment, soil pollution, Texas, water pollution

Croise, J., W. Kinzelbach, and J. Schmolke. 1991. Computation of air flows induced in the zone of aeration during in situ remediation of volatile hydrocarbon spills. IAHR Proceedings. 3:437-444.
Key Words: Germany, pollution, ground water, environmental geology, soils, oil spills, hydrocarbons, unsaturated zone, Darcy's law, sensitivity analysis, West Germany, Central Europe, Europe, organic materials, reclamation, controls, preventive measures, volatiles.

Cross, B.L. 1992. A guide to local ground water protection. In: Proceedings of the Underground Injection Pract Counc Winter Mtg, Jan 26-29, Corpus Christi, TX, pp. 61-89.
Key words: Water Pollution, Groundwater, Leak, Legal, Oil Spill, Pipeline, Texas

Cross, A.M. 1992. Monitoring marine oil pollution using AVHRR data. Observations off the coast of Kuwait and Saudi Arabia during January 1991. International Journal of Remote Sensing. 13(4):781-788.
Key words: Water Pollution, Oil Spills, Remote Sensing
In support of a United Nations Environment Programme (UNEP) initiative to assess the impact of marine oil pollution during the conflict over Kuwait, a time series of five Advanced Very High Resolution Radiometer (AVHRR) scenes recorded during January 1991 was analysed. Evidence of the oil slick was observed adjacent to the Mina al Ahmadi oil terminal at Sea Island and close to the Kuwaiti coastline. The identification of the slick was supported by negative results from cloud tests, by the observation that it was warmer than the sea at night and cooler by day, and by its juxtaposition with the known source at Sea Island. The extent of the slick was determined using a thermal threshold and its trajectory mapped over

one week. The slick appeared to extend over 144 km2 on 29 January. This experience suggests that AVHRR can be a useful data source for slick monitoring, particularly when airborne reconnaissance is difficult. (Author abstract) 18 Refs.

Crossland, N.O. 1988. Validating the hazard assessment process. Chemistry and Industry. 1:23 24.
Key words: biodegradation, fish, soil, water pollution

Croswell, William F. and John C. Fedors. An ongoing assessment of the use of space technology in monitoring oil spills. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Los Angeles, Ca, pp. 313 316. Washington, D.C.: American Petroleum Institute.
Keywords: assessment, monitoring, oil spills.

Crouch, R.L., S.C. Burnitt, H.H. Porterfield. 1965. Investigation of ground-water contamination in the Vealmoor oil field, Howard and Borden Counties, Texas. Texas Water Comm. Repts. LD-0265.

Crouch, Michael S. 1990. A semi-quantitative approach to soil vapor surveys. In: Proceedings of the National Outdoor Action Conference on Aquifer Resotration, Ground Water Monitoring and Geophysical Methods. 4:267-277.
Key Words: Soils, pollution, ground water, field studies, gases, detection, organic materials, volatiles, quantitative analysis, techniques, monitoring, site exploration, case studies, oil spills, seepage, reclamation, sampling.

Crouse, MSTC James W. 1989. National strike force employment in humanitarian relief: Monongahela River oil spill. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, pp. 81 83. Washington, D.C.: American Petroleum Institute.
Keywords: national strike force, Monongahela River, oil spill.

Crow, Walter, Eric Anderson, Edward Minugh. 1987. Subsurface venting of vapors emanating from hydrocarbon product on ground water. Ground Water Monitoring Review. 7(1):51.
Key Words: Groundwater (contaminated), hydrocarbon vapor removal, venting system, oil spill mitigation.

Crow, P. 1991. Oil spill response group aiming for full operation. Oil & Gas Journal. 89(48):19-21.
Key Words: Oil Spills, MSRC Role.
Describes the role of the Marine Spill Response Corporation, financed by major US oil companies through

the Marine Protection Association. Once in full operation in 1993, a MPA member may summon MSRC to be responsible for the clean up of a large spill. MSRC may work with, or under direction of the Coast Guard. The Corporation has regional bases, and has ordered offshore response vessels, with oil/water separators and skimming systems. Other equipment ordered includes various booms and shallow water vacuum skimmers, barges and pumps. Proposed research will focus on mitigation of shoreline effects, remote sensing for oil spill tracking and prevention of oil loss from damaged ships. States may be lobbied to adopt federal standards of limited immunity for oil spill responders. (C.J.U.).

Crow, P. 1992. U.S. Oil spill cleanup firm aims for full operation next summer. Oil Gas J. 90(52):21-23.
Key words: Oil Spill, Contingency Planning, Pollution Control Equipment, Remote Sensing

Crump-Wiesner, Hans J. and Allen L. Jennings. 1975. Properties and effects of non-petroleum oils. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 29 32. Washington, D.C.: American Petroleum Institute.
Keywords: oils.

Crusse, R.E. 1991. Mosquito fleet: Using charter boats to respond to oil spills. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, (Condensation) API Publication N.4529, pp. 710 11.
Key words: Accident, Alaska, Boom, Bulk, Crude Oil, Oil Waste

Cubit, J. D. 1987. An oil spill affecting coral reefs and mangroves on the Caribbean Coast of Panama. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, D, pp. 401 406. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, coral, mangroves, Panama.

Cubit, J.D., and J.L. Connor. 1993. Effects of the 1986 Bahia Las Minas oil Spill on reef flat Communities. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 329-334.
Key words: Toxic Effect, Crude Oil, Oil Spill, Contamination, Crude Oil, Environmental Impact

Cundell, A. M. and R. W. Traxler. 1973. The isolation and characterization of hydrocarbon-utilizing bacteria from Chedabucto Bay, Nova Scotia. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C., pp. 421 426. Washington, D.C.: American

Petroleum Institute.
Keywords: hydrocarbon, bactria, Chedabucto Bay, Nova Scotia.

Cunningham, J. 1989 . Decision-making on the use of dispersants: the role of the states. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, pp. 353 356. Washington, D.C.: American Petroleum Institute.
Keywords: dispersants.

Cunningham, J. M. 1991. Use of dispersants in the United States: perception or reality? In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991, San Diego, CA, pp. 389 394. Washington, D.C.: American Petroleum Institute.
Keywords: dispersants.

Curran, R. 1992. Going commercial...The Alberta Oil Sands Technology & Research Authority is bringing its mobile oilsands demonstration plant to a lease near you. Oilweek (8/17/92): 43
Key words: tar sands, Canada, oil, legal consideration, North America, separation

Curran, B. 1990. Entrepreneur targets spill cleanup. Oilweek 41(37):10.
Key words: Economic Factor, Growth, Pollution Control

Cywin, Allen. 1969. Federal research and development program for oil spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, 1969, New York, NY, pp. 15 22. Washington, D.C.: American Petroleum Institute.
Keywords: federal, research, oil spill.

D. T. Tsahalis. 1979. Contingency planning for oil spills: riverspill a river simulation model. In: Proceedings of the API et al. Oil Spill Prevention, Behavior, Control, Cleanup Conf, Los Angeles, CA, March 19 22. pp. 27 36.
Key words: Oil Spill Model, Water Pollution, Offshore Oil

D'Ozouville, L. 1979. Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Los Angeles, CA.
Key words: oil, offshore, sediments, Amoco Cadiz, oil spill

Dahl, E., and T. I. Bern. 1983. A 100-well study of offshore blowout causes. Norw Maritime Res11(4):19 26.
Key words: Blowout, Oil Spill

Dahlin, Jeffrey and Jacqueline Michel. 1989. Resource response guides. In: Proceedings of the 1989 Oil

Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, p. 582. Washington, D.C.: American Petroleum Institute.
Keywords: resource, response.

Dahlin, H. 1987. Vision of tracking on oil pollution via satellite. In: Proceedings of the Conference on oil pollution control towards the year 2000, September 23 25 1987, Bergen, Norway, 9 pp.
Key words: Oil Spill, Remote Sensing, Water Pollution Control
The last 15 years we have seen many visions and promising ideas about future use of satellites. Fancy pictures, showing different features on land and sea, have been produced from information collected by satelliteborne sensors. We usually get excited of this new view of the earth. But what is operational today, or just experimental, and what will be operational in the future The vision is that in the year 2000 oil pollution is monitored by a system of satellites - polar platforms - equipped with microwave sensors (Synthetic Aperture Radar, SAR) covering the whole ocean with a repetition period of 3 days. Coastal and other sensitive areas are also covered by airborne surveillance. To follow a discovered oil slick between the satellite passages and before the combatting of the oil, numerical models are used with a much higher accuracy than today. 4 figs.

Dahlmann, Gerhard and Dagmar Timm. 1993. Comparative investigations of oiled seabirds and beaches in the netherlands, Denmark, and the Federal Republic of Germany. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 885 887. Washington, D.C.: American Petroleum Institute.
Keywords: oiled, seabirds, beaches, Netherlands, Denmark, Germany.

Dailey, J. J., P. E. Cassidy, and B. J. Yager. 1975. Beach protection by a degradable, sprayed film. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 415 424. Washington, D.C.: American Petroleum Institute.
Keywords: beach, degradable, film.

Dalton, William J. and A. J. Heikamp, Jr. 1985. Early experiences with a single-vessel offshore spill cleanup system. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 57 60. Washington, D.C.: American Petroleum Institute.
Keywords: vessel, offshore, spill, cleanup.

Danenberger, E.P. 1991. Oil-spill Contingency Planning for OCS Operations. In: Proceedings of the US

Minerals Manage Serv 7TH Amer Soc Civil Eng Et al Coastal & Ocean Manage Symp (coastal zone 91)
(Long Beach, Calif, 7/8-12/91) proc v 1, PP 472-484.
Key words: oil spill, administration, business operation, continent, continental margin, continental shelf, contingency planning, control, earth structure, emergency, management, planning, pollution control, response, strategy, accident, air pollution, Alaska, Atlantic Ocean, barrier, blowout (well), book, California, contamination, crude oil

Danenberger, E. P., Capt. R. B. Eldridge, and M. Crocker. 1983. Oil spill contingency planning for Georges Bank. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983, San Antonio, TX, pp. 123 128. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, contingency, Georges Bank.

Daniel, P., and J. Poitevin. 1992. A numerical study of movements of an oil slick on the sea surface in the Persian Gulf from 25 January 1991 to 1 February 1991. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:249-260.
Key words: Oil Spill, Contamination, Environmental Pollution, Remote Sensing

Davidson, K.S. 1988. Geologic controls on oil migration within a coastal limestone formation. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 1:233-251.
Key words: Water Pollution, Oil Spill, Groundwater, Monitoring

Davidson, Lt. D. A., Cdr. M. W. Mastenbrook, and Lt. Cdr. G. Wiltshire. 1989. Pollution response in the western Pacific. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, pp. 568 569. Washington, D.C.: American Petroleum Institute.
Keywords: pollution, response, Pacific.

Davidson, David A. 1993. Developing standardized facility contingency plans. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 7 11. Washington, D.C.: American Petroleum Institute.
Keyword: standardized, facility, contingency plans.

Davies-Venn, C., J.C. Young, and H.H. Tabak. 1992. Impact of chlorophenols and chloroanilines on the kinetics of acetoclastic methanogenesis. Environmental science & technology. 26(8):1627 1635.

Keywords: biodegradation, microorganism
Bench-scale tests were conducted to assess the impact of monochlorophenols and monochloroanilines on the kinetics of acetoclastic methanogenesis. The procedure involved adding toxicant at two to three concentrations to cultures transferred from an acetate-enriched seed culture reactor. A control without toxicant was included as a basis for comparison. Unacclimated cultures were used to minimize the biodegradation of the toxic organic chemicals during the test. A finite-difference, nonlinear, least-squares algorithm was used to estimate kinetic parameters by obtaining a best fit of the experimental data to the classical Monod growth and substrate utilization model.

Davis, G. E. 1992. State legislative trends affecting oil pipelines. In: Proceedings of the API Pipeline Conf, April 7-8, Houston, TX. pp. 263-267.
Key words: Oil Spills, Pipelines

Hovey, D. J., and E. J. Farmer. 1993. Pipeline accident, failure probability determined from historical data. Oil Gas J. 91(28):104-107
Key words: Oil Spills, Pipeline, Probability Process

Davis, W.C. and T.M. Pankratz. 1988. Treatment of process wastewater from petrochemical plants using a rotating biological contractor: A case study. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 472-482.
Key words: Bacteria, Biodegradation, Bioreactors, Industrial Wastes, Monitoring, Wastewater
A rotating biological contractor (RBC) process can be utilized in virtually any industrial or municipal application where the liquid wastewater characteristics are amenable to biological oxidation. Biological oxidation, in this fixed film process, uses innocuous bacteria, protozoa, and algae to convert the soluble (dissolved) organic pollutants into new cell mass and gaseous by-products. A six month field pilot study, using an RBC, was conducted at a southern petrochemical plant. The purpose of this study was to determine the feasibility of the RBC process as a means of treating a unique industrial wastewater for direct discharge. The pilot study utilized industrial wastewater containing blowdown from an ethane and propane gas cracking furnace quench tower co-mingled with storm water runoff. The polluted wastewater must be treated prior to reuse or discharge. Following start up, and after the establishment of a biofilm on the contractor media, the operating parameters were varied in an effort to determine the optimum operating conditions. Variations included: Increasing and decreasing the plant flow rates, varying the speed of shaft rotation, pre-aeration, and the addition of powdered activated carbon. The pilot test results

indicated that the RBC can provide effective biological treatment of the industrial wastewater within the requirements of the permit limits.

Davis, Joe O. 1991. Depth zoning and specialized processing methods for electromagnetic geophysical surveys to remote sense hydrocarbon type groundwater contaminants. Ground Water Management. 5:905-913.
Key Words: Geophysical methods, ground water, pollution, electromagnetic methods, applications, oil spills, monitoring, occurrence, detection.

Davis, C. E. 1975. Multielement true boiling point gas chromatograph for monitoring oil pollution. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp.93 96. Washington, D.C.: American Petroleum Institute.
Keywords: gas, chromatograph, monitoring, oil, pollution.

Davis, B.A., J.R. Jensen, E.W. Ramsey III, and J. Michel. 1990. Enhanced environmental sensitivity index mapping using remote sensing and geographic information system technology. U.S. Fish Wildl Serv Biol Report. 18:59-60.
Key words: Wildlife, Sensitivity, Oil Spill

Davison, John, Francoise Brunel, Angelika Phanopoulos, and Kone Kaniga. 1989. Engineering bacteria for environmental pollution control and agriculture. In: Proceedings of the Biotechnology & Biodegradation Int Workshop, Lisbon, Portugal (Gulf Publishing), pp.83-104.
Key words: Biodegradation, Microorganism, Bacteria, Hydrocarbons
The potential for deploying Pseudomonas bacteria as pollution-control agents rests on the solution of technical problems in genetic engineering. These problems focus on the ability to identify and clone degradative genes and the ability to stably incorporate these genes into suitable Pseudomonas strains.
Recent advances in these fields are surveyed, and the evolution of two methods to isolate and characterize degradative genes, are highlighted. Examples cited concern the genetic coding for degradation of vanillate and sodium dodecyl sulfate. Transposon vectors carrying multiple cloning sites have been constructed to allow for stable insertion of cloned DNA into the Pseudomonas chromosome.

Dawson, H.E., Roberts, P.V. 1991. Residual halogenated organic liquids in saturated porous media. Eos, Transactions, American Geophysical Union. 72(17):127.
Key Words: Ground water, pollution, organic materials, halogens, liquid phase, porous materials, saturation, aquifers, oil spills, bouyancy, hydraulic conductivity, experimental studies, theoretical studies,

controls, crude oil.

De A. Araujo, R. P., K. Momo, E. Gheradi-Goldstein, M. G. Nipper, and P. G. Wells. 1987. Marine
dispersant program for licensing and research in Sao Paulo State, Brazil. In: Proceedings of the 1987 Oil
Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, MD, pp. 289 292.
Washington, D.C.: American Petroleum Institute.
Keywords: marine, dispersant, research, Brazil.

De Souza, A.R. 1991. Environmental consequences of the 1990-1991 Persian Gulf War: remote-sensing
datasets of Kuwait and environs. Res Explor, pp. 5 48.
Key words: Kuwait, Chemical Process, Oil Spill, Remote Sensing

De Jong, S.A. Short- and long-term effects of discharged OBM cuttings, with and without previous
washing, tested in field and laboratory studies on the Dutch Continental shelf, 1985 1990. In Proceedings
of the First International Conference on Health, Safety and Environment In Oil and Gas Exploration and
Production Part 2 (of 2) in Hague, Neth.
Key words: Dutch, degradation, disposal, environmental impact, bioassay
A Dutch programme was carried out to study the distribution of discharged washed and unwashed
oil-containing cuttings in the sediment and waterphase and their effects on selected test species in the Dutch
part of the North Sea. The distribution of OBM cuttings in sediment around drilling locations was related
to the total amount of oil discharged in the watercolumn. Increased oil contents were found over a range of
1000 to 5000 m in residual current direction. Total oil contents remained high at locations where unwashed
OBM cuttings were discharged. At one location oil was found in high concentrations up to 6 years after
discharge of OBM cuttings, specially due to the persistence of the oil fractions 'Other peaks' and 'UCM'.
Washing of OBM cuttings resulted in lower amounts of oil discharged, lower concentrations in the
sediment in the vicinity of the platform (up to 100 m), equal concentrations at 250 m but higher
concentrations up to at more than 500 m off the platform when compared with unwashed cuttings and the
respective amount of oil discharged. However, within one year, degradation of oil seems to have taken
place at one of the washed sites at 5000 m. During discharge in the watercolumn, oil was taken up by
Mytilus edulis from washed cuttings as well as from unwashed cuttings. Leaching of oil from the sediment
into the waterphase was measurable in the field for only a limited period of time, less than a year after
discharge. Several sediment-inhabiting species were tested on their response to oil contamination. Four
species tested in experimental boxcosm set-ups. Echinocardium cordatum, Amphiura Lagis Koreni and

Nucula turgida responded to elevated contamination levels by increased mortality. Boxcosm experiments supported the conclusion derived from the results of field studies on the macrofauna distribution around drilling sites. i.e. the NOEC-value should be estimated in the order of 1-10 mg oil kg1 dry sediment left bracket 12 right bracket. For boxcosms taken at unwashed and washed sites one year after discharge this was confirmed. Preliminary results of a boxcosm experiment with sediment where discharge of unwashed OBM cuttings had taken place 6 years before, the NOEC-value seemed to have increased. Experimental boxcosms enable assessment of possible adverse effects of experimentally treated drilled cuttings or other toxic substances on the (macro)benthic infauna. Adverse effects were also seen at one of the washed sites using a short-term bioassay test with the sediment-inhabiting amphipod Bathyporeia sarsi. (Author abstract)
22 Refs.

Dean, Kenneson, William Stringer, Joanne Groves, Kristina Ahlnas, and Thomas Royer. 1989. The Exxon-Valdez oil spill, Alaska. In: Proceedings of the Seventh thematic conference on Remote sensing for exploration geology; methods, integration, solutions, 7:149-150.
Key words: Alaska, Pacific Ocean, Pollution, Remote Sensing, Oil Spills, Prince William Sound

Dean, T. A., L. McDonald, M. S. Stekoll, and R. R. Rosenthal. 1993. Damage assessment in coastal habitats: lessons learned from Exxon Valdez. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 695 697.
Washington, D.C.: American Petroleum Institute.
Keywords: damage, coastal, Exxon Valdez.

Dean-Ross, D. 1989. Bacterial abundance and activity in hazardous waste-contaminated soil. Bulletin of Environmental Contamination and Toxicology. 43(4):511-517.
Key words: Bacteria, Biodegradation, Hydrocarbons, Indiana, Microorganisms, Monitoring, Soils
The office of Technology Assessment has estimated that there may be as many as 10,000 abandoned hazardous waste disposal sites across the United States, many of which have the potential to adversely impact drinking water supplies. Of the many options available for the remediation of these sites, the use of microorganisms to degrade organic chemicals offers many advantages in terms of speed, efficiency and cost. Bioremediation has been used with success to treat soils contaminated by kerosene and other hydrocarbons products. In these studies, the indigenous soil populations of the contaminated soils were effective in removing the spilled hydrocarbons and returning the soil to productivity. The effectiveness of bioremediation for non-hydrocarbon compounds or the complex

mixtures of chemicals likely to occur at abandoned hazardous waste sites has received less attention. The present study was designed to determine the activity of indigenous microbial populations at a hazardous waste site, their degree of adaptation to toxic chemicals present in the waste mixture, and their ability to degrade toxic organic compounds, using phenol as a model substrate.

DeBono, Gerald. Investigating Waste Oil Disposal by Combustion. Interim rept. Coating and Chemical Lab Aberdeen Proving Ground Md, 18p. Jan 74.
Key words: waste oil, disposal, burning
In response to efforts directed towards waste oil disposal, APG Post Engineers initiated a program in 1968 whereby waste oil was introduced into No. 6 Fuel Oil and subsequently burned for heat. Because of the heavy consistency of No. 6 Fuel Oil, no operational difficulties occurred. However, in August 1972, APG switched to No. 2 Fuel Oil and some concern was generated regarding the miscibility of the waste oil with a lighter fuel. To date, no maintenance problems have resulted from burning the waste oil, nor have any emission levels been exceeded. However, these results may be due to the relative lightness of the waste oil and the low waste oil/fuel oil dilution ratio (1%) in which they are burned. (Author)

Debusschere, K. 1993. Implementing the shoreline cleanup assessment team process in the Gulf of Mexico. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 95 97. Washington, D.C.: American Petroleum Institute.

Degagne, D., W. Remmer. 1990. A practical approach to enforcement of heavy oily waste disposal. In: 1st U.S. Environ Protect Agency Oil & Gas Explor & Prod Waste Manage Pract Int Symp (New Orleans, 9/10 13/90).
Key words: oil, disposal, petroleum, oil recovery.

Delaney, Lt. Cdr. Steven J. 1981. Statutory criteria: Coast Guard penalty assessments under section 311(b), federal water pollution control act. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981, Atlanta, GA, pp. 595 600. Washington, D.C.: American Petroleum Institute.
Keywords: Coast Guard, penalty, section 311(b), federal, water pollution control act.

Delikat, LCDR D. S. 1993. Benzene vapor concentrations during a simulated crude oil spill. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 805 806. Washington, D.C.: American

Petroleum Institute.
Keywords: benzene.

Delille, D., and N. Vaillant. 1990. The influence of crude oil on the growth of subantarctic marine
bacteria. Antarctic Science. 2(2):123.
Key words: Bacteria, Degradation, Water Pollution

Delshad, M., and G.A. Pope. 1989. Comparison of the three-phase oil relative permeability models.
Transp Porous Media. 4(1):59-83.

Delvigne, Gerard A. L. 1987. Netting of viscous oil. In: Proceedings of the 1987 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, MD, pp. 115 122.
Washington, D.C.: American Petroleum Institute. 1987.
Keywords: netting, viscous, oil.

Delvigne, G.A.L. 1987. Laboratory experiments on oil spill protection of a water intake. In: Proceedings
of the International conference on oil in freshwater, October 1984, Edmonton, AB, pp.446 458.
Key words: petroleum, environmental transport, materials recovery, oil spills, water polllution control,
weathering
The threat of oil pollution to water intakes is a serious problem in areas with oil exploration and production
activities, refineries and oil transport. The Delft Hydraulics Laboratory has performed an extensive study
of protective measures for the specific case of cooling water and drinking water intake channel in an area
with a high oil-spillage risk. The transport, spread and weathering processes of oil slicks were computed
with a numerical simulation model taking into account the local wind and wave conditions and water
currents. Protective measures against the penetration of surface-floating oil in the intake channel were
tested in a hydraulic scale model in a wind-wave flume with a water depth h = 0.7 m. The tests were
aimed at the analysis of the different ways in which floating mechanical barriers and pneumatic barriers
may fail to retain the oil. Various types of oil and oil emulsions were used under the (scaled) extreme
conditions of wind, waves and currents. The flume experiments led to the following results. Pneumatic
barriers fail to retain oil at the entrance of the intake channel because of the entrainment of oil droplets
from the oil slick even when the water current velocity in the channel is as low as 0.10 m/sec. Floating
barriers fail to retain high-viscous oil and emulsified oil independently of the draft when the normal
component of the current exceeds 0.15 m/sec. However, oil can be trapped by a double-boom
configuration across the intake channel by taking advantage of the circulation zone behind the first barrier.
5 refs., 8 figs., 1 tab.

Delvigne, G.A.L. 1991. On scale modeling of oil droplet formation from spilled oil. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp. 501 6.
Key words: Additive, Dispersant, Fluid Flow, Oil Waste, Pollution Control

Delvigne, Gerard A. L. 1985. Experiments on natural and chemical dispersion of oil in laboratory and field circumstances. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 507 514. Washington, D.C.: American Petroleum Institute.
Keywords: chemical, dispersion, oil.

Delvigne, Gerard A. L. Barrier failure by critical accumulation of viscous oil. In Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, pp. 143 148. Washington, D.C.: American Petroleum Institute.
Keywords: barrier, viscous, oil.

Delvigne, Gerard A. L. 1993. Natural dispersion of oil by different sources of turbulence. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 415 419. Washington, D.C.: American Petroleum Institute.
Keywords: dispersion, oil, turbulence.

Delvigne, Gerard A. L. 1989. A sampler for the collection of dispersed oil droplets. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, pp. 567 568. Washington, D.C.: American Petroleum Institute.
Keywords: Dispersed, Oil.

Delzer, G.A.Kidd, D.R. 1992. Adsorbent compositions for the removal of hydrogen sulfide from fluid streams. Phillips Petroleum Co. 1992.
This patent describes a sorbent composition effective in the removal of hydrogen sulfide from gaseous streams comprising zinc oxide and a Group IIA metal silicate wherein the concentration of the zinc oxide is in the range of from about 10 weight percent to about 95 weight percent based on the total combined weight of the zinc oxide and the Group IIA metal silicate.
Key words: adsorbents, chemical compostion, air pollution control, sorbent, injection processes, hydrogen sulfides, water pollution, control, sorbent, recovery systems, desulfurization, gaseous wastes, liquid wastes, oil spills.

DeMoll, E. 1990. The role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii. Kentucky Univ., Lexington, KY (USA). Dept. of Microbiology and Immunology. 4.
Research continues on the role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii. This report summarizes current progress of the research. Topics include: A survey of other methanogens for the purine degradation pathway; isolate and characterize the enzyme and products of formiminoglycine cleavage; ascertain the fate of glycine from the formiminoglycine cleavage; elucidate the route of incorporation of the formyl moiety of formiminoglycine into methane biosynthesis; determine the percent methane and amino acid synthesis from purine degradation; and related studies on xanthine dehydrogenase and pyrimidine degradation of M. Vannielii. (SM).
Key words: methane, biosynthesis, bacteria, enzymes, nitrogen cycle, aromatics, oxidoredutases.

Denac, M., Miguel, A., Dunn, I.J. 1988. Modeling dynamic experiments on the anaerobic degradation of molasses waste water. Biotechnol. Bioeng. Symp.(United States). 31:1:1-10.
The kinetics of anaerobic degradation of a molasses waste water were measured under constant pH conditions in a laboratory scale packed bed reactor. In continuous and batch experiments the formation and degradation rates of the organic acids (butyric, propionic and acetic) have been followed. The influence of hydrogen gas on the acid degradation rates has been measured and, contrary to the literature and the thermodynamic calculations, no inhibition was detected, biofilm diffusional effects may be the reason. Two dynamic simulation models were tested, a heterogeneous model, which considered the biofilm diffusion-reaction phenomena and a quasihomogeneous model with the same kinetics. Except for hydrogen, the diffusion effects were found to be negligible. Otherwise both models gave essentially the same results and the time profiles of acids, hydrogen, carbon dioxide and methane agreed relatively well with dynamic startup experiments. Batch experiments showed the acid concentrations to be highly sensitive to the initial molasses concentration. This aspect was not included in the model but is being investigated further.
Key words: methane, biosynthesis, molasses, continuous culture, kinetics, waste water, bioconversion, digestion, bacteria, pH value, alkanes, digestion, bioconversion, diffusion, batch culture.

Denis, J. and L. Loubersac. 1987. Application of high-resolution space imagery for contingency planning.
In: Proceedings of the 1987 Oil Spill Conference(Prevention,

Behavior, Control, Cleanup), April 6 9,
1987, Baltimore, MD, pp. 630. Washington, D.C.: American
Petroleum Institute.
Keywords: imagery, contingency, planning.

Denis, Jacques and Jacques Populus. Space imagery contribution to
coastal atlas mapping. In: Proceedings
of the 1989 Oil Spill Conference(Prevention, Behavior, Control,
Cleanup), February 13 16, 1989, San
Antonio, TX, pp. 572. Washington, D.C.: American Petroleum
Institute.
Keywords: imagery, coastal, mapping.

Dennis, David M. 1977. Effectively recovering oil spills to
groundwater. In: Proceedings of the 1977 Oil
Spill Conference(Prevention, Behavior, Control, Cleanup), March 8
10, 1977, New Orleans, LA, pp.
255 258. Washington, D.C.: American Petroleum Institute.
Keywords: recovering, oil spills, groundwater.

Dennis, LCDR Samuel J. 1975. United States Coast Guard high seas
oil containment system (HSOCS). In:
Proceedings of the 1975 Conference on Prevention and Control of
Oil Pollution, March 25 27, 1975, San
Francisco, CA, pp. 365 368. Washington, D.C.: American Petroleum
Institute.
Keywords: United States, Coast Guard, oil, containment, (HSOCS).

DeNoville, Ronald C. 1979. Adjusting and handling oil spill
pollution catastrophe claims. In: Proceedings
of the 1979 Oil Spill Conference(Prevention, Behavior, Control,
Cleanup), March 19 22, 1979, Los
Angeles, CA, pp. 105 107. Washington, D.C.: American Petroleum
Institute.
Keywords: oil spill, pollution, claims.

Depaoli, D. W., S.E. Herbes, J.H. Wilson, D.K. Solomon, H.L.
Jennings. 1991. In situ Soil Venting -
Full Scale Test, Hill AFB, Guidance Document. Volume 2. Final
rept. Oct 87-Jan 90. 236(p).
Key Words: Cleaning, costs, emission, emission control,
extractoin, fuels, jet engine fuels, scale, soils,
test and evaluation, venting, volume, reclamation, ground water,
decontamination, Air Force facilities,
Utah, chemical contamination, oil spills, permeability, soil
tests, organic compounds.

Department of the Interior. 1992. Availability of Report of the
Technology Assessment and Research
Program. 57(123).
The Minerals Management Service (MMS) is announcing the
availability of the report entitled
''Technology Assessment and Research Program for Offshore
Minerals Operations,'' 1991 Report, OCS
Study MMS 91- 0057.

Department of Transportation. 1993. Establishment of Area

Committees for the Coastal Zone. 58(134).
SUMMARY: The Coast Guard is announcing the establishment of Area Committees for the coastal zone of the United States. The Area Committees prepare Area Contingency Plans (ACPs) for the response to discharges of oil or hazardous substances into the waters of the United States in order to minimize the harm to the environment in the most cost-efficient manner.

Department of Transportation. 1993. Discharge Removal Equipment for Vessels Carrying Oil. 58(244):Part V.
SUMMARY: The Coast Guard is issuing regulations that require vessels carrying oil in bulk as cargo to carry discharge removal equipment, install spill prevention coamings, and install emergency towing arrangements. The Coast Guard also is requiring vessels to have a prearranged capability to calculate damage stability in the event of a casualty. Regulations requiring removal equipment are mandated by the Oil Pollution Act of 1990 (OPA 90). The purpose of the regulations is to reduce the risk of oil spills, improve vessel oil spill response capabilities, and minimize the impact of oil spills on the environment.
The Coast Guard is issuing an interim final rule in order to solicit further public comment and information on emerging technologies that prevent, contain, or remove discharges of oil from vessels into the marine environment.

Department of Health and Human Services. 1989. Decision guide for identifying substance-specific data needs related to toxicological profiles. Notice 54(174): ATSDR-11.
Key words: toxicological profiles, research
This notice announces the Decision Guide for Identifying Substance-Specific Data Needs Related to Toxicological Profiles. Section 104(i)(2) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), as amended by the Superfund Amendments and Reauthorization Act (SARA) (Pub. L. 99-499), requires that ATSDR prepare (1) a list of hazardous substances found at NPL sites (in order of priority), (2) toxicological profiles of those substances, and (3) a research program to fill data gaps associated with the substances. The priority list of substances was published in the Federal Register on April 17, 1987 and October 20, 1988 (52 FR 12866 and 53 FR 41280). The availability of the first 10 final toxicological profiles was published in the Federal Register on April 6, 1989 and June 23, 1989 (54 FR 14037 and 54 FR 26417). As the first step in preparing a research program, ATSDR has developed a Decision Guide. This Decision Guide, as approved by the Agency's Board of Scientific Counselors, is published below. Public comment is invited.

Department of Transportation. 1993. Response Plans for Marine Transportation-Related Facilities.
58(23):Part III.
The Coast Guard is establishing regulations requiring response plans for marine transportation-related (MTR) facilities including deepwater ports, certain Coast Guard-regulated onshore facilities, marinas, tank trucks, and railroad tank cars. This interim final rule (IFR) also establishes additional response plan requirements for facilities located in Prince William Sound, Alaska, permitted under the Trans-Alaska Pipeline Authorization Act (TAPAA). This IFR addresses all MTR facilities that could reasonably be expected to cause substantial harm to the environment by discharging oil into or on the navigable waters of the United States, adjoining shorelines, or the exclusive economic zone. Regulations requiring facility response plans and discharge removal equipment are mandated by the Federal Water Pollution Control Act (FWPCA), as amended by the Oil Pollution Act of 1990. The purpose of requiring facility response plans and discharge removal equipment is to enhance private sector planning and response capabilities to minimize the environmental impact of spilled oil.

Department Of Comerce. 1993. In Situ Burning Oilspill Workshop.
58(243).
SUMMARY: The National Institute of Standards and Technology will conduct a workshop on behalf of the Minerals Management Service, Department of the Interior. The workshop will present the current state of knowledge to the user community and to interested parties. Participants will help to identify and to prioritize research needs and information needs to support decisions on the use of in situ burning of spilled oil. Specific emphasis will be given to environmental and to operational implications of in situ burning response technology. Preprints of the technical papers will be available to attendees to facilitate their participation in panel discussions. After the workshop a proceedings will be published containing the technical papers and the research and information needs identified by the attendees.

Department of Commerce. 1988. Workshop on Alaska Arctic Offshore Oil Spill Response Technology;
Meeting. 53(217).

Department of Transportation. 1992. South Florida Oil Spill Research Center. 57(95).
The Coast Guard intends to establish a Federally Funded Research and Development Center to address prevention, tracking and cleanup of oil discharges in the unique tropical and subtropical environment around South Florida. The Coast Guard is seeking letters of interest with capabilities statements from

interested parties.

Department of Transportation. 1993. Oil Pollution Act of 1990; Appointment of Area Committee
Members and Designation of Area Committee Responsibilities. 57(11).
The Coast Guard is providing notice of the development of policy regarding the appointment of members
to Area Committees in the coastal zones. It is also providing notice of the responsibilities of the Area
Committees to conduct local contingency planning under the Oil Pollution Act of 1990 (OPA 90). This
notice solicits comments from the public regarding the establishment of Area Committees under the
direction of Coast Guard predesignated Federal On-Scene Coordinators (OSCs), appointment of members,
and implementation of pollution response planning responsibilities. The Coast Guard hopes for early
participation by the public in order to expedite the creation of these policies. The Coast Guard and EPA
are refining response policies designed to minimize the harm caused by discharges of oil or releases of
hazardous substances in the most cost-effective manner. These policies will be published as part of the
revised National Contingency Plan (NCP) (40 CFR part 300), currently being developed.

Department of Transportation. 1993. Vessel Response Plans. 58(23):Part III.
The Coast Guard is establishing regulations requiring response plans for certain vessels that carry oil in
bulk as cargo and additional requirements for certain vessels operating in Prince William Sound, Alaska.
These regulations are mandated by the Federal Water Pollution Control Act (FWPCA), as amended by the
Oil Pollution Act of 1990 (OPA 90). The purpose of these requirements is to improve response capabilities
and minimize the impact of oil spills from these vessels.

Department of the Interior. 1989. Fifth Seminar on Technology Assessment and Research Program for
Outer Continental Shelf Oil and Gas Operation. 54(51).

Department of Transportation. 1994. Emergency flow restricting devices/leak detection systems.
59(12):Docket No. PS-133.
For further information contact: Lloyd W. Ulrich, (202) 366-4556.
In 1991, the Department issued a report on emergency flow restricting devices (EFRDs) that proposed
seeking public input on the placement of EFRDs at certain locations on hazardous liquid pipelines. The
Pipeline Safety Act of 1992 mandated that the Department issue regulations prescribing the circumstances
under which operators must use EFRDs and other equipment used to detect and locate pipeline ruptures on
hazardous liquid pipelines. The regulations are to be issued following a survey and assessment of the

effectiveness of such equipment. This advance notice of proposed rulemaking (ANPRM) poses a series of questions in order to solicit public input for the survey process.

Department of the Interior. 1988. Oil and gas and sulphur operations in the outer continental shelf; outer continental shelf minerals and rights-of-way management, general; and outer continental shelf orders for all regions of the outer continental shelf. 53(63). This rule restructures and consolidates into one document the existing multitier rules of the Offshore program of the Minerals Management Service (MMS) that govern oil, gas, and sulphur exploration, development, and production operations in the Outer Continental Shelf (OCS). The new rule is intended to eliminate redundant, burdensome, unnecessary, and counterproductive requirements imposed by the existing rules; introduce more performance standards; introduce new and updated requirements; and simplify the language of the rules.

Department of the Interior. 1991. Outer continental shelf Beaufort sea oil and gas lease sale 124. 56(101):Part III.

Department of Energy. 1992. National environmental policy act implementing procedures. 57(80):Part II. The Department of Energy (DOE) is revising the existing rule at 10 CFR part 1021, titled ''Compliance with the National Environmental Policy Act,'' to incorporate revised provisions of DOE's Guidelines for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA). DOE is also revoking its existing NEPA guidelines. This rule incorporates changes required by certain policy initiatives instituted by the Secretary of Energy to facilitate participation of the public and affected states in the NEPA process for proposed DOE actions. The rule also includes a revised and expanded list of typical classes of actions, including categorical exclusions. Categorical exclusions are classes of actions that normally do not require the preparation of either an environmental impact statement or an environmental assessment.

Department of Commerce. 1994. Natural resource damage assessments. 59(005):Part II. SUMMARY: Section 1006(e)(1) requires the President, acting through the Under Secretary of Commerce for Oceans and Atmosphere, to promulgate regulations for the assessments of natural resource damages resulting from discharges of oil. By today's Notice, NOAA is seeking comments concerning the proposed rule. The proposed rule is for the use of authorized federal, state, and tribal officials referred to in the Oil Pollution Act of 1990 (OPA) as trustees, for the assessment of damages to natural resources and/or

services from a discharge of oil. Natural resource damage assessments are not identical to response or remedial actions addressed by the larger statutory scheme of OPA. Assessments are not intended to replace response actions, which have as their primary purpose the protection of human health, but to supplement them, by providing a process for determining proper compensation to the public for injury to natural resources.

Depetris, R. 1993. Oil Sorbent Products and Method of Making Same. Patent No. US 5186831, c 2/16/93, 8 pp.
Key words: sorbent, collecting agent, fiber, oil skimming, oil spill, oil water separation, physical separation, sorption, p) USA, absorbent, absorption, adsorbent, adsorption, aperture, barrier, business operation, capacity, casings, cellulose, chart, composite material, construction material, container, contamination, control

DePetris, Robert. 1993. Preparation and use of oil sorbent products. Patent No. US 5186831_A, 8 pp.
Key words: Pollution Oil Spill, Remediation, Petroleum, Spill Cleanup

Der, Dr. J. J. and Douglas J. Graham. 1973. Quantitative evaluation of mechanical oil spill cleanup devices. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C., pp.627 634. Washington, D.C.: American Petroleum Institute.
Keywords: evaluation, oil spill, cleanup.

Der, James J. and Edward L. Ghormley. 1975. Oil contaminated beach cleanup. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 431 436. Washington, D.C.: American Petroleum Institute.
Keywords: beach, cleanup.

Desai, Sanjay, Rakesh Govind, and Henry Tabak. 1990. Determination of Monod Kinetics of Toxic Compounds by Respirometry for Structure-Biodegradability Relationships. Emerging Technologies in Hazardous Waste Management (ACS Sym Series 422). pp. 142 56.
Keywords: biodegradation, water pollution
The presence of many organic chemicals in the environment can be attributed to inadequate disposal techniques. The key to evaluating the fate of toxic organic chemicals is dependant on evaluating their susceptibility to biodegradation, one of the most important mechanisms in controlling these concentrations in an aquatic system because toxic pollutants can be mineralized and rendered harmless. Experiments using an electolytic respirometer have been conducted to collect oxygen-consumption data of toxic compounds by

a graphical method. The first-order kinetic constants for the substituted phenols were related to the structure of the compounds by the group contribution method.

Descleves, Cdr. M. and Robert Pellen. 1993. Intercalibration exercise for remote sensing aircraft. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 553 560. Washington, D.C.: American Petroleum Institute.
Keywords: intercalibration, remote sensing, aircraft.

Deslauriers, Paul C. 1983. Transfer and storage systems for the Alaskan Beaufort Sea. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983, San Antonio, TX, pp. 573. Washington, D.C.: American Petroleum Institute.
Keywords: storage, Alaskan, sea.

Deslauriers, Paul C. 1983. Oil spill response training for cooperatives and individual organizations. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983, San Antonio, TX, pp. 233 236. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, response.

Desmarquest, J. P. 1985. Recent advances in dispersant effectiveness evaluation: experimental and field aspects. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 445 452. Washington, D.C.: American Petroleum Institute.
Keywords: dispersant, evaluation.

Desmarquest, J.P. 1983. A Field test and assessment of oil dispersant efficiency. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX., p.574.
Key words: assessment, dispersant.

Desvousges, W. H. 1993. NRDA case study: the Arthur Kill oil spill. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 711 716. Washington, D.C.: American Petroleum Institute.
Keywords: NRDA, Arthur Kill, oil spill.

Devinny, J.S. 1990. Subsurface migration of hazardous wastes. In: Devinny, J.S., L.G. Everett, J.C.S. Lu, R.L. Stollar (eds.), Microbiology of subsurface wastes. Van Nostrand Reinhold: New York, NY, pp. 116-141.
Key words: Biodegradation, Microorganisms, Monitoring, Waste Disposal, Water Pollution Transport

The microbiological activity in aquifers makes the subsurface migration of hazardous wastes more difficult to predict, but may also create opportunities for waste cleanup which are inexpensive and which carry minimal environmental side effects. The growth phases in microbial cultures have substantial implications for the subsurface migration of hazardous waste and for the design of remedial action. Groundwater cleanup requires the use of all growth phases: the growth curve, the lag phase, the exponential phase, and the stationary and endogenous phases. Early in the cleanup process, substrate will be abundant, and exponential growth will occur. Later, the stationary and endogenous phases will complete the removal of the contaminants. If microbiological waste treatment is attempted, it is important to be aware of the growth phases, and to provide the appropriate amounts of oxygen and nutrients at the appropriate times. In some cases, the physical nature of the soils may limit the effectiveness of microorganisms. For some highly toxic chemicals, the minimum concentration necessary for microbial growth may exceed acceptable levels, or the substrate concentration may be too high. In some cases, it may be necessary to dilute the contaminants to promote biodegradation. Limitations of nitrogen and phosphorus are common, and their addition to systems where biodegradation is to be promoted is helpful. Efforts at promoting biodegradation should also include mixed inocula from several sources to insure that the maximum possible variety of species will be present. Many of the hazardous substances which are causing concern for groundwater quality are biodegradable. Some products of microbial activity, however, may cause problems, including toxic byproducts, odors, and acids.

Dewling, R. T., J. S. Dorrler, and G. D. Pence, Jr. 1971. Dispersant use vs water quality. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971, Washington, D.C., pp. 271 278. Washington, D.C.: American Petroleum Institute.
Keywords: dispersant, water.

Dewling, Richard T. and Carlos Celso Do Amaral E. Silva. 1979. Impact of dispersant use during the Brazilian Marina incident. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Llos Angeles, CA, pp. 269 276. Washington, D.C.: American Petroleum Institute.
Keywords: dispersant, Brazilian Marina.

Di Luise, G. 1991. Unsaturated medium hydrocarbons pollution evaluation. In: Proceedings of the 1ST SPE et al Health, Safety & Environ in Oil & Gas Explor & Prod Int Conf, November 11-14, 1991, The

Hague, Netherlands, 2:803-809.
Key words: Soil Pollution, Oil Spill, Groundwater, Water Pollution

Diaz, J.V. 1992. Method of Absorbing Oil Using Powdered Aquatic Lily Plant. Patent No. US 5114593, 5pp.

Diaz, Anibal. 1983. Emulsions and debris tests at OHMSETT. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983, San Antonio, TX, pp. 576. Washington, D.C.: American Petroleum Institute.
Keywords: emulsions, OHMSETT.

Dick, R., R. Jackson, F. Kuja, A. Loveless, M. Paul, and S. Wiles. 1990. Improved airborne laser fluorosensor for assessment of marine pollution. In: Proceedings of the Env Canada Arctic & Marine Oilspill Program 13th Technical Seminar, June 6 8 1990, Edmonton, AB, 315 328.
Key words: Monitoring, Marine Water Analysis, Oil Spill, Satellite Applications, Marine Pollution Control
Conservation of marine resources requires monitoring systems which can provide both synoptic data on water quality and the real-time information required to deal with spill emergencies. Airborne laser fluorosensors can contribute to both tasks. As part of a program sponsored by Environment Canada, the US Minerals Management Service, and Fisheries & Oceans Canada, an improved fluorosensor has been built and tested. Adjustable range gating allows for detection of submerged oil and depth profiling. The fluororsensor is detailed.

Dick, R., M. Fruhwirth, M. Fingas, and C. Brown. 1992. Laser fluorosensor work in Canada. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing For Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:223-236.
Key words: Remote Sensor, Canada, Oil Spill, Remote Sensing

Dick, R., M.F. Fingas. 1992. First results of airborne trials of a 64-channel laser fluorosensor for oil detection. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar, June 10 12 1992, Edmonton, Canada, pp. 365-379.
Key words: Oil Spills, Remote Sensing
A new 64 channel airborne laser fluorosensor for oil detection has been assembled and tested. The laser environmental airborne fluorosensor (LEAF) consists of a XeCl excimer laser, a 64 spectral channel, range-gated receiver, and an operator console that includes a data logger. LEAF is easily installed in any aircraft having a 10 in. camera hatch. Laser pulses are reflected off the surface being investigated and the

fluorescence signals from each pulse are digitized along with other data. A series of flight tests of the LEAF system was conducted over several targets including contaminated and clean ponds at an oil refinery and a test site containing oil spilled on ice, sand, and gravel. LEAF was shown able to detect reproducible and distinct signatures from fresh and aged oily material on various surfaces. Changes in spectral shape due to weathering could be detected using simple algorithms, even from small areas which receive less than 10 laser shots per measurement. 9 refs., 12 figs., 1 tab.

Dickens, D., R. Belore, I. Buist, B. Humphrey. 1988. Evaluation of hovercraft for dispersant application.
Report No. CA-95,MICROLOG-89-00751, p. 57.
Key words: air cushion vehicles, oil spills, surfactants
A series of field trials were carried out in Vancouver, Canada in July and August 1986 to determine whether or not hovercraft should be considered for dispersant application. Questions are: the ability of the hovercraft to ''fly'' over an oil slick at high speed without displacing the oil out of the path, the potential for using the hovercraft to impart vertical mixing energy into the water column to aid in the dispersant process and, the ability to mount a suitable spray boom and obtain a uniform spray pattern across the swath width. The field trials and subsequent interpretation of results provide positive answers to the first and second question. The question of mixing energy requires some qualification. The hovercraft contributes considerable mixing energy to the immediate water surface through air entrainment but this effect is short lived and there does not appear to be significant long term vertical mixing in the hovercraft wake. Recommendations are made for operating procedures and boom mounting which should ensure a uniform drop size and dose rate across a swath up to 18 m. The cushion air escaping from around the craft perimeter is not an important factor in adversly affecting the dispersant spray pattern. Depending on the type of machine available, hovcercraft have the capability of treating up to a 1km/sup 2/ slick between loads, at average speeds in the 15 to 25 knot range. The inherent advantages of high transit speed to the site (up to 45 Knots), amphibious operation (i.e. not draft limited) and lack of ceiling or visibility restrictions provide hovercarft with unique capabilities in the dispersant application role. Two patents relating to the process have been abstracted. Appendix B gives the sprecifications of two different models of hovercrafts. 14 refs., 29 figs., 6 tabs.

Dicks, Brian and Kingsley Iball. 1981. Ten years of saltmarsh monitoring: the case history of the Southhampton Water Saltmarsh and a changing refinery effluent discharge. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup),

March 2 5, 1981, Atlanta, GA, pp.
361 374. Washington, D.C.: American Petroleum Institute.
Keywords: saltmarsh, monitoring, Southhampton, refinery,
effluent, discharge.

Diebel, D., T. Hengstermann, R. Reuter, and R. Willkomm. 1989.
Laser fluorosensing of mineral oil
spills. In: Proceedings of the Inst Petrol London Remote Sensing
of Oil Slicks Int Mtg, May 17 18 1988,
London, England, pp. 127-142.
Key words: Remote Sensing, Oil Spill, Crude Oil, Pollution
Control

Diekmann, R., Hempel, D.C., Noertemann, B., Knackmuss, H.J. 1988.
Degradation of
6-aminonaphthalene-2-sulphonic acid by mixed cultures: Kinetic
analysis. Appl. Microbiol.
Biotechnol.(Germany, Federal Republic of). 29:1:85-88.
The degradation of 6-aminonaphthalene-2-sulphonic acid (6A2NS) by
mixed cultures via an interspecies
transfer of 5-aminosalicylic acid (5AS) was investigated using a
continuous chemostat culture. Two
different bacterial communities were employed. Steady-state data
were obtained from a multi-species
culture only, but not from a defined two-species culture.
Experimental data showed the conversion of
6A2NS into 5AS to be rate-determining for degradation. Both the
Monod equation, and an exdtended
model regarding the interspecies transfer of 5AS, were found to
be suitable to describe the relationship
between biomass and substrate concentration, depending on the
flow rate of continuous culture. Substrate
consumed for endogenous metabolism was considered according to
Pirt (1975).
Key words; amines, biodegradation, naphthalene, sulfonic acids,
biodegradation, batch culture, biomass,
continuous culture, biochemical reaction kinetics, organic sulfur
compounds, renewable energy sources,
condensed aromatics.

Diem, D.A., Ross, B.E., Kerfoot, H.B. 1988. Field evaluation of a
soil-gas analysis method for detection
of subsurface petroleum hydrocarbon contamination. 1988 DOE model
conference proceedings. Volume
4. 1067-1078.
Key Words: Oil spills detection, carbon dioxide, contamination,
geochemical surveys, ground water, land
pollution, site characterization, carbon compounds, carbod
oxides, chalocogenides, hydrogen compounds,
oxygen compounds.

Diem, D.A., Ross, B.E., Kerfoot, H.B. 1988. Field evaluation of a
soil-gas analysis method for detection
of subsurface diesel fuel contamination. National Water Well
Association, Dublin, OH (US). 527(p):1015-
1031.
Key Words: Gas spills detection, gas spills monitoring, ground

water contamination, oil spills detection,
oil spills monitoring, soils gas analysis, carbon dioxide,
hydrocarbons, land pollution, site characterization,
soil chemistry, Texa

Dietrich, G., Winter, J. 1990. Anaerobic degradation of
chlorophenol by an enrichment culture. Applied
Microbiology and Biotechnology (Germany, F.R.). 34:2:0175-7598.
An anaerobic mixed culture from sewage sludge was enriched in a
yeast extract and peptone-containing
medium; it was able to degrade 2-chlorophenol completely to
methane and CO{sub 2}. Degradation rates
of 2-chlorophenol of up to 0.18 g/l per day were observed in
suspended cultures without biomass retention
and of 0.375 g/l per day in cultures immobilized on Liapor clay
beads. Attempts to isolate the
dechlorinating organism failed. The mixed culture was reduced to
three morphologically distinctive
microorganisms using a medium with limited amounts of yeast
extract and peptone and n-butyrate as a
co-substrate. Under these conditions the phenol-degrading
bacterium was lost and phenol accumulated in
the medium. No growth and no dehalogenation of 2-chlorophenol was
obtained when yeast extract and
peptone were omitted completely. Besides serving as a source of
supplementary components yeast extract
and peptone were apparently required as the main source of
carbon, whereas reducing equivalents for
reductive dehalogenation were obtained by oxidation of
n-butyrate. A spirochaete-like organism was
presumably the dechlorinating bacterium. The mixed culture lost
its dehalogenation capability if this
organism was lost. n-Butyrate could be replaced by n-valerate,
hexanoate, heptanoate, octanoate,
pelargonic acid, n-decanoic acid or palmitate as co-substrates
for dehalogenation of either 2-chlorophenol,
2-bromophenol or complete dechlorination of 2,6-dichlorophenol,
whereas from 2,4-dichlorophenol only
the substituent in the ortho-position could be eliminated.
Key words: organic chlorine compounds, phenol, biochemical
reaction kinetics, microorganisms.

Dietzel, K. 1987. Polyurethane-flexible foam oil barrier
production system for the protection of harbours,
shorelines, and aquaculture projects. Final Report.
Bundesministerium fuer Forschung und Technologie,
Bonn (Germany, F.R.). Report No. NP-7753271, 51 pp.
Key words: Foams, Oil Spills, Petroleum, Tanker Ships, Oil
Retention Booms
Among several sponsored projects concerning the combat of oil
pollution a method and a prototyp of an oil
barrier production system has been developed. This method
produces continuously a barrier of flexible
polyurethane foam at any length needed at the place of an oil
spill off board a ship for the protection of
harbours, shorelines or aquaculture facilities. The modulus
system permits to build units of any size

needed. The production speed of a barrier is, independent of temperatures and weather conditions,
250-400 metres per hour; a method and a prototype of a semiautomatic sewing device for the production of
the skin, surrounding the floating element made up of flexible polyurethane foam. The production speed
for this type of skin is about
1200 metres a day (24 working hours per day). With 17 refs., 1 tab., 17 figs. (ERA citation 13:000222)

Dietzel, Karl. 1985. Automatic sample-taking oil tracker buoy. In: Proceedings of the 1985 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 638.
Washington, D.C.: American Petroleum Institute.
Keywords: oil, tracker, buoy.

Dillon, Tom M. 1981. Effects of dimethylnaphthalene and fluctuating temperatures on estuarine shrimp.
In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5,
1981, Atlanta, GA, pp. 79 86. Washington, D.C.: American Petroleum Institute.
Keywords: dimethylnaphthalene, temperatures, shrimp.

Dinnerstein, Madelyn. 1992. Pro Terra goes buggy when it comes to soil. (Pro Terra Environmental
Contracting Co. uses bioremediation for environmental problems) (Inside Report: Wetlands) Business
First-Columbus. 8:21 22.

DiSalvo, L. H. and H. E. Guard. 1975. Hydrocarbons associated with suspended particulate matter in San
Francisco Bay waters. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution,
March 25 27, 1975, San Francisco, CA, pp. 169 176. Washington, D.C.: American Petroleum Institute.
Keywords: hydrocarbons, particulate, San Fransico Bay.

Ditto, Lt. Jane R. 1985. Waterborne trade of petroleum in the wider Caribbean region. In: Proceedings of
the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los
Angeles, CA, pp. 650. Washington, D.C.: American Petroleum Institute.
Keywords: waterbone, petroleum, Caribbean.

Dixit, D. and J. W. Anderson. 1977. Distribution of naphthalenes within exposed Fundulus similus and
correlations with stress behavior. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior,
Control, Cleanup), March 8 10, 1977, New Orleans, LA, pp. 633 636. Washington, D.C.: American
Petroleum Institute.
Keywords: napthalenes, Fundulus similus, stress.

Dobbs, R.A., M. Jelus and K.Y. Cheng. 1988. Partitioning of toxic

organic compounds on municipal
wastewater treatment plant solids. In: Proceedings of the
Conference on Biotechnology for Degradation of
Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA,
pp. 584-600.

Key words: Biodegradation, Monitoring, Waste Management
Preliminary studies have shown that partitioning of municipal
wastewater treatment plant solids was not
affected by solids-to-liquid ratio. Kinetic data on sorption of
toxic organic compounds on wastewater
treatment plant solids showed an initial rapid uptake followed by
a slower rate over an extended period of
time. Freeze-dried solids did not exhibit the same sorption
characteristics as viable biomass. A correlation
between sorption of toxic organics on wastewater treatment plant
solids and octanol/water partition
coefficient has been established. The relationship should be
useful for estimating the removal of toxic
organic compounds in municipal and industrial wastewater
treatment plants by the sorption mechanism.
The correlation also provides a basis for predicting
concentrations of toxic compounds in various sludges
provided the equilibrium concentration in the aqueous phase is
known (or assumed).

DOE. 1991. IOGCC/DOE oil and gas environmental workshop. USDOE,
Washington, DC. Report No.
CONF-9105430--Summ., 20p.
Key words: Environmental Impact, Petroleum, Pollution
Regulations, Groundwater, Monitoring, Oil Spill,
US DOE
The Interstate Oil and Gas Compact Commission (IOGCC) in
cooperation with US Department of Energy
(DOE) has developed a workshop format to allow state regulatory
officials and industry representatives the
opportunity to participate in frank and open discussions on
issues of environmental regulatory compliance.
The purpose in providing this forum is to assist both groups in
identifying the key barriers to the economic
recoverability of domestic oil and gas resources while adequately
protecting human health and the
environment. The following topics were discussed, groundwater
protection; temporarily abandoned and
idle wells; effluent discharges; storm water runoff; monitoring
and compliance; wetlands; naturally
occurring radioactive materials; RCRA reauthorization and oil
pollution prevention regulation. At the
conclusion, all of the participants were asked to complete a
questionnaire which critiqued the day activities.
A discussion of each of the issues is made a part of this report
as is a summary of the critique
questionnaire which were received.

Dole, L. R. 1992. Fixation of pumping station contaminated soils.
In: Proceedings of HMC-South '92
Exhibitor Conference and Exhibition, Feb. 26 28, New Orleans, LA.

Hazardous Materials Control
Research Institute: Greenbelt, MD, pp. 28 29.
Key words: Oil Spills, Land Pollution, Groundwater, Biphenyl, Hydrocarbons
This paper reports the development, testing, and implementation of a one-step solidification/stabilization
process. This process was developed for the contaminated soils at gas pumping stations. These
contaminated soils have PCB's, petroleum hydrocarbons, VOCs, including degreasers and BTXs, and
heavy metals. Clayey sands were spiked and tested to develop data above the highest concentrations of
contaminants at the gas pumping station. Similar stations are scattered throughout the United States.

Dolfing, J., Tiedje, J.M. 1988. Acetate inhibition of methanogenic, syntrophic benzoate degradation.
Methanospirillum. Appl. Environ. Microbiol.(United States). 54:7:1871-1873.
Acetate inhibited benzoate degradation by a syntrophic coculture of an anaerobic benzoate degrader (strain
BZ-2) and Methanospirillum strain PM-1; the apparent K/sub i/ for acetate was approximately 40 mM.
The addition of acetate resulted in a decrease in the hydrogen concentration in the coculture, indicating that
phenomena related to interspecies hydrogen transfer affected this value and that the effect of acetate on the
benzoate-degrading partner was probably greater than the apparent K/sub i/ for the coculture suggests.
Key words: acetates, biological effects, anaerobic conditions, methane, hydrogen, biosynthesis, carboxylic
acid salts,organic acids, bacteria, inhibition, elements, nonmetals, monocarboxylic acids.

Donaghey, L. F. 1985. Groundwater protection through early detection of hydrocarbon leaks. In:
Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28,
1985, Los Angeles, CA, pp. 263 266. Washington, D.C.: American Petroleum Institute.
Keywords: groundwater, hydrocarbon.

Donahue, John and Jacon Hoogland. 1991. National park service contingency plan for natural and cultural
resources. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup),
March 4 7, 1991, San Diego, CA, pp. 385 386. Washington, D.C.: American Petroleum Institute.
Keywords: national park service, contingency plan, resoucres.

Donaldson, T.L., Strandberg, G.W., Palumbo, A.V. 1989. Biotreatment of TCE-contaminated
groundwater. American Institute of Chemical Engineers spring national meeting.
A trickle-bed bioreactor containing a consortium of microorganisms using methane as the primary carbon
source was used to treat a synthetic groundwater containing

trichloroethylene (TCE) and
trans-1,2-dichloroethylene (DCE). With influent concentrations of TCE and DCE of 1 mg/L each and an
average residence time of about 50 min, >50% of the TCE and >90% of the DCE was degraded. The
reactor exhibited first-order kinetics with respect to TCE degradation.
Key words: chlorinated aliphatic hydrocarbons, contamination, aerobic conditions, water pollution,
microorganisms, oxygen, mineralization, chemical reactions, flow rate, methanotrophic bacteria, hydrogen
compounds.

Donaldson, Susan G., Glenn C. Miller, and W.W. Miller. 1990. Volatilization of gasoline constituents
from soil; a remedial investigation. In: Proceedings of the National Outdoor Action Conference on Aquifer
Restoration, Ground Water Monitoring and Geophysical Methods. 4:721-735.
Key Words: Reclamation, pollution, soils, experimental studies, volatilization, oil spills, moisture,
biodegradation, hydrocarbons, organic materials, synthetic materials.

Donnaly, R.J. 1989. The onshore disposal of drilling wastes. In: Proceedings of the API et al Drilling
Wastes INT Conf, April 5-8, 1988, Calgary, Canada, pp. 843-848.
Key words: Drilling Waste, Disposal, Eurasia, Europe, Groundwater, Map, Oil Spill

Donnelly, K.C., P. Davol, K.W. Brown, M. Estiri, and J.C. Thomas. 1987. Mutagenic activity of two
soils amended with a wood-preserving waste. Environ. Sci. Technol.(United States). 21:1:57-64.
Organic compounds extracted from soils amended with a wood-preserving bottom sediment induced a
mutagenic response in bioassays using Salmonella typhimurium and Aspergillus nidulans. The maximum
level of mutagenic activity was observed in the base fraction from the waste-amended Bastrop soil. In the
bioassay using S. typhimurium, the base fraction collected immediately after application from the Bastrop
soil induced 77 net revertants/mg of extract, while the base fraction collected 540 days after waste
application induced 1561 net revertants/mg extract. Since the amount of extractable material decreased
greatly over this period, degradation appears to have reduced the weighted activity of wood-preserving
waste added to soil. The weighted activity, as measured with S. typhimurium strain TA98, of the neutral
fraction from 1 g of waste-amended Norwood soil was reduced from 7322 net revertants immediately after
application to 1541 net revertants 1200 days after application. Major residual organic constituents in the
soil were tentatively identified by GC/MS/DS and included pentachlorophenol, trimethylnaphthalene,
acenaphthylene, fluoranthene, pyrene, and

cyclopentaphenanthrene. 37 references, 1 figure, 5 tables.
Key words: acenaphthence, mutagen screening, pyrene, soils, contamination, ground disposal, revertants, salmonella, gas chromatography, mass spectroscopy, revertants, wood, mutants, separation processes, waste, presvatives, condensed aromatics, hydrocarbons.

Donohoe, Capt. M. J., Cdr. B. A. Russell, and P. Clark. 1993. Pollution prevention, preparedness, and response coordination efforts between the U. S. Coast Guard and coastal, Great Lakes, and Inland River states. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 23 24. Washington, D.C.: American Petroleum Institute.
Keywords: pollution, prevention, response, U.S. Coast Guard.

Donohue, Lt. Cdr. Michael J. 1981. Contingency plans: a useful tool of bureaucratic burden. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981, Atlanta, GA, pp. 513 516. Washington, D.C.: American Petroleum Institute.
Keywords: contingency plans, bureaucratic.

Dorrier, J. S., R. Ayers, and D. C. Wooten. 1975. High current control of floating oil. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San Francisco, CA, pp. 347 354. Washington, D.C.: American Petroleum Institute.
Keywords: floating, oil.

Dorrler, J. Stephen. 1969. Limited oil spills in harbor areas. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, 1969, New York, NY, pp. 151 156. Washington, D.C.: American Petroleum Institute.
Keywords: oil spills, harbor.

Dorrler, J. Stephen. 1973. Sorbent system development for oil spill cleanup. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973, Washington, D.C., pp. 309 314. Washington, D.C.: American Petroleum Institute.
Keywords: sorbent, oil spill, cleanup.

Dosoretz, C., Lamed, R. 1987. Education and production. Chicken manure methanogenesis. 1. Selective inhibition of acetate conversion to methane. Poult. Sci.(United States). 66:4:576-585.
Thermophilic (55 C) methanogenesis of chicken manure was examined after prolonged acclimatization procedures. Unusual steady state parameters were obtained in quasi-continuous operations: volatile solids = 24 to 96 g/L, retention time = 5 to 20 days, in which methane was continuously formed (.5 to .7/L.L/day), H/sub 2/ was not present, but acetate (19 to 222

mM), other fatty acids, and ammonia nitrogen (800 to 2,830 mg/L) levels were very high. Tracer (2-(/sup 14/C) acetate) studies showed that acetate accumulation resulted from inhibition of acetate conversion to methane. Enumeration of H/sub 2/-oxidizing methanogenic populations as well as acetate-degrading methanogens indicated adequate populations in chicken manure relative to cow manure. Thus, measurement of acetate degradation activities indicated its inhibition, whereas bacterial enumeration studies indicated no lack of methanogenic bacterial populations. These findings are in disagreement with the uninhibited fast rate of aceticlastic methanogenesis in cow manure. Therefore, it may be concluded that the methanogenic populations are unchanged, but their capacity to decarboxylate acetate is somehow blocked, which would lead to concomittant accumulation of acetate in addition to the formation of CO/sub 2/ and H/sub 2//CO/sub 2/-derived methane as the major fermentation end products. (Refs. 33).
Key words: acetates, bioconversion, methane, digestion, production, ammonia, carboxylic acid, thermophilic, hydrocarbons, birds, fowl, elements, alkanes, inhibition, agricultural wastes, animals, hydrides.

Dossena, G, M. Kanu, and L. Ceffa. 1987. The use of environmental mapping in the preparation of oil spill contingency plans for coastal areas. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, MD, pp. 622. Washington, D.C.: American Petroleum Institute.
Keywords: environmental, mapping, oil spill, contingency plans, coastal.

Dott, W. 1989. Comparison of autochthonous bacteria and commercially available cultures with respect to their effectiveness in fuel oil degradation. Journal of Industrial Microbiology. (1989): 4(5).
Key words: bacteria, degradation, oil, hydrocarbons.
This study examined the microbial degradation of fuel oil by nine highly adapted different commercially available mixed bacterial cultures (DBC-plus, Flow Laboratories, Meckenheim, F.R.G.) and a bacterial community from a domestic sewage sludge sample. All mixed cultures were cultivated under aerobic batch conditions shaking (110 rpm) at 20.degree.C in a mineral base medium containing 1 or 5% (v/v) fuel oil as the sole carbon source. Percent degradation of fuel oil and the n-alkane fraction was recorded for the nine DBC-plus cultures and the mixed population of the activated sludge sample. The increase in colony counts, protein, and optical density was studied during a 31-day incubation period for DBC-plus culture A, DBC-plus culture A2 and the activated sludge sample. The

activated sludge mixed culture was most effective in degrading fuel oil, but various isolated bacterial strains from this bacterial community were not able to grow on fuel oil as the sole carbon souce. In contrast, the n-alkane degradation rates of the DBC-cultures were lower, but single strains from the commercially available mixed cultures were able to mineralize fuel oil hydrocarbons. Strains of Pseudomonas aeruginosa were isolated most frequently and these organisms were able to grow very rapidly on fuel oil as a complex sole carbon source. The results indicate that fuel oil degradation in domestic sewage sludge is performed by mixed populations of naturally occurring bacteria and does not depend on the application of highly adpated commercially available cultures.

Douglass, R. H., S. J. Koster and T. A. Sorensen. 1992. Importance of site characterization and feasability studies in effective remediation. In: Proceedings of HMC-South '92 Exhibitor Conference and Exhibition, Feb. 26 28, New Orleans, LA. Hazardous Materials Control Research Institute: Greenbelt, MD, pp. 318 332.
Key words: Gasoline, Underground Storage, Groundwater, Oil Spills, Remedial Action
Comprehensive site characterizations and feasibility studies are key to effective remediation of contaminated soils and groundwater. In this paper, three case histories are examined where data gathered from extensive site investigations were used to design and implement effective remedial treatment systems. The sites were all contaminated by benzene, toluene, ethylbenzene, and xylenes (BTEX), but from various sources. In all cases, BTEX were the regulated target compounds that resided in the soil structure and groundwater in various phases. Variations in geologies, hydrogeologies, and contamination phase characteristics led to the design and appliation of three separate technologies to treat the same contaminants.

Douglass, R.H., and W.M. Korreck. 1992. Removal of trapped dehy reboiler condensate from soils near a water table aquifer using in-situ volatilization. In: Proceedings of the Pennwell Conf & Exhibit co Petro-Safe 92 Conf, January 27-29, 1992, Houston, TX, pp. 781-793.
Key words: In-situ, Remediation, Soil Pollution, Water Pollution, Groundwater, Legal, Monitoring, Vadose Water

Downey, D.C., Elliott, M.G. 1990. Performance of selected in situ soil decontamination technologies: An Air Force perspective. Environmental Progress (USA). 9(3):169-173.
Key Words: Jet engine fuels, underground storage, soils decontamination, de-aviation fuels, ground water,

military personnel, oil spills, cleaning, hydrogen compounds, oxygen compounds.

Downey, D.C., P.R. Guest, and C.A. Culley. 1991. Physical and biological treatment of deep diesel-contaminated soils. In: Proceedings of the Nat Water Well Ass & API Petrol Hydrocarbons & Org Chem in ground water: Prev, Detection, & Restoration Conf, November 20-22, 1991, Houston, TX, pp. 361-376.
Key words: Soil Pollution, Spill, Bioremediation, Groundwater, Legal, Map, Oil Spill, Regulation, Water Pollution

Downey, D.C., R.E. Hinchee, M.S. Westray, and J.K. Slaughter. 1988. Combined biological and physical treatment of a jet fuel-contaminated aquifer. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:627-645.
Key words: Bioremediation, Oil Spill, Pipeline, Soil Pollution, Water Pollution, Groundwater, Vadose Water

Dracos, T., J.H. Vandermeulen, and S.E. Hrudey. 1987. Immiscible transport of hydrocarbons infiltrating in unconfined aquifers. Oil in freshwater: Chemistry, biology, countermeasure technology. 512(p):161-175.
Key Words: Aquifers contamination, hydrocarbons environmental transport, ground water, oil spills, surface tension, water pollution, hydrogen compounds, mass transfer, organic compounds, oxygen compounds, pollution, surface properties.

Driscoll, William J. 1979. Pipeline and hazardous materials transportation safety and oil spill reduction. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Los Angeles, Ca, pp. 23 26. Washington, D.C.: American Petroleum Institute.
Keywords: pipeline, hazardous materials, transportation, oil spill.

Dragun, James. 1988. Microbial degradation of petroleum products in soil. In: Calabrese, E.J., and P.T. Kostecki (eds.), Soils contaminated by petroleum; environmental and public health effects. John Wiley & Sons, New York, NY, pp. 289-300.
Key words: Soils, Pollution, Reclamation, Biodegradation, Hydrocarbons, Bacteria

Dredging & Port Construction. 1992. New Workboats with Improved Speed, Stability and Safety Characteristics for Harbours and Surveys. Dredging & Port Construction, 19(11), p 25.

The Traktakat 26 Rapid Response Pollution control craft has a 8m catamaran hull, and is fitted with a
Palfinger PC 2000 Compact marine hydraulic crane mounted forward portside, lift 1795kg at 1m radius.
The supplier, Marshall Branson, also offer the Bravo Fast Landing Support Craft which can carry
dispersant booms or mechanical skimmers. The skimmer has a perforated plate skimming tray, with
absorbent mops used for minor oil spills. (C.J.U.)
Key words: vessels, oil spills

Driskell, W. B. 1993. Impacts on intertidal infauna: Exxon Valdez oil spill and cleanup. In: Proceedings
of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa,
Fl, pp. 355 361. Washington, D.C.: American Petroleum Institute.
Keywords: impacts, intertidal, infauna, Exxon Valdez, oil spill, cleanup.

Du Bey, Richard A. and Eugene R. Fidell. 1979. Damage assessment rulemaking: issues and alternatives.
In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22,
1979, Los Angeles, CA, pp. 79 90. Washington, D.C.: American Petroleum Institute.
Keywords: damage assessment.

Duah, D.K.A. 1989. A decision-based risk model for the management of sites contaminated with
petroleum products. National Water Well Association, Dublin, OH, (US). 698(p):577-587.
Key Words: Oil spills remedial action, oil spills water pollution abatement, remedial action decision tree
analysis, contamination, decision making, ground water, mathematical models, risk assessment, site
characterization, water pollution, hydrogen compounds, oxygen compounds, pollution abatement.
Contaminants released to the environment are controlled by a complex set of processes including various
forms of transport, transformation and biological uptake. To reduce costs in planning for environmental
cleanup of contaminated sites, it is important that the decision-making process be well defined. Decision
analysis provides tools useful for analyzing conditions at petroleum contaminated sites that could potentially
lead to adverse consequences. The basic concepts involved in the development and analysis of event trees,
as applied to strategizing environmental assessment tasks, are presented in this paper. This will aid in the
development of a structured decision framework, that will facilitate systematic decision-making for the
cleanup of petroleum contaminated sites. The model will provide an effective way to build the
comprehensive and technically defensible information base necessary for tackling potential environmental
hazards.

Dubiel, Edwin J. 1979. The practical aspects of litigating an oil spill (plaintiff's viewpoint). In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Los Angeles, CA, pp. 91 94. Washington, D.C.: American Petroleum Institute.
Keywords: litigating, oil spill.

Ducey, Jr., Donald L. and Ann Hayward Walker. 1993. Department of Defense support to spill response operations. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993, Tampa, FL, pp. 57 62. Washington, D.C.: American Petroleum Institute.
Keywords: Department of Defense, spill, response.

Duerden, F. Colin and James J. Swiss. 1981. KURDISTAN: an unusual spill successfully handled. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981, Atlanta, GA, pp. 215 220. Washington, D.C.: American Petroleum Institute.
Keywords: KURDISTAN, spill.

Duerden, F. C., W. L. Pierce, and R. G. Simmons. 1979. Firemen and emergency personnel oil spill training program. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Los Angeles, CA, pp. 209 212. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, training.

Duffy, J. J., E. Peake, and M. F. Mohtadi. 1977. Subsurface persistence of crude oil spilled on land and its transport in groundwater. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977, New Orleans, LA, pp. 475 478. Washington, D.C.: American Petroleum Institute.
Keywords: oil, spilled, land, transport, groundwater.

Duhalt, L.R. Cleaning up oil spills on land or water, by applying dried and pulverised aquatic water lily.
Patent No. US 734887_910724.
Key words: Accumulating, Adsorption, Boom, Concentration, Crude Oil, Economic Factor, Sun

Dunford, R. W., S. P. Hudson, and W. H. Desvousges. 1991. Linkages between oil spill removal activities and natural resource damages. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991, San Diego, CA, pp. 377 384. Washington, D.C.: American Petroleum Institute.
Keywords: oil spill, removal, natural resource, damages.

Dunford, R. W., S. P. Hudson, and W. H. Desvousges. 1993. Experimental contingent values for reducing environmental damages from oil spills. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993,Tampa, FL, pp. 699 703. Washington, D.C.: American Petroleum Institute.
Keywords: reducing, environment, damages, oil spills.

Dutrieux, E., F. Secchi, and O. Guelorget. 1987. Bioindicators as a tool for assessment of hydrocarbon impact and weathering in mangrove forests. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: bioindicators, assessment, hydrocarbon, forests.

Dutrieux, E., F. Secchi, and O. Guelorget. 1987. Bioindicators as a tool for assessment of hydrocarbon impact and weathering in mangrove forests. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, MD, pp. 628. Washington, D.C.: American Petroleum Institute.
Key words: bioindicators, assessment, hydrocarbon, weathering, mangrove.

Dutrieux, E., F. Martin, and A. Debry. 1990. Growth and mortality of Sonneratia caseolaris planted on an experimentally oil-polluted soil. Marine Pollution Bulletin. 21(2):62-68.
Key words: Pollution Control

Duval, W., S. Hopkinson, R. Olmsted, and R. Kashino. 1989. The Nestucca oil spill: Preliminary evaluation of impacts on the west coast of Vancouver Island. British Columbia Ministry of Environment and Parks, Victoria, BC. Report No. EC/V-89-06403, 123 pp.
Key words: British Columbia, Oil Spills, Environmental Impacts
In December 1988, a collision occurred between the fuel barge Nestucca and its tender tug off the mouth of Grays Harbor Washington. An unknown proportion of bunker C oil moved north and eventually stranded along the west coast of Vancouver Island. Activities were intiated to determine the short-term impacts of the spill on the biophysical environment. The results of many of these studies are described. In general, oiling was confined to exposed outer shorelines, but small quantities of oil reached the seafloor in a few nearshore areas. Oil was observed in a variety of different forms in the coastal marine environments. The spill resulted in some mortality and damage to plants within the intertidal zone.
Salt-marsh habitat in a lagoon at Friendly Cove on Nootka Island was extensively contaminated and required an intensive clean-up effort. Oiled Dungeness crabs were recovered from traps in a few areas.
Observation of dead gammarid amphipods on oil mats indicate that

some losses of intertidal fauna occurred. A Herring spawning area in Ucluelet Harbour was heavy oiled. However, herring and herring spawn passed all organoleptic inspections. The most apparent initial impact of the oil spill was the death of approximately 12,500 seabirds Although significant amounts of oil were observed in the immediate vicinity of a sea otter colony, only one oiled dead animal was collected. Although some oil-contaminated seals and sea lions were reported, impacts of the spill on either group appear minimal. Preliminary assessment data indicate that the spill had no significant impact on salmon or groundfish fishery resources, and little apparent effect on the salmon farming industry. 37 refs., 16figs., 7 tabs.

Dwyer, D.F., F. Rojo, and K.N. Timmis. 1988. Bacteria and new pathways for degradation of pollutants and their fate in model ecosystems. Risk Assessment for Deliberate Releases. pp.100-110.
Key words: Bacteria, Hydrocarbons, Biodegradation, Wastewater, Degradation
Considerable potential exists for using genetically engineered bacteria to degrade environmental pollants in industrial and municipal waste streams. The degradation mechanisms and efficiency of two genetically engineered pseudomonads is described. These microorganisms are able to degrade chlorinated and methylated benzic acids which often exist in industrial waste streams. The bacteria can survive in model aerobic sludge ecosystems where they were able to degrade substituted benzoates.

Dyke, C.A., and C.R. Bartels. 1990. Removal of organics from offshore produced waters using nanofiltration membrane technology. Environmental Progress. 9(3):183-186.
Key words: Water Decontamination, Oil Spills
The separation of oil and produced water mixtures from oil and gas producing wells has traditionally been accomplished by gravity settlers (e.g., multi-phase separators, skimmers, and flotation cells). However, current EPA regulations on the organic content of discharged produced water have reached the limits of these separation techniques. The industry is in need of new technologies to treat these waters. One such technology that the authors have found promising is organics/water separation by nanofiltration membranes.

E&P Environment. RRC proposes oil spill cleanup rule. E&P Environment. 4:7.

E&P Environment. 1993. Texas crude oil spill rule takes effect. E&P Environment. 4:23.

E&P Environment. 1993. Arco, NRDC settle North Slope lawsuit. E&P

Environment. 4:10.

E&P Environment. 1993. Sandia tests oil slick detection technology. E&P Environment. 4(14).

Earle, S.A. 1991. Exxon (Corp) oil cleanup may have hurt ecology. Chemical & Engineering News.
69(15):11.
Key words: Accident, Alaska, Animal, Beach, Biology, Environmental Impact, Pollution Control

Eastern Offshore News. 1990. Oil spill preparedness in the upstream petroleum industry (TFOSP). Eastern Offshore News. 12(1):2 4.
Key words: offshore operations, oil spills, pollution control, blowouts, Canada, petroleum
The offshore and onshore groups represented by Canadian Petroleum Association (IPA) and Independent Petroleum Association of Canada (IPA) carried out a study on the current preparedness of the industry to handle spills. The offshore group chose 12 scenerios related to subsea and above-platform oil well blowouts while the onshore group chose 8 scenerios covering a range of production and transportation of oil. The study recommends that more resources be allocated to improve the training of on-site personnel; better communications be implemented within companies and between companies and regulatory agencies.
Also recommended was continued research on oil spill countermeasures such as the physical containment and recovery of oil, chemical dispersion, shoreline protection and cleanup, in-situ combustion, fireproof booms, and disposal of oil spill cleanup debris. Onshore, the study concludes that the industry is prepared and equipped to manage and control most types of spills on land as well as in water. However, equipment needs to be developed to handle spills in congested waters. 1 tab.

Eckenfelder, W.W. 1989. Toxicity reduction and priority pollutant removal for industrial wastewaters.
Water, Sewage and Effluent, 9(2):13 15, 17 19.
Key words: bacteria, biodegradation, legal, microorganism, oil, pollution control, water pollutant

Ecker, Cdr. William J. and Lt. Cdr. Robert J. Sancrant. 1979. A safety analysis of the foreign tanker boarding program: January 1977 through June 1978. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979, Los Angeles, CA, pp. 317 322.
Washington, D.C.: American Petroleum Institute.
Keywords: safety, foreign, tanker.

Eckert, Eric G. and Joseph W. Maresca, Jr. 1993. Location of leaks in pressurized underground pipelines.
In: Proceedings of the 1993 Oil Spill Conference(Prevention,

Preparedness, Response), March 29 April 1,
1993, Tampa, FL, pp. 806 809. Washington, D.C.: American
Petroleum Institute.
Keywords: leaks, underground, pipelines.

Eddleman, H.L. Oil spill barrier which can be collapsed for
storage, comprises units for floating around
oil spill in order to recover it. Patent No. US 424118_891019.
Key words: Boom, Cylinder, Economic Factor, Oil Waste, Pollution
Control

Edwards, E.A., L.E. Willis, M. Reinhard, and D. Grbic-Galic.
1992. Anaerobic degradation of toluene
and xylene by aquifer microorganisms under sulfate-reducing
conditions. Applied and Environmental
Microbiology (United States). 58:3:0099-2240.
Toluene and the three isomers of xylene were completely
mineralized to CO{sub 2} and biomass by
aquifer-derived microorganisms under strictly anaerobic
conditions. The source of the inoculum was
gasoline-contaminated sediment from Seal Beach, California.
Evidence confirming that sulfate was the
terminal electron acceptor is presented. Benzene and ethylbenzene
were not degraded under the
experimental conditions used. Successive transfers of the mixed
cultures that were enriched from aquifer
sediments retained the ability to degrade to toluene and xylenes.
Greater than 90% of {sup 14}C-labeled
toluene or {sup 14}C-labeled o-xylene was mineralized to {sup
14}CO{sub 2}. The doubling time for the
culture grown on toluene or m-xylene was about 20 days, and the
cell yield was about 0.1 to 0.14g of cells
(dry weight) per g of substrate. The accumulation of sulfide in
the cultures as a result of sulfate reduction
appeared to inhibit degradation of aromatic hydrocarbons.
Key words: sulfate-reducing bacteria, metabolism, anaerobic dig.

Edwards, David T. and David B. Pascoe. 1991. Outcome of the IMO
conference on international
co-operation on oil pollution preparedness and response. In:
Proceedings of the 1991 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup), March 4 7,
1991, San Diego, CA, pp. 357 362.
Washington, D.C.: American Petroleum Institute.
Keywords: leaks, underground, pipelines.

Edwards, David T. 1987. International and regional arrangements
on cooperation in combating marine
pollution. In: Proceedings of the 1987 Oil Spill
Conference(Prevention, Behavior, Control, Cleanup),
April 6 9, 1987, Baltimore, MD, pp. 201 208. Washington, D.C.:
American Petroleum Institute.
Keywords: international, marine, pollution.

Edwards, David T. 1993. Status of implementation of the OPRC
convention and resolution adopted by the
OPPR conference. In: Proceedings of the 1993 Oil Spill

Conference(Prevention, Preparedness, Response),
March 29 April 1, 1993, Tampa, FL, pp. 649 653. Washington, D.C.:
American Petroleum Institute.
Keywords: implementation, OPRC, OPPR.

Efroymson, R.A., and M. Alexander. 1991. Biodegradation by an
arthrobacter species of hydrocarbons
partitioned into an organic solvent. 57(5): 1441-1447.
An Arthrobacter strain mineralized naphthalene and n-hexadecane
dissolved in
2,2,4,4,6,8,8-heptamethylnonane. The extent of mineralization
increased with greater volumes of solvent.
Measurements under aseptic conditions of the partioning of
naphthalene into the aqueous phase from the
solid phase or from heptamethylnonane showed that the rates were
rapid and did not limit mineralization.
The rate of mineralization of hexadecane was rapid, although
partitioning of the compound into aqueous
solution was not detected.
Key words: Arthrobacter, biodegradation, hydrocarbon, partition,
coefficient, organic solvent, aqueous,
solution, hexadecane, Naphthalene, mineralization,
solubilization, microorganism culture, pollutant,
actinomycetes, bacteria.

Eganhouse, Robert P., Mary Jo Baedecker, Curtis Phinney, Jessica
A. Hopple. 1988. Composition and
alteration of hydrocarbons in ground water. Open-File Report
(United States Geological Survey. 1978).
C27.
Key Words: Minnesota, hydrogeology, ground water, Beltrami
County Minnesota

Eganhouse, R P, T.F. Dorsey, A.M. Westcott, and C.S. Phinney.
1992. Transport and fate of
monoaromatic hydrocarbons in a petroleum contaminated aquifer.
ACS, Division of Environmental
Chemistry, Preprints. 32(1):550-53.
Key Words: Accumulating, ACS, aquifer, aromatic hydrocarbon,
association, benzene, benzene ring, C6,
C7, compounds, condensation of a document, crude oil, crude oil
(well), decomposition, deterioration,
District 2, ground water, health/disease, hydrocarbon, hydrology,
isomer, meeting paper, Minnesota,
molecular structure, North America

Eger, C. K. 1993. Implementation of field techniques to
stabilize abandoned oil wells: Boyd's Creek,
Kentucky. In: Proceedings of the 1993 Oil Spill
Conference(Prevention, Preparedness, Response), March
29 April 1, 1993, Tampa, FL, pp. 83 88. Washington, D.C.:
American Petroleum Institute.
Keywords: oil, wells, Kentucky.

Egli, Christine, Thomas Tschan, and Rudolf Scholtz. 1988.
Transformation of tetrachloromethane to
dichloromethane and carbon dioxide by acetobacterium woodii.

Applied & Env Microbiology.
54(11):2819-2824.
Key words: Hydrocarbons, Bacteria, Degradation, Water Pollutants
This study examines the mechanism by which anaerobic bacteria metabolize the common water pollutant, tetrachloromethane by comparing the efficiencies of five anaerobic strains. The presense of a bacterial acetyl-coenzyme A pathway was essential for the transformation of tetrachloromethane into dichloromethane and carbon dioxide. Experiments with A. woodii in the presence of 14C-tetrachloromethane showed that the radioactive carbon is transformed into CO2, acetate and pyruvate.

Ehler, Charles N., Daniel J. Basta, and Thomas F. LaPointe. 1983. Analyzing the potential effects of operational discharges of oil from ships in the Gulf of Mexico. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983, San Antonio, TX, pp. 323 330. Washington, D.C.: American Petroleum Institute.
Keywords: discharges, oil, ships, Gulf of Mexico.

Eidam, C.L., E.V. Fitzpatrick, J.F. Conlon. 1975. The Casco Bay oil spill: problems of cleanup and disposal. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA. American Petroleum Institute: Washington, D.C. pp. 217 - 222.
Key words: Casco Bay, oil spill, cleanup, disposal.

Einhorn, I.N., S.F. Sears, J.C. Hickey, J.H. Viellenave, and G.S. Moore G S. 1992. Characterization of petroleum contaminants in groundwater and soils. In: Proceedings of the 5th Annual Mass Univ et al. Hydrocarbons Contaminated Soils Conf, September 24 27, 1990, Amherst, MA. 2:89 143.
Keyword: biodegradation

Eisenberg, D. M., A. W. Olivieri, and P. W. Johnson. 1985. Investigation and cleanup of fuel tank leaks in the San Francisco Bay area: a regulatory strategy. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985, Los Angeles, CA, pp. 285 288. Washington, D.C.: American Petroleum Institute.
Keywords: investigation, cleanup, tank, leaks, San Francisco Bay, regulatory.

Eisler, Ronald. 1975. Toxic, sublethal, and latent effects of petroleum on Red Sea macrofauna. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975, San francisco, CA, pp. 535 540. Washington, D.C.: American Petroleum Institute.
Keywords: toxic, sublethal, petroleum, Red Sea, macrofauna.

Eisman, M. P., S. Landon-Arnold and C. M. Swindoll. 1991. Determination of petroleum hydrocarbon toxicity with Microtox reg sign. Bulletin of Environmental Contamination and Toxicology 47(6):811 816.
Key words: Oil Spills, Groundwater,
The goal of this toxicity investigation was to determine the toxicity of petroleum fuels and fuel components which are likely to contaminate the subsurface environment. Various fuels and individual components, water soluble fractions of fuels, and soil leachates were tested for toxicity using the Microtox (reg sign). The fuels used included diesel, unleaded gas, and the aviation fuels JP4 and JP5. Individual components were chosen from the following chemical groups: alkanes, cycloalkanes, alkenes, alkylbenzenes, and polynuclear aromatic hydrocarbons.

El-Zoobi, M.A., G.E. Ruch, and F.R. Groves Jr. 1990. Effect of cosolvents of hydrocarbon partition coefficients for hydrocarbon mixtures and water. Environ Sci Technol. 24(9):1332-1338.
Key words: Water Pollution, Groundwater, Oil Spill, Pollution Control

El Din, A.M.S., R.A. Arain, and A.A. Hammoud. 1991. A Contribution to the problem of trihalomethane formation from the Arabian Gulf water. Desalination. 85(1):13-32.
Key words: Oil Pollution Detection
The Arabian Gulf water at Umm Al Nar (Abu Dhabi, UAE) is analyzed for components expected to influence trihalomethane (THM) formation in case of chlorination. Chromatograms of chlorinated clean seawater show four peaks corresponding to bromoform (BF), di-bromochloromethane (DBCM), di-chlorobromomethane (DCBM) and chloroform (CF). The BF peak, representing ca. 95% of the THMs, is suitable for detection of oil pollution. This has been substantiated during an actual oil spillage that affected the intakes.

Elder, D. M., S. A. Yuill and C. Barclay. 1992. Use of the Jacques Whitford Environment Limited Air Induction System to bioremediate hydrocarbon contaminated soil in Sydney River, Nova Scotia, Canada. In: Proceedings of Special Symposium on Emerging Technologies for Hazardous Waste Management, Sept. 21 23, Atlanta, GA. American Chemical Society (ACS): Washington DC, pp. 235 238.
Key words: Oil Spills, Water Pollution, Remedial Action, Nova Scotia
This paper reports that in late 1990, Esso Petroleum Canada invited Jacques Whitford Environment Ltd to submit a remediation plan for the Sydney River Bulk Plant Terminal that would allow continuous operation with few disruptions. The site, which is separated by a public road, is about 150 meters long and 100

meters wide and slopes gently down towards Sydney Harbor. Groundwater levels on the site are influenced by a one meter tidal range. A previous site assessment indicated high levels of hydrocarbon contamination in both soil and groundwater. Small amounts of free product were present, some of which was seeping into the harbor at the intertidal zone.

Electric Power Research Institute, Inc. 1993. Video fluorescence monitor for determination of PCB or PCB mineral oil spill outline. Patent No. PCT International; WO 9313404_A1, 19 pp.
Key words: Optical Imaging Devices, Soil Pollution

Eley, Lt. W. D. 1989. Is overexposure to benzene likely during crude oil spill response? In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989, San Antonio, TX, pp. 127 130. Washington, D.C.: American Petroleum Institute.
Keywords: benzene, oil spill, response.

Eller, J.D. System for collecting oil spills etc., from water, comprises main vessel with containment boom and pump to collect oil and secondary vessels to direct oil to collector. Patent No. US 485625_900227.
Key words: Accumulating, Boom, Containment, Crude Oil, Economic Factor, Oil Waste, Pollution Control Equipment, Unloading

Ellingsen, L. Containment of floating, polluting oil on sea surface, by creating ice barrier-boom contg. oil spillage created by freezing water with cold gas emission. Patent No. NO 891613_890420.
Key words: Boom, Containment, Pollution Control, Oil Spill

Ellis, James M., and Douglas A. Richmond. 1991. Mapping the coastal plain of the Congo with airborne digital radar. In: Proceedings of the 8th Thematic Conference on Geologic Remote Sensing, April 29 May 2 1991, Denver, CO, 1:87-100.
Key words: Airborne Radar, Coastal Plains, Oil, Remote Sensing
An airborne radar survey was flown over the coastal plain of the Congo during May 1988 to improve mapping of structure, stratigraphy, geomorphology, topography, and culture in support of petroleum exploration.^Fourteen 'radar-morphologic' units were interpreted based on texture and drainage pattern.^Interpretation of stereo flight strips modified the placement of published structural axes and provided numerous new dip and strike estimates.^A fault zone (5 km wide by 100 km long) was interpreted based on an alignment of lakes, swampy terrain, disrupted drainage, and topographic breaks.

Ellis, J.M., P.O. Caldwell, and P.B. Goodwin. 1989. Utilization of Landsat TM to improve mapping of

the Niger Delta. In: Proceedings of the Seventh thematic conference on Remote sensing for exploration geology; methods, integration, solutions, pp. 283 297.
Key words: Nigeria, Data Processing, Remote Sensing, Petroleum, Geomorphology, Coastlines

Ellis, S.D.E., and P.S. Stamp. 1987. The nordic response to marine oil spills. PET. REV. 41(483):28,30-31.
Key words: Boom, Business, Economic Factor, Pollution Control, Skimmer

Ellis, J.M., P.D. Caldwell, and P.B. Goodwin. 1991. Merging satellite images and maps to improve operations, Niger delta, Nigeria. In: Proceedings of the Annual meeting of the American Association of Petroleum Geologists (AAPG), April 7 10 1991, Dallas, TX, pp. 568-569.
Key words: Nigera Petroleum Deposits, Remote Sensing, Well Drilling
Satellite images that are merged with digital maps provide an accurate and cost-effective base for analyzing petroleum activity, environmental conditions, and culture across the Niger delta. Landsat Thematic Mapper (TM) images reveal numerous uncharted shoals and spits along the margin of the delta. It also documents extensive changes and errors in existing maps of the delta's coastline. TM band 4 clearly delineates the land/water contact of widespread mangrove swamps. Acceptable Landsat and SPOT images are usually acquired between November and February when clouds and airborne dust ('Harmattan') are at a minimum. Landsat TM imagery was selected as the optimum onshore sensor primarily because the three reflected IR bands retain their resolution during mild Harmattan conditions (visible-light images are severely degraded). Black and white SPOT imagery (10 m resolution, one band) is used to resolve offshore petroleum structures, when atmospheric conditions permit. Clear SPOT images can be merged with color TM to maximize onshore information. Existing airborne radar images (acquired 1976-1977) are excellent for regional geology, but cannot support current, large-scale (>1:100,000) mapping requirements. In order to upgrade satellite images into map-oriented, large-scale plots useful for field operations and to correct the geographical content of basemaps, images and maps were digitally merged together. Images are registered to Nigeria's 'Colony Grid Bell' map projection, and map files (Lat/Long, wells, seismic, facilities, names, etc.) are digitally embedded into the images. Wells, surveyed monuments, and Global Positioning System (GPS) fixes that are visible on the images are used for this registration.

Elsas, N.E. 1992. Oil Spill Recovery System. Patent No. US

5169519, 8pp.
Key words: oil skimming, adsorbent, belt, contamination, conveyor belt, environmental pollution, oil spill, oil water separation, oil water separator, physical separation, separation equipment, solid adsorbent, sorbent, water pollution

Elsas, N.E. Oil spill recovery system, has device for depositing elongated continuous quilt pref. of polypropylene on spilled oil. Patent No. US 849487_920311.
Key words: Adsorption Boom, Homopolymer, Hydrocarbon, Oil Waste, Pollution Control, Waste Material

Ember, L., 1991. War devastates ecology of Persian Gulf region. Chemical and Engineering News. 69(10):5.
Key Words: Accident, accidental fire, agriculture, air pollutant, air pollution, animal, biology, carbon deposit, crude oil, crude oil (well), disaster control, ecology, economic factor, explosion, fire fighting, ground water, gulf, health/disease, industrial plant, invertebrate, Kuwait, Middle East, oil and gas fields, oil refinery, oil waste, oil well, particulates, Persian Gulf, respiratory tract, Saudi Arabia, shellfish, toxic effect, waste deposit, waste material, water pollutant, water pollution.

Emergencies Engineerings Division. 1993. Papers related to treatment of contaminated soil and water. Emergencies Engineering Division, 189 pp.
Key words: Soil and Water Pollution
Papers covering the treatment of soil contaminated with heavy metals; use of the mobile enhanced oxidation unit; removal of dichloromethane, metal ions, and arsenic from groundwater; oil spill sorbents, the separation of stable water-in-oil emulsions, and a comparison of stream and air stripping for the removal of volatile organic compounds from water; and removal of petroleum- derived hydrocarbons from contaminated soils by solvent extraction.

Emergency Flow Restricting Devices/Leak Detection Systems. Wednesday, January 19, 1994. Department of Transportation (DOT), Research and Special Programs Administration. 59(012).

Emerson, Raymond R. 1981. The Importance of contingency measures in determining outer continental shelf oil and gas development. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: contingency measures, continental shelf, oil.

Emery, Bruce D., John Cuddeback. 1983. Development of advanced oil spill dispersant application system for Fokker F27 Aircraft. In: Proceedings of the 1983 Oil Spill

Conference (prevention, behavior, control, cleanup), February 28 - March 3, San Antonio, TX.
Key words: oil spill, dispersant, aircraft.

Emge, LCDR Micheal L. 1993. Applicability of the clean water act to Indian tribes: may tribes stop or constrain a cleanup? In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL. American Petroleum Institute: Washington, D.C.
Key words: water.

Energy Books Quarterly. 1993. Water Pollution: 1993 Oil Spill Conference: Prevention, Preparedness, Response (American Petroleum Institute, 1220 L Street NW, Washington, DC 20005. Tel. (202) 682-8375), indexed, 898 pages, $65.00, paperback (book), order no. 4580. Energy Books Quarterly. 7(3)

Energy Research Abstracts. 1987. Spills-of-opportunity research. Environmental studies revolving funds, No.069. report No. HC-8702, 123 pp.
Key words: Biological Effects, Environmental Effects, Waste Management
This report presents studies to provide investigation of spills-of-opportunity (accidental oil spills). The recommended studies are based on following spilled oil from its point of release through to its subsequent fate and behaviour, on its biological effects, and on to the steps taken to control and remove it. Evaluation of countermeasures are recommended because such work has largely been excluded from previous.

Energy Daily. 1990. Texas likes microbes for oil spill cleanup. Energy Daily. 18:139.

Energy Research Abstracts. 1987. Field research spills to investigate the physical and chemical fate of oil in pack ice. Environmental studies revolving funds, No.062. Report No. RER-8702, 123 pp.
Key words: Oil Spill, Field tests, Oil Spill Monitoring
Three experimental crude oil spills, of 1 m/sup 3/ each were carried out in pack ice offshore of Cape Breton Island. Ice conditions for the spills ranged from 6/10 dynamic open pack ice to 9+/10 pack ice in a state of moderate compression. Oil spreading was dramatically reduced compared with that on open water; simple ice concentration and oil viscosity correction factors to Fay's (1969) spreading equations adequately model the results. Evaporation of the oil and subsequent property changes were well predicted using the evaporative exposure technique of Stiver and Mackay (1983). No water-in-oil emulsification was observed, even in extremely dynamic conditions. The rocking action of ice floes in a swell did result in temporary natural dispersion of oil near floe edges. Only minor oiling of floes was observed; the significant oil/ice interaction

was with brash and slush ice between floes. No pumping of oil between converging ice floes occurred.
In-situ burning of oil contained by brash in high pack ice concentrations proved to be effective
contermeasure; nothing seemed feasible for the oil in lower concentration, dynamic pack ice conditions. 30
refs., 8 tabs., 56 figs.

Energy Report. 1993. Arco environmental group settle suit over north slope drilling mud disposal. Energy
Report. 21:21.

Energy Resources Conservation Board. Skimmer oil separators Ltd. waste processing and disposal facility
Lloydminster Field: decision D87-21, Application 871196. Energy Resources Conservation Board, Calgary,
Alberta (Canada). Report No. ERCB/C-D87/21|CE-01053, 7 pp.
Key words: Waste Oils, Materials Recovery, Environmental Effects
This report on the decision of the Board for a waste processing and disposal facility for oily wastes such as
tank bottoms, oil spill debris, and ecology pit cleanings presented evidence on the need for the facility, the use
and impact on groundwater, the treatment process, the location, potential contamination of surface and
groundwaters, the disposal of the produced material (clean oil, dead oil, salty water and clean sand) and other
environmental effects such as related to trucking of materials to and from the facility. Interventions from two
groups of citizens are included. The Board's decision in favour of the current siting of the facility is
presented, subject to various conditions regarding monitoring of environmental effects, hours of operation,
and further testing of the process to ensure the stated results.

Energy Daily. 1991. Tiny houston firm may help clean persian gulf oil spill. Energy Daily. 19:20.

Engel, R.H., M.J. Neat. 1971. Toxicity of oil-dispersing agents determined in a circulating aquarium system.
In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: toxicity, oil-dispersing, aquarium.

Engelhardt, F.R. 1993. The MSRC research and development program: An update on progress. In:
Proceedings of the 1993 International oil spill conference: Prevention, preparedness, response, March
29 April 1 1993, Tampa, FL, pp. 537 540.
Key words: Oil Spills, Petroleum Industry, Biodegradation
The research and development program of the Marine Spill Response Corporation is solidly under way in a
variety of project areas. These include remote sensing, in-situ burning, dispersants, oil water separation,
countermeasures effectiveness, bioremediation, and evaluation of spill effects. More than thirty projects have
been contracted. Among these are remote sensing studies, which started with in-depth market analyses,

technical feasibility evaluations, and field studies. The remote sensing program is engaged in rapid development of a research test bed system, as well as longer-term studies on sensor development and use of satellite systems. In-situ burning studies included a detailed analysis of operational feasibility and information needs; preparations are being made for test burns at sea and improvements of fire-resistant barrier systems. Studies are underway on both aerial dispersant application system development and dispersant effects in selected environments. Studies have commenced on the development of oil water separators for vessels of opportunity used in oil spill response, as well as the related issue of demulsification. The effectiveness of spill countermeasures is being investigated from both engineering and ecological perspectives. Bioremediation projects are under way to promote the development of test systems and on shoreline test sites. Interest continues in test spills in the marine environment, including participation in experimental spills outside the United States and a search for possible scenarios where such field experiments can be carried out in United States waters. In all of these project areas, the research and development program stresses information transfer by way of meetings and publications, and is initiating publication of a peer reviewed international journal on oil spill science and technology.

Engelhardt, F.R. 1992. The MSRC [Marine Spill Response Corporation] research and development program. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar, June 10 12 1992, Edmonton, Alberta, pp. 261-269.
Key words: Oil Spill Research Programs, Pollution Control
The Marine Spill Response Corporation (MSRC) is a nonprofit corporation chartered in August 1990 to respond to large oil spills on coastal and tidal waters, and certain inland waters, of the USA. Implementation of an active research and development (R D) program is one of the MSRC's chartered missions. Design and sponsorship of projects is in keeping with the concept of best effort inherent in MSRC operations, based on the premise that enhanced knowledge and technological development will improve future response capabilities. A detailed exercise was conducted to set priorities for further R D, involving extensive consultation with the oil spill R D community. The MSRC R D program is now fully activated, with projects under way in the areas of remote sensing, in-situ burning, dispersants, oil/water separation, spilled oil properties, countermeasures effectiveness, and bioremediation. The program stresses cooperation with other R D sponsors, and has started an active information dissemination process. 6 refs., 1 tab.

Engerer, M.J. 1992. Containment of spills from ships. 29pp.
Key Words: Oil spills-oil spill pollution containment, tanker

ships-oil retention booms, design, pollution
control, pollution control equipment.

Engineering Computer Opteconomics, Inc. 1990. Oil-recovery
systems for Coast Guard coastal buoy tenders.
Volume 1. Technical report. Final report. Engineering Computer
Opteconomics, Inc., Annapolis, MD.
AD-A-235890/1/XAB, 128p.
Key words: oil spills, cleaning, skimmers, transport, coastal
regions, petroleum, recovery
Available oil spill recovery systems were investigated for their
applicability to be deployed from existing and
proposed U.S. Coast Guard buoy tenders. These systems for use in
ocean environments and coastal regions,
included containment boom and skimming devices. Storage for the
recovered fluid and possible separation of
oil and water from the recovered fluids were investigated. It was
found that the limited low speed
maneuvering capability of the buoy tenders restricted the overall
efficiency of the recovery process and the
selection of the recovery systems. Additionally, the buoy tenders
will have to be deployed with a barge or
utilize floating dracones for storage as onboard tankage is not
available for use. Suggestions for deployment
are provided as well as recommendations for further
investigations.

Engineering News-Record. 1991. Market's resistance to recession
will be tested this year. Engineering
News-Record. 226(4):28.

Engineering News-Record. 1992. EPA and 114 PRPs sign Superfund
cleanup pact. Engineering
News-Record. 228(1):3.

Engineering News-Record. 1991. New terminal in backyard of old.
<Subheading> New land-side/air-side
buildings located between existing runways will completely
replace Pittsburgh's 1952 terminal next year.
Engineering News-Record. 227(10):21.

Engineering News-Record. 1993. Superfund site gets the bugs out.
Engineering News-Record. 231(5):32.

Engineering News-Record. 1991. Sowing seeds of a cleanup.
Engineering News-Record. 227(19):25.

Englehardt, F. R., I. W. Ginsberg and C. Giammona. 1993.
Photogrammetric engineering and remote sensing.
In: Proceedings of the 1st Thematic Conference on Remote Sensing
for Marine and Coastal Environments,
June 15 17, New Orleans, LA. 59(3):168.
Key words: Remote Sensing, Landsat, Coastal Ecology, Oil Spill
The present conference discusses the estimation of
photosynthetically available radiation over oceans from
satellite data, the derivation of shallow seafloor reflectance
and water depth from an unmixing multispectral

imager, monitoring and modeling of the marine coastal environment, laser-based noninvasive methods of ocean-surface probing, multispectral change vector analysis for monitoring the coastal marine environment, and multispectral remote sensing and truth data from an oil spill. Also discussed are a spatially variable light-frequency-selective component-based airborne pushbroom imaging spectrometer, surface circulation estimation via sequential satellite imagery, and monitoring of marine ecology changes with Landsat TM. (For individual items see A93-28131 to A93-28143.)

Englehardt, F.R., Irving W. Ginsberg, and Charles Giammona. 1993. Thematic Conference on Remote Sensing for Marine and Coastal Environments, 1st, New Orleans, LA, June 15-17, 1992, Proceedings.
PE&RS - Photogrammetric Engineering and Remote Sensing. 59(3):168 pp.
Key words: Coastal Ecology, Marine Environments, Remote Sensing
The present conference discusses the estimation of photosynthetically available radiation over oceans from satellite data, the derivation of shallow seafloor reflectance and water depth from an unmixing multispectral imager, monitoring and modeling of the marine coastal environment, laser-based noninvasive methods of ocean-surface probing, multispectral change vector analysis for monitoring the coastal marine environment, and multispectral remote sensing and truth data from an oil spill.^Also discussed are a spatially variable light-frequency-selective component-based airborne pushbroom imaging spectrometer, surface circulation estimation via sequential satellite imagery, and monitoring of marine ecology changes with Landsat TM.

English, C.W., and R.C. Loehr. 1990. Removal of organic vapors in unsaturated soil. National Water Well Association, Dublin, OH (US). 664(p):297-308.
Key Words: Benzene environmental transport, benzene removal, soils land pollution abatement, soils sorptive properties, xylenes environmental transport, xylenes removal, biodegradation, land pollution, oil spills, petroleum, soil chemistry, sorption, volatile matter, alkylated aromatics, chemical reactions, chemistry, decomposition, energy sources, fossil fuels, hydrocarbons, mass transfer, organic compounds, pollution abatement, surface properties.

Ensley, B. 1990. A recombinant E. coli with enhanced performance for chemical synthesis and hazardous waste degradation. In: Proceedings of the American Chemical Society, April 22 27, 1990, Boston MA.
American Chemical Society, Washington, DC, p.39.
Key words: Bacteria, Biodegradation, Escherichia Coli (E. coli)
Toluene monoxyogenase is a recently identified enzyme system that catalyzes the parahydroxylation of toluene. It was recently discovered that this enzyme catalyzed the degradation of trichloroethylene (TCE) and

other chlorinated aliphatics. This enzyme system is active in the native strain only when the cultures are grown at the expense of toluene as a sole source of carbon and energy. Toulene is also necessary as a co-substrate during the catalytic process with the native strain. To overcome the obvious deficiencies that the requirement for toluene presents in manufacturing processes or waste degradation, the genes encoding the toluene monooxygenase pathway were transferred to an E. coli under new regulation. Toluene monoxygenase activity in E. coli was placed under regulation of the tac and PL promoter systems permitting induction of this enzyme in the absence of toluene. The recombinant E. coli were active against the same range of substrates as the original organism and were able to rapidly degrade trichloroethylene and other chlorinated aliphatics with glucose as the co-substrate.

Environment Canada. 1992. Proceedings of the Fifteenth Arctic and Marine Oilspill Program Technical Seminar. In: Proceedings of the 15. Arctic and Marine Oilspill Program Technical Semin., June 10 12 1992, Edmonton, Alberta.
Key words: Oil Spills, Pollution Effects, Remote Sensing
At the Fifteenth Arctic and Marine Oilspill Program Technical Seminar held in Edmonton, AB, Canada, June 10-12, 1992, 57 papers were presented. Subjects covered relating to oilspills in the marine and arctic environment were behaviour and fate, environmental impact, experimental research, remote sensing, in situ burning, bioremediation, biological effects, shoreline cleanup and containment and recovery.

Environment Week. 1991. Saudis seek microbes for persian gulf cleanup. 4:5.

Environment Week. 1993. EPA's Reilly reviews his tenure, looks ahead To browner's agenda. Environment Week. 6:1.

Environment Canada. 1991. Selection Criteria and Laboratory Evaluation of Oilspill Sorbents, Update IV Environ Canada Report EPS 3/SP/3 (73).
The results of experimental tests evaluating the effectiveness of sixteen commercially available oil spill sorbents are presented. Both organic and synthetic sorbents are evaluated for three types of petroleum products and two hydrocarbon solvents. The results of aging on the test sorbents are detailed. A variety of criteria were used to evaluate the performance of the sorbents, including maximum capacity, water pickup, and reusability. The synthetic sorbents typically outperformed the organic sorbents.
20 diagram(s), 4 reference(s), 16 table(s)
Key words: oil spill cleanup, pollution control|sorption,oil spills, petroleum, pollutant fate

Environment Canada. 1991. Fourteenth Arctic and Marine Oil Program technical seminar. In: Proceedings of the 14. Arctic and marine oilspill program technical seminar, June 12 14 1991, Vancouver, 690 pp.
Key words: Oil Spill Meetings
A seminar on marine and Arctic oil spills presented papers on the behavior and fate of oil in the environment, biological degradation and biological effects, emergency preparedness initiatives, computer systems for oil spill response, the legal and social context of oil spills, risk analysis and environmental impacts, in-situ burning of spilled oil, spill countermeasures, remote sensing and spill tracking, and shoreline cleanup (notably in the case of the Exxon Valdez incident). Separate abstracts have been prepared for 47 papers from this seminar.

Environment Week. 1991. Officials from key US government agencies say EPA fiscal 1992 budget proposal hits $6.2 Billion. Environment Week. 4:6.

Environmental Protection Agency. 1988. Effects of temperature and redox conditions on degradation of chlorinated phenols in freshwater sediments. Environmental Research Lab. 23.
The effect of temperature and redox conditions on the anaerobic degradation of 2,4-dichlorophenol (2,4-DCP) was investigated in anaerobic sediment slurries, prepared from local freshwater pond sediments. Under methanogenic conditions, 2,4-DCP dechlorination occurred in the temperature range between 5 and 50 C. Although dechlorination was not observed above 50 C, anaerobic bacterial activity was indicated by methane formation up to 60 C. In sediment samples from two sites and at all temperatures from 5 to 50 C, 2,4-DCP was transformed to 4-chlorophenol (4-CP). The 4-CP intermediate was subsequently degraded after an extended lag period. Adaptation periods for 2,4-DCP transformation decreased between 5 and 25 C, were essentially constant between 25 and 35 C, and increased between 35 and 40 C. degradation rates increased exponentially between 15 and 30 C, had a second peak at 35 C, and decreased to about 5% of the peak activity by 40 C. In one sediment sample, an increase in degradation rates was observed following the minimum at 40 C, suggesting that at least two different organisms were involved in the 2,4-DCP dechlorination. Storage of the original sediment slurries for 2 months at 12 C resulted in increased adaptation times but did not affect the degradation rates.
Key words: chlorinated aromatic hydrocarbons, biodegradation, fresh water, slurries, chemical reaction, dispersions, dechlorination, alkanes, sediments.

Environmental Protection Agency. 1993. National Oil and Hazardous Substances Pollution Contingency Plan.

Oil and Gas Extraction Point Source Category; Offshore Subcategory Effluent Limitations Guidelines and New Source Performance Standards. (1993): 58.
Key words: Clean Water Act, oil, spill response, pollutants, oil, gas
Summary: The U.S. Environmental Protection Agency (EPA or the Agency) is today proposing revisions to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Oil Pollution Act of 1990 (OPA) amends existing provisions of the Clean Water Act (CWA) and creates major new authorities addressing oil and, to a lesser extent, hazardous substance spill response. The revised CWA requires the President to revise the NCP to reflect these changes. The OPA specifies a number of revisions to the NCP that are intended to enhance and expand upon the current framework, standards, and procedures for response. The last revisions to the NCP were promulgated on March 8, 1990. The proposed revisions will affect all NCP subparts except F (State Involvement in Hazardous Substance Response) and I (Administrative Record for Selection of Response Action).

Environmental Protection Agency. 1990. Hazard ranking system. Rules and Regulations. 55(241) Part II: 40 CFR Part 300.
Keywords: EPA, environment, hazardous waste
The Environmental Protection Agency (EPA) is adopting revisions to the Hazard Ranking System (HRS), the principal mechanism for placing sites on the National Priorities List (NPL). The revisions change the way EPA evaluates potential threats to human health and the environment from hazardous waste sites and make the HRS more accurate in assessing relative potential risk. These revisions comply with other statutory requirements in the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Environmental Protection Agency. 1993. Office of water chemicals; final test rule. Rules and Regulations, 58(216).
Keywords: water contaminants
EPA is issuing a final rule, under section 4 of the Toxic Substances Control Act (TSCA), requiring manufacturers and processors to test four chemical substances for certain health effects. Oral 14-day repeated dose and oral 90-day subchronic toxicity studies are required for each of the following substances: Chloroethane (CAS No. 75-00-3); 1,1-dichloroethane (CAS No. 75-34- 3); 1,1,2,2-tetrachloroethane (CAS No. 79-34-5); and 1,3,5- trimethylbenzene (CAS No. 108-67-8). This rule also supports EPA's effort to develop Health Advisories (HAs) for unregulated drinking water contaminants that are monitored under section 1445 of the Safe Drinking Water Act (SDWA). The proposed rule which was published on May 24, 1990 was referred to as the Office of Drinking Water Chemicals

proposed test rule.

Environmental Protection Agency. 1990. Twenty-Sixth report of the interagency testing committee to the administrator; receipt of report and request for comments regarding priority list of chemicals. Notice. 55(108) Part IV: OPTS-41033, FRL 3765-4.
Keywords: Toxic Substances Control Act, EPA, chemical
The Interagency Testing Committee (ITC), established under section 4(e) of the Toxic Substances Control Act (TSCA), transmitted its Twenty-sixth Report to the Administrator of EPA on May 8, 1990. This report, which revises and updates the Committee's priority list of chemicals, adds one chemical and three chemical groups to the list. One chemical and one chemical group are recommended with intent-to-designate. The Twenty-sixth Report is included with this notice. The ITC has removed one chemical and one chemical group from the priority list. Crotonaldehyde (CAS No. 4170-30-3) was removed from the priority list because the EPA published a consent order on November 9, 1989 (54 FR 47062). Disperse blue dyes were removed from the priority list because the EPA published a consent order on November 21,1989 (54 FR 48102), that requires testing of CAS No. 3618-72-2. EPA invites interested persons to submit written comments on the report, and to attend Focus Meetings to help narrow and focus the issues raised by the ITC's intent to designate recommendations. Additionally, EPA is soliciting interest in public participation in the consent agreement process for sodium cyanide and isocyanates.

Environmental Protection Agency. 1992. Ethylene bisdithiocarbamates (EBDCs); Notice of Intent to Cancel; Conclusion of Special Review 57(41) Part VI.
Key words: EBDCs
This notice of concludes the Special Review and risk/benefit of the EBDCs and announces EPA's intent to cancel registrations and to deny applications for registration for all pesticide products containing EBDCs as an active ingredient unless the registrations/applications comply with the terms and conditions of registration set forth in this Notice. This action is based on the Agency's determination that use of the EBDCs without such modified terms and conditions will result in unreasonable adverse effects to humans or the environment.
In summary, EPA is announcing its intent to cancel any EBDC product registration bearing one or more of the following food uses of EBDCs: apricots, carrots, celery, collards, mustard greens, nectarines, peaches, rhubarb, spinach, succulent beans, and turnips. In addition, EPA is announcing its intent to cancel EBDC products registered for other uses unless certain label modifications are made.

Environmental Protection Agency. 1989. Twenty-fifth Report of the Interagency Testing Committee to the

Administrator; Receipt of Report and Request for Comments Regarding Priority List of Chemicals 54(237).
Key words: Toxic Substances Control Act
The Interagency Testing Committee (ITC), established under section 4(e) of the Toxic Substances Control Act (TSCA), transmitted its Twenty-Fifth Report to the Administrator of EPA on November 1, 1989. This report, which revises and updates the Committee's priority list of chemicals, adds 13 chemicals to the list for priority consideration by EPA in promulgation of test rules under section 4(a) of the Act. This list contains five designated chemicals, one intent-to-designate chemical, and seven recommended without designation chemicals. The Twenty-Fifth Report is included with this notice. The designated chemicals are: pentabromodiphenyl ether (CAS No. 32534-81-9), octabromodiphenyl ether (CAS No. 32536-52-0), decabromodiphenyl ether (CAS No. 1163-19-5), hexabromocyclododecane (CAS No. 3194-55-6), and 1,2-bis(2,4,6-tribromophenoxy)ethane (CAS No. 37853-59-1). These chemicals are designated for response within 12 months. Therefore, in response to ITC's designation, EPA will either initiate rulemaking under section 4(a) of TSCA, or publish a Federal Register notice explaining the reasons for not initiating such rulemaking within 12 months. The chemical 4-Vinylcyclohexene (CAS No. 100-40-3), is recommended with intent-to-designate. The chemicals recommended without intent-to-designate are: 2,4,6-tribromophenol (CAS No. 118-79-6), tetrabromophthalic anhydride (CAS No. 632-79-1), dibromoneopentyl glycol (CAS No. 3296-90-0), Ethylene Bis-(tetrabromophthalimide) (CAS No. 32588-76-4), ethylene bis(5,6-dibromonorbornane-2,3-dicarboximide) (CAS No. 41291-34-3), tribrominated polystyrene (CAS No. 57137-10-7), and ethylene bis(pentabromophenoxide) (CAS No. 61262-53-1). The ITC has removed one chemical, 1,6-hexamethylene diisocyanate (CAS No. 822-06-0), from the priority list because the EPA published a Notice of Proposed Rulemaking on May 17, 1989 (54 FR 21240). EPA invites interested persons to submit written comments on the report, and to attend Focus Meetings to help narrow and focus issues raised by the ITC's recommendations. Additionally, EPA is soliciting interest in public participation in the consent agreement process for 4-vinylcyclohexene.

Environmental Protection Agency. 1993. Standards for the Use or Disposal of Sewage Sludge. Rules and Regulations 58(032) Part II.
Key words: Sewage, Waste Disposal
Under authority of Sections 405(d) and (e) of the Clean Water Act (CWA), as amended (33 U.S.C.A. 1251, et seq.), the Environmental Protection Agency (EPA) is promulgating regulations to protect public health and the environment from any reasonably anticipated adverse effects of certain pollutants that may be present in

sewage sludge. The regulations establish requirements for the final use and disposal of sewage sludge in three circumstances. First, the regulations establish requirements for sewage sludge when the sludge is applied to the land for a beneficial purpose (including sewage sludge or sewage sludge products that are sold or given away for use in home gardens). Second, the regulations establish standards for sludge when the sludge is disposed on land by placing it on surface disposal sites (including sewage sludge- only landfills). Third, the regulations establish requirements for sewage sludge when incinerated. The standards for each end use and disposal practice consist of general requirements, numerical limits on the pollutant concentrations in sewage sludge, management practices and, in some cases, operational requirements. The final rule also includes monitoring, recordkeeping and reporting requirements. $Standards apply to publicly and privately owned treatment works that generate or treat domestic sewage sludge, as well as to any person who uses or disposes of sewage sludge from such treatment works. The rule requires compliance with these standards as expeditiously as possible but no later than 12 months from the date the rule is published, or within 24 months of publication if construction of new pollution control facilities is required to comply with the regulations. The final rule also includes conforming amendments to 40 CFR parts 257 and 403.

Environmental Protection Agency. 1993. Final Modification to NPDES General Permit for the Western Portion of the Outer Continental Shelf (OCS) of the Gulf of Mexico. (1993): 58.
For Further Information Contact: Ms. Ellen Caldwell, EPA Region 6, 1445 Ross Avenue, Dallas, Texas 75202, Telephone: (214) 655-7513.
Gulf of Mexico, monitoring, EPA, water toxicity, oil
Summary: Region 6 of the U. S. Environmental Protection Agency (EPA) today modifies NPDES General Permit GMG290000, which authorizes discharges from existing and new dischargers (but not new sources) in the Offshore Subcategory of the Oil and Gas Extraction Point Source Category (40 CFR part 435, subpart A) to the Western portion of the Outer Continental Shelf of the Gulf of Mexico. As modified, the permit contains conditions implementing recently promulgated Offshore Subcategory Guidelines, contains changes to the critical dilutions at which produced water shall have no chronic toxicity, and addresses various industry concerns on monitoring requirements. EPA Region 6 has also deleted several monitoring conditions it no longer considers necessary. In addition, EPA today issues a general administrative compliance order requiring those dischargers covered by GMG 290000 who cannot comply with the permit's produced water toxicity and/or oil and grease limits to achieve compliance no later than 7 months after becoming aware of such

non-compliance.

Environmental Protection Agency. 1992. Superfund record of decision (EPA Region 10): Elmendorf Air Force Base, Operable Unit 2, source area ST41, Anchorage, AK. (First remedial action), September 1992. Interim report. Environmental Protection Agency, Washington, DC. Report No. PB-93-964604/XAB, 31p.
Key words: Alaska, Groundwater, Soil Pollution, Leaks, Oil Spills, Pollution Control, Tanks, Underground Storage
The 13,130-acre Elmendorf Air Force Base (AFB) site is located adjacent to the municipality of Anchorage, Alaska. From 1940 to 1991, Elmendorf AFB used a 20-acre portion of the site, referred to as source area ST41, to store the fuel product JP-4 and aviation gasoline in four 1-million gallon underground tanks. As a result of numerous leaks and above-ground spills since the tanks were installed in the 1940s, USAF conducted investigations through its Installation Restoration Program (IRP). These investigations revealed several hundred thousand gallons of fuel in the ground water and soil. The ROD addresses an interim remedy at Elmendorf AFB. The action is needed to reduce further spread of fuel constituents through the recovery of floating product on the ground water surface, and containment of seeps. Future RODs will include a final remedy for ground water and soil at ST41, as OU2, and will address the other six OUs at the site. The primary contaminants of concern affecting the ground water at ST41 are the compounds in JP-4, especially VOCs such as benzene, toluene, and xylenes. The selected interim remedial action for the site are included.

Environmental Protection Agency. 1991. Twenty-Seventh Report of the Interagency Testing Committee to the Administrator; Receipt of Report and Request for Comments Regarding Priority List of Chemicals 56(44) Part VIII.
Key words: IRIS group
The Interagency Testing Committee (ITC), established under section 4(e) of the Toxic Substances Control Act (TSCA), transmitted its Twenty-seventh Report to the Administrator of EPA on November 19, 1990. As noted in this Report, which is included with this notice, the Committee revised the Priority List by adding one chemical and four chemical groups. The Committee is designating six chemicals from the IRIS group, as well as 4-vinylcyclohexene and sodium cyanide, that were previously recommended with intent-to-designate. The aldehydes chemical group is recommended with intent-to-designate. N-phenyl-1-naphthylamine, two chemicals from the IRIS group, the sulfone group, and a group of substantially produced chemicals in need of subchronic tests are recommended. The ITC has not removed any chemicals from the Priority List as a result

of EPA actions. EPA invites interested persons to submit written comments on the Report. EPA is not holding a Focus Meeting for these chemicals and will proceed immediately to rulemaking. EPA is taking this action because (1) The designated chemicals have a statutory deadline and require a response by EPA within 1 year; and (2) the intent-to-designate group is unlikely to yield consensus in a timely manner because of the inability to identify interested parties on a chemical specific basis.

Environmental Protection Agency. 1992. Land disposal restrictions for newly listed wastes and contaminated debris. Proposed Rules 57(6)Part II.
Key words: Oil Spills, Groundwater, Waste Disposal
For general information, contact the RCRA Hotline at (800) 424-9346 (toll free) or (703) 920-9810 locally.
For information on treatment standards for newly listed wastes or contaminated debris, contact the Waste Treatment Branch, Office of Solid Waste (OS-322W), U.S. Environmental Protection Agency, 401 M St., SW., Washington, DC 20460, (703) 308-8434. For information on capacity determinations or national capacity variances, contact the Capacity Programs Branch, Office of Solid Waste (OS-322W), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460, (703) 308-8440.

Environmental Protection Agency. 1993. Final Regulatory Determination on Four Large-Volume Wastes From the Combustion of Coal by Electric Utility Power Plants. Rules and Regulations 58(151) Part V.
Key words: Coal, Wastes, Fossil Fuel Combustion
For Further Information on the regulatory determination, contact the RCRA/Superfund hotline at (800) 424-9346 or (703) 412-9810, or Patti Whiting at (703) 308- 8421.

Environmental Protection Agency. 1991. Superfund record of decision (EPA region 5): Ossineke groundwater contamination site, Alpena County, Ossineke, MI. Unpublished Final Report Prepared for the Environmental Protection Agency. Washington, DC: Office of Emergency and Remedial Response. 38 pp.
Key words: Groundwater, Underground Storage, Remedial Action, Superfund, Oil Spills
The Ossineke groundwater contamination site is an area overlying a contaminated aquifer in Ossineke, Alpena County, Michigan. The site hydrogeology is characterized by an upper aquifer and lower confined aquifer, both of which supply drinking water to local residents. Historically there have been two contaminant source areas of concern within Ossineke. Area 1 is in the center of the Town of Ossineke where two gas stations are located, consisting of underground storage tanks, and a former automobile rustproofing shop. Area 2 is a laundry and dry cleaning facility that has an associated wash water pond containing chlorinated

hydrocarbons and VOCs. The State advised all users of the upper aquifer to stop using their wells. In 1982, the State discovered that a snow plow had hit a gasoline pump causing an unknown amount of gasoline to spill and, subsequently, contaminate the basements of several businesses. In 1986, the State replaced residential wells affected by groundwater contamination. Because the contaminants of concern have been confirmed to be related to petroleum releases from underground storage tanks, the Superfund program does not have the authority to address cleanup under CERLCLA. The selected remedial action for the site is that not further action.

Environmental Protection Agency. 1992. Superfund record of decision (EPA Region 4): New Hanover County Airport Burn Pit Site, New Hanover County, Wilmington, NC. (First remedial action), September 1992. Final report
Environmental Protection Agency, Washington, DC (United States). Office of Emergency and Remedial Response. 96pp. ERA (Energy Research Abstracts), ETD (Energy Technology Data Exchange), INS (US Atomindex input)
The New Hanover site was located on Gardner Road approximately 500 feet west of the New Hanover County Airport terminal, New Hanover, North Carolina. From 1968 to 1979, the site was used for fire-fighter training purposes. During training exercises, jet fuel, gasoline, petroleum storage bottoms, fuel oil, kerosene, and sorbent materialsfrom oil spill cleanup were burned in a pit. During its active years, water from the pit was allowed to flow onto land surfaces. Inspections conducted after the pit was abandoned showed that most of the standing liquid in the pit was water. In addition to the burn pit area, fire-fighting activities resulted in contamination at several other site areas, including an auto burn area; a railroad tank burn area; an aircraft mock-up area; a fuel tank and pipelines area; and two stained soil areas north of the burn pit. The ROD addressed restoration of the aquifer to drinking water quality as a final action for the site. The primary contaminants of concern that affect the soil and ground water were VOCs, including benzene; and metals, including chromium and lead.
Key words: hazardous materials--remedial action, US Superfund--remedial action, benzene, chemical spills, chromium, contamination, decision making, drinking water, fire fighting, fuels, gasoline, ground water, kerosene, land pollution, lead, metals, North Carolina, oils, organic compounds, pipelines, pollution control, soils, storage, US EPA, waste disposal

Environmental Protection Agency. 1988. Office of solid waste chemicals; correction. Rules and Regulations. 53(232):OPTS-42088E, FRL-3484-5.
Keywords: hazardous waste

Environmental Protection Agency (EPA). 1993. National oil and hazardous substances pollution contingency plan. Proposed Rules. For further information contact: Ms. Elizabeth Zeller, Emergency Response Division (5202-G), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460, or call 703-603-8780.
Keywords: National Oil Contingency Plan, Contingency Plan, Oil Pollution Act, oil, spill response
The U.S. Environmental Protection Agency (EPA or the Agency) is today proposing revisions to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Oil Pollution Act of 1990 (OPA) amends existing provisions of the Clean Water Act (CWA) and creates major new authorities addressing oil and, to a lesser extent, hazardous substance spill response. The revised CWA requires the President to revise the NCP to reflect these changes. The OPA specifies a number of revisions to the NCP that are intended to enhance and expand upon the current framework, standards, and procedures for response. The last revisions to the NCP were promulgated on March 8, 1990. The proposed revisions will affect all NCP subparts except F (State Involvement in Hazardous Substance Response) and I (Administrative Record for Selection of Response Action).

Environmental Protection Agency. 1990. Land disposal restrictions for third third scheduled wastes. Rules and Regulations. 55(106) Part II: 40 CFR Parts 148, 261, 262, 264, 265, 268, 270, 271, and 302.
Keywords: EPA, soil disposal, hazardous wastes
For general information contact the RCRA Hotline at: (800) 424-9346 (toll-free) or (202) 382-3000 locally.
The Environmental Protection Agency (EPA) today is promulgating regulations implementing the last of five Congressionally mandated prohibitions on land disposal of hazardous wastes (the third one-third of the schedule of restricted hazardous wastes, hereafter referred to as the Third Third). This action is taken in response to amendments to the Resource Conservation and Recovery Act (RCRA), enacted in the Hazardous and Solid Waste Amendments (HSWA) of 1984. When fully effective in May 1992, this rule, combined with the previous rulemakings, is expected to require treatment of a total of seven million tons of hazardous waste managed in RCRA-regulated facilities.

Environmental Protection Agency. 1989. Technical amendments to test rules and consent orders. Rules and Regulations. 54(124):OPTS-42113, FRL-3609-2.
Keywords: EPA, standards, chemical, testing, Toxic Substances Control Act
Pursuant to 40 CFR 790.55 and 790.68, EPA has approved by letter certain modifications to test standards and schedules for chemical testing programs under section 4 of

the Toxic Substances Control Act (TSCA).
These modifications, requested by test sponsors, will be incorporated and codified in the respective test regulation or consent order. Because these modifications do not significantly alter the scope of a test or significantly change the schedule for its completion, EPA approved these requests without seeking notice and comment. EPA will annually publish a notice describing all of the modifications granted by letter for the previous year. This is the first such annual notice.

Environmental Protection Agency, Seattle, WA. Region X. Waste Reduction Assistance Program (WRAP)
On-Site Consultation Audit Report: Aviation Facility. In Alaska Health Project, Anchorage., 40. 1987.
Portions of this document are not fully legible. Sponsored by Environmental Protection Agency, Seattle, WA. Region X.
Alaska, hazardous materials, water pollution, pollution, oil storage The document reports on an environmental audit of a typical Alaskan aviation maintenance shop. It identifies the hazardous wastes produced and the processes that cause them, makes recommendations to reduce the amount of waste generated, identifies common waste management practices and recommends methods for storage and shipping, and provides a general analysis of the cost benefits of the recommended waste reduction methods.
Appendices include a synopsis of small quantity generator regulations, a table of hazardous wastes from the aviation industry, and several articles about used oil disposal.

Environmental Studies Research Fund. 1988. Laboratory stuies of the behaviour and fate of waxy crude oil spills. Environmental studies research fund report No.084., 247 p.
Key words: oil pollution containment, experimental data, oil spills, pollution containment
A series of small and mid-scale laboratory tests were undertaken to investigate the fate and behaviour of spills of waxy crude oils at sea. The results indicate that the behaviour of such oils are very different from that of less viscous, conventional oils. This is concluded to be primarily due to the precipitation of waxes, asphaltenes and other unknown resinous compounds as the oil evaporates or as environmental temperatures drop. The major characteristics of waxy oil spills include very slow spreading or non-spreading behaviour, reduced evaporation rates, curtailed natural dispersion and anomalous emulsification. The end result of this unique behaviour is that waxy oil spills will likely survive much longer on the sea surface than equivalent non-waxy oils would. Theoretical and empirical equations were developed to describe the behaviour of oils and combined into a computer model capable of detailed predictions of the fate, behaviour and properties of oil spills at sea. The model has the capability to deal with both

blowouts and batch spills. Preliminary, small-scale countermeasures tests indicated that although waxy oil forms could be contained by conventional booming systems, the recovery of the oil using skimmers could prove difficult because of the semi-solid form of the oil and its lack of adhesion to oleophilic surfaces. Netting systems would also prove difficult to use since the gelled oil easily extrudes through mesh material at low pressures. A conventional chemical dispersant was completely ineffective on the waxy oils at temperatures below their pour point. Due to the slow weathering of waxy oils and the subsequent entrapment of volatile components, they may burn more efficiently than conventional oils, but may be more difficult to ignite. 23 refs., 64 figs., 29 tabs.

Environmental Protection Agency. 1988. National oil and hazardous substances pollution contingency plan. 53(245).
The Environmental Protection Agency (EPA) is proposing revisions to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Superfund Amendments and Reauthorization Act of 1986 (SARA) amends existing provisions of and adds major new authorities to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Furthermore, SARA mandates that the NCP be revised to reflect these amendments. The proposed NCP revisions are intended to implement regulatory changes necessitated by SARA, as well as to clarify existing NCP language and to reorganize the NCP to coincide more accurately with the sequence of response actions.

Environmental Protection Agency. 1993. Fact sheet for the multi-sector stormwater general permit. 58(222):Part II.
SUMMARY: The following provides notice for draft NPDES general permits and accompanying fact sheets for storm water discharges associated with industrial activity in the following Regions: $Region I-for the States of Maine, Massachusetts, and New Hampshire; for Indian lands located in Connecticut, Massachusetts, New Hampshire, Maine, Rhode Island, and Vermont; and for Federal facilities in Vermont. Region II-for the Commonwealth of Puerto Rico; for Indian lands located in New York; and for Federal facilities in the U.S. Virgin Islands. Region III-for the District of Columbia and for Federal facilities in Delaware. Region IV-for the State of Florida; and for Indian lands located in Alabama, Florida, Mississippi, and North Carolina. Region VI-for the States of Louisiana, New Mexico, Oklahoma, and Texas; and for Indian lands located in Louisiana, New Mexico (except Navajo lands and Ute Mountain Reservation lands), Oklahoma, and Texas. $Region VIII-for the State of South Dakota; for Indian lands located in Colorado,

Montana, North Dakota, South Dakota, Utah (except Goshute Reservation and Navajo Reservation lands), and Wyoming; for the portion of the Pine Ridge Reservation located in Nebraska; for the Ute Mountain Reservation in Colorado and New Mexico; and for Federal facilities in Colorado. Region IX-for the State of Arizona; for the Territories of American Samoa, Guam, Johnston Atoll, and Midway and Wake Island; for the Commonwealth of the Northern Mariana Islands; for the Republic of Palau (Trust Territory of the Pacific Islands); and for Indian lands located in California and Nevada; and for the Goshute Reservation in Utah and Nevada, the Navajo Reservation in Utah, New Mexico, and Arizona, the Duck Valley Reservation in Nevada and Idaho; and the Fort McDermitt Reservation in Oregon and Nevada. Region X-for the State of Alaska, and Idaho; for Indian lands located in Alaska, Oregon (except for Fort McDermitt Reservation lands), Idaho (except Duck Valley Reservation lands), and Washington; and for Federal facilities in Washington. The proposed permit is intended to cover storm water discharges associated with industrial activity to waters of the United States, including discharges through large and medium municipal separate storm sewer systems, and through other municipal separate storm sewer systems. The proposed permit is intended to cover discharges from the following types of industrial activities: lumber and wood products facilities; paper and allied products manufacturing facilities; chemical and allied products manufacturing facilities; asphalt paving and roofing materials manufacturers and lubricants; stone, clay, glass and concrete products facilities; primary metals facilities; metal mines (ore mining and dressing); coal mines; oil and gas extraction facilities; nonmetallic mines and quarries; hazardous waste treatment, storage or disposal facilities; landfills, land application sites and open dumps; automobile salvage yards; scrap and waste material processing and recycling facilities; steam electric power generating facilities; railroad transportation facilities, local and suburban transit and interurban highway passenger transportation facilities, petroleum bulk oil stations and terminals, motor freight transportation facilities and U.S. Postal Service facilities; water transportation facilities; ship or boat building/repair facilities; airports; wastewater treatment plants; food and kindred products facilities; textile mills, apparel and other fabric manufacturing facilities; furniture and fixture manufacturing facilities; printing and publishing facilities; rubber and miscellaneous plastic product manufacturing facilities; leather tanning and finishing facilities; facilities that manufacture fabricated metal products, jewelry, silverware, and plated ware; facilities that manufacture transportation equipment, industrial, or commercial machinery; and facilities that manufacture electronic equipment and components, photographic and optical goods. Publication of these

draft general permits and fact sheets is designed to comply with the requirements of 40 Code f Federal Regulations (CFR) 124.10 simultaneously for all draft general permits being noticed today. $The language of the proposed permit is provided as an appendix to the preamble of this notice. Most conditions of the draft general permits are intended to apply to all of the general permits indicated above. Where conditions in different permits vary by State, these differences are indicated in the appendix.

Environmental Protection Agency. 1988. Underground storage tanks; technical requirements. 53(185)
The Environmental Protection Agency (EPA) today finalizes regulations for underground storage tanks containing petroleum or substances defined as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), except any substance regulated as a hazardous waste under Subtitle C of the Resource Conservation and Recovery Act (RCRA). These regulations were first proposed on April 17, 1987 (52 FR 12662) and a subsequent Supplemental Notice was published on December 23, 1987 (52 FR 48638). Under Section 9003 of RCRA, EPA must establish requirements for leak detection, leak prevention, financial responsibility, and corrective action for all underground storage tanks containing regulated substances as necessary to protect human health and the environment. Today's final rule sets forth requirements satisfying the mandates of section 9003, except that final requirements concerning financial responsibility will be addressed later by EPA in another Federal Register notice.

Environmental Protection Agency. 1993. National oil and hazardous substances pollution contingency plan. 58(203):Part III.
SUMMARY: The U.S. Environmental Protection Agency (EPA or the Agency) is today proposing revisions to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Oil Pollution Act of 1990 (OPA) amends existing provisions of the Clean Water Act (CWA) and creates major new authorities addressing oil and, to a lesser extent, hazardous substance spill response. The revised CWA requires the President to revise the NCP to reflect these changes. The OPA specifies a number of revisions to the NCP that are intended to enhance and expand upon the current framework, standards, and procedures for response. The last revisions to the NCP were promulgated on March 8, 1990. The proposed revisions will affect all NCP subparts except F (State Involvement in Hazardous Substance Response) and I (Administrative Record for Selection of Response Action).

Environmental Protection Agency. 1990. Hazardous waste management systems: identification and listing of

hazardous waste; CERCLA hazardous substance designation-petroleum refinery primary and secondary
oil/water/solids separation sludge listings (F037 and F038).
55(213):Part III.
The Environmental Protection Agency (EPA) is today promulgating regulations under the Resource
Conservation and Recovery Act (RCRA) to add two wastes to the list of hazardous wastes under 40 CFR
261.31. These wastes, designated F037 and F038, are generated in the separation of oil/water/solids from
petroleum refinery process wastewaters and oily cooling wastewaters. $EPA is also amending Appendix VII
of 40 CFR 261 to add the organic and inorganic constituents for which these wastes are listed. In addition,
EPA is adding these wastes to the list of hazardous substances under the Comprehensive Environmental
Response, Compensation, and Liability Act (CERCLA) and setting their reportable quantities at the statutory
level of one pound. EPA is taking this action because these wastes, when improperly treated, stored,
transported, disposed of, or otherwise managed, are potentially capable of posing a substantial hazard to
human health or the environment. Today's rulemaking will extend RCRA and CERCLA coverage to all oil/
water/solids separation sludges and floats generated from wastewaters from petroleum refineries regardless of
the type of device used to separate the wastes from the process wastewaters and oily cooling wastewaters and
regardless of where treatment takes place. The effect of listing these wastes will be to subject them to the
hazardous waste regulations of 40 CFR 124, 262 through 266, 270, and 271 of this Chapter; the notification
requirements of section 3010 under RCRA; and the notification requirements of section 103 under CERCLA.

Environmental Protection Agency. 1993. Proposed water quality guidance for the great lakes system.
58(072):Part II.
SUMMARY: This document provides opportunity for comment on the proposed Water Quality Guidance for
the Great Lakes System (Guidance) developed under section 118(c)(2) of the Clean Water Act (CWA), as
amended by section 101 of the Great Lakes Critical Programs Act of 1990 (CPA). This Guidance, once
finalized, will establish minimum water quality standards, antidegradation policies, and implementation
procedures for waters within the Great Lakes System in the States of New York, Pennsylvania, Ohio, Indiana,
Illinois, Minnesota, Wisconsin, and Michigan, including the waters within the jurisdiction of Indian tribes.
Today's proposal also is intended to satisfy the requirements of section 118(c)(7)(C) of the Clean Water Act
that EPA publish information concerning the public health and environmental consequences of contaminants
in Great Lakes sediment and that the information include specific numerical limits to protect health, aquatic
life, and wildlife from the bioaccumulation of toxins. The

proposed Guidance specifies numeric criteria for selected pollutants to protect aquatic life, wildlife and human health within the Great Lakes System and methodologies to derive numeric criteria for additional pollutants discharged to these waters. The proposed Guidance also contains specific implementation procedures to translate the proposed ambient water quality criteria into enforceable controls on discharges of pollutants, and a proposed antidegradation policy for the Great Lakes System. The Great Lakes States and Tribes must adopt water quality standards, antidegradation policies, and implementation procedures for waters within the Great Lakes System which are consistent with the final Guidance. If a Great Lakes State or Tribe fails to adopt consistent provisions within two years of EPA's publication of the final Guidance, EPA will promulgate such provisions within the same two-year period.

Environmental Protection Agency. 1992. Final NPDES general permits for storm water discharges associated with industrial activity. 57(175):Part III. The Regional Administrators of Regions I, IV, VI, VIII, IX, and X (the ''Regions'' or the ''Directors'') are issuing final National Pollutant Discharge Elimination System (NPDES) general permits for storm water discharges associated with industrial activity (except discharges from construction activity) in 11 States (Alaska, Arizona, Florida, Idaho, Louisiana, Maine, New Hampshire, New Mexico, Oklahoma, South Dakota, and Texas); the Territories of Johnston Atoll, Midway and Wake Islands; on Indian lands in Alaska, Arizona, California, Colorado, Florida, Idaho, Maine, Massachusetts, Mississippi, Montana, New Hampshire, Nevada, North Carolina, North Dakota, Utah, Washington, and Wyoming; from Federal facilities in Colorado, and Washington; and from Federal facilities and Indian lands in Louisiana, New Mexico, Oklahoma, and Texas. These general permits establish Notice of Intent (NOI) requirements, prohibitions, requirements to develop and implement storm water pollution prevention plans, and requirements to conduct site inspections for facilities with dischargers authorized by the permit. In addition, these general permits establish monitoring requirements for certain classes of facilities and a numeric effluent limitation for discharges of coal pile runoff subject to the general permits.

Environmental Protection Agency. 1989. Proposed general demonstration NPDES permit for oil and gas operations in portions of the gulf of mexico; fact sheet. 54(198) The Regional Administrator of Region VI is proposing to issue a general demonstration NPDES permit to gather information on certain discharges in the Offshore Subcategory of the Oil & Gas Extraction Point Source Category. This general demonstration permit would establish BCT and BAT effluent limitations,

prohibitions and other conditions on discharges of drill cuttings from mineral oil-based muds. The permit conditions would be based on application of thermal treatment and solvent extraction technologies for the treatment of cuttings from oil-based muds. The permit would allow discharges of treated cuttings from mineral oil-based muds from no more than 20 oil and gas facilities only. No more than seven (7) demonstrations of a vendor's technology would be allowed. Only facilities located in certain Federal waters in the portion of the Gulf of Mexico for which EPA Region VI administers general permit GMG280000 would be eligible for coverage. For wastestreams other than those associated with treatment of drill cuttings from mineral oil-based muds, the limitations, prohibitions and conditions set forth in general permit GMG280000 would continue to apply to facilities covered by this demonstration permit. This general demonstration permit would expire five years after the date of its publication in the Federal Register as a final permit. This fact sheet sets forth the principal facts and the significant factual, legal, and policy questions considered in developing this draft permit. A copy of the draft permit is also being published today immediately following this fact sheet. The references cited in this fact sheet are available for public review at the address listed below. Public Comments Interested persons may submit comments on this proposed demonstration permit to EPA Region VI at the address below. The Region is seeking comments on all aspects of this proposed demonstration permit No. GMG280000, which would continue to be applicable to facilities covered by this general demonstration permit for wastestreams other than those associated with treatment of drill cuttings from mineral-oil based muds.

Environmental Protection Agency. 1990. Proposed NPDES general permit for the coastal waters of Louisiana. 55(110):Part II.

The Regional Administrator of Region 6 (the ''Region'') is today issuing a draft National Pollutant Discharge Elimination System (NPDES) general permit for discharges in the Coastal Subcategory of the Oil and Gas Extraction Point Source Category (40 CFR part 435, subpart D). This draft NPDES general permit establishes proposed effluent limitations, prohibitions, reporting requirements, and other conditions on discharges from oil and gas facilities engaged in production, field exploration, drilling, well completion, and well treatment operations. Produced water, produced sand and source water and sand discharges are excluded from coverage under this general permit, but will, however, be regulated under a separate general coastal permit. This draft permit is being issued as a Best Professional Judgment (BPJ) determination of Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) levels of

pollution control. This permit, when issued as final, will authorize discharges from oil and gas facilities to the coastal waters of Louisiana. This permit will not authorize discharges to areas defined as ''Onshore'' (see 40 CFR part 435, subpart C), or from ''new sources'' (see 40 CFR 122.2 and 40 CFR 122.29).|

Environmental Protection Agency. 1991. Hazardous Waste Management System; General; Identification and Listing of Hazardous Waste; Used Oil. 56(184):Part II.
This notice announces the availability of additional data on the composition of used oil and used oil residuals. EPA will consider the new data in making its final decision whether or not to list some or all used oils as hazardous waste, as proposed in November, 1985. Also, based on a portion of the new data, EPA is today considering amending its regulations under the Resource Conservation and Recovery Act (RCRA) by listing as hazardous four wastes from the reprocessing and re-refining of used oil. Finally, today's notice provides additional information on the proposed used oil management standards for recycled oil under section 3014 of RCRA. Public comment is requested on the proposed used oils and residuals to be listed as hazardous, on a number of specific aspects of the newly available data, on specific aspects of the Agency's approach for used oil management standards, and on several aspects of the hazardous waste identification program as related to used oil.

Environmental Protection Agency. 1991. National Pollutant Discharge Elimination System General Permits and Reporting Requirements for Storm Water Discharges Associated With Industrial Activity. 56(159):Part II.
Section 405 of the Water Quality Act of 1987 (WQA) added section 402(p) of the Clean Water Act (CWA) which requires the Environmental Protection Agency (EPA) to develop a phased approach to regulating storm water discharges under the National Pollutant Discharge Elimination System (NPDES) program. EPA published a final regulation on November 16, 1990, (55 FR 47990) establishing permit application requirements for storm water discharges associated with industrial activity and for discharges from municipal separate storm sewer systems serving a population of 100,000 or more. In the permit application regulations, EPA defined the term ''storm water discharge associated with industrial activity'' in a comprehensive manner to cover a wide variety of facilities. This definition greatly expanded the number of industrial facilities subject to the NPDES program. $This notice requests comments on a National NPDES permitting strategy to address the large number of storm water discharges associated with industrial activity. To assist in implementing the strategy, this notice requests comments on proposed regulatory changes to existing minimum requirements

for NPDES permits with regard to annual monitoring reports and minimum requirements for filing notices of intent to be authorized to discharge under NPDES general permits. $This notice also requests comments on separate general permits for the majority of storm water discharges associated with industrial activity in 12 States (MA, ME, NH, FL, LA, TX, OK, NM, SD, AZ, AK, ID), and 6 Territories (District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and the Trust Territory of the Pacific Islands) without authorized NPDES State programs; on Indian lands in AL, CA, GA, KY, MI, MN, MS, MT, NC, ND, NY, NV, SC, TN, UT, WI, and WY; located within Federal facilities and Indian lands in CO and WA; and located within Federal facilities in Delaware. Separate general permits are being noticed for each State.

Environmental Protection Agency. 1992. Technology Evaluation Report: The Carver-Greenfield Process, Dehydro-Tech Corporation. Report No. EPA/450/R-92/002, 230 pp.
Key words: Sludge Drying, Separation, Oil Pollution, Hydrocarbons, Oil Spills
The report evaluated the ability of Dehydro-Tech Corporation's (DTC) Carver-Greenfield Process to separate oil contaminated waste drilling muds to their constituent solids, oil and water fractions. The Carver-Greenfield Process (C-G) was developed by DTC in the late 1950's and is licensed in over 80 plants worldwide. The technology is designed to separate solid-liquid mixtures into three product streams: a clean, dry solid; a water product substantially free of solids and organics; and a concentrated mixture of extracted organics. A mobile pilot plant was used for the demonstration. The C-G Process demonstration was conducted at EPA's Edison, New Jersey facility in August, 1991. Waste drilling muds from the PAB Oil and Chemical Services, Inc. (PAB Oil) site in Vermilion Parish, Louisiana were processed in the demonstration. PAB Oil, which ceased operation in 1983, operated three oil drilling mud separation pits from which the waste material used in the demonstration was collected.

Environmental Protection Agency. 1993. Significant new uses of certain chemical substances. Rules and Regulations. For further information contact: Susan B. Hazen, Director, Environmental Assistance Division (TS-799), Office of Toxic Substances,Environmental Protection Agency, Rm. E-543B, 401 M St., SW.,Washington, DC 20460, Telephone: (202) 554-1404, TDD: (202) 554-0551.
Keywords: EPA, Toxic Substances Control Act
EPA is promulgating significant new use rules (SNURs) under section 5(a)(2) of the Toxic Substances Control Act (TSCA) for certain chemical substances which were the subject of premanufacture notices (PMNs) and subject to TSCA section 5(e) consent orders issued by

EPA. Today's action requires certain persons who intend to manufacture, import, or process these substances for a significant new use to notify EPA at least 90 days before commencing the manufacturing or processing of the substance for a use designated by this SNUR as a significant new use. The required notice will provide EPA with the opportunity to evaluate the intended use, and if necessary, to prohibit or limit that activity before it occurs. EPA is promulgating this SNUR using direct final procedures.

Environmental Protection Agency. 1993. Land disposal restrictions for newly identified and listed hazardous wastes and hazardous soil. Proposed Rules. 58(176) Part II: EPA+/- 530-7-93-011, FRL-4725-5, RIN 2050-Ad37. For further information contact: For general information, contact the RCRA Hotline at (800) 424-9346 (toll-free) or (703) 412-9810 locally. For technical information on treatment standards, contact the Waste Treatment Branch, Office of Solid Waste (OS-322W), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC. 20460, (703)308-8434.
Keywords: Clean Water Act, soil disposal, waste, recycling, regulations
EPA is proposing treatment standards for the newly identified organic toxicity characteristic wastes (except those managed in Clean Water Act (CWA) systems, CWA-equivalent systems, or Class I Safe Drinking Water Act (SDWA) injection wells), and treatment standards for all newly listed coke by-product and chlorotoluene production wastes that must be met before these wastes are land disposed. EPA is also proposing to require ignitable characteristic wastes with a high total organic carbon (TOC) content and toxic characteristic pesticide wastes, that are being disposed in Class I nonhazardous waste injection wells, to either be injected into a well that is subject to a no-migration determination, or be treated to meet the LDR treatment standards prior to injection. These treatment standards and the dilution prohibitions for high TOC ignitables and pesticides are being proposed in order to comply with a proposed consent decree with the Environmental Defense Fund. This proposal also contains alternative standards for soil contaminated with prohibited hazardous wastes that will encourage use of noncombustion treatment technologies in treating hazardous soil. In addition, EPA is proposing several revisions to previously promulgated treatment standards and requirements in order to simplify the implementation of the land disposal restriction rules, including setting universal treatment standards. Finally, EPA is proposing to modify the hazardous waste recycling regulations which will allow streamlined regulatory decisions to be made regarding the regulation of certain types of recycling activities.

Environmental Protection Agency. 1991. Oil Pollution Prevention;

Non-transportation-related Onshore and Offshore Facilities. 56(204):Part II.
The U.S. Environmental Protection Agency is proposing to revise the Oil Pollution Prevention regulation (40 CFR part 112) promulgated under section 311(j)(1)(C) of the Clean Water Act (CWA), as amended by the Oil Pollution Act of 1990. This proposed rule establishes requirements for Spill Prevention, Control, and Countermeasures (SPCC). Plans to prevent spills of oil by non-transportation-related onshore and offshore facilities into the waters of the United States or adjoining shorelines. The proposed revision involves changes in the applicability of the regulation and the required procedures for the completion of SPCC Plans, as well as the addition of a facility notification provision. The proposed rule also reflects changes in the jurisdiction of section 311 of the CWA made by 1977 and 1978 amendments to the CWA.

Environmental Protection Agency. 1992. Final NPDES General Permits for Storm Water Discharges Associated With Industrial Activity. 57(175):Part III.
The Regional Administrators of Regions I, IV, VI, VIII, IX, and X (the''Regions'' or the ''Directors'') are issuing final National Pollutant Discharge Elimination System (NPDES) general permits for storm water discharges associated with industrial activity (except discharges from construction activity) in 11 States (Alaska, Arizona, Florida, Idaho, Louisiana, Maine, New Hampshire, New Mexico, Oklahoma, South Dakota, and Texas); the Territories of Johnston Atoll, Midway and Wake Islands; on Indian lands in Alaska, Arizona, California, Colorado, Florida, Idaho, Maine, Massachusetts, Mississippi, Montana, New Hampshire, Nevada, North Carolina, North Dakota, Utah, Washington, and Wyoming; from Federal facilities in Colorado, and Washington; and from Federal facilities and Indian lands in Louisiana, New Mexico, Oklahoma, and Texas. $These general permits establish Notice of Intent (NOI) requirements, prohibitions, requirements to develop and implement storm water pollution prevention plans, and requirements to conduct site inspections for facilities with dischargers authorized by the permit. In addition, these general permits establish monitoring requirements for certain classes of facilities and a numeric effluent limitation for discharges of coal pile runoff subject to the general permits.

Environmental Protection Agency. 1992. Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Recycled Used Oil Management Standards. 57(176):Part III.
The Agency is promulgating a final listing decision for used oils that are recycled and is simultaneously promulgating standards for the management of used oil under RCRA section 3014. EPA has made a final listing decision for used oils that are recycled based upon the

technical criteria provided in sections 1004 and 3001 of RCRA. EPA determined that recycled used oil does not have to be listed as a hazardous waste since the used oil management standards issued in this rulemaking are adequately protective of human health and the environment. These standards cover used oil generators, transporters, processors and re-refiners, burners, and marketers. These standards are promulgated under the authority of section 3014 of RCRA and will be codified in a new part 279 of chapter 40 of the Code of Federal Regulations. When these management standards go into effect, service station dealers who collect used oil from do-it- yourself (DIY) generators and who are in compliance with the standards promulgated, may be eligible for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 114(c) liability exemption. EPA is continuing to evaluate the potential hazards associated with management of used oil. When this analysis is completed, the Agency will publish Notice(s) of Data Availability in theFederal Register over the next several months, as necessary. EPA will also, at that time, solicit opinion from the public on what, if any, additional steps may be necessary regarding used oil management.

Environmental Protection Agency. 1992. Hazardous Waste Management; Liquids in Landfills. 57(223):Part II.
Under authority of the Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA), EPA is promulgating this final rule regarding the landfill disposal of containerized liquids mixed with sorbents. This rule satisfies the statutory requirement that EPA issue a rule that prohibits the disposals in hazardous waste landfills of liquids that have been sorbed in materials that biodegrade or that release liquids when compressed as might occur during routine landfill operations. This rule will help assure the stability of materials in hazardous waste landfills.

Environmental Protection Agency. 1992. Hazardous waste management system: identification and listing of hazardous waste and CERCLA hazardous substance designation; reportable quantity adjustment, chlorinated toluenes production wastes. Rules and Regulations. The RCRA/Superfund Hotline, toll-free at (800) 424-9346 or locally at (703) 920-9810. For technical information on the RCRA hazardous waste listings, contact Dr. Ambika Bathija, Office of Solid Waste (OS-333), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460, (202) 260-4770.
Keywords: EPA, RCRA
The U.S. Environmental Protection Agency (EPA) is amending the regulations for hazardous waste management under the Resource Conservation and Recovery Act (RCRA) by adding three wastes generated

during the production of the alpha- (or methyl-) chlorinated toluenes, ring-chlorinated toluenes, benzoyl chlorides, and compounds with mixtures of these functional groups, collectively referred to in this document as ''chlorinated toluenes,'' to the list of hazardous wastes from specific sources. EPA is also amending appendix VII of 40 CFR part 261 to add the constituents for which these wastes are being listed. The effect of this regulation is that these three wastes will be subject to regulation as hazardous wastes. In addition, EPA is amending regulations promulgated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) that are related to today's waste listings. In particular, EPA is amending CERCLA regulations by designating the listed wastes as CERCLA hazardous substances and establishing the reportable quantities applicable to these wastes.

Environmental Protection Agency. 1991. Understanding bioremediation: A guidebook for citizens. Office of Emergency and Remedial Response, Environmental Protection Agency, Washington, D.C. (United States). 23 p
Keywords: biodegradation, land pollution, microorganisms, waste management, monitoring, transport
Bioremediation - a process that uses microorganisms to transform harmful substances to nontoxic compounds - is one of the most promising new technologies for treating chemical spills and hazardous waste problems. In order to improve the technology and better understand its capabilities, the U.S. Environmental Protection Agency (EPA) is encouraging field tests and evaluation of waste site cleanups using bioremediation. As bioremediation is considered more frequently as a cleanup alternative, citizens need information about this process to help them contribute to informed decision-making regarding the cleanup of waste sites in their communities. The brochure answers some questions about what bioremediation is, where it can be used effectively, and its advantages and disadvantages.

Environmental Protection Agency. 1992. Land disposal restrictions for newly listed wastes and hazardous debris. Rules and Regulations. 57(160) Part II: FRL-4132-4, RIN 2050-AD36. For general information, contact the RCRA Hotline at (800) 424-9346 (toll free) or (703) 920-9810 locally. For information on treatment standards for newly listed wastes or hazardous debris, contact the Waste Treatment Branch, Office of Solid Waste (OS-322W), U.S. Environmental Protection Agency, 401 M St., SW., Washington, DC 20460, (703) 308-8434.
Keywords: EPA, soil disposal, hazardous waste
The Environmental Protection Agency (EPA) is finalizing treatment standards under the land disposal restrictions (LDR) program for certain hazardous wastes listed after November 8, 1984, pursuant to a

proposed consent decree filed with the District Court that established a promulgation date of June 1992 (EDFv.Reilly, Civ. No. 89-0598, D.D.C.). EPA is also finalizing revised treatment standards for debris contaminated with listed hazardous waste or debris that exhibits certain hazardous waste characteristics (hereinafter referred to as hazardous debris), and several revisions to previously promulgated standards and requirements. These actions are being taken as part of the RCRA Reform Initiative, and are expected to facilitate implementation of the LDR program.

Environmental Protection Agency. 1993. Oil Pollution Prevention; Non-Transportation-Related Onshore Facilities. 58(030):Part II.
SUMMARY: This proposed rule would revise the Oil Pollution Prevention regulation, originally promulgated under the Clean Water Act (CWA). The proposed revision would incorporate new requirements added by the Oil Pollution Act of 1990 that direct facility owners and operators to prepare plans for responding to a worst case discharge of oil and to a substantial threat of such a discharge. Other regulatory changes to strengthen the existing regulation also are proposed.

Environmental Protection Agency. 1993. National Oil and Hazardous Substances Pollution Contingency Plan. 58(203):Part III.
SUMMARY: The U.S. Environmental Protection Agency (EPA or the Agency) is today proposing revisions to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Oil Pollution Act of 1990 (OPA) amends existing provisions of the Clean Water Act (CWA) and creates major new authorities addressing oil and, to a lesser extent, hazardous substance spill response. The revised CWA requires the President to revise the NCP to reflect these changes. The OPA specifies a number of revisions to the NCP that are intended to enhance and expand upon the current framework, standards, and procedures for response. The last revisions to the NCP were promulgated on March 8, 1990. The proposed revisions will affect all NCP subparts except F (State Involvement in Hazardous Substance Response) and I (Administrative Record for Selection of Response Action).

Environmental Protection Agency. 1992. Guidelines for exposure assessment. Notices 57(104) Part VI: FRL-4129-5. For Additionnal Information: Michael A. Callahan, Director, Exposure Assessment Group, Office of Health and Environmental Assessment (RD-689), U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460, 202-260-8909.
Keywords: EPA, guidelines, exposure, wildlife, human

Environmental Protection Agency. 1988. Office of solid waste chemicals; final test rule. Rules and

Regulations. 53(115):OPTS-42088D, FRL-3396-8.
Keywords: EPA, Toxic Substances Control Act, biodegradation
EPA is issuing a final test rule, under section 4 of the Toxic Substances Control Act (TSCA), requiring and/or recommending that manufacturers and processors of 33 chemicals perform testing for human health effects and/or chemical fate in support of EPA's hazardous waste regulatory program under the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. The required health effects testing is a subchronic toxicity study via oral gavage. The required chemical fate testing includes tests to determine one or both of the following: Adsorption characteristics, and hydrolysis rates. EPA is also recommending, but not requiring, anaerobic biodegradation rate testing for 32 chemicals.

Environmental Protection Agency. 1991. Twenty-Eighth report of the interagency testing committee to the administrator; receipt of report and request for comments regarding priority list of chemicals. 56(160) Part IX OPTS-41035, FRL 3937-4. Notice
Keywords: Toxic Substances Control Act
The Interagency Testing Committee (ITC), established under section 4(e) of the Toxic Substances Control Act (TSCA), transmitted its Twenty-Eighth Report to the Administrator of EPA on May 31, 1991. As noted in this Report, which is included with this notice, the Committee revised the Priority Testing List by designating 6 chemicals and recommending 3 chemicals and 11 chemical groups. The six designated chemicals are: acetone, n-butanol, dimethyl terephthalate, di-(2-ethylhexyl) adipate, isobutyl alcohol, and thiophenol. There are no recommended with intent-to-designate chemicals. The three recommended chemicals are: allyl alcohol, 2,4- dichlorophenol, and m-dinitro-benzene. The 11 recommended chemical groups are: aldehyde hydrates, alkoxysilanes, alkynes, cyanoacrylates, hydrazines,isothiocyanates, methyl ethylene glycol ethers, nitroalcohols, oxiranes, propylene glycol ethers and esters, and phosphoniums. The ITC has not removed any chemicals from the Priority List as a result of EPA actions. EPA invites interested persons to submit written comments on the Report. EPA is not holding a Focus Meeting for these chemicals and will proceed immediately to rulemaking. EPA is taking this action because the designated chemicals have a statutory deadline and require a response by EPA within 1 year.

Environmental Protection Agency. 1991. Prince William Sound and Gulf of Alaska restoration. Federal Register. 56(41):8898-903.
Key words: Accident, Alaska, Animal, Biology, Bird, Crude Oil, Economic Factor, Environmental Protection, Legal Consideration, Pollution Control

Environmental Protection Agency. 1991. Reportable quantity

adjustments for petroleum refinery primary
treatment. Proposed Rules 56(59) Part III: 40 CFR Part 302.
Keywords: EPA, petroleum, refinery
The U.S. Environmental Protection Agency (EPA or the Agency) is
proposing to adjust the reportable
quantities (RQs) for waste stream F037 and F038 (sludges from
petroleum refinery separation processes)
under the Comprehensive Environmental Response, Compensation, and
Liability Act of 1980 (CERCLA), as
amended. In a final rule published on
November 2, 1990 (55 FR 46354), EPA designated waste streams F037
and F038 as hazardous under
CERCLA and assigned each of them a statutory RQ of one pound. In
this proposed rule, the Agency is
exercising its authority under section 102(a) of CERCLA by
proposing to adjust the statutory RQs for waste
streams F037 and F038.

Environmental Protection Agency. 1988. Tri-City Oil
Conservationist Corp, Florida Department of
Environmental, US Environmental Protection Agency. March 14,
1988. National Oil and Hazardous
Substances Contingency Plan ((NCP)) The National Priorities List
((NPL)) Request for Comments. Fed.
Regist. 53(49):8223-25.
Key Words: Airport, aquifer, benzene ring, business operation,
contingency plan, C6, C7, C8, District 1,
economic factor, financial assistance, Florida, fuel oil, gas
turbine fuel, government document, ground water,
ground level, heating fuel, hydrocarbon solvent, jet fuel, legal
consideration, material handling, motor fuel,
North America, oil waste, organic solvent, pollution control,
pollution source, potable water, public affairs,
saturated chain, single structure type, soil (earth), soil
analysis, soil pollutant, soil pollution, toluene,
transportation terminal, US Environmental Protection Agency, USA,
USE, waste material, water pollutant,
water pollution, water quality, xylene.

Envirotech International Ltd. 1991. New petroleum dispersant,
cleaning agent. Oil & Gas Journal. 89(6):64.
Key words: Accident, Biodegradability, Chemical Cleaning, Crude
Oil, Environemtnal Protection, Pollution
Control

Epler, Lt. Cdr. G.F. 1991. U.S. Coast Guard oil spill contingency
planning. In: Proceedings of the 1991 Oil
Spill Conference (prevention, behavior, control, cleanup), March
4 7, San Diego, CA.
Key words: Coast Guard, oil spill contingency.

Epple, D., M. Visscher, W. A. Wallace, and J. W. Wilkinson. 1977.
Controlling pollution of the marine
environment: an economic analysis. In: Proceedings of the 1977
Oil Spill Conference(Prevention, Behavior,
Control, Cleanup), March 8 10, 1977, New Orleans, LA, pp. 31 34.
Washington, D.C.: American Petroleum

Institute.
Keywords: pollution, marine, environment, economic.

Erasmus., Graham I. H. Kerley; Theuns. 1987. The Management of Oiled Penguins. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987 in Baltimore, MD.
Key words: management, oiled penguins

Erchul, R.A. 1990. A conductivity cone penetrometer to detect contaminant plume flow rate. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:419-428.
Key Words: Pollution, ground water, engineering geology, well-logging, detection, instruments, penetrometers, electrical logging, applications, Rockbridge County Virginia, cone penetration tests, Virginia, Southeastern U.S., Eastern U.S. United States, central Virginia, experimental studies, oil spills.

Ergas, S.J., E.D. Schroeder, and D.P.Y. Chang. 1991. VOC emission control from wastewater treatment facilities using biofiltration. In: Proceedings of the AWMA 84th Annual Meeting, June 16 21, 1991, Vancouver, B.C. N.91-105.4 V6B (1991) 13 pp.
Key words: transport, water pollution, hydrocarbon, biodegradation, legal

Erickson, Brad. 1985. North La Crosse underground fuel oil spill. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words; underground, oil spill.

Ermisch, O., Rehm, H.J. 1989. Degradation of polycyclic aromatic hydrocarbons by the immobilized mold Trichoderma harzianum in soil. 7. DECHEMA annual meeting on biotechnology and 58. meeting of the European Biotechnology Federations, and joint meeting of Society for Industry Microbiology (SIM).
780-781.
There are only a few informations available about the degradation of polycyclic aromatic hydrocarbons (PAH) by various fungi. Using a model system (fine gravel, 1.0 to 1.5 mm), different immobilization technics it was feasible to degrade anthracene by Trichoderma harzianum. The carbon dioxide release was determined by using {sup 14}C labeled anthracene. In bottles filled with gravel a carbon dioxide release up to 47% by in Ca-alginat immobilized cells and 9.9% by adsorpted cells (to gravel) was measured. A mixing of the fluid did influence the degradation in a positive way. The corresponding values of assay not shaked were 14% and 11.8%. In constrast to bacteria Trichoderma harzianum only degrades anthracene using other substrates as connetabolites. Another feature of mycelium is the fast and

strong adsorption of anthracene. Within 2 minutes more than 80% of the added anthracene were adsorbed. By the feature of anthracene adsorption it is possible to accumulate the contaminating anthracene in order to reduce the anthracene concentration within toxical limits. By biochemical assays anthracene-binding proteins were determined. Using affinity chromatography and SDS-gelelektrophoresis the molecular weights 55000, 53000, 51000 and 34000 were measured.
Key words: polycyclic aromatic hydrocarbons, biodegradation, anthracene, carbon 14, immobilized, quantative chemical analysis, trichoderma, land pollution.

Eryuzlu, N.E., R. Hausser. 1977. Use of floating deflectors for oil spill control in fast flowing waters. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: deflectors, oil spill, water.

Eshia Boo Inc. Vessel for collecting and sepg. oil and water in marine environment, uses at least partially submerged internal collection and separation of the oil-water mixt., for recovering spilled oil from surface.
Patent No. WO 91US4689_910701.
Key words: Boom, Oil Waste, Pollution Control, Waste Material

Essaid, H. I., Herkelrath, W. N., Hess, K. M. 1991. Air, oil, and water distributions at a crude-oil spill site, Bemidji, Minnesota. Water Resources Investigations. pp.614-620.
Key Words: Minnesota, pollution, ground water, environmental geology, oil spills, saturation, USGS, Midwest, United States, north-central Minnesota, Bemidji Minnesota, Beltrami County Minnesota, field studies, numerical models.

Esslinger, A., J. Tilgner, and J. Rathsack. 1992. Entwicklung eines Laserfluorosensors fuer die Meeresueberwachung. Schlussbericht. (Development of a laser fluorosensor for maritime surveillance. Development of a power supply for airborne mission and laser EMC encapsulation. Final report). Krupp MaK Maschinenbau G.m.b.H., Kiel (Germany, F.R.). Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 177 pp.
Key words: Airborne Equipment, Pollution Monitoring, Remote Sensing, Laser Applications
Today it is possible to realize an airborne Laserfluorosensor for remote sensing of thin oil spills as well as other fluorescent pollutions at the sea surface. Main tasks of Krupp MaK in this cooperation project together with the University of Oldenburg were the mechanical structure for an airborne mission, a high sophisticated power supply for the conversion of an 28 V DC-aircraft voltage to the high voltage as needed for the Laser, development of soft- and hardware for the sensor located analyzing computer and an additional operator

console. All sensor components were arranged around the modified standard laser tube in a way which gives a high grade of mechanical and optical stability. The power supply is a minimum loss two step DC-DC-Voltage Converter which provides a maximum power of about 3 Kilowatts. The Laserfluorosensor should be able to detect a lot of additional chemical substances on sea surface. (orig.). (FR 6159.) (Copyright (c) 1993 by FIZ. Citation no. 93:001662.)

Estes, J.E. 1973. Volumetric determination of marine oil spills using coordinated airborne and surface sampling data. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: marine, oil spills, sampling.
Estimates of the volume of recoverable petroleum product at contaminated sites are frequently based on apparent product thickness measurements in monitoring wells. Since the apparent thickness is known to exceed the actual thickness of the mobile product layer, field methods for determining the actual thickness should be developed and cross-validated. Existing field methods for determining actual product thickness were compared at a spill site. The methods evaluated were: Yaniga's bailer test, split-spoon coring, and digging a test pit. Comparable values of actual product thickness at this point were produced by three methods: Yaniga's bailer test (0.54 ft), the CONCAWE equation modified to use the measured product density (0.56 ft), and sampling soils from the test pit (0.6 ft). A new tool for measuring actual product thickness in the field was built and tested. The new tool was tested in the lab in sand-filled Plexiglas enclosures and at the field site along with the three comparable methods. The tool is a steel rod which is driven into a shallower aquifer. When the tip reaches water-saturated sediments, an electronic circuit issues a warning. The rod has a longitudinal slot which holds a replaceable insert coated with product indicator chemicals. The tool is left in place for several minutes before being withdrawn. The indicator strip shows the position of layers containing free product and of the oil-water capillary fringe by changing color in two distinct ways. The total thickness of the individual product layers is taken as the actual thickness.

Evans, P.J., Ling, W., Goldschmidt, B., Young, L.Y., Ritter, E.R. 1992. Metabolites formed during anaerobic transformation of toluene and o-xylene and their proposed relationship to the initial steps of toluene mineralization. Applied and Environmental Microbiology (United States). 58:2:0099-2240.
Strain T1 is a facultative bacterium that is capable of anaerobic toluene degradation under denitrifying conditions. While 80% of the carbon from toluene is either

oxidized to carbon dioxide or assimilated into cellular carbon, a significant portion of the remainder is transformed into two dead-end metabolites. These metabolites were produced simultaneous to the mineralization of toluene and were identified as benzylsuccinic acid and benzylfumaric acid. Identification was based on comparison of mass spectra of the methyl esters of the metabolites and authentic compounds that were chemically synthesized. Strain T1 is also capable of o-xylene transformation during growth on toluene, o-Xylene does not serve as a source of carbon and is not mineralized. Rather, it is transformed to analogous dead-end metabolites, (2-methylbenzyl)-succinic acid and (2-methyl-benzyl)-fumaric acid. o-Xylene transformation also occurred during growth on succinic acid, which suggests that attack of the methyl group by succinyl-coenzyme A is a key reaction in this transformation. The authors reason that the main pathway for toluene oxidation to carbon dioxide involves a mechanism similar to that for the formation of the metabolites and involves an attack of the methyl group of toluene by acetyl-coenzyme A.
Key words: toluene, biodegradation, metabolites, mineralization, succinic acid.

Evans, P.J., D.T., Kwang Shin Kim, Young, L.Y. 1991. Anaerobic degradation of toluene by a denitrifying bacterium. Applied and Environmental Microbiology (United States). 57:4:1139-1145.
A denitrifying bacterium, designated strain T1, that grew with toluene as the sole source of carbon under anaerobic conditions was isolated. The type of agar used in solid media and the toxicity of toluene were determinative factors in the successful isolation of strain T1. Greater than 50% of the toluene carbon was oxidized to CO{sub 2}, and 29% was assimilated into biomass. The oxidation of toluene to CO{sub 2} was stoichiometrically coupled to nitrate reduction and denitrification. Strain T1 was tolerant of and grew on 3 mM toluene after a lag phase. The rate of toluene degradation was 1.8 {mu}mol min{sup {minus}1} liter{sup {minus}1} (56 nmol min{sup {minus}1} mg of protein{sup {minus}1}) in a cell suspension.
Strain T1 was distinct from other bacteria that oxidize toluene anaerobically, but it may utilize a similar biochemical pathway of oxidation. In addition, o-xylene was transformed to a metabolite in the presence of toluene but did not serve as the sole source of carbon for growth of strain T1. This transformation was dependent on the degradation of toluene.
Key words: toluene, biodegradation, anaerobic conditions, biological, carbon dioxide.

Evans, D.D. 1992. In-situ burning: NIST studies. In: Proceedings from the first international oil spill R D forum, June 1 4 1992, McLean, VA, pp. 241-245.
Key words: Oil Spill Mitigation, Petroleum, Research Programs

In-situ burning of spilled oil has distinct advantages over other countermeasures. It offers the potential to convert rapidly large quantities of oil into its primary combustion products, carbon dioxide and water, with a small percentage of other unburned and residue byproducts. Because the oil is converted to gaseous products of combustion by burning, the need for physical collection, storage, and transport of recovered fluids is reduced to the few percent of the original spill volume that remains as residue after burning. Burning oil spills produces a visible smoke plume containing smoke particulate and other products of combustion which may persist for many kilometers from the burn. This fact gives rise to public health concerns, related to the chemical content of the smoke plume and the downwind deposition of particulate, which need to be answered.
In 1985, a joint Minerals Management Service (MMS) and Environment Canada (EC) in-situ burning research program was begun at the National Institute of Standards and Technology (NIST). This research program was designed to study the burning of large crude oil spills on water and how this burning would affect air quality by quantifying the products of combustion and developing methods to predict the downwind smoke particulate deposition. To understand the important features of in-situ burning, it is necessary to perform both laboratory and mesoscale experiments. Finally, actual burns of spilled oil at sea will be necessary to evaluate the method at the anticipated scale of actual response operations. In this research program there is a continuing interaction between findings from measurements on small fire experiments performed in the controlled laboratory environments of NIST and the Fire Research Institute (FRI) in Japan, and large fire experiments at facilities like the USCG Fire Safety and Test Detachment in Mobile, Alabama where outdoor liquid fuel burns in large pans are possible.

Evans, D.D. 1991. Burning of oil spills. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: burning, oil spills.

Evans, James A. 1979. A Legal overview of cleanup operations. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA. Year.
Key words: legal overview, cleanup.

Evans, David. 1989. Generation and dispersal of smoke from oil spill combustion. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: dispersal, smoke, oil spill.

Evans, D.D. 1989. In-situ burning of oil spills. In: Proceedings of the US Dep Interior Minerals Manage Serv

Alaska Arctic Offshore Oil Spill Response Technol Workshop, November 29 December 1 1988, Anchorage, Alaska, (Nist Spec Publication No 762) pp. 47-95.
Key words: Oil Spill, Chemical Process, Contamination, Pollution Control, Crude Oil

Evans, Lt. Clayton W. 1985. The Effects and implications of oil pollution in mangrove forests. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: effects, implications, oil pollution, forests.

Evans, D.D. 1988. In-situ burning of oil spills. NIST Spec. Publ., 762(Alaska Arct. Offshore Oil Spill Response Technol. Workshop Proc., 1988) 47-95 (1989) Chem. Abstr. ABSTR. NO. 41958 V112 N.6.
Key words: Abstract, Boom, In-situ, Pollution Control, Waste Disposal

Evans, P.J., Ling, W., Palleroni, N.J., Young, L.Y. 1992. Quantification of denitrification by strain T1 during anaerobic degradation of toluene. Applied Microbiology and Biotechnology (Germany). 37:1:136-140.
Strain T1 is a denitrifying bacterium that is capable of toluene degradation under anaerobic conditions.
During anaerobic growth on toluene, the specific growth rate of strain T1 was 0.14 h{sup -1}. Nitrite accumulated in the medium stoichiometrically with the depletion of nitrate. When nitrate was nearly depleted from the medium nitrite reduction and dinitrogen formation began. A non-kinetic model was formulated that was based on a hypothesis of non-simultaneous nitrate and nitrite reduction, independent of the concentrations of nitrate and nitrite. The model was verified experimentally over a wide range of conditions that included nitrate and nitrite limitation, toluene limitation, and various ratios of nitrate to nitrite. The model and its experimental verification demonstrated that strain T1 reduces nitrate and nitrite non-simultaneously, even if nitrite is initially present in the medium in addition to nitrate.
Key words: toluene, biodegradation, culture media, denitrification, nitrates, pseudomonas.

Evans, D.D., H. Koseki, E.J. Tennyson, W.D. Walton, H.R. Baum, K. A. Notarianni, J.R. Lawson, H.C. Tang, K.R. Keydel, R.G. Rehm, D. Madrzykowski, and R.H. Zile. 1992. In-situ burning of oil spills (to remove them): Mesoscale experiments. In: Proceedings of the Environment Canada 15th Arctic and Marine Oil Spill Technical Seminar, June 10 12 1992, Edmonton, Alberta, pp. 593-657.
Key words: Air Pollution, Alabama, Computer Simulation, Crude Oil, Louisiana, Petroleum

Evins, A.A. IV. 1992. Down-hole hydrocarbon collector. Patent No. US 5080781920114, 11p.
Key words: Pollution Control Equipment, Groundwater, Oil Spill, Water Pollution

Exxon Corp. 1989. Exxon (Corp.) claims success in the Alaska oil spill cleanup. Oil Gas J. 87(40):24,27.
Key words: Accident, Alaska, Boom, Diaster Control, Gulf, Oil Waste Pollution Control Equipment, Oil Spill, Supertanker

Exxon Corp. 1990. Alaska spill clean-up. Marine Pollution Bulletin. 21(7):316.
Key words: Alaska, Biochemical Reaction, Biodegradation, Containment, Pollution Control

Exxon Valdez. 1990. (Exxon) Valdez oil spill technology...1989 operations. Exxon Production Research Co Report (1990), 100P.
Key words: Adsorbent, Biodegradation, Boom, Monitoring, Oil Waste, Pollution Control Equipment

Exxon Corp. 1989. Alaskan oil spill clean-up. Mar. Pollut. Bull. 20(6):248.
Key words: Alaska, Animal, Crude Oil, Economic Factor, Environmental Impact, Legal Consideration, Pollution Control

Exxon Valdez. 1989. Valdez oil spill technology...1989 operations. Exxon Production Research Co Report (1990) 100P.
Key words: adsorbent, adsorption process, aerial belt, biochemical reaction, biodegradation, boom, bulk carrier, buoyancy, circle, coastal area, commercial, condensation, containment, curve, esso, fertilizer, lipophilic, low temperature, map, report report, ship, skimmer, soil pollutant.

Eyman, L.D., and T.D. Anderson. 1988. Innovative technologies for the treatment of hazardous and mixed wastes. In: Proceedings of the International symposium on the management of low and intermediate level radioactive wastes, May 16, 1988, Stockholm, Sweden, 13 pp.
Key words: disposal, monitoring, biodegradation, oil spill, soil
The treatment, storage, and disposal of hazardous and mixed wastes incur significant costs for Department of Energy (DOE) installations. These wastes must be managed under strict environmental controls and regulations to prevent the possibility of migration of hazardous materials to the biosphere. Through the Hazardous Waste Remedial Actions Program, the DOE is seeking to develop innovative ways of improving current treatment technologies to eliminate the hazardous components of wastes, reduce waste management costs, and minimize the volume requiring disposal as hazardous or mixed waste. Sponsored projects progress from research and development to field demonstration. Among the

innovative technologies under development are supercritical water oxidation of hazardous chemicals, microwave-assisted destruction of chlorinated hydrocarbons, paramagnetic separation of metals from waste, detoxification and reclamation of waste acid, nitrate destruction through calcination, treatment/disposal of reactive metals, and methodologies for encapsulation. Technologies at a demonstration phase include detoxification of mixed waste sludge, microbial degradation of polychlorinated biphenyls in soil, and the remediation process for a hydrocarbon spill. 14 refs.

Fagoe, Capt. Thomas E. 1991. Coast Guard response to the Volgoneft 263 oil spill. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: Coast Guard, Volgoneft, oil spill.

Falconer, R.K.H., and L.J. Handley. 1990. Oil spills: some aspects of contingency planning. In: Proceedings of the New Zeal Oil Explor Conf, September 11 13 1989, Queenstown, New Zeal, 2:323-330.
Key words: Oil Spills, Contingency Planning, Environmental Pollution

Faller, J., Huehnerfuss, H., Koenig, W.A., Krebber, R., Ludwig, P. 1991. Do marine bacteria degrade alpha -hexachlorocyclohexane stereoselectively. Environmental Science and Technology (United States). 25:4:0013-936X.
The enantiomeric ratio of a chiral organic pollutant has been determined gas chromatographically for the first time at low concentrations as encountered in a North Sea water sample by using heptakis (3-O-butyryl-2,6-di-O-pentyl)-{beta}-cyclodextrin as a chiral stationary phase. As an example, the separation of the enantiomers of {alpha}-hexachlorocyclo-hexane ({alpha}-HCH) is shown herein. However, the method is expected to be generally applicable to many environmental problems that are related to chiral biogenic and anthropogenic substances and chiral degradation products. The potential of this experimental approach for a discrimination between enzymatic and nonenzymatic processes in marine and terrestric ecosystems is discussed.
Key words: chlorinated alicyclic hydrocarbons.

Falta, R.W., I. Javandel, K. Pruess, and P.A. Witherspoon. 1989. Density-driven flow of ags in the unsaturated zone due to the evaporation of volatile organic compounds. Water Resources Res. 25(10):2159-2169.
Key words: Groundwater, Soil Pollution, Water Pollution, Oil Spill

Fan, Chi-Yuan, Anthony N. Tafuri. 1991. Screening methodology for

assessing cleanup technologies for
leaking underground storage tanks. In: Proceedings of the 1991
Oil Spill Conference (prevention, behavior,
control, cleanup), March 4 7, San Diego, CA.
Key words: cleanup, underground, tanks.

Fang, C.S., S.A. Jr. Smith. 1985. Cleaning of ocean floor near
offshore platforms in the gulf coast. In 1985
Spring National Meeting and Petro Expo '85 - American Institute
of Chemical Engineers. in Houston, TX,
U.S.A. Year.
Key words: waste, disposal, oil well, offshore, incineration,
Gulf of Mexico
After decades of offshore drilling in the Gulf of Mexico, the
ocean floor near some platforms in the area is
covered with contaminated sediment. An attempt was made to clean
the ocean floor. Water along with
gravels, sands and silt was taken from the ocean floor at the
rate of 30 gpm, and fed to shale shakers,
desanders and a settling tank. 300 bbl per day of contaminated
gravels, sands and silt were collected and
shipped back to the inland incineration plant for disposal. The
treated water, which has 5% silt and 841 ppm
hydrocarbons, is returned to the ocean. The cleaning facilities
are built on a barge. 8 refs.

Fanta, George F., Thomas P. Abbott, Robert C. Burr, and William
M. Doane. 1987. Ion exchange reactions
of quaternary ammonium halides with wheat straw. Preparation of
oil-absorbents. Carbohydr. Polym.
7(2):97-109.
Key words: Paraffin Oils, Petroleum, Oil Spills

Fantasia, J.F., H.C. Ingrao. 1973. The Development of an
experimental airborne laser oil spill remote sensing
system. In: Proceedings of Joint Conference on Prevention and
Control of Oil Spills, March 13 15,
Washington, D.C.
Key words: laser, oil spill, remote sensing.

Farke, Hubert. 1985. Field experiments with dispersed oil and a
dispersant in an intertidal ecosystem: fate
and biological effects. In: Proceedings of the 1985 Oil Spill
Conference (prevention, behavior, control,
cleanup), February 25 28, Los Angeles, CA.
Key words: oil, dispersant, intertidal, biological.

Farlow, John S., Frank J. Freestone. 1975. United States
Environmental Protection Agency's test facility
OHMSETT: the first six months. In: Proceedings of the 1975
Conference on Prevention and Control of Oil
Pollution, March 25 27, San Francisco, CA.
Key words: Environmental Protection Agency, OHMSETT.

Farlow, J. S. 1989. Cunningham, J. M. Oil Spill Research and
Development Needs for the 1990's.
EPA/600/D-88/278, 18 pp.

Key words: Water Pollution Control, Cleaning, Skimmers, Oil Spills
In the 1970s and the early 1980s the emphasis of Federally-sponsored oil spill research was on mechanical spill control devices and removal methods such as booms, skimmers, and sorbents, with later efforts also focused on dispersing agents. The preponderance of the work was directed toward oil spills in open ocean and coastal areas. Private research programs and field experience also contributed to the extensive knowledge-base capabilities and limitations of mechanical and chemical oil spill control and cleanup methods. In fiscal 1988, research and development in prevention and cleanup of oil spills was suspended by the U.S. Environmental Protection Agency (EPA) in favor of other high priority topics. However, recent events have shown that further research is needed on preventing and cleanup methods, especially for inland spills. Furthermore, innovations developed since the early 1980s have yet to be evaluated in a controlled setting, even in the open sea. The paper presents topics for an oil spill research and development agenda through the beginning of the 1990s that will help to fill those voids in the areas of spill prevention and response.

Farlow, J.S., Cummingham, J.M. 1993. Plunging Water Jets: Evaluating an Innovative High-Current Diversionary Boom. Meeting Paper Abstract. 897-898.
Key Words: Pollution control equipment, current velocity, floating barrier, fluid flow, hydraulic jet, oil skimming, oil spill, oil water separation, physical separation, water jet.

Farlow, John S., Richard A. Griffiths. 1981. OHMSETT research overview, 1979 1980. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: OHMSETT.

Farlow, J.S., R. Landreth, D.E. Ross. 1977. Practical recommendations for oil spill debris disposal. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: recommendations, oil spill, debris, disposal.

Farmer, W.S., Robinson, K.G., Novak, J.T. 1989. Effect of bacterial addition on biodegradation of toluene in subsurface soils. 43. industrial waste conference. 75-81.
The purpose of this study was to determine whether microorganisms cultured in the laboratory using toluene as the sole carbon source were capable of enhancing the degradation of toluene present as a contaminant in soil. In particular, the effect of these acclimated organisms on the biodegradation of absorbed toluene in soils was studied.

Key words: gasoline, storage facilities, land pollution control, technology assessment, biodegradation, water pollution, toluene, subsurface environments, petroleum industry, health hazards.

Farrington, John W., Gilbert C. Medeiros. 1975. Evaluation of some methods of analysis for petroleum hydrocarbons in marine organisms. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: analysis, petroleum, hydrocarbons, marine.

Fast, Olov. 1987. Swedish Coast Guard starts using third generation maritime surveillance system. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: Coast Guard, maritime, surveillance.

Fast, O., and E. Cronstrom. 1991. Remote sensing support for the volgoneft cleanup. Mar Technol SOC et al Conf (MTS 91), November 10 14 1991, New Orleans, LA, 2:1060-1066.
Key words: Oil Spill, Remote Sensing, Contamination, Pollution Control

Fast, O., E. Cronstrom, J. Askne, and K. Ahlqvist. 1992. Design considerations and experience of a microwave radiometer in an integrated oil spill surveillance system. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:205-214.
Key words: Remote Sensor, Oil Spill, Environmental Pollution

Fast, Olov. 1985. Monitoring an oil spill experiment with the Swedish maritime surveillance system. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: monitoring, oil spill, maritime.

Fast, O. 1990. Airborne instruments for monitoring marine pollution. In: Proceedings of the ninth EARSeL symposium, Espoo, 1989, pp. 92-96.
Key words: Airborne Instrument, Pollution Monitoring, Marine Pollution, North Sea
Oil spill monitoring is the area in which airborne remote sensing of marine pollution has reached operational status. Over the North Sea and the Baltic Sea several thousand flight hours per year are presently used for this purpose. Agreements on using these instruments have been reached between the North Sea coastal states and is being negotiated between the Baltic Sea coastal states. The agreements contain both a recommendation to use a standard remote sensing package for monitoring of the sea and an invitation to yearly calibration exercises, where results are compared. The standard field-proven

instrument package consists of a SLAR, an IR/UV line scanner, a scanning microwave radiometer and photographic cameras, all integrated with a central sensor control system with real-time image processing. -from Author.

Fatemeh, Rafii, W.R. Butler, and C.E. Cerniglia. 1992. Differentiation of a rapidly growing, scotochromogenic, polycyclic-aromatic-hydrocarbon-metabolizing strain of Mycobacterium sp. from other known Mycobacterium species. Archives of microbiology. 157(6):512-520.
Key words: Mycobacterium, Biodegradation, Hydrocarbon, Bacteria
A rapidly-growing, acid-alcohol fast, scotochromogenic, polycyclic-aromatic-hydrocarbon-degrading Mycobacterium sp. isolate, Pyr-1, which was different from known Mycobacterium species based on biochemical tests, was further analyzed to compare its mycolic acids, cellular proteins, and nucleic acids with those of known species. Mass spectral analysis of the mycolic acids of Mycobacterium sp. Pyr-1 indicated that its mycolic acids were C SUB 6 SUB 0 H SUB 1 SUB 2 SUB 0 O SUB 3 and O SUB 6 SUB 2 H SUB 1 SUB 2 SUB 4 O SUB 3.

Fava, F., Marchetti, L. 1991. Degradation and mineralization of 3-chlorobiphenyl by a mixed aerobic bacterial culture. Applied Microbiology and Biotechnology (Germany). 36:2:240-245.
A mixed bacterial culture obtained from polychlorinated-biphenyl-contaminated river sediments proved capable of degrading 3-chlorobiphenyl (3-CB) under aerobic laboratory conditions. Almost total mineralization of 150 mg/l of 3-CB occurred when, after 3 days of incubation, the mineral medium was supplied with benzoic acid as a carbon source. Two strains of Pseudomonas capable of degrading the substrate to 3-chlorobenzoic acid and a strain of Pseudomonas fluorescens capable of co-metabolizing this metabolite were selected from the mixed culture. A nearly stoichiometric amount of chloride, which defines the percentage of total mineralization, was eliminated during mixed culture growth.
Key words: chlorinated aromatic hydrocarbons, biodegradation, cell cultures, pollution control, quantative chemical analysis.

Fawn, D.R. Jr. 1990. The Rachel-B/coastal towing incident. Spaulding, M.L., Reed, M. 1990. Oil spills. American Society of Engineers. 570(p):188-196.
Key Words: Oil spills cleaning, Texas oil spills, barges, biodegration, monitoring, oil retention booms, petroleum, tanker ships, US Coast Guard, chemical reactions, decomposition, developed countries, energy sources, Federal Region VI, fossil fuels, National Organizations, North America, pollution control equipment, US DOT, US Organizations, USA.

Fay, James A. 1971. Physical processes in the spread of oil on a water surface. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 - 17, Washington, D.C.
Key words: oil, water.

Fayad, Nabil M., L. Edora, H. El-Mubarik, and B. Polancos, Jr. 1992. Effectiveness of bioremediation product in degrading the oil spilled in the 1991 arabian gulf war. Bull Environ Contam Toxicol. 49(6):787-797.
Key words: Persian Gulf, Oil Spill, Cleanup, Biodegradation, Microorganism, Oil Spills, Hydrocarbons, Bacteria, Water Pollution
During the 1991 war in the Arabian Gulf, the coastline and water of the gulf became contaminated with crude oil. The use of a bacterial slurry for bioremediation of the spill was investigated. Aquaria containing 5, 10, or 20 g crude oil/l seawater were used for the study. Nutrient alone or in combination with the bacterial slurry was added to the experimental aquaria. Response was interpreted as alkane degradation, and decrease in C-18:phytane ratio. At all concentrations, addition of nutrients alone caused decreases in both parameters, probably because of the activity of microorganisms already present in the seawater. At the lowest and highest concentrations, addition of bacteria further decreased these parameters. However, the presence of nutrients and bacteria caused the dispersion of many more alkanes into the seawater, making this method of bioremediation more useful for coastlines than open water.

Federal Data and Information Source. 1993. Key word and subject index to the Federal Register and Unified Agenda. 58(78):Part LXII.

Fedorak, P.M. 1988. Microbial degradation on n-alkyl tetrahydrothiophenes found in petroleum. Appl. Environ. Microbiol. (1988): 54.
Key words: petroleum, biodegradation, hydrocarbons, bacteria
Although n-alkyl-substituted tetrahydrothiophenes are found in nonbiodegraded petroleums, they are not found in petroleums which have undergone biodegradation in their reservoirs. These observations suggested that this group of compounds with alkyl chain lengths from approximately C10 to at least C30 is biodegradable. Two of these sulfides, 2-n -dodecyl-tetrahydrothiophene (DTHT) and 2-n-undecyl-tetrahydrothiophene, were synthesized, and their biodegradabilities were tested by using five gram-positive, n-alkane-degrading bacterial isolates. The alkyl side chains of these compounds were oxidized, and the major intermediates found in 2-n-undecyl-tetrahydrothiophene- and DTHT-metabolizing cultures were 2-tetrahydrothiophene-carboxylic acid (THTC) and 2-tetrahydrothiophene-acetic acid (THTA),

respectively. Four n-alkane-degrading fungi were also shown to degrade DTHT, yielding both THTA and THTC.

Fedorak, P.M., and T.M. Peakman. 1992. Microbial degradation of some N-Alkylthiophenes. In: Proceedings of the 4th Inst Gas Technol Gas, Oil, & Environ Biotechnol Int Symp, Dec 9-11, 1991, Colorado Springs, CO, pp.307-323.
Key words: Biodegradation, Bacteria, Hydrocarbon, Alaska

Fedorak, P.M., J.D. Payzant, D.S. Montgomery, and D.W.S. Westlake. 1998. Microbial degradation of n-alkyl tetrahydrothiophenes found in petroleum. Appl Environ Microbiol. 54(5):1243-1248.
Key words: Biodegradation, Bacteria, Hydrocarbon, Microorganism, Petroleum, Weathered Oil, Canada, Oil Spill

Feenstra, S., D. M. Mackay and J. A. Cherry. 1991. A method for assessing residual NAPL based on organic chemical concentrations in soil samples. Ground Water Monitoring Review 11(2):128 136.
Key words: Groundwater, Oil Spills, Remedial Action
Groundwater contamination by non-aqueous phase liquid (NAPL) chemicals is a serious concern at many industrial facilites and waste disposal sites. NAPL in the form of immobile residual contamination, or pools of mobile or potentially mobile NAPL, can represent continuing sources of groundwater contamination. In order to develop rational and cost-effective plans for remediation of soil and groundwater contamination at such sites, it is essential to determine if non-aqueous phase liquid (NAPL) chemicals are present in the subsurface and delineate the zones of NAPL contamination. Qualitatively, soil analyses that exhibit chemical concentrations in the percent range or greater than 10,000 mg/kg would generally be considered to indicate the presence of NAPL. However, the results of soil analyses are seldom used in a quantitative manner to assess the possible presence of residual NAPL contamination when chemical concentrations are lower and the presence of NAPL is not obvious. The assessment of the presence of NAPL in soil samples is possible using the results of chemical and physical analyses of the soil, and the fundamental principles of chemical partitioning in unsaturated or saturated soil. The method requires information on the soil of the type typically considered in groundwater contamination studies and provides a simple tool for the investigators of chemical spill and waste disposal sites to assess whether soil chemical analyses indicate the presence of residual NAPL in the subsurface.

Feidieker, D. 1992. Biodegradation of different chlorobenzenes and hexachlorocyclohexanes by mixed bacterial cultures. Soil Decontamination Using Biological Processes. (1992): 6 9 December.

Key words: soil, decontamination, biodegradation, chemical, hydrocarbon
Under aerobic conditions cultures from contaminated soils mineralize chlorobenzenes and alpha-hexachlorocyclohexane. 1,2-dichlorobenzene, beta-hexachlorocyclohexane, 4-chloro- and 2,4, 5-trichlorophenol are not degraded, 1,2,4, 5-tetrachlorobenzene only partially. Mono- and tetrachlorobenzene and chlorophenol are decomposed under anaerobic conditions. Co-substrates are not enhancing. Paper given at Int. Symp. Soil Decontamination Using Biological Processes, Karlsruhe, D, 6 9.12.92.

Feinstein, S.,P.W. Brooks, T. Gentzis, Z. Aizenshtat, and J. Slager. 1991. Petrological and geochemical characterization of hydrogen-rich coaly matter in the Agur 1 drillhole, Negev, Israel. Energy Sources (United States). 13:3:0090-8312.
Five samples from Cretaceous and Jurassic organic-rich shale and coal layers in clastic intervals in the Agur 1 borehole (Negev, southern Israel) were analyzed in order to determine their genetic history, as well as their potential as a source for oil and gas. The results obtained suggest that the Cretaceous sample has a 'normal' coaly composition and low maturation in the lignite range whereas the Jurassic samples have unique maceral and geochemical characteristics that reveal evolution through two major stages. In the first stage, terrestrially derived organic material was accumulated under partially oxidizing conditions forming coaly deposits. However, pulses of faster subsidence have resulted in formation of deeper lagoons. Consequently, coaly materials from the surrounding highs were eroded, transported, and redeposited within nearby lagoons. The transportation and redeposition were involved with selective removal of some of the humic substances, progressive bacterial degradation of some plant lipids, and further diagenesis under reducing conditions. These effects are particularly pronounced in the organic-rich shale and less in the coal. RockEval pyrolysis S2 indicates that the studied samples have the potential to generate hydrocarbons. However, vitrinite reflectance, UV-fluorescence, Tmax, and sterane and triterpane isomerization ratios indicate an immature to marginally mature level, suggesting that the samples studied did not reach the major phase of oil generation. In addition, because of the unique composition of the organic materials, the major products anticipated upon generation are gas, aromatics, and oxygen-rich compounds. 31 refs., 6 figs., 5 tabs.
Key words: coal deposits, petrology, chemical composition, geologic history, resource potential.

Feng, S.S., M. Reed, and D.P. French. 1989. The chemical database for the natural resource damage assessment model system. Oil Chem Pollut. 5(2 3):165 193
Keywords: environmental impact, biodegradation, database,

offshore, oil spill, oil waste

Fennell, D., Nelson, Y.M., Underhill, S.E., White, T.E,, Jewell, W.J. 1993. TCE degradation in a methanotrophic attached-film bioreactor. Biotechnology and Bioengineering (United States). 42:7:859-872.
Trichloroethene was degraded in expanded-bed bioreactors operated with mixed-culture methanotrophic attached films. Biomass concentrations of 8 to 75 g volatile solids (VS) per liter static bed (L[sub sb]) were observed. Batch TCE degradation rates at 35C followed the Michaelis-Menten model, and a maximum TCE degradation rate (q[sub max]) of 10.6 mg TCE/gVS [center dot] day and a half velocity coefficient (K[sub s]) of 2.8 mg TCE/L were predicted. Continuous-flow kinetics also followed the Michaelis-Menten model, but other parameters may be limiting, such as dissolved copper and dissolved methane-q[sub max] and K[sub s] were 2.9 mg TCE/gVS [center dot] day and 1.5 mg TCE/L, respectively, at low copper concentrations (0.003 to 0.006 mg Cu/L). The maximum rates decreased substantially with small increases in dissolved copper.
Methane consumption during continuous-flow operation varied from 23 to 1,200 g CH[sub 4]/g TCE degraded. Increasing the influent dissolved methane concentration from 0.01 mg/L to 5.4 mg/L reduced the TCE degradation rate by nearly an order of magnitude at 21C. Exposure of biofilms to 1.4 mg/L tetrachloroethene (PCE) at 35C resulted in the loss of methane utilization ability. Tests with methanotrophs grown on granular activated carbon indicated that lower effluent TCE concentrations could be obtained. The low efficiencies of TCE removal and low degradation rates obtained at 35C suggest that additional improvements will be necessary to make methanotrophic TCE treatment attractive.
Key words: bioreactors, efficiency, chlorinated.

Ferguson, T., Mah, R., Chynoweth, D.P., Isaacson, R. 1987. Methanogenic bacteria. Anaerobic digestion of biomass. 49-63.
The methanogenic (methane-producing) bacteria carry out the terminal step in the formation of biogas from the anaerobic decomposition of biomass. Methane is the final product of mineralizing the organic materials in digesters and most anaerobic, freshwater habitats. Most of the chemical energy in the starting materials (substrates) actually ends up in the methane released by these anaerobic bacteria. In direct contrast, aerobic bacterial metabolism releases most of the chemical energy in the starting substrates by oxidizing them to carbon dioxide and water; bacterial cells are also produced. Anaerobic processes not only form an energy-rich product but also make less cell material and are consequently doubly useful in the degradation of biomass.
The methanogens are discussed in terms of anaerobic digestion, and the rapidly growing list of methanogens

is updated.
Key words: methanogenic bacteria, anaerobic digestion, genetics, methane, production, waste processing, renewable, hydrocarbons, bioconversion, alkanes, biology, digestion, energy sources.

Ferriere, Dale. 1993. Waste minimization concepts applied to oil spill response. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 - April 1, Tampa, FL.
Key words: waste.

Ferschl, A., Loidl, M., Ditzelmueller, G., Hinteregger, C., Streichsbier, F. 1991. Continuous degradation of 3-chloroaniline by calcium-alginate-entrapped cells of Pseudomonas acidovorans CA28: Influence of additional substrates. Applied Microbiology and Biotechnology (Germany). 35:4:0175-7598.
Cells of Pseudomonas acidovorans strain CA28 capable of degrading aniline, 3-chloroaniline (3-CA), and 4-chloroaniline (4-CA) were immobilized in 1.5% (w/v) calcium alginate and cultivated in a special air-lift fermentor. For 6 weeks the fermentor was run as chemostat with 3-CA (850 to 1166 {mu}mol.l{sup -1}) as the sole source of carbon, nitrogen, and energy at dilution rates up to 0.297 h{sup -1}, which resulted in complete mineralization of the chloroaniline. Effects of aniline, monochloroanilines, 2,6-dichloroaniline, 3,4-dichloroaniline, fructose and acetate on the continuous degradation of 3-CA were estimated by single addition of these substrates to the fermentor. Fructose and acetate were metabolized without affecting 3-CA degradation, whereas addition of aniline derivatives resulted in a reversible decrease of the 3-CA degradation rate and thus intermediate accumulation of 3-CA in the fermentor.
Key words: aniline, biodegradation, chlorinated aromatic hydrocarbons.

Fiebig, R., Dellweg, H. 1988. Comparison of one stage and two stage anaerobic digestion of molasses distillery slops. Technology of biological processes - safety in biotechnology - applied genetic engineering. Lectures. 5. DECHEMA annual meeting of biotechnologists (DJB-5) and 22. meeting of Europaeische Foerderation Biotechnologie. 383-388.
The one stage and two stage anaerobic digestion of diluted and undiluted beet molasses slops was investigated in UASB ('upflow anaerobic sludge blanket') and anaerobic filter-reactors. The application of a two stage digestion led to a comparably higher process stability and conversion efficiency only when a strong dilution of the slops of 50% or more of the original waste water concentration was used. In acidification and one stage digestion of the complex organic matter, the degradation of betaine was a limiting factor with an optimum at pH 7.5. At this pH the acidification process had in general its optimal product composition.

Ammonium produced during digestion led to an increase in alkalinity and at pH 8.0 the methanogenic consumption of the volatile fatty acids in the process was inhibited to a certain degree. This inhibition was increased by the process-produced sulfide but could be avoided by pH regulation to 7.2.
Key words: molasses, anaerobic digestion, bioreactors, gas yields, methane, bacteria, pH value, digestion, organic hydrocarbons.

Fiedler, Fritz R., Shevenell, Thomas C. 1990. How to solve the remediation twin dilemmas; how much? and how long? A case study using vapor extraction techniques for gasoline contaminated soils. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:603-617.
Key Words: Reclamation, soils, natural resources, pollution, experimental studies, gaseous phase, oil spills, methods, unsaturated zone, case studies, monitoring.

Field, J.A., Lettinga, A., Geurts, M. 1987. Methanogenic toxicity and anaerobic degradability of potato starch wastewater phenolic amino acids. Biol. Wastes(United Kingdom). 21:1:37-54.
Potatoes which are important agricultural feedstocks for the starch industry, contain tyrosine and phenol oxidase. Since L-dopa can be formed from tyrosine by phenol oxidase, both tyrosine and L-dopa are presumably present in potato starch wastewaters. The purpose of this study was to evaluate the methanogenic toxicity and anaerobic degradability of these two phenolic amino acids. Tyrosine was found to be negligibly toxic to methane bacteria, while L-dopa caused from 40% to 50% inhibitions of the methanogenic activity at a concentration of 327 mg/liter. The toxicity of L-dopa occurred only if anaerobic sludge was exposed to L-dopa in the presence of Volatile Fatty Acids (VFA). The L-dopa toxicity could be minimized by maintaining low VFA concentrations in the media and by adapting the sludge to VFA prior to L-dopa exposure. Both tyrosine and L-dopa were anaerobically degraded to CH/sub 4/; however, only tyrosine was degradable after prolonged operation of continuously VFA-fed, granular sludge, packed columns. Phenol and p-cresol were identified as phenolic intermediates of anaerobic tyrosine degradation. Both p-cresol were identified as phenolic intermediates of anaerobic tyrosine degradation. Both p-cresol and m-cresol were identified as phenolic intermediates of anaerobic L-dopa degradation. (Refs. 29).|
Key words: anaerobic digestion, tyrosine, methanotrophic, bacteria, phenol, toxicity, volatile matter.

Fieseler, C., B. Noll, H. Koehler. 1992. Biological degradation of environmental contaminants in mixed contaminated soil. Soil Decontamination Using Biological

Processes.
6 9 December, 1992.

Figge, K. 1992. Studies on the microbial degradation of dioxin-like and other not-easily degradable substances in soils. Soil Decontamination Using Biological Processes. (1992): 6 9 December.
Key words: degradtion, biodegradation, soil, bacteria, hydrocarbon, degradation.
Pseudomonas HH 69 and PS 14 and Sphingomonas RW 1 are investigated for biodegradation of dibenzofuran, dibenzo-p-dioxin, and tetrachlorobenzene in experimental soils. Pure strains achieve up to 80% bioconversion depending on initial cell concentration and with a pH of 4 to 8. Other soil pollutants considerably affect microbial decomposition. Paper given at Int. Symp. Soil Decontamination Using Biological Processes, Karlsruhe, D, 6 9.12.92.

Findlay, M., and M. Dooley. 1991. Biodegradation of liquid coal tar in an aqueous bioreactor. In: Proceedings of the 3RD Inst Gas Technol (Chicago) Gas, Oil, Coal, & Environ Biotechnol Int Symp, December 3 5, 1990, New Orleans. pp. 93 104.
Keywords: bacteria, biodegradation, equipment, soil remediation, soil pollution, water pollution

Fingas, M., M. Fruwirth, and L. Gamble. 1992. A review of oil spill remote sensing...Sensors and aircraft. In: Proceedings of the Environment Canada 15th Arctic and Marine Oil Spill Technical Seminar, June 10 12 1992, Edmonton, Alberta, Proceedings pp. 407-25.
Key words: Absorption Spectroscopy, Radar

Fingas, M. 1991. Studies on the physical and chemical behavior of oil and dispersant mixtures. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: physical, chemical, oil, dispersant.

Fingas, M.F., and M. Fruhwirth. 1993. Assessment (by Environment Canada) of sensors and aircraft for oil spill remote sensing, (particularly the capability of sensors to detect oil and to discriminate oil from background targets). In: Proceedings of the API - EPA - USCG 1993 International Oil Spill Prevention, Preparedness, Response Conference, March 29 April 1 1993, Tampa, FL, API Publication N.4580 893.
Key words: Abstract, API, Remote Sensing, US Coast Guard

Fingas, M.F. 1993. The Effectiveness of dispersants: variation with energy. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: dispersants.

Fingas, M.F. 1991. Testing the effectiveness of spill-treating agents: laboratory test development and initial results. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: spill treating.

Fingas, Merv F. 1989. Laboratory testing of dispersant effectiveness: the importance of oil-to-water ratio and settling time. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: dispersant, oil-to-water, settling.

Fingas, M., M. Fruhwirth, and L. Gamble. 1992. Oil spill remote sensing sensors and aircraft. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar, June 10 12 1992, Edmonton, Canada, pp. 407-425.
Key words: Oil Spills, Remote Sensing, Technology Assessment
The most common form of remote sensing as applied to oil spills is aerial remote sensing. The technology of aerial remote sensing, mainly from aircraft, is reviewed along with aircraft-mounted remote sensors and aircraft modifications. The characteristics, advantages, and limitations of optical techniques, infrared and ultraviolet sensors, fluorosensors, microwave and radar sensors, and slick thickness sensors are discussed. Special attention is paid to remote sensing of oil under difficult circumstances, such as oil in water or oil on ice. An infrared camera is the first sensor recommended for oil spill work, as it is the cheapest and most applicable device, and is the only type of equipment that can be bought off-the-shelf. The second sensor recommended is an ultraviolet and visible-spectrum device. The laser fluorosensor offers the only potential for discriminating between oiled and un-oiled weeds or shoreline, and for positively identifying oil pollution on ice and in a variety of other situations. However, such an instrument is large and expensive. Radar, although low in priority for purchase, offers the only potential for large-area searches and foul-weather remote sensing. Most other sensors are experimental or do not offer good potential for oil detection or mapping. 48 refs., 8 tabs.

Fingas, M.F., and M. Fruhwirth. 1992. Assessment of sensors and aircraft suitable for oil spill remote sensing. In: Proceedings of the 1st US Environ Protect Agency et al remote Sensing For Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:99-113.
Key words: Oil Spill, Remote Sensing, Aerial Photography

Fingas, Merv. 1990. Remote sensing of oil spills. In: Proceedings of the Env Canada Arctic & Marine Oilspill Program 13th Technical Seminar, June 6 8 1990, Edmonton,

AB.
Key words: Remote Sensing, Oil Spill, Marine Pollution
Remote sensing has become an increasingly important part of oil spill countermeasures. The most common means of remote sensing is the use of optical techniques; aerial mapping is very common. Various remote sensing techniques are detailed and discussed, including ultraviolet sensors, fluorosensors, microwave and radar, and slick thickness sensors. The cheapest and most universal device is the infrared camera. The laser fluorosensor offers the only potential for discriminating between oiled weeds or shoreline and un-oiled ones, and for positively identifying oil pollution on ice, among ice and in a variety of other situations. Radar offers the only potential for large area searches and foul weather remote sensing. Whatever equipment is used, the package should always include a real time display and printer as well as a photographic camera for recording purposes.

Fingas, M.F. 1989. Field measurements of effectiveness: Historical review and examination of analytical methods. Flaherty, L.M. (ed.) Oil dispersants: New ecological approaches. American Society for Testing and Materials: Philadelphia, PA, pp. 157-178.
Key words: Oil Spills, Remote Sensing
Data are provided on 106 separate offshore experimental spills to determine dispersant field effectiveness. Effectiveness ratings for 25 of these spills were assigned by the experimenters; they vary from 0 to 100% and have an average of 33%. Measurement techniques used for these experiments include: subsurface measurements to determine oil in the water column, surface sampling to determine oil remaining, dispersant application amount or distribution, and the use of remote sensing to observe visually the results or to quantify the area of surface oil. Existing means of detection and quantification appear to be effective. The mathematical relationships used to provide the integrated amount of oil in the water column are also examined. It is shown by simulation that effectiveness claimed is highly sensitive to both assumptions and mathematical treatment. Historical data are used to show that effectiveness values can vary over an order of magnitude depending on the algorithm used. A number of phenomena have been observed at spill sites. Herding of oil occurs immediately after dispersant application and has sometimes been misinterpreted as dispersion. Examinations of spills where slicks were monitored for longer than 3 hr show that extensive resurfacing of oil occurred. Resurfacing is particularly problematic because, depending on current and wind, resurfacing may occur outside slick boundaries. When this occurs, resurfaced oil is not included in subsequent calculations, and consequently, effectiveness is overestimated. 44 refs., 7 figs., 3 tabs.

Fingas, M. 1992. The Newfoundland oil spill burn experiment. Spill Technology Newsletter (Canada). 17(4).
Key words: Oil Spill, Combustion
A major offshore oil-spill combustion experiment is being planned for waters off Newfoundland. The experiment is designed to answer outstanding questions on the acceptability of in-situ oil spill burning. In the experiment, variables will be controlled to allow quantitative measurement of the scientific and operational parameters that will enhance understanding of in-situ combustion as an operational oil-spill response technique. The proposed full-scale tests follow six years of testing in laboratory tanks. Analyses have shown that the high temperatures reached during efficient in-situ combustion result in relatively complete destruction of the oil. Tests have shown that the most important factor in this regard is that the oil must be thickened sufficiently before effective burning will occur. Such thickening is potentially possible in the offshore, under suitable wind and sea conditions, using fireproof containment booms. The experiment will involve measurement of emissions to the air, levels of oil in water, and operational parameters of in-situ burning.
Time and location of the experiment are chosen to minimize ecological damage and for operational reasons.
When suitable conditions are present in early August 1993, two 45-m[sup 3] batches of crude oil will be released into a containment boom and ignited. The burn residue will be recovered mechanically, and a secondary containment and recovery system will be towed behind the fireproof boom to pick up any fugitive oil or residue. 3 figs., 6 tabs.

Fingas, M. 1992. In-situ burning of oil spills: Review and research properties. In: Proceedings from the first international oil spill R D forum, June 1 4 1992, McLean, VA, pp. 247-252.
Key words: Oil Spill Mitigation, Petroleum, Research Programs
In-situ burning of oil spills has been tried over the past thirty years but has never been fully-accepted as an oil-spill cleanup option - largely because of the lack of understanding of the combustion products and the principles governing the combustibility of oil-on-water. Extensive research is currently underway to understand the many facets of burning oil. A consortium of over 15 agencies in the United States and Canada have joined forces to study burning and to conduct large scale experiments. This effort will result in data which should lead to broader acceptance of in-situ burning as an acceptable spill countermeasures alternative. Burning has distinct advantages over other counter-measures. First and foremost, it offers the potential to rapidly remove large quantities of oil. In-situ burning has the potential to remove as much oil in one day as several mechanical devices could in one month. Application of in-situ burning could prevent a large amount of

shoreline contamination and damage to biota by removing oil before it spreads and moves to other areas. Secondly, in-situ burning requires minimal equipment and much less labor than any other technique. It can be applied in areas where other methods cannot be used because of distances and lack of infra-structure. Thirdly, burning of oil is a final solution compared to mechanical recovery. When oil is recovered mechanically it still has to be transported, stored and disposed of. Fourth and finally, burning may be the only option available in certain situations. Oil amongst ice and on ice are examples of situations where practical alternatives to burning do not exist. There are disadvantages to burning. The first and most visible disadvantage is the large black smoke plume that burning oil produces. The second disadvantage is that the oil must be a minimum thickness to burn.

Fingas, Merv, Nanci Laroche. 1990. An introduction to in situ burning of oil spills. Spill Technology Newsletter. 15(4):1 9.
Key words: Oil Spill Cleanup, Oil Spill Incidents, Polycyclic Aromatic Hydrocarbons
In situ burning of oil spills continues to be controversial, yet studies indicate that it is a highly efficient means of removing spilled oil. Atmospheric emissions from spill burns have been determined to be harmless, and burning is less costly, less labor-intensive, and faster than conventional means of spill cleanup. An analysis of studies on oil burns charts the progress of burning as an effective spill countermeasure. Ignition methods vary from simple to sophisticated, and technology is ongoing to develop effective ignition devices. Oil slick thickness is the major factor for in situ burning slicks must at least 2-3 mm thick to burn and water content, weathering, slick location, burning efficiency, and containment are other considerations for effective burning.

Fingas, M. 1990. Remote sensing of oil spills. In: Proceedings of the 13th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 6 8 1990, Edmonton, Canada, pp. 361-386.
Key words: Remote Sensing, Oil Spill, Contamination, Prince William Sound

Fingas, M., and E. Tennyson. 1988. Evaluation of two new oil spill chemical additives: Elastol and demoussifier. Spill Tech. Newsl(Canada). 13(2):40-46.
Key words: Oil Spill Additives
A new oil spill treating agent, Elastol, has been developed for enhancing the recovery potential of oil. When added to oil, the powder renders oil visco-elastic making it adhesive to oil spill recovery equipment. A major study was undertaken jointly by the US Mineral Management Service and Environment Canada to evaluate this new spill additive. Laboratory testing was done and studies were conducted in large-scale test tanks and

in a major field exercise off Canada's east coast. At the same time, a demoussifier was tested in large outdoor tanks and at sea. This product, which also consists of a mixture of longchain polymers which have no measurable toxicity to humans or to aquatic life, breaks up water-in-oil emulsions and prevents their formation. This paper reviews the laboratory and field tests of these two additives. It was found that elastol functioned well in the laboratory, test tank and field situations; it caused oil to become viscoelastic in all applications, and improved oil skimmer recovery. Elastol and demoussifier are able to float with and mix with oil so that application is not critical as it is with dispersants. Elastol retards slick spreading; however, this effect, for physical reasons, is not sufficient for countermeasures purposes such as in-situ burning of oil on water. The demoussifier prevented emulsion in the test slicks and broke water-in-oil emulsions 10-15 s after application. 3 refs., 2 figs., 1 tab.

Fingas, Merv. 1990. The technology of oil spill remote sensing. Spill Technology Newsletter. 15(3):1 17.
Key words: Oil Spill, Detection, Remote Sensing
Remote sensing implies that a sensor other than the eye is used to detect a target of interest at a distance. The technology of oil- spill remote sensing is described. Technologies assessed include: optical cameras and other techniques, infrared sensors, ultraviolet sensors, fluorosensors, microwave and radar, slick thickness sensors, and satellite remote sensing. These devices vary greatly in price, size, and state of development. Whatever sensor is acquired, the equipment package should include a real-time display and printer as well as a photographic camera for documentation purposes.

Fingas, Merv F. 1989. Laboratory testing of dispersant effectiveness: the importance of oil-to-water ratio and settling time. In Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. 365 374. San Antonio, TX : Washington, D.C.: American Petroleum Institute.
Keywords: testing, dispersant, oil, water.

Fingas, Mervin F., Mark A. Bobra, and Ronald K. Velicogna. 1987. Laboratory studies on the chemical and natural dispersibility of oil. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: chemical, dispersibility.

Finger, Stanley M., T.S. Yu. 1973. Analytical examination of oil/water separation by coalescence. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil/water, coalescence.

Fiocco, R.J. 1991. Development of Corexit 9580: a chemical beach

cleaner. In: Proceedings of the 1991 Oil
Spill Conference (prevention, behavior, control, cleanup), March
4 7, San Diego, CA.
Key words: Corexit 9580, chemical, beach, cleaner.

Fiocco, Robert J., Vincent W. Ridley. 1975. Slop tank design for
improved load-on-top. In: Proceedings of
the 1975 Conference on Prevention and Control of Oil Pollution,
March 25 27, San Francisco, CA.
Key words: tank design.

Fischel, Marion. 1987. Preliminary assessment of the effect of an
oil spill on a Louisiana marsh. In:
Proceedings of the 1987 Oil Spill Conference (prevention,
behavior, control, cleanup), April 6 9, Baltimore,
MD.
Key words: assessment, effect, oil spill.

Fischel, M., W. Grip, and I.A. Mendelssohn. 1989. Study to
determine the recovery of a Louisiana marsh
from an oil spill. In: Proceedings of the API et al Oil Spill
(Prev, Behav, Contr, Cleanup) 20th Anniv Conf,
February 13 16 1989, San Antonio, TX, pp. 383-387.
Key words: Vegetation, Crude Oil, Environmental Impact,
Louisiana, Oil Spill, Petroleum, Contamination,
Pollution Control

Fischel, Marion, Gordon A. Robilliard. 1991. Natural resource
damage assessment of the Shell oil spill at
Martinez, California. In: Proceedings of the 1991 Oil Spill
Conference (prevention, behavior, control,
cleanup), March 4 7, San Diego, CA.
Key words: damage assessment, oil spill.

Fischel,M., W. Grip, and I. Mendelssohn. A study to determine the
recovery of a louisiana marsh from an oil
spill, api et al oil spill (prev, behav, contr, cleanup) 20th
annivconf (san antonio, 2/13-16/89) proc pp
383-387, 1989 (13 refs)
Key words: crude oil, environment, environmental impact, flora,
louisiana, north america, oil spill, petroleum,
swamp, united states, western us

Fischer, Jeffrey M., Arthur L. Baehr, and Nicholas P. Smith.
1991. An investigation of the transport and
microbial degradation of hydrocarbons in the subsurface at a
gasoline-spill site in Galloway Township, New
Jersey. Water-Resources Investigations. 243-249.
Key Words: New Jersey, pollution, ground water, environmental
geology, oil spills, transport, USGS,
Eastern U.S., United States

Fischer, E.M., S.P. Cernohous, and A.A. Allen. 1992. Oil-Sorbing
Boom. 5(p).
Key Words: Floating barrier, adsorption, oil spill, oil water
separation, physical separation, sorption, USA,
absorption, adhesion, adhesive, adsorbent, alkene, buoyancy,

business operation, composite material,
construction material, contamination, ecology, engineering
drawing, environmental pollution, fiber,
flexibility, foamed plastic, hydrocarbon compound

Fischer, E.M. 1988. High Temperature Oil Containment Boom.
Minnesota Mining & Mfg. Co. 7(pp).
Key Words: Floating barrier, containment, fabric, fire
resistance, oil spill, physical property, Europe,
aluminum oxide, boron oxide, buoyancy, ceramic, coating material,
combustion, composition, construction
material, contamination

Fischer, E.M., and S.M. Sanocki. 1989. Redeployable High
Temperature Oil Boom. 6(pp).
Key Words: Floating barrier, composite material, containment,
fire resistance, oil spill, physical property,
pollution control, USA, alloy, alumina, aluminum oxide, boron
oxide, buoyancy, ceramic, chemical process,
chloroethylene, chloroethylene homopolymer, coating material,
combustion, compound, construction material,
contamination, data

Fischer, E.M., S.P. Cernohous, and A.A. Allen. 1992. Oil-Sorbing
Boom. Minnesota Mining & MFG CO.
Patent No. US 5165821, c 11/24/92, f 8/21/91 (Appl 748045)
(e02b-015/06) (5 pp; 12 claims).
Key words: floating barrier, adsorption, barrier, float, oil
spill, oil water separation, physical separation,
sorption, wall

Fitch, R. 1993. Remote oil spill detector for oil terminals and
API separators. In: Proceedings of the 13th
Bien API et al Oil Spill (Prev, Preparedness, Response & Coop)
Int Conf, March 29 April 1 1993, Tampa,
FL, pp. 880-881.
Key words: Oil Spill, Remote Sensing, Spill Transportation

Fitzgerald, Daniel E. 1977. Utilization of dispersants in
offshore areas. In: Proceedings of the 1977 Oil Spill
Conference (prevention, behavior, control, cleanup), March 8 10,
New Orleans, LA. Year.
Key words: dispersants, offshore.

Fitzhenry, L.C., R.M. Bacon, and J.M. Gronseth. 1991.
Reservoir/Well repair and environmental impact
management of cold lake C7-13 surface discharge. In: Proceedings
of the SPE Therm Oper Int Symp, Feb 6-
8, 1991, Bakersfield, CA, pp. 5-12.
Key words: Soil Pollution, Biodegradation, Bioremediation,
Disposal, Groundwater, Oil Spill, Water
Pollution

Fitzmaurice, M.R., and A.J. Johnston. 1993. Can oil slicks be
contained? In: Proceedings of the 11th
Australasian Conference on Coastal and Ocean Engineering. Part 2
(of 2). Townsville, Queensland,

Australia. National Conference Publication - Institution of Engineers, Australia, 2(93):pt 4.
Key words: Oil Booms, Oil Spills, Ocean Currents, Flow Control
Oil booms are the primary device for the containment of oil spills. Booms may fail to contain low viscosity oil slicks because of drainage or entrainment failure. These failures, where the oil has low viscosity, have been identified in the technical literature both experimentally and theoretically. These results suggest that containment of low viscosity oil slicks can be successful. Delvigne (1) introduced the phenomena of critical accumulation which was a failure that is unique to the containment of high viscosity oil. His experimental results suggested that oil spill containment was impossible where current speeds exceeded approximately equals 0.15 ms minus 1. This paper presents the observations of an experimental program assessing the containment of high viscosity oils. Details of a numerical model developed to predict the failure behaviour of high viscosity oil is presented. A multiple boom system is suggested as a means of avoiding critical accumulation failure and thus achieving the goal of enhanced oil slick containment high viscosity oil. (Author abstract) 8 Refs.

Flaherty, L. M., J. E. Riley, and A. G. Hansen. 1987. A computerized tool for oil spill response decision making. In Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987, Baltimore, MD, pp. 269 274. Washington, D.C.: American Petroleum Institute.
Keywords: computerized, oil spill, response.

Flaherty, L.M., and J.M. Jordan. 1989. Sorbent performance study for crude and refined petroleum products.
In: Proceedings of the API et al Oil Spill (Prev, Behav, Contr, Cleanup) 20th Anniv Conf, February 13 16, 1989, San Antonio, TX. pp. 155 160.
Keywords: waste oil recovery, biodegradation, environmental impact, floating barrier, offshore, oil spill, soil pollution, water pollution

Flaherty, L.M., A.G. Hansen, and A. Dalsimer. 1989. Use of a computerized spill response tool for emergency response, personnel training, and contingency planning.
In: Proceedings of the Amer Soc Testing Mater Oil Dispersants : New Ecol Approaches Symp, October 12 14, 1987, Williamsburg, VA. pp. 84 90.
Keywords: oil spill, contingency planning, Atlantic Ocean, biodegradation, dispersant, environmental impact, Gulf of Mexico, water pollution

Fleming, K., J.P.P. Dick. 1977. Experience in monitoring the oil content of ballast water being discharged by tankers. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.

Key words: monitoring, oil, ballast, discharged, tankers.

Fleming, James T., John Sanseverino, and Gary S. Sayler. 1993. Quantitative relationship between naphthalene catabolic gene frequency and expression in predicting PAH degradation in soils at town gas manufacturing sites. Environ Sci Technol. 27(6):1068-1074.
Key words: Biodegradation, Microorganism, Soil Pollution, Hydrocarbon, Bacteria The 83-kilobase NAH7 plasmid from Pseudomonas putida G7 contains genes for 11 enzymes necessary for the degradation of naphthalene.
Nucleic acid hybridization techniques were used to determine the frequency and distribution of naphthalene genes in manufactured gas plant soils. The observed gene levels were related to naphthalene gene frequency, radiolabeled naphthalene mineralization rates, and soil naphthalene concentrations. A strong correlation between the NAH7 naphthalene dioxygenase gene and radiolabeled naphthalene mineralization rates was observed.

Fleming, J.W. 1990. Correction method for contaminated sites.Patent US 4948297900814.
Keywords: soil pollution, bacteria, biodegradation, oil spill, Gulf Coast, map, Mexico Gulf, soil pollution, Texas, water pollution

Fliermans, C.B. 1989. Aerobic microorganism for the degradation of chlorinated aliphatic hydrocarbons. Dept. of Energy, Washington, D.C. 8.
This patent describes a chlorinated aliphatic hydrocarbon-degrading micro-organism. It has American Type Culture Collection accession numbers ATCC 53570 and 53571, in a biologically pure culture aseptically collected from a deep subsurface habitat and enhanced. It mineralizes trichloroethylene and tetrachloroethylene to HCl, H{sub 2}O and CO{sub 2} under aerobic conditions stimulated by methane, acetate, methanol, tryptone- yeast extract, propane and propane-methane.
Key words: bacteria, cell cultures, biodegradation, chlorinated aliphatic hydrocarbons, water, yeasts, propane, wastes, aerobic conditions, carbon dioxide, methane, methanol, alkanes, alcohols.

Flyvbjerg, J., Jorgensen, C., Arvin, E., Jensen, B.K., Olsen, S.K. 1993. Biodegradation of ortho-cresol by a mixed culture of nitrate-reducing bacteria growing on toluene. Applied and Environmental Microbiology (United States). 59:7:2286-2292.
Ground water contaminated with creosote or oil contains a mixture ofphenols and monoaromatic hydrocarbons. The possibility for anaerobic biodegradation of mixtures of these contaminates is of interest.
The biodegradation of phenol and cresols has been shown to occur under different anaerobic redox

conditions. In mixtures of aromatic hydrocarbons, partial degradation of o-xylene has been observed concommitant with the degradation of toluene, while no loss of o-xylene occurred with out toluene metabolism. This study further investigates the toluene-dependent degradation of o-cresol. On the basis of the experimental data, a mathematical model describing the kinetics of o-cresol degradation was developed and the kinetic parameters of the process were estimated. 35 refs., 3 figs., 1 tab.
Key words: bacteria, biochemical reaction, kinetics, biochemical, mathematical models, cresols, biodegradation, toluene, enzymes, experimental, ground water, hydrocarbons, metabolism, petroleum, phenols.

Fogel, S. 1988. Feasibility of biodegradation of tetrachloroethylene in contaminated aquifers. Final report. Cambridge Analytical Associates, Boston, MA (United States).40. Tetrachloroethylene, a solvent and de-greasing agent is widely spilled and disposed of on soil. It is easily transported in ground water, causing wide-spread aquifer contamination. Conventional technology for the treatment of solvent-contaminated aquifers, which involves pumping out the water and above-ground treatment by physical/chemical techniques, is slow and expensive. CAA Bioremediation Systems has carried out experiments to demonstrate the feasibility of in situ biodegradation of tetrachloroethllylene. The process would involve controlled addition of nutrients to the ground water to stimulate the activity of naturally occurring bacteria. A twenty-three liter laboratory aquifer simulator was constructed, filled with soil and amended ground water was recirculated throughout the soil. Methanogenic conditions were brought about in the reactor within 15 days and terachloroethylene was shown to degrade rapidly to dichloroethylene. Oxygen was then introduced and the oxidiation of dichlororethylene by methanotrophic bacteria was initiated. The aquifer simulator experiment indicated that aquifer conditions can be manipulated in situ to bring about the complete degradation of terachloroethylene.
Key words: chlorinated aliphatic hydrocarbons, growth, bacteria, waste disposal, water pollution.

Flyvbjerg, J., E. Arvin, B. K. Jensen and S. K. Olsen. 1991. Biodegradation of oil- and creosote-related aromatic compounds under nitrate-reducing conditions. In: R. E. Hinchee and R. F. Olfenbuttel (eds.), In Situ Bioreclamation. Butterworth Publishers: Stoneham, MA, pp. 471 479.
Key words: Groundwater, Water Pollution, Oil Spills, Remedial Action
Oil- and creosote-contaminated groundwater typically contains a complex mixture of phenolic compounds, aromatic hydrocarbons with one to three rings, and nitrogen, sulphur, and oxygen-containing heterocyclic

compounds. It is well established that most of these chemicals are easily biodegraded in the presence of oxygen, but comparatively little is known about their biodegradability under anaerobic conditions. However, the past 10 years have seen an increasing interest in the potential of the nitrate-reducing bacteria for pollutant destruction. This is because nitrate-reducing redox conditions often exist between the aerobic and strictly anaerobic zones in polluted aquifers, and because the addition of nitrate to contaminated sites would be a feasibly in-situ technique due to the low cost and high solubility of this electron acceptor. The purpose of this paper is to investigate the potential for biodegradation of phenols and aromatic hydrocarbons in creosote-contaminated groundwater during nitrate-reducing conditions.

Flyvbjerg, J., E. Arvin, B.K. Jensen, and S.K. Olsen. 1993. Microbial degradation of phenols and aromatic hydrocarbons in creosote-contaminated groundwater under nitrate-reducing conditions. Journal of Contaminant Hydrology. 12(1-2):133-150. Key words: Degradation, Hydrocarbon, Groundwater, Denmark
At Fredensborg, Denmark, the bacteria in the creosote-contaminated groundwater degraded a mixture of toluene, phenol, the cresols (o-, m- and p-cresol) and the dimethylphenols 2,4-DMP and 3,4-DMP at both 10 degrees and 20 degreesC. Benzene, the xylenes, naphthalene, 2,3-DMP, 2,5-DMP, 2,6-DMP and 3,5-DMP were resistant to biodegradation during 7-12 months of incubation. It was demonstrated that the degradation of toluene, 2,4-DMP, 3,4-DMP and p-cresol depended on nitrate or nitrite as electron acceptors. 40-80% of the nitrate consumed during degradation of the aromatic compounds was recovered as nitrite, and the consumption of nitrate was accompanied by a production of ATP. Stoichiometric calculations indicate that in addition to the phenols and toluene other carbon sources present in the groundwater contributed to the consumption of nitrate. -from Authors.

Fogel, S., Findlay, M., Moore, A. 1989. Enhanced bioremediation techniques for in situ and onsite treatment of petroleum contaminated soils and groundwater. Petroleum contaminated soils. Volume 2. Calabrese, E.J., Kostecki, P.T. 3. national conference on the environmental and public health effects of soils contaminated with petroleum products. 515.
Bioremediation is a process by which organic contaminants are destroyed by the action of soil bacteria. Since the constituents of petroleum products are naturally occurring chemicals, soil bacteria capable of degrading them are relatively ubiquitous. These bacteria are capable of obtaining energy by breaking down petroleum hydrocarbons to carbon dioxide and water, as well as incorporating portions of the hydrocarbon to support their own growth. The types of petroleum products that the

authors have treated by biological degradation include gasoline, jet fuel, No 2, No 4, and No 6 heating fuels, diesel fuel, waste oil, and cutting oil. Bioremediation can be carried out in situ for saturated soils located below the water table. Unsaturated soils can be also treated in situ or onsite. The same principles are involved, but the methods of delivering the oxygen and mineral nutrients differ. In this chapter, two case studies are presented to illustrate both types of soil treatment.
Key words: petroleum, biodegradation, land pollution, water pollution, water treatment, oxygen, energy.

Fogel, S. 1987. Feasibility of coal tar biodegradation by land treatment. Final report. Cambridge Analytical Associates, Boston, MA (USA). Bioremediation Systems Div. 53.
Coal tar, a by-product of coal gasification, contains monoaromatic and polycyclic aromatic hydrocarbons (PAH) which have been identified as carcinogens. Billions of gallons of this waste have been disposed of at numerous gas manufacturing facilities in the United States. The treatment of tar-contaminated soil by bacterial degradation has shown great promise, since one-, two-, and three-ring PAH can be readily degraded by bacteria. Research was carried out to establish whether 4- and 5-ring PAH could also be degraded by bacteria. The data indicated that 4-ring PAH could degrade when dissolved in a hydrocarbon carrier or when applied to soil as a component of coal tar. Experiments to stimulate the bacterial degradation of benzo(a)pyrene, a 5-ring PAH, were unsuccessful.
Key words: coal gasification, land reclamation, land pollution, progress report, remedial action.

Foget, C.R., S. Thornton, R. Castle. 1977. Evaluation of selected surface treatment agents for the protection of shorelines from oil spills. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: surface treatment, shorelines, oil spills.

Foght, J.M., Westlake, D.W.S. 1987. Biodegradation of hydrocarbons in freshwater. Oil in freshwater: Chemistry, biology, countermeasure technology. Vandermeulen, J.H., Hrudey, S.E. (ed.). 1987. International conference on oil in freshwater. 217-230:512.
Bacteria, yeasts and filamentous fungi are the most important hydrocarbon degraders in freshwater systems, and the ability to degrade hydrocarbons is widespread throughout these groups. The factors influencing biodegradation in freshwater systems are the same, namely: the physical state and chemical properties of the oil, ambient temperature, nutrient supply, aeration, and pH. The physical state of the oil determines its availability to microbes, while the chemical properties determine susceptibility to attack. Nutrient status and aeration can be the most important factors in environmental

degradation of hydrocarbons. Of the hydrocarbon compounds in oil, members of the saturate and aromatic fractions are most readily degraded. Low molecular weight compounds are more readily utilized than high molecular weight, complex ones. The products of microbial attack of hydrocarbons can be CO{sub 2} cells, low molecular weight compounds usually richer in oxygen, and unaltered hydrocarbons. This is a result of the fact that environmental conditions are usually not optimal for the complete conversion of biodegradable hydrocarbons to cellular material and that most of the hydrocarbons in oil are not susceptible to short-term microbial alteration. The introduction of hydrocarbons into freshwater aquatic systems will result in changes in the microbial composition. Hydrocarbons will be toxic to some species, other species will be unaffected while some will grow obtaining energy and cell carbon at the expense of biodegradable hydrocarbons. The net result from the introduction of hydrocarbons is a reduction in the number of species present. 59 refs., 3 tabs.
Key words: fresh water, decontamination, biodegradation, bacteria, yeasts, fungi, hydrogen, molecular weight.

Foght, J.M., P.M. Fedorak, D.W.S. Westlake. 1990. Mineralization of carbon-14 hexadecane and carbon-14 phenanthrene in crude oil specificity among bacterial isolates. Canadian Journal of Microbiology (1990):36(3).
Key words: freshwater, marine, estuarine, petroleum, environment
Bacteria isolated from freshwater, marine, and estuarine samples were tested for the ability to produce 14CO2 from n-[1-14C]hexadecane or [9-14C]phenanthrene added to Prudhoe Bay crude oil. Of 138 isolates tested, 54 (39%) mineralized the model aliphatic compound hexadecane and 6 (4%) mineralized the model aromatic compound phenanthrene. None mineralized both compounds. There was no apparent correlation between degradative ability and genus or source. Additional hydrocarbon -degrading bacteria from diverse sources were tested and found to mineralize either hexadecane or phenanthrene. Of 61 hexadecane- and 21 phenanthrene-mineralizing bacteria tested, none mineralized both model compounds. Selected isolates and commercially available cultures were tested for mineralization of specific 14C-labelled mono-, di-, and tri-cyclic aromatics. An apparent hierarchy of degradation was observed: strains mineralizing the mono- and di-cyclic aromatics toluene and naphthalene did not mineralize biphenyl or the tricyclic aromatics anthracene and phenanthrene, whereas those strains that mineralized the tricyclic aromatics also mineralized the smaller substrates. Similarly, not all n-alkaline-mineralizing isolates tested mineralized the isoprenoid pristane. A combined culture consisting of one aliphatic- and one aromatic-degrading isolate was tested for mineralization of the model compounds and for degradation of other crude oil components by gas

chromatography. No synergism or antagonism was observed compared with degradation by the individual isolates.

Foght, J.M., Westlake, D.W.S. 1988. Degradation of polycyclic aromatic hydrocarbons and aromatic heterocycles by a Pseudomonas species. Canadian Journal of Microbiology. 34(10): 1135-1141.
Key words: polycyclic aromatic compound, heterocyclic compound, biodegradation, isolation, identification, strain, pseudomonas, mineralization, metabolic intermediate, sulfur heterocycle, regulation(control), in vitro, pollutant behavior, hydrocarbon, pseudomonadaceae, pseudomonadales, bacteria.

Foght, J.M., Dw.S. Westlake. 1991. Cross hybridization of plasmid and genomic DNA from aromatic and polycyclic aromatic hydrocarbon degrading bacteria. Canadian journal of microbiology. 37(12):924-932.
Key words: Bacteria, Hydrocarbon, Degradation

Foght, Julia M., David L. Gutnick, and Donald W. Westlake. 1989. Effect of emulsan on Bbodegradation of crude oil by pure and mixed bacterial cultures. Applied & Env Microbiology. 55(1):36-42.
Key words: Biodegradation, Petroleum, Oil Spill, Cleanup, Hydrocarbons, Degradation
Crude oil was treated with purified emulsan, a heteropolysaccharide bioemulsifier produced by the oil-degrading bacterium Acinetobacter calcoaceticus. A mixed bacterial population and nine different pure cultures isolated from various sources were tested for biodegradation of emulsan-treated and untreated crude oil. Biodegradation of linear alkanes and other saturated hydrocarbons, both by pure cultures and by the mixed population, was reduced 50-90% after emulsan pretreatment. Aromatic biodegradation by pure cultures was either unaffected or slightly stimulated by emulsification of the oil, while aromatics degradation by the mixed culture was reduced some 90%. The results have implications both for the stability of oil emulsions during storage and transport and for their biodegradability following accidental spills.

Foley, Cdr. Jerome P., Lt. (jg) Stephen J. Tresidder. 1977. The St. Lawrence oil spill of June 23, 1976: are you ever truly ready? In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words; St. Lawerence oil spill.

Folger, Jr., Frank C. 1973. Prevention: The best method of controlling pollution. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: controlling, pollution.

Folsom, B.R., Chapman, P.J. 1991. Performance characterization of a model bioreactor for the
biodegradation of trichloroethylene by 'pseudomonas cepacia' g4. Pub. in Applied and Environmental
Microbiology, v57 n6 p1602-1608 Jun 91. See also PB90-264201. Prepared in cooperation with Technical
Resources, Inc., Gulf Breeze, FL.
Of the volatile organic chemicals present in common groundwater contaminants, trichloroethylene (TCE) is
the one most commonly found. TCE has been shown to be biodegraded by axenic cultures of aerobic
organisms. Pseudomonas cepacia G4 grown in chemostats with phenol demonstrated constant specific
degradation rates for both phenol and trichloroethylene (TCE) over a range of dilution rates. Washout of cells
from chemostats was evident at a dilution rate of 0.2/h at 28C. Increased phenol concentrations in the nutrient
feed led to increased biomass production with constant specific degradation rates for both phenol and TCE.
The addition of lactate to the phenol feed led to increased biomass production but lowered specific phenol and
TCE degradation rates. The maximum potential for TCE degradation was about 1.1 g per day per g of cell
protein. Cell growth and degradation kinetic parameters were used in the design of a recirculating bioreactor
for TCE degradation. In the reactor, the total amount of TCE degraded increased as either reaction time or
biomass was increased. TCE degradation was observed up to 300 microM TCE with no significant decreases
in rates. On the average, the reactor was able to degrade 0.7 g of TCE per day per g of cell protein. The
results demonstrate the feasibility of TCE bioremediation through the use of bioreactors. (Copyright (c)
1991, American Society for Microbiology.)
Key words: chlorinated aromatic hydrocarbons, biodegradation, bioreactors, enzymes, remedial, bacteria.

Folsom, B.R., Chapman, P.J., 1990. Phenol and trichloroethylene degradation by Pseudomonas cepacia G4:
Kinetics and interactions between substrates. Applied and Environmental Microbiology (USA). 56:5:1279-
1285.
Intact cells of Pseudomonas cepacia G4 completely degraded tricloroethylene (TCE) following growth with
phenol. Degradation kinetics were determined for both phenol, used to induce requisite enzymes, and TCE,
the target substrate. Apparent K{sub s} and V{sub max} values for degradation of phenol by cells were 8.5
{mu}M and 466 nmol/min per mg of protein, respectively. At phenol concentrations greater than 50 {mu}M,
phenol degradation was inhibited, yielding an apparent second-order inhibitory value, K{sub SI}, of 0.45 mM
as modeled by the Haldane expression. A partition coefficient for TCE was determined to be 0.40 {plus
minus} 0.02, (TCE{sub air})/(TCE{sub water}), consistent with Henry's Law. To eliminate experimental
problems associated with TCE volatility and partitioning, a

no-headspace bottle assay was developed,
allowing for direct and accurate determinations of aqueous TCE
concentration. By this assay procedure,
apparent K{sub s} and V{sub max} values determined for TCE
degradation by intact cells were 3 {mu}M
and 8 nmol/min per mg of protein, respectively. Following a
transient lag period, P.cepacia G4 degraded TCE
at concentrations of a least 300 {mu}M with no apparent
retardation in rate. Consistent with K{sub s} values
determined for degradation, TCE inhibited phenol degradation.
Key words: chlorinated aliphatic hydrocarbons, biodegradation,
phenol, metabolism, kinetics, organic
chlorine compounds, microorganisms, organic halogen compounds.

Folsom, Blair A., Clyde Johnson. 1977. Development of a high
current streamlined oil boom/skimmer for
inland waterways. In: Proceedings of the 1977 Oil Spill
Conference (prevention, behavior, control, cleanup),
March 8 10, New Orleans, LA.
Keywords: oil, boom/skimmer, waterways.

Folsom, B. R., P. R. Kurisko and B. D. Ensley. 1992. Development
of a biotreatment system for the
remediation of groundwater contaminated with hydrocarbons and
trichloroethylene. In: Proceedings of
Special Symposium on Emerging Technologies for Hazardous Waste
Management, Sept. 21 23, Atlanta,
GA. American Chemical Society (ACS): Washington DC, p. 173.
Key words: Bioremediation, Water Pollution, Oil Spills
Inadvertent release of fuels and solvents into soil has resulted
in groundwater contamination across the United
States. This paper reports on the development of biologically
based systems for treating mixtures of chemical
contaminants which often requires knowledge of both degradative
pathways and interactions between
individual chemicals. These issues may necessitate the use of
specialized microorganisms and/or treatment
systems designed to overcome these limitations. One strategy for
the treatment of chemical mixtures which
cannot be source separated, such as contaminated groundwater, is
a modular system to sequentially
biodegrade groups of compatible chemicals. A two-state bioreactor
system was constructed for the treatment
of groundwater contaminated with benzene and TCE. This treatment
system is undergoing development for a
field pilot demonstration. Successful implementation of this
system should result in significant cost and time
savings compared to competitive technologies.

Fondekar, S.P., L.V.G. Rao. 1991. Remote sensing of oil slicks.
Curr. Sci. 60(11):636-639.
Key words: Remote Sensing, India, Oil Spills, Pollution
Monitoring
Airborne remote sensing is very useful for oil-spill monitoring
and surveillance. It ranks very high among
available methods due to its capability of large area coverage
with good resolution and speed for detection of

oil slicks. It overcomes the drawback of expensive conventional surveying methods. An airborne remote sensing system used for monitoring and surveillance of oil comprises different sensors such as side-looking airborne radar, synthetic aperture radar, infrared/ultraviolet line scanner, passive microwave radiometer, laser beam fluorosensor and laser-illuminated active gated television. These sensors provide more objective information for detection, quantification and classification of oil as well as identification of a polluting vessel. A brief discussion and working principle of these sensors are presented and their capabilities discussed.

Ford, D.L., J.H. Vandermeulen, and S.E. Hrudey. 1987. Technology for removal of hydrocarbons from surface and groundwater sources. Oil in freshwater: Chemistry, biology, countermeasure technology. Pergamon Press, New York, NY (US).413-430, 512(p).
Key Words: Ground water decontamination, hydrocarbons biodegradation, petroleum materials recovery, surface waters decontamination, de-activated carbon, adsorption, aeration, oil spills, sedimentation, sediments, water pollution, adsorbents, carbon, chemical reactions, decomposition, energy sources, fossil fuels, hydrogen compounds, management, nonmetals, organic compounds, oxygen compounds, pollution, processing, recovery sorption, waste management, waste processing.

Ford, R. Glenn, Michael L. Bonnell. 1985. Computer simulation of the effects of oil development on seabird and marine mammal populations. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: computer simulation, oil, development, seabird, marine, mammal.

Forns, Joseph M. 1977. The effects of crude oil on larvae of lobster Homarus Americanus. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: effects, oil, lobster.

Forrest, R. G. 1985. A Major oil barge pollution incident on the Arkansas River. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: oil barge, pollution, Arkansas River.

Fortnagel, P. 1989. Regioselective dioxygenation prompts cleavage of ether bonds. Die Naturwissenschaften. (1989): 76
Key words: bacteria, degradation, hydrocarbon, biodegradation
Polychlorinated dibenzofurans and dibenzodioxins are pollutants of major concern together with polychlorinated biphenyls and polybrominated biphenyl ethers. The oxygenolytic cleavage of the ether bond

occuring as the initial enzymatic step of high regioselectivity in the course of the bacterial attack on such aromatic compounds is reported for model compounds. There is a new pathway for the degradation of biaryl ethers. In a two-step reaction an enzymatically controlled hydroxylation is followed by a thermodynamically controlled spontaneous cleavage of the ether bridge.

Fotheringham, Nick. 1981. Biomass exportation from offshore production platforms in East Texas. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: biomass, offshore, production, East Texas.

Fouillet, B., P. Chambon, R. Chambon, M. Castegnaro, and N. Weill. 1991. Effects of ozonation on mutagenic activity of polycyclic aromatic hydrocarbons. Bulletin of Environmental Contamination and Toxicology (United States). 47:1:0007-4861.
In this study, four polycyclic aromatic hydrocarbons were tested. Benzo(a)pyrene (B(a)P), Chrysene (CH), 7,12-dimethylbenzo(a)-anthracene (DMBA) and 3-methylcholanthrene (MCA) in hexane were treated with ozone to determine the effectiveness of degradation and to evaluate the genetic properties of ozone byproducts. Two types of ozonation were carried out: partial ozonation and total ozonation. The disappearance of parent compounds and the appearance of ozone byproducts were measured by high performance liquid chromatography (HPLC) coupled with spectrofluorimetry and U.V. spectrophotometry. Plate incorporation mutagenicity assay, using a Salmonella typhimurium strain, was used to test the ozone byproducts with and without metabolic activation.
Key words: ozone, biological, polycyclic, mutagen screening.

Fraga., William J., Robin W. Lehr, and Robert J. Lardner. 1987. Oil spill simulation from the Marjan offshore oil field. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil spill, Marjan, offshore.

Francis, M.M. 1989. A study to achieve enhanced oil degradation based on composting the oil with a biomass product. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). 90.
A preliminary study of degradation of oil sludges in closed reactors with leachate recycle was performed. Oily sludges from a conventional oil refinery and from a heavy oil refinery were used. Sludge was first treated with permanganate to oxidize complex aromatic molecules. The sludge was then absorbed into the peat product Oclansorb, mixed with bacterial culture and nutrients and allowed to degrade in reactor systems. Microbial biomass rapidly increased in the reactors which generate a

certain amount of heat. degradation of oil in the sludge from conventional oil refining, as monitored by total oil recovery and gas chromatography, was observed mainly in the saturate fraction up to C35 size molecules. Sludge from heavy oil refining was degraded in the saturate fraction and also in the complex components of the oil which were not resolved by gas chromatogaphy. Heavy metals did not accumulate in the leachate, implying that they were retained in the peat matrix. Polynuclear aromatic hydrocarbon compounds did not accumulate in the leachate waters, implying that they were being degraded by microbial activity. Permanganate did not oxidize the oil due to a low permanganate/carbon ratio and to the insolubility of permanganate in oil. However, apparent enhanced biodegradation of the complex components of the heavy oil sludge treated with 0.75 moles potassium permanganate/Kg sludge still implied the involvement of permanganate effects. 16 refs., 25 figs., 11 tabs.
Key words: petroleum refineries, waste processing, sludges, biodegradation, potassium, alkaline metal compounds, polycyclic aromatic hydrocarbons.

Frank, Uwe. 1975. Identification of petroleum oils by fluorescence spectroscopy. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: petroleum, fluorescence, spectroscopy.

Frank, Ronald L. 1987. Oil pollution control on the Buffalo River. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: oil, pollution, control, Buffalo River.

Frank, Uwe, D. Stainken, M. Gruenfeld. 1979. Methods of source identification and quantification of oil pollution. In: Proceedings of the 1979 Oil Spill Conference (prevention, dehavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: identification, quantification, oil, pollution.

Franke, S. 1991. Bioremediation is economic clean-up. Amer. Oil Gas Reporter 34(9):25-27 Petroleum Abstracts ABSTR. NO. 521,536.32(12):25-27.
Key Words: Abstract, accident, bacteria, biochemical reaction, biodegradation, bioremediation, blowout, business operation, cargo, crude oil, crude oil (well), economic factor, environmental protection, failure, full scale, ground water, meteorological phenomenon, microorganism, motion, nutrient medium, oil waste, oil well, onshore, operating condition

Frankenfeld, John W. 1973. Factors governing the fate of oil at sea: variations in the amounts and types of dissolved or dispersed materials during the weathering process. In: Proceedings of Joint Conference on

Prevention and control of oil spills, March 13 15, Washington, D.C.
Key words: oil, sea, variations, dissolved, dispersed, weathering.

Franklin, Harry L. 1977. The story of a successful oil spill cooperative: the Corpus Christi area oil spill control association. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil spill, Corpus Christi, control.

Franzi, David A. 1988. Surficial and subsurface distribution of aquifer sediments at the Bemidji, Minnesota, research site. Open-File Report (United States Geological Survey. 1978). C5-C10.
Key Words: Minnesota, environmental geology, pollution, Beltrami County Minnesota, USGS, Midwest, United States, northwestern Minnesota, Bemidji Minnesota, oil spills, ground water, aquifers, crude oil, outwash, clastic sediments.

Fraser, J.P. 1989. Guidelines for use of dipersants on spilled oil: a model plan. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: guidelines, dispersants, spilled oil.

Fraser, J.P. 1989. Methods for making dispersant use decisions. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: dispersant, decisions.

Fraser, J.P. 1985. Advance planning for dispersant use/non-use. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: planning, dispersant, use/non-use.

Fraser, J.P., D.P. Montoro, J.R. Mortenson, and M.E. Rugg. 1989. Response to the April 1988 Oil Spill at Martinez, California. In: Proceedings of the Api et al oil spill (prev, behav, contr, cleanup) 20th anniv conf (San Antonio, 2/13-16/89) proc pp 65-69, 1989 (1 ref)
Key words: oil spill, case history, cleaning, control, crude oil, crude oil storage, data, petroleum, pollution control, storing, viscous crude oil, administration, amphibian, beach, bird, buildings, business operation, California, chordata, cleanup cost, coast, composition, containment, contamination, cost, economic factor, environment, environmental impact

Fraser, J.P. 1979. Oil spill countermeasures, a rational system for selection and sizing of equipment. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los

Angeles, CA.
Key words: countermeasures, selection, sizing, equipment.

Fredrickson, J.K., F.J. Brockman, D.J. Workman, S.W. Li, and T.O. Stevens. 1991. Isolation and characterization of a subsurface bacterium capable of growth on toluene, naphthalene, and other aromatic compounds. Applied and Environmental Microbiology (United States). 57:3:0099-2240.
Bacterium, designated F199, utilized toluene, naphthalene, dibenzothiophene, salicylate, benzoate, p-cresol, and all isomers of xylene as a sole carbon and energy source. This bacterium was isolated from Middendorf sediments, a Cretaceous age formation that underlies the Southeast Coastal Plain in South Carolina, at a depth of approximately 410 m. F199 is a gram-positive, irregular-shaped bacterium that has a varied cell morphology that is dependent on culture medium type and growth stage. F199 required microaerobic conditions (40 to 80 {mu}M O{sub 2}) for growth on hydrocarbons, glucose, acetate, and lactate in mineral salts medium but not for growth on rich media. ({sup 14}C)naphthalene mineralization by F199 was induced by either naphthalene or toluene; however, ({sup 14}C)toluene mineralization by this strain was induced by toluene but not naphthalene. F199 was also found to harbor two plasmids larger than 100 kb. Restricted F199 plasmid and geonomic DNA did not hybridize with toluene (pWWO) or naphthalene (NAH7) catabolic plasmid DNA probes. The presence in the Middendorf formation of bacteria with the capacity for degrading a variety of aromatic compounds suggests that indigenous microorganisms may have potential for in situ degradation of organic contaminants.
Key words: polycylic aromatic hydrocarbons, biodegradation, carbon 14 compounds, plasmids, cretaceous.

Freestone, Frank J., Richard B. Tabakin. 1975. Review of Environmental Protection Agency research in oil-water separation technology. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: Environmental Protection Agency, research, oil-water, separation.

Freestone, F.J., R.A. Anderson, N.P. Trentacoste. 1975. United States Environmental Protection Agency research in high-speed devices for the recovery of thin-film oil spills. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: Environmental Protection Agency, research, recovery, thin-film, oil spills.

Frei, C.S. 1989. Biological decarbonization of spent petroleum catalysts. Cambrian Engineering Group Ltd., Mississauga, ON (Canada). 83.

A laboratory program investigated the efficacy of commercially available cultures of microorganisms on the decarbonizing of spent petroleum catalysts, with a view to finding an economically viable biological alternative to the current, energy-intensive regeneration methods. A literature search found that degradation, although difficult, might be possible using a mixed culture. Some of the factors suggested that might be of importance were the presence of nutrients, emulsifiers, surfactants, and metals. While there was no evidence to suggest that bacteria could not function in the presence of the metals expected, there was also no documentation on the leaching capabilities of commercially available bacteria formulations. A catalyst characterization study found that about 20% of the catalyst sample was carbon, and significant metals present included V, Ni, Mo, and Co. Decarbonization experiments indicated that the formulations tested were able to accomplish little or no degradation of the hydrocarbons present. Results suggested that much of the carbon present was in graphitic form, or that the graphitic carbon was masking the biologically useful carbon and making it difficult for the bacteria to act upon it. Attempts to optimize the culture growth met with inconsistent results. 95 refs., 5 figs., 1 tab.
Key words: catalysts, decarbonization, bench-scale, biodegradation, reviews, chemical reactions, decomposition.

Freiberger, Arnold. 1971. Burning agents for oil spill cleanup. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: burning, oil spill, cleanup.

Fremling, Calvin R. 1981. Impacts of a spill of No. 6 fuel oil on Lake Winona. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: spill, fuel oil, Lake Winona.

French, Deborah P., Mark Reed. 1993. Natural resource damage assessment models for Great Lakes, coastal, and marine environments. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: assessment, Great Lakes, coastal, marine.

Freyer, S., R. Eberhardt, D. Schuerbuescher, and C. Wandrey. 1989. Computer-aided interactive optimization of biotechnical processes using the example of anaerobic sewage purification 7. DECHEMA annual meeting on biotechnology and 58. meeting of the European Biotechnology Federations, and joint meeting of Society for Industry Microbiology (SIM). 572-575.
The process-connected PC can directly evaluate the on-line recorded data and use the 'findings' for further

process control and optimization. The growth and productivity of microorganisms are substantially
influenced by temperature in addition to pH and substrate composition. At the same time, the process
temperature is also a relevant cost factor in biotechnical processes. The experimental reactor works according
to the high-performance biogas procedure involving an anaerobic mixed population fixed on sintered glass.
The pH value is controlled according to the pH-auxostatic method using a parameter-adaptive controller
installed on the computer. An equilibrium is established between the addition of the acid substrate (vapour
condensate contains about 0.5 mol of acidic aicd as the organic main constituent) and the degradation rate of
the bacteria. This provides a direct relationship between substrate flow and performance of the reactor at a
constant rate of conversion. (orig./EF).
Key words: bioreactors, computerized control, optimization, waste water, biosynthesis, bioconversion,
control, bacteria, temperature monitoring.

Fricke, Peter. 1979. The Assessment of socio-economic effects of oil spills: toward a methodology. In:
Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los
Angeles, CA.
Key words: assessment, socio-economic, effects, oil spills.

Friedman, Bruce, David W. Taylor. 1979. Light scattering techniques for discriminating between oil and
particulates in contaminated water. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior,
control, cleanup), March 8 10, New Orleans, LA.
Key words: scattering, discriminating, particulates, water.

Friesen, B.C. 1992. Solving the fine tails challenge. In: Proceedings of the Aostra-Can Heavy Oil Ass
Fueling the Future Conf (Calgary, Can, 6/10 12/92).
Key words: disposal, biodegradation, oil, disposal

Frink, Lynne, Mary Jane Dalton. 1989. Establishing a wildlife response after the Ashland oil spill. In:
Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San
Antonio, TX.
Key words: wildlife, response, Ashland oil spill.

Frink, Lynne. 1987. An overview: rehabilitation of oil contaminated birds. In: Proceedings of the 1987 Oil
Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: rehabilitation, oil, contaminated, birds.

Frogbrook, K. 1990. Straw mat booms. Marine Pollution Bulletin. 21(10):494.
Key words: Beach, Boom, Oil Waste, Pollution Control Equipment

Fu-Min, Menn, B.M. Applegate, and G.S. Sayler. 1993. NAH plasmid-mediated catabolism of anthracene and phenanthrene to naphthoic acids. Applied and environmental microbiology. 59(6):1938-1942.
Key words: Bacteria, Degradation, Hydrocarbons
Pseudomonas fluorescens 5R contains an NAH7-like plasmid (pKA1), and P. fluorescens 5R mutant 5RL contains a bioluminescent reporter plasmid (pUTK21) which was constructed by transposon mutagenesis. Polymerase chain reaction mapping confirmed the localization of lux transposon Tn4431 300 bp downstream from the start of the nahG gene. Two degradation products, 2-hydroxy-3-naphthoic acid and 1-hydroxy-2-naphthoic acid, were recovered and identified from P. fluorescens 5RL as biochemical metabolites from the biotransformation of anthracene and phenanthrene, respectively. This is the first report which provides direct biochemical evidence that the naphthalene plasmid degradative enzyme system is involved in the degradation of higher-molecular-weight polycyclic aromatic hydrocarbons other than naphthalene.

Fucik, K.W., H.W. Armstrong, J.M. Neff. 1977. The Uptake of Naphthalenes by the clam, Rangia cuneata, in the vicinity of an oil separator platform in Trinity Bay, Texas. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: uptake, Naphthalenes, clam, oil separator, Trinity Bay, Texas.

Fukuzaki, S., N. Nishio, M. Shobayashi, an d S. Nagai. 1990. Inhibition of the fermentation of propionate to methane by hydrogen, acetate, and propionate. Applied and Environmental Microbiology (USA). 56:3:719-723.
Inhibition of the fermentation of propionate to methane and carbon dioxide by hydrogen, acetate, and propionate was analyzed with a mesophilic propionate-acclimatized sludge that consisted of numerous flocs (size, 150 to 300 {mu}). The acclimatized sludge could convert propionate to methane and carbon dioxide stoichiometrically without accumulating hydrogen and acetate in a propionate-minimal medium. Inhibition of propionate utilization by propionate could be analyzed by a second-order substrate inhibition model. For inhibition by hydrogen and acetate to propionate utilization, a noncompetitive product inhibition model was used. It could be concluded that the increase in undissociated propionic acid concentration was a key factor in inhibition of propionate utilization and that hydrogen and acetate cooperatively inhibited propionate degradation, suggesting that hydrogenotrophic and acetoclastic methanogens might play an important role in enhancing propionate degradation to methane and carbon dioxide.
Key words: methane, biosynthesis, inhibition, acetates,

carboxylic acids, elements, organic acids, nonmetals.

Fullerton, H. 1990. The use of microbes for major cleanups. Energy process-Can. 82(4):22,30.
Keywords: biodegradation, bacteria, oil waste, soil pollution, waste material, disposal, oil spill, weathering

Fulleylove, R.J., T.E. Lester. 1977. Oil spill contingency planning for the BP forties oilfield production, pipeline and terminal systems. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil spill, planning, production, pipeline.

Funatani, Chikao. 1979. Japanese governmental and industrial measures for the control of marine oil spills. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: industrial, control, marine oil spills.

Funderburk, R.E. 1989. Stabilizing hydrocarbons: concurrent treatment and stabilization. In Pennwell Conf & Exhibit Co Petro-safe 89 Conf (Houston, 10/3 5/89) in Year.
Key words: disposal, oil, hydrocarbon, petroleum

Furukawa, K., and N. Arimura. Purification and properties of 2,3-dihydroxybiphenyl dioxygenase from polychlorinated biphenyl-degrading Pseudomonas pseudoalcaligenes and Pseudomonas aeruginosa carrying the cloned bphC gene. J. Bacteriol.(United States). 169:2:924-927.
2,3-Dihydroxybiphenyl dioxygenase, involved in biphenyl and polychlorinated biphenyl degradation, was purified from cell extracts of polychlorinated biphenyl-degrading Pseudomonas pseudoalcaligenes KF707 and Pseudomonas aeruginas PAO1161 carrying the cloned bphC gene (encoding 2,3-dihydroxybiphenyl dioxygenase). The purified enzyme contained ferrous iron as a prosthetic group. The specific activities decreased with the loss of ferrous iron from the enzyme, and the activity was restored by incubation with ferrous iron in the presence of cysteine. Addition of ferric iron caused the complete inactivation of the enzyme. The molecular weight was estimated to be 250,000. Sodium dodecyl sulfate-polyacrylamide gel electrophoresis showed a single band with a molecular weight of 31,000, indicating that the enzyme consists of eight identical subunits. The enzyme was specific only for 2,3-dihydroxybiphenyl with a K/sub m/ value of 87 ..mu..M. No significant activity was observed for 3,4-dihydroxybiphenyl, catechol, or 3-methyl- and 4-methylcatechol. The molecular weight, subunit structure, ferrous iron requirement, and NH/sub 2/-terminal sequence (starting with serine up to 12 residues) were the same between the two enzymes obtained from KF707 and PAO1161 (bphC).

Key words: chlorinated aromatic hydrocarbons, biodegradati8on, oxygenases, molecular structure, halogenated aromatic hydrocarbons, decomposition, genetic engineering, pseudomonas, purification, bacteria, organic chlorine compounds, recombinant DNA.

Gabrick, A. 1990. Controlling and Recovering Oil Spills from the Environment. Patent No. US 4941978, c 7/17/90, f 8/7/89 (Appl 390170) (c02f-001/28) (4 pp; 8 claims).
Key words: absorbent, change, control, disposal, elastomer, expansion, oil spill, oil swelling, pollution control, sorbent, synthetic rubber, waste disposal, (p) USA, absorption, applying, block polymerization, butene copolymer

Gabrick, A. 1992. Controlling and Recovering Oil Spills from the Environment. Patent No. US 5104548, c 4/14/92, f 7/11/90, pr US 8/7/89 (Appl 390170) (C02f-001/28) (44 pp; 9 claims) see related patent abstract # 492733
Key words: absorbent, sorbent, (p) USA, ecology & pollution

Gabrielson, Ira N. 1969. More cooperation in oil pollution research. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.

Gaelli, R. 1987. Biodegradation of dichloromethane in waste water using a fluidized be bioreactor. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 27:2:206-213.
Biological treatment of a synthetic waste water containing 120 mM dichloromethane (10.2 g/l) was carried out under aerobic conditions using dichloromethane-degrading bacteria as an inoculum. The bacteria were adsorbed to support particles and grown in a fluidized bed bioreactor. Charcoal and sand particles were compared as support materials with regard to abrasion, the maximum degradation rate for dichloromethane and the stability of the biological activity in the system. The use of charcoal led to the incorporation of coal dust into the biomass and to an uncontrollable thickness of the biofilm. Therefore the system became unstable and the biological activity decreased. In contrast sand as support material was indifferent to abrasion and allowed biofilm thickness to be controlled. The dichloromethane degrading capacity of the bioreactor increased during the first 30 days. It reached a steady state level of 1.6 g CH/sub 2/Cl/sub 2//lxh. Dichloromethane concentration in the effluent was <0.01 mM(<0.85 mg/l) and consequently the degradation efficiency better than 99.99%.
Key words: chlorinated aliphatic hydrocarbons, biodegradation, chemical reactions, waste processings, charcoal, electon microscopy, aerobic conditions, bioreactors, sand, time dependence, waste water.

Gainer, J.D. 1971. Alberta oil spill contingency plan. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: Alberta, oil spill, contingency plan.

Gaines, T.H. 1969. Pollution control at a major oil spill. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: pollution control, oil spill.

Gaire, R.J., G. Mazzella. 1988. Moving vertical bed retorting of Colorado oil shale: topical report. In U.S. Dep Energy Rep No DOE/MC/22134-2634 May 1988.
Key words: oil recovery, oil, disposal, petroleum

Galaska, E.G., G.J. Skladany, E.K. Nyer. 1990. Biological treatment of groundwater, soils, and soil vapors contaminated with petroleum hydrocarbons. In: Proceedings of the 44th industrial waste conference annual Purdue industrial waste conference. 951(p):11-22.
Key Words: Gasoline biodegradation, oil spills, pollution control, ground water, land pollution control, soils, underground storage, water pollution control, chemical reactions, decomposition, hydrogen compounds, liquid fuels, oxygen compounds, petroleum products, pollution control.

Gallagher, John J. 1985. Responsibilities of underwriters in casualties threatening oil spills. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: underwriters, oil spills.

Gallagher, John J., A.J. Heikamp. 1985. The Louisiana Offshore Oil Port Computerized Oil Spill Contingency Plan. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words; offshore, oil spill, contingency plan.

Gallagher, John J. 1989. Managing elements of response to major maritime oil spills. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: maritime, oil spills.

Galt, J.A., D.L. Payton. 1983. The Use of receptor mode trajectory analysis techniques for contingency planning. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: receptor, trajectory analysis, contingency planning.

Galt, J.A., G.Y. Watabayashi, D.L. Payton, and J.C. Petersen. 1991. Trajectory analysis for the Exxon Valdez: Hindcast study. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int

Conf, March 4 7 1991, San Diego, CA, pp. 629-634.
Key words: Oil Spreading, Contamination, Environmental Pollution, Oil Spill, Petroleum, Remote Sensing

Galt, J.A., Carol H. Pease. 1977. The Use of a diagnostic circulation model for oil trajectory analysis. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: diagnostic, oil trajectory analysis.

Ganten, Richard H. 1981. The International oil pollution compensation fund: functions and operations. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: oil pollution, compensation.

Ganten, Reinhard H. 1983. The International oil pollution compensation fund. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil pollution, compensation.

Ganten, Reinhard H. 1985. The Tanio spill: a case history of the International Oil Pollution Compensation Fund. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: spill, International, compensation.

Gardenier, John S. 1981. Navigational safety approaching offshore deepwater ports. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: navigational safety, offshore.

Gardner, George R., Paul P. Yevich, Peter F. Rogerson. 1975. Morphological anomalies in adult oyster, scallop, and Atlantic silversides exposed to waste motor oil. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: anomalies, oyster, scallops, silversides, exposed, oil.

Garrett, M., G.A. Jeffress. 1993. Managing oil spills: Texas GIS incorporates near-real time environmental data. Geo Info Systems. 3(1):29-35.
Key words: Oil Spill, GIS, Environmental Data
This article describes the development of a pilot system that incorporates wind speed and direction, water temperature, air temperature, and other environmental data into a graphical display within a GIS for monitoring an oil spill. Such data are presently collected automatically and in near-real time as part of the Texas Coastal Ocean Observation Network (TCOON) and transferred

to a GIS data base. -from Authors

Garrett, William D. 1979. Confinement and control of oil pollution on water with monomolecular surface films. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: confinement, control, oil, water, films.

Garrity, S.D., S.C. Levings, and K.A. Burns 1993. Chronic oiling and long-term effects of the 1986 Galeta Spill on fringing mangroves. In: Proceedings of the 13th Bien API et al oil spill (Prev, Preparedness, Response & Coop) INT conf, March 29 April 1 1993, Tampa, FL, pp. 319-324.
Key words: Toxic Effect, Crude Oil, Flora, Oil Spill, Petroleum, Contamination, Environmental Pollution

Garrity, S.D., S.C. Levings. 1990. Effects of an oil spill on the gastropods of a tropical intertidal reef flat. mar environ res v 30, no 2, pp 119-153.
Key words: administration, business operation, contingency planning, control, environment, environmental impact, management, oil waste, oil waste fate, planning, pollution control, strategy, waste material

Garry, Bert James. 1983. The Massachusetts Oil Spill Contingency Planning Program. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: Massachusetts Oil Spill Contingency planning.

Gasparik A. 1993. Use of synthetic sorbents in oil spill cleanup. Petro-Safe '93/4th Annual Oil, Gas, and Petrochemical Industries Environmental and Safety Conference (Houston 1/26-28/93) Proceedings Book 3 V9 391-400.
Key words: acid, resistance, acidity, basicity, adsorbent, adsorption, basic monomer, chemical resistance, coastal area, cost, economic factor, homopolymer, hydrocarbon, meeting paper, monoolefinic monomer, oil waste, physical property, pollutant, pollution control, reclaiming, review, single structure type, soil pollutant, soil treating, sorbent.

Gassmann, G., R. Pocklington. 1984. Hydrocarbons in waters adjacent to an oil exploratory site in the western north Atlantic Ocean. Environ Sci Technol (1984): 18.
Key words: hydrocarbon, offshore, oil, disposal, oil spill

Gassmann, Gunter, and Wilfried Gunkel. 1983. Long-term investigations on chemical and microbial changes of a slightly oil polluted beach. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: investigations, chemical, microbial, oil, beach.

Gatellier, C.R. 1973. Experimental ecosystems to measure fate of oil spills dispersed by surface active products. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15.
Key words: ecosystems, measure, oil, dispersed.

Gates, Donald C., Kevin M. Corradino, William R. Senftner. 1983. OHMSETT tests of truck-mounted vacuum systems for oil spill recovery. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: OHMSETT, tests, vacuum, oil, recovery.

Gates, Donald C., Kevin M. Corradino. 1985. OHMSETT tests of the Toscon weir skimmer and gravity differential separator. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: OHMSETT, tests, Toscon, skimmer, separator.

Gattuso, P. 1992. Oil Containment Boom and Skimmer. 6(pp).
Key Words: Floating barrier, contamination, environmental pollution, oil skimming, oil spill, oil water separation, oil water separator, physical separation, separation equipment, water pollution, USA, aperture, bladder, buoyance, business operation

Gaudiosi, LCDR Richard. 1993. Enforcement jurisdiction of pollution prevention requirements for oil transfer pipelines. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: jurisdiction, pollution, prevention, pipelines.

Gauge, W.K., J.J. Kilbane, R.L. Kelley, and V.J. Srivastava. 1990. Enhancement of microbial degradation of hydrocarbons in soil and water. In: Proceedings of the 2nd Inst Gas Technol Gas, Oil, Coal, & Environ Biotechnol Int Symp,December 11 13, 1989, New Orleans, LA. pp. 171 203.
Keywords: bioremediation, bacteria, biodegradation, soil remediation, in-situ, soil pollution

Gauger, W.K., J.J. Kilbane, R.L. Kelley, and V.J. Srivastava. 1990. Enhancement of microbial degradation of hydrocarbons in soil and water. In: Proceedings of the 2nd Inst Gas Technol Gas, Oil, Coal, & Environ Biotechnol Int Symo, December 11-13, 1989, New Orleans, LA, pp.171-203.
Key words: Bioremediation, Bacteria, Hydrocarbon, In-situ, Soil Pollution, Water Pollution, Weathering

Gauger, W.K., S.E. Williams. 1987. Media for bacterial cultivation in oil shale waste effluent. Microbiologica (Bologna). (1987): 10(1).
Key words: hydrocarbon, degradation, bacterium, water, coal

Preparation of culture media for the selection, isolation and enumeration of microorganisms which grow in oil shale process waters (retort waters) is described. These waters are typically high in hydrocarbon components, some of which may be inimical in the environment but that are subject to degradation by microorganisms. A complex medium containing filter sterilized retort water and supplemented with nitrogen and phosphorus was prepared and found to be useful for isolation and enumeration of microbial populations. Additionally, a chemically defined culture medium that contained many inorganic constituents present in an example retort water was prepared. Both media were used to isolate and begin taxonomic characterization of a Pseudomonas-like bacterium obtained from Omego-9 retort water. The procedures detailed in this paper have been used to prepare culture media for several retort waters and a coal gasification waste water.

Gauthier, C. C. 1990. Enforcement of federal underground storage tank regulations. Environmental Law 20(2):261 289.
Key words: Groundwater, Oil Spills, Environmental Legislation
During the 1980s, underground storage tanks (USTs) were leaking petroleum products into the soil and groundwater at an alarming rate. The federal government has recently developed an UST regulatory program that includes operating and financial responsibility requirements. Federal regulation requires UST system owners to notify state environmental agencies of the existence of these systems, and directs the EPA to formulate regulations concerning UST release detection, prevention, and corrective action, as well as for financial responsibility for leaks of regulated substances from USTs. State environmental agencies are required to compile tank inventories and to provide this information to the EPA. The EPA is mandated to establish a federal program for the regulation of USTs that allows state programs to operate in lieu of the federal program if they are no less strict than the federal requirements and can be adequately enforced. To recover shallow spills, the contaminated soil may be excavated and placed in a landfill. For deeper pollution, the only methods of treatment are flushing and recovery or an in-situ treatment, such as biological degradation using bacteria. Ethical issues include the relationship between the public demand for petroleum products, environmental damage, and the conflicts encountered by environmental consulting firms. Legal issues concern the notification of the public and the sale of property on which storage tanks are located, as well as the increasing involvement of the legal system in enforcement of environmental legislation.

Gauthier, M.J., B. Lafay, R. Christen, L. Fernandez, M. Acquaviva, P. Bonin, and J.C. Bertrand. 1992. Marinobacter hydrocarbonoclasticus gen. nov., sp. nov., a new,

extremely halotolerant,
hydrocarbon-degrading marine bacterium. International journal of systematic bacteriology. 42(4):568-576.
Key words: Biodegradation, Hydrocarbon, Bacteria, Petroleum
On the basis of phenotypical characteristics and analysis of 16S rRNA sequence, a new species belonging to
a new genus is described, and the name Marinobacter hydrocarbonoclasticus is proposed. This organism,
isolated from Mediterranean beawater near a petroleum refinery, is a gram-negative, aerobic, rod-shaped
bacterium. It grows at NaCl concentrations of 0.08 to 3.5 M and uses various hydrocarbons as the hole source
of carbon and energy. Its DNA has a guanine-plus-cytosine content of 52.7 mol%.

Gearing, Juanita M. 1979. Rates of transport and fates of petroleum hydrocarbons in a controlled marine
ecosystem and a note on analytical variability. In: Proceedings of the 1979 Oil Spill Conference (prevention,
behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: transport, petroleum, hydrocarbons, marine, ecosystem, variability.

Gehring, MKC George O. 1981. A Unique inland oil spill, Glenrock, Wyoming. In: Proceedings of the 1981
Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: inland oil spill.

Genders, S. 1988. In-Situ detection and tracking of oil in the water column. In: Proceedings of the Chem &
Natur Dispersion of Oil on Sea Int Seminar, November 10 12 1986, Trondheim, Norway, Pap; Oil Chem
Pollut, 4(2):113-126.
Key words: Oil Spill, Contamination, Water Pollution, Aromatic Hydrocarbon, Petroleum, Pollution Control,
Remote Sensing

Genthner, B.R.S., W.A. Price, and P.H. Pritchard. 1989. Anaerobic degradation of chloroaromatic
compounds in aquatic sediments under a variety of enrichment conditions. Pub. in Applied and
Environmental Microbiology, Vol. 55, No. 6, 1466-1471(Jun 1989).
Anaerobic degradation of monochlorinated phenols and monochlorinated benzoates by a variety of aquatic
sediments was compared under four enrichment conditions. A broader range of compounds was degraded in
enrichments inoculated with sediment exposed to industrial effluents. Methanogenic and 1 mM
BESA-amended enrichments were most likely, while nitrate and sulfate enrichments least likely, to degrade
the compounds tested. Chlorophenols were more readily degraded than chlorobenzoates. However,
2-chlorophenol, 3-chlorophenol, and 3-chlorobenzoate degradation was observed most often and with equal
frequency. Para-chlorinated compounds were least likely to be degraded. A relative order of ortho < meta <

para was observed for onset of chlorophenol degradation, while the order for chlorobenzoate degradation was meta < ortho < para. In laboratory transfers, 2- and 3-chlorobenzoate degradation was most easily maintained, while degradation of para-chlorinated compounds was least stable.
Key words: chlorinated aromatic hydrocarbons, biodegradation, industrial wastes, chemical reactions, organic compounds, wastes.

Genung, R.K., C.D. Scott, E.L. Gaden, Jr., A.E. Humphrey, G. Carta and D.J. Kirwan. 1989. Bioprocessing applications in the management of nuclear and chemical wastes. In: Proceedings of the Meeting on Bioprocessing Research for Energy Applications, November 2-4, 1988, Alexandria, VA, pp. 75-86.
Key words: Biodegradation, Disposal, Government Policies
The US Department of Energy (DOE), the US Department of Defense (DOD), and other federal agencies already face profound challenges in finding strategies that manage budgets and priorities will bringing their sites and facilities into compliance with current status and regulations and with agency policies and orders. While it is often agreed that current technology can be used to address most waste management and environmental restoration needs, it is also argued by many that the costs of implementing current technology will be too high unless the standards and schedules for compliance are relaxed. Since this is socially unacceptable, efforts to improve the efficiency of existing technologies and to develop new technologies should be pursued. A sizeable research, development, and demonstration effort can be easily justified if the potential for reducing costs can be shown. Bioprocessing systems for the treatment of nuclear and chemically hazardous wastes offer such promise.

Geraci, A.L., F. Landolina, L. Pantani, and G. Cecchi. 1993. Laser and infrared techniques for water pollution control. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 525-529.
Key words: Remote Sensing, Oil Spill, Pollution Control

Geraci, A.L., and F. Lolli. 1989. Integrated remote sensing system for maritime surveillance operations in Italy. In: Proceedings of the API et al Oil Spill (Prev, Behav, Contr, Cleanup) 20th Anniv Conf, February 13 16 1989, San Antonio, TX, pp. 131-136.
Key words: Remote Sensing, Oil Spill, Pollution Control

Geraci, J.R. 1988. Physiologic and toxicologic effects on cetaceans. US Dep Interior Minerals Manage Serv Atlantic OCS Reg Report No. MMS 88-0049 (Synthesis of effects of oil on marine mammals) pp. 167-202.
Key words: Mammal, Detection, Contamination, Crude Oil, Environmental Impact, Oil Spill, Petroleum,

Remote Sensing

Geraci, A., A. L. Larosa. 1992. Oil pollution and water quality mapping of Augusta Bay, Italy using remote sensing techniques. In: Proceedings of the Environment Observation and Climate Modelling through International Space Projects. 2:675 680.
Key words: Coastal Ecology, Oil Pollution, Remote Sensing, Sicily, Landsat
Remotely sensed data for oil pollution and water quality mapping over Augusta Bay in Sicily, Italy, since 1977, to investigate the usefulness of remote sensing techniques to the analysis of resource related problems, is reported. Landsat MSS (Multispectral Scanner) and TM (Thematic Mapper) data, along with MSS data, thermal infrared imagery, ultraviolet and infrared photography from lightplanes and helicopters are among the data acquired. Color coded imagery, showing oil pollution, distinguishing different types of it and calculating their extension were obtained. Color coded images, each depicting the distribution of a selected water quality parameter, were produced.

Gerard, M.W. and Gerard I. 1991. Process for Neutralising Hydrocarbon Pollution and Products Therefore. Can 2022638, p 2/15/91, f 8/3/90, pr fr 8/14/89 (appl 8910867) and Fr 12/1/89 (appl 8915907) (c01f-011/46; c04b-011/02; b01d-015/00) (19 pp; 14 claims; assigned to M. W. Gerard, I. Gerard, E. F. Vannier and M. M Vannier)
Key words: solid adsorbent, adsorbent, chemical dehydration, chemical process, contamination, control, environmental pollution, gypsum, mineral, oil spill, pollution control, sorbent, sulfate mineral, water pollution, (p) Canada, additive, adsorption, adsorption capacity, business operation, calcium sulfate, composition, data

Gerbasi, Peter J., Kenneth J. Smith, and John Fillos. 1991. Biological treatment of petroleum hydrocarbons. Ground Water Management. 8:409-425.
Key Words: Pollution, ground water, organic materials, hydrocarbons, experimental studies, biodegradation, oil spills, pollutants, recovery, water treatment.

Gersberg, R.M., W.J. Dawsey, and M.D. Bradley. 1991. Biodegradation of monoaromatic hydrocarbons in groundwater under denitrifying conditions. Bull Environ Contam Toxicol. 47(2):230-237.
Key words: Biodegradation, Microorganism, Hydrocarbons, Bacteria, In-situ, Groundwater
Indigenous subsurface microorganisms will cause the degradation of fuel hydrocarbons such as xylene, benzene, and toluene under the proper conditions. Enhanced in situ biodegradation of these and other contaminants has been considered as a means of aquifer remediation. Nutrients were added and other organic

amendments were
made to a sample of gasoline-contaminated groundwater in an
attempt to determine the prospects for such
biodegradation. Results indicate that enhanced in situ
biodegradation of these chemicals under denitrifying
conditions could be an effective means of aquifer remediation.

Gerstl, Z. 1989. Ecological studies vol. 73. Toxic organic
chemicals in porous media second international
workshop on behavior of pollutants in porous media bet dagan
Israel June 1987.
Key words: pollution, biodegradation

Geselbracht, L., J. Rubin, T.M. Leschine. 1989. A Proposed
resource damage assessment methodology for
Washington State. In: Proceedings of the 1989 Oil Spill
Conference (prevention, behavior, control, cleanup),
February 13 16, San Antonio, TX.
Key words: damage assessment.

Geselbracht, Laura, Richard Logan. 1993. Washington's marine oil
spill compenation schedule: simplified
resource damage assessment. In: Proceedings of the 1993 Oil Spill
Conference (prevention, preparedness,
response), March 29 April 1, Tampa, FL.
Key words: marine oil spill compensation, assessment.

Geselbracht, Lance, Robert Giattino, and Daniel Landry 1991.
Observations of the effects of soil venting on
separate-phase hydrocarbons. Ground Water Management. 5:419-429.
Key Words: Reclamation, soils, pollution, methods, vacuum
extraction, oil spills.

Getman, Lt. James H. 1977. Performance tests of three fast
current oil recovery devices. In: Proceedings of
the 1977 Oil Spill Conference (prevention, behavior, control,
cleanup), March 8 10, New Orleans, LA.
Key words: tests, oil recovery.

Getman, Lt. J.H. 1975. United States Coast Guard arctic
oil-pollution program. In: Proceedings of the 1975
Conference on Prevention and Control of Oil Pollution, March 25
27, San Francisco, CA.
Key words: Coast Guard, Arctic, pollution.

Getter, Charles D., Geoffrey I. Scott; Jacqueline Michel. 1981.
The Effects of Oil Spills on Mangrove
Forests: A Comparison of Five Oil Spill Sites in the Gulf of
Mexico and Caribbean Sea. In Proceedings of
the 1981 Oil Spill Conference(Prevention, Behavior, Control,
Cleanup), March 2 5, 1981 in Atlanta, GA
Year.
Key words: oil spills, mangrove, Gulf of Mexico, Caribbean

Getter, Charles D. 1981. Mapping the distribution of protected
and valuable, oil-sensitive coastal fish and
wildlife. In: Proceedings of the 1981 Oil Spill Conference

(prevention, behavior, control, cleanup), March
2 5, Atlanta, GA.
Key words: mapping, oil-sensitive, coastal, fish, wildlife.

Getter, Charles D., Geoffrey I. Scott, Jacqueline Michel. 1981.
The Effects of oil spills on mangrove forests:
a comparison of five oil spill sites in the Gulf of Mexico and
Caribbean Sea. In: Proceedings of the 1981 Oil
Spill Conference (prevention, behavior, control, cleanup), March
2 5, Atlanta, GA.
Key words: effects, oil, mangrove forests, Gulf of Mexico,
Caribbean.

Getter, Charles D., Thomas G. Ballou. 1985. Field experiments on
the effects of oil and dispersant on
mangroves. In: Proceedings of the 1985 Oil Spill Conference
(prevention, behavior, control, cleanup),
February 25 28, Los Angeles, CA.
Key words: experiments, effects, oil, dispersant, mangroves.

Getter, Charles D. 1985. Tropical oil pollution investigations in
coastal systems (tropics). In: Proceedings of
the 1985 Oil Spill Conference (prevention, behavior, control,
cleanup), February 25 28, Los Angeles, CA.
Key words: oil pollution, coastal.

Getter, Charles D., Thomas G. Ballou, and Jeffrey A. Dahlin.
1983. Preliminary results of laboratory testing
of oil and dispersants on mangroves. In: Proceedings of the 1983
Oil Spill Conference (prevention, behavior,
control, cleanup), February 28 March 3, San Antonio, TX.
Key words: testing, oil, dispersant, mangroves.

Geyer, Richard A. 1981. Naturally occurring hydrocarbons in the
Gulf of Mexico and the Caribbean. In:
Proceedings of the 1981 Oil Spill Conference (prevention,
behavior, control, cleanup), March 2 5, Atlanta,
GA.
Key words: hydrocarbons, Gulf of Mexico, Caribbean.

Ghassemi, M. 1987. In situ technologies for remediation of
contaminated sites. Part 3: Soil vapor extraction.
Environmental and Waste Management World. 1(4):9-10.
Key words: Organic Wastes, In-situ Processing, Oil Spills
The paper discusses the in-situ technique of soil vapor
extraction (SVE) for removal of volatile organic
compounds (VOCs) from contaminated soils. SVE involves the
application of vacuum to extraction wells
to cause a flow of clean air from the atmosphere into the
subsurface, the resulting gas being treated to trap
organics. The technique is most effective on leaks from
underground tanks, where contamination is in the
unsaturated zone in relatively permeable formations, and where a
cleanup schedule of months or years is
feasible. Compounds exhibiting vapor pressure of about 0.5 to 1.0
mm Hg are likely candidates for removal
by SVE. These include cleaning solvents like trichloroethylene,

1,1,1- trichloroethane, pentane, methylene chloride, methyl ethyl ketone, tetrachloroethylene, and most constituents in gasoline. SVE is attractive because it is a proven technology in full scale applications. SVE can only remove VOCs, so some sites may use multiple cleanup techniques. Design of the blower, piping system, and equipment and monitoring instrumentation for extracted gas management, must all be tailored to the site conditions. Two SVE systems at Twin Cities Army Ammunition Plant in New Brighton, Minnesota, have been operating since 1986. Each system has extracted 30 tons of VOCs so far. Estimated costs are at least $30,000 per acre. 4 refs.

Ghiorse, W.C., J.L. Sinclair, K. Malachowsky, and Madsen, E.L. 1989. Microbiology of a manufactured gas waste site. 1989 symposium on biological processing of coal and coal-derived substances. Proceedings. EPRI symposium on biological processing of coal and coal-derived substances. 4.37-4.48:437.
An exploratory investigation was conducted to examine the feasibility of bioremediation at a manufactured gas coal-tar waste site. Geohydrologic and chemical studies showed a narrow plume of contamination containing polyaromatic hydrocarbons and other soluble coal-tar constituents moving down gradient from the source in the saturated zone. Enumeration of total and viable cells in sediment core samples showed that aerobic heterotrophic bacteria were 100-fold less abundant in the vadose zone than in surface soil, but bacterial populations were only 10-fold less abundant at the water table interface and in the saturated aquifer zone. Actinomycetes and fungi were detected in the surface soil and vadose zone, but not in samples below the water table. Samples from an underlying clay bed contained very low numbers of viable bacteria.
Mineralization of {sup 14}C-labeled naphthalene and phenanthrene was examined in sediment samples taken at several depths from within the contaminant plume and from an adjacent uncontaminated area. Significant mineralization activity was detected in water-table interface and saturated samples from the contaminated area. Sediments from the vadose zone and underlying clay in the contaminated zone and from all depths in the uncontaminated area did not mineralize naphthalene or phenanthrene. Preliminary DNA-DNA colony hybridization experiments with the Nah7 plasmid of Pseudomonas putida PpG7 which carries genes for napthalene degradation showed the highest levels of hybridization in samples that most actively mineralized napthalene and phenanthrene. These results indicate that enrichment of bacterial guilds capable of degrading naphthalene and phenanthrene has occurred in the plume. A potential exists for using bioremediation strategies at this site, but further microbiological and geohydrological work is needed to determine the environmental factors controlling biodegradation of contaminants.

Key words: coal gasification plants, bacteria, biodegradation, geochemistry, ground water.

Ghunaim, I., M. Abuzar and F. S. Qurnas. 1992. Delineation and monitoring of oil spill in the Arabian Gulf by using Landsat Thematic Mapper (TM) data. In: Proceedings of the 1st Annual Environmental Protection Agency et al. Remote Sensing for Mar & Environ Thematic Conference, June 15 17, New Orleans, LA. 2:1151 1160.
Key words: Absorption Spectroscopy, Arabian Sea, Landsat, Oil Spill

Giannopoulis, J. 1990. California above ground storage tank program. In: Proceedings of the Center for Energy & Environ Manage Above Ground Storage Tanks Conf, Oct. 29-30, 1990, San Francisco, CA, 17pp.
Key words: California, Legal, groundwater, Monitoring, Oil Spill, Water Pollution

Gibs, Jacob, G. Brown, Allan Turner, Kenneth S. 1991. Use of a multilevel sampler to determine vertical concentration gradients of volatile aromatic hydrocarbons in ground water, Galloway Township, New Jersey. Water-Resources Investigations. 268-275.
Key Words: New Jersey, pollution, ground water,

Gibson, Marjorie J. 1991. Bald eagles in Alaska following the Exxon Valdez oil spill. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: eagles, Exxon Valdez, oil.

Gibson, Thomas L., and Abdul S. Abdul. 1988. Microbial degradation of aromatic hydrocarbons in hydrogeologic materials; microcosm studies. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods, Las Vegas, NV, 2:53-70.
Key words: Groundwater, Pollution, Biodegradation, Bacteria

Gijzen, H.J., K.B. Zwart, F.J.M. Verhagen, and G.D. Vogels. 1988. High-rate two-phase process for the anaerobic degradation of cellulose, employing rumen microorganisms for an efficient acidogenesis. Biotechnol. Bioeng.(United States). 31:5:418-425.
A novel two-stage anaerobic process for the microbial conversion of cellulose into biogas has been developed. In the first phase, a mixed population of rumen bacteria and ciliates was used in the hydrolysis and fermentation of cellulose. The volatile fatty acids (VFA) produced in this acidogenic reactor were subsequently converted into biogas in a UASB-type methanogenic reactor. A stepwise increase of the loading rate from 11.9 to 25.8 g volatile solids/L reactor volume/day (g VS/L/day) did not affect the degradation

efficiency in the acidogenic reactor, whereas the methanogenic reactor appeared to be overloaded at the highest loading rate. Cellulose digestion was almost complete at all loading rates applied. The two-stage anaerobic process was also tested with a closed fluid circuit. In this instance total methane production was 0.438 L CH/sub 4//g VS added, which is equivalent to 98% of the theoretical value. The application of rumen microorganisms in combination with a high-rate methane reactor is proposed as a means of efficient anaerobic degradation of cellulosic residues to methane. Because this newly developed two-phase system is based on processes and microorganisms from the ruminant, it will be referred to as Rumen Derived Anaerobic Digestion (RUDAD)-process.
Key words: cellulose, anaerobic digestion, biogas process, bioreactors, fermentation, methanogenic bacteria, digestive system, gastrointestinal tract, hydrocarbons, organic compounds, polysaccharides, synthesis, animals, biosynthesis, microorganisms.

Gilbertson, N., and J.J. Severns. 1992. Biological treatment: Soil impacted with crude oil. In: Proceedings of the Pennwell Conf & Exhibit co Petro-Safe 92 Conf, January 27-29, 1992, Houston, TX, pp. 743-749.
Key words: Bioremediation, Oil Spill, Soil Pollution, Environmental Impact, Groundwater, Legal, Monitoring, Water Pollution

Gilchrist, W.C.M., and H.A.A.M. Masri. 1989. Abu Dhabi National Oil Company: A group approach to oil spill prevention and control. In: Proceedings of the 1989 API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 209-13.
Key words: Abu Dhabi, Accident, Biology, Crude Oil, Economic Factor, Environmental Impact, Pollution Control

Gilchrist, Ralph E. 1977. The spill training and education program at Texas A&I, Corpus Christi. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: spill, training, education, Corpus Christi.

Gilewicz M. Monpert, G. Acquaviva M., Mille, G. Bertrand, J.C. 1991. Anaerobic oxidation of 1-n-heptadecene by a marine denitrifying bacterium. Applied microbiology and biotechnology. 36(2): 252-256. Federal Republic of Germany.
Key words: pseudomonas, marine sediments, isolation, hydrocarbon, oxidation, anaerobiosis, biodegradation, emulsification, microorganism culture, pollutant, pseudomonadaceae, pseudomonadales, bacteria.

Gilfillan, Edward S. 1985. Tidal area dispersant experiment,

Searsport, Maine: an overview. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: tidal area, dispersant.

Gilfillan, E.S. 1987. The importance of using appropriate experimental designs in oil spill impact studies: an example from the Amoco Cadiz oil spill impact zone. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: experimental, oil spill, impact, Cadiz.

Gilfillan, Edward S. 1983. Effect of spills of dispersed and non-dispersed oil on intertidal infaunal community structure. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: dispersed, non-dispersed, oil, intertidal, infaunal.

Gilfillan, Edward S. 1973. Effects of seawater extracts of crude oil on carbon budgets in two species of mussel. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: seawater, oil, mussel.

Gilfillan, Edward S. 1981. Fate of the Zoe Colocotroni oil spill and its effects on infaunal communities associated with mangroves. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: Zoe Colocotroni, oil spill, infaunal, mangroves.

Gilges, K., and J. Shearman. 1991. The aftermath of (the Persian Gulf) war. Chemical Engineering. 98(7):44A,44C-44D.
Key words: Accidental Fire, Blowout, Boom, Carbon, Crude Oil

Gill, S.D. 1979. Developing a dispersant spraying capability. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: dispersant.

Gill, Shawn. 1977. Dispersant field trials in Canadian Waters. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: dispersant, Canadian.

Gill, S.D., R.H. Goodman, and J. Swiss. 1985. Halifax '83 Sea trial of oil spill dispersant concentrates. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.

Key words: halifax, oil, dispersant.

Gill, Shawn D. and W. Ryan. 1979. Assessment of the ACW-400 oil skimmer by the Canadian Coast Guard.
In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil skimmer, Coast Guard.

Gill, S.D., C.A. Bonke, and J. Carter. 1985. Management of the Uniacke G-72 Incident. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: management, Uniacke.

Ginsburg, P., S. Sterling, and S. Gottehrer. 1993. Experiment in democracy : the citizen oversight council as a means of mitigating environmental impacts of terminal and tanker operations. In: Proceedings of the 13th BIEN API et al. Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29-April 1, Tampa, FL.
Pp. 253-258.
Key words: Oil Spills, Tanker, Water Pollution

Giraitis, Cdr. David M. 1993. U.S. Coast Guard National Spill response resource inventory. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: Coast Guard, spill, response.

Glaeser, John L. 1973. An Effective oil spill containment-recovery system for high seas use. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil spill, containment, seas.

Glaeser, LTJG John L. 1971. Oil pollution problems in the Arctic. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: oil, pollution, Arctic.

Glaser, J.A., A.D. Venosa, and E.J. Opatken. 1991. Development and evaluation of application techniques for delivery of nutrients to contaminated shoreline in Prince William Sound. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: dispersant, sediments.

Glaser, J. A. 1992. Hazardous-waste degradation by wood-degrading fungi. Environmental Protection Agency, Cincinnati, OH. Report No. EPA 600/A 92/172, 17 pp.
Key words: Biodegradation, Fungi
The persistence and toxicity of many hazardous waste constituents indicates that the environment has limited capacity to degrade such materials. The competence and presence

of degrading organisms significantly
effects one's ability to treat and detoxify these hazardous waste chemicals. Competence is often specified by
the ability of the organisms to convert toxic chemicals to non-toxic entities and most desirable to carbon
dioxide. A wood degrading fungus, Phanerochaete chrysosporium has been investigated to determine its role
as a degrader of toxic waste materials. Due to its widely recognized ability to degrade lignin, a persistent
biogenic polymer, and the non specific enzyme systems supporting such activity, it was thought to have great
promise as a toxic waste degrader.

Glasgow, James and Douglass Gleason. 1983. The Development of a dispersant applicator for cleaning oiled
sediments. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup),
February 28 March 3, San Antonio, TX.
Key words: dispersant, sediments.

Goclik, E. R., Mueller Hurtig, and F. Wagner. 1990. Influence of the glycolipid-producing bacterium
Rhodococcus Erythropolis on the degradation of a hydrocarbon mixture by an original soil population. Appl
Microbiol Biotechnol. 34(1):122-126.
Key words: Biodegradation, Bacteria, Bioremediation, Hydrocarbon, Soil Pollution

Godoy, F.E., D.L. Hazelwood, (U.S.) Hazardous material control. Minimization of industrial oil wastes.
(1990):

Gold Phillip. April 29, 1991. Saudis Behave as if There Is No Use Crying over Spilled Oil. Insight.
7(17):26(2).
Key Words: Kuwait, Persian Gulf, Saudia Arabia, Oil spill, cleanup, oil spills, crude, oil spill incidents, oil
spills-pipeline, warfare, oil skimmers, oil wells, Iraq.

Goldberg, N.N. 1981. An Analysis of tanker casualties for the ten-year period, 1969 1978. In: Proceedings
of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.

Goldman, S.D. 1988. Software and environmental engineering. Chemical Engineering Progress.
84(12):29 34
Key words: biodegradation, monitoring, petroleum, pollution control, waste disposal, waste water

Goldsmith, Robert L. and Sohrab Hossain. 1973. Oil water separation by ultrafiltration. In: Proceedings of
Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil, water, ultrafiltration.

Goldstein, Arnold M., Robert M. Koros, and Barry L. Tarmy. 1973.

Engineering study of an oil gellation technique to control spills from distressed tankers. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil, gellation, control, tankers.

Golik, A., N. Rosenberg. 1987. Quantitative evaluation of beach-stranded tar balls by means of air photographs. Mar Pollut Bull, 18(6):289-293.
Key words: Tar, Hydrocarbon Compound, Oil Spill, Biodegradation, Contamination, Remote Sensing

Golob, Richard S. and Eric Brus. 1991. Statistical analysis of tanker spills in U.S. waters: 1978 1990. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: analysis, tanker, spills, U.S. waters.

Goodman, R.H. 1987. A Technique for the measurement of under-ice roughness to determine oil storage volumes. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: measurement, under-ice, oil.

Goodman, R.H. and J.W. Morrison. 1985. A Simple remote sensing system for the detection of oil. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: remote sensing, detection, oil.

Goodman, R.H., C.H. Peabody, and A.G. Holoboff. 1987. TACID: a computer-based information system for on-scene commanders. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: TACID, computer-based, information.

Goodman, R., S. Nadeau, and A. Holoboff. 1992. The development and use of contemporary oil spill models in the preparation of a response plan for cold lake bitumen. In: Proceedings of the Environment Canada 15th Arctic and Marine Oil Spill Technical Seminar, June 10 12, Edmonton, Alberta, Canada. Imperial Oil Ltd, pp. 1 10.
Key words: Oil Spills, Models, Contingency Planning, Water Pollution, Bitumen

Goodman, I., R. Eades, C. Krueger, M. Galliot, and J. Dean. 1990. Completing site cleanups: A three-tiered approach based on best use and technical limits of corrective action technologies and institutional controls. Analytic of a Book Conference Literature. 664(p):229-231.
Key Words: Oil spills land pollution abatement, oil spills water pollution abatement, pollution control

equipment, technology assessment, de-civil liability, Delaware, land pollution, land reclamation, Minnesota, pollution regulations, site characterization, state government, storage facilities, underground storage, US EPA water pollution, water reclamation, federal region III, federal region V, national orgainzations, North America, pollution abatement, USA.

Goodman, R.H. 1990. The Exxon Valdez Incident, One Year Later. In: Proceedings of the 13th Environ. Can. Arctic & Mar. Oil Spill Program Tech. Seminar, June 6 8 1990, Edmonton, Canada, pp. 475 477. (1990)
Key words: Health, Environment, Pollution Control, Boom, Bulk, Skimmer

Goodman, R.H., H.M. Brown, J. Kuiper, W.J. van den Brink. (eds.) 1987. A simple remote sensing system for the determination of dispersants effectiveness. Fate and Effects of Oil in Marine Ecosystems. In: Proceedings of the Conference on Oil Pollution Organized Under the Auspices of the International Association on Water Pollution Research and Control (IAWPRC) by the Netherlands Organization for Applied Scientific Research, Feburary 23 27 1987, TNO Amsterdam, The Netherlands, pp. 57-66.
Key words: Marine Pollution, Oil Pollution, Oil Slicks, Remote Sensing
This paper describes the development of a simple remote sensing system for the detection of oil on water. Signals from sensors operating in the ultraviolet and infrared are combined in a computer-based image processing system to produce information on the area of thick and thin portions of the slick, from which the effectiveness of dispersants can be calculated. The design parameters, the selection of sensors, and the integration of these sensor signals into a user friendly display is discussed. The use of this UV/IR system in field oil spill experiments and in an actual spill situation is described.

Goodman, R. 1992. Overview and future trends in oil spill remote sensing. In: MTS '92: Global Ocean Partnership, October 19 21 1992, Washington, DC, pp. 98-104.
Key words: Remote Sensing, Marine Pollution, Oil Spills
Surveillance and tracking of oil spills has been a feature of most spill response situations for many years. The simplest and most direct method uses visual observations from an aircraft and handplotting of the data on a map. All of the remote sensing systems use some form of electro-magnetic radiation to detect the oil. The present state of the art in detecting oil on water relies to a large extent on visual observations, supplemented by sensors that extend the spectrum of visual observation. These involve image-producing systems that operate in the thermal infrared (IR) and ultraviolet (UV).

Goodman, R. 1992. Client needs for surveillance and tracking

during an oil spill. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:69-78.
Key words: Oil Spill, Business Operation, Geographic Information System

Goodman, R.H. 1988. Simple remote sensing for the detection of oil on water, no. 98. Esso Resources Canada Ltd., Calgary, AB. Research Dept. Report No. ER/C-098|MICROLOG-89-02439, 40 pp.
Key words: Oil Spills, Remote Sensing
A review is presented of various remote sensing systems that may be applicable to development of a system for the aerial detection of oil spills on water. The advantages and disadvantages of active radar, passive microwave, thermal infrared, near infrared, visible light, and ultraviolet systems are discussed. A system was selected based on the criteria of small size, portability, lack of a requirement for external mounting on an aircraft, ability to operate on its own power or on a standard 28 volt aircraft system, a mission life compatible with air fuel limitations, and real time output capability. The selected system uses three television cameras, one for detecting ultraviolet radiation, one for infrared, and one to record information from navigational and flight instruments. A computer based integration system was designed to obtain a synchronized composite image from those three sensors. A number of tests using this remote sensing system are described. It has been found that the system works well and is reliable, although there are some difficulties in interpreting the infrared data, and information is not provided on oil slick thickness. 53 refs., 15 figs., 1 tab.

Goodman, R.H., and M.F. Fingas. 1988. The use of remote sensing in the determination of dispersant effectiveness. Spill Technology Newsletter. 13(3):55 59.
Key words: Oil Spill Analysis, Dispersants, Remote Sensing, Oil Spill Cleanup
Recent experiments designed to measure oil spill dispersant effectiveness in an open ocean environment have included a remote sensing program. Aide-looking radar, photography, and ultraviolet sensors have been evaluated for their ability to detect dispersant efficacy. As a result of a recent study conducted in the Canadian Beaufort Sea, a number of issues have been identified concerning the use of ultraviolet/infrared equipment for such measurement. The impact of emulsuin ball formation, the variability of ambient solar radiation, and the presence of a thermally suppressed region on remote sensing system accuracy is considered.
Until the nature of emulsion balls and their formation criteria can be determined, and until a remote sensing method of oil thickness measurements can be developed, it is not possible, with any degree of precision, to measure dispersant effectiveness using ultraviolet/infrared

sensors alone.

Goodman, R.H. 1992. Current perspective on remote sensing. In: Proceedings of the first international oil spill R&D forum, June 1 4 1992, McLean, VA, pp. 47-50.
Key words: Oil Spills, Monitoring, Oil Spills, Remote Sensing, Pollution Control
Surveillance and tracking of oil spills has been a feature of most spill response situations for many years. The simplest and most direct method uses visual observations from an aircraft and hand-plotting of the data on a map. This technique has proven adequate for most small spills and for responses in fair weather. As the size of the spill increases or the weather deteriorates, there is a need to augment visual aerial observations with remote sensing methods. Remote sensing and its associated systems are one of the most technically complex and sophisticated elements of an oil spill response. During the past few years, a number of initiatives have been undertaken to use contemporary electronic and computing systems to develop new and improved remote sensing systems.

Goodman, R.H. 1990. Remote sensing - what do you really need?. In: Proceedings of the 13th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 6 8 1990, Edmonton, Canada, pp. 479-485.
Key words: Remote Sensing, Oil Spill, Petroleum

Goodman, R.H. 1989. The use of computers in spill response. In: Proceedings of the Dangerous goods emergency response '89 Conf, May 16 18 1989, Halifax, Canada, pp. 25-34.
Key words: Hazardous Materials Spill, Information Systems, Personal Computers, Oil Spills

Goodman, R.H. 1989. Application of the Technology in North America. 1989. In: Proceedings of the Inst Petrol London Remote Sensing of Oil Slicks Int Mtg, May 17 18 1988, London, England, pp. 39-65.
Key words: Remote Sensing, Oil Spill Pollution Control, Contamination

Goodman, R. 1992. Will specialized equipment and supplies needed for an oil spill response be available when you need them. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar, June 10 12 1992, Edmonton, Alberta, pp. 253-260.
Key words: Oil Spill, Pollution Control Equipmemt
As a consequence of recent and highly publicized oil spills, much effort and money has been expended on the development of new oil spill response technologies. Since medium to large size spills are infrequent events, however, it has historically been difficult to maintain a stable source of supplies for high-technology oil spill response methods. Examples of such methods include laser fluorosensors for spill detection, computer

models for predicting spill trajectories, and bioremediation and in-situ burning of spills. Problems with spill response research is the duplication of research, relative inaccessiblity of the relevant literature, lack of continuity of staff who understand advanced spill response techniques, lack of training in new techniques, regulatory constraints on the use of new techniques, and lack of availability of the latest spill control equipment and materials. Rather than burden oil spill response funding groups with the responsibility for maintaining expensive systems for response to unlikely or infrequent events, it is suggested that oil spill technology research groups should investigate alternative users for their technologies. For example, if a chemical used for suppressing soot during oil spill burning were also applicable to pool burning of oil in sumps and test flares, there would be a commercial incentive to make it readily available. 22 refs.

Goodman., N.M., H.M. To, and R.H. Browm. 1987. Data analysis and modeling of dispersant effectiveness in cold water. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: analysis, dispersant, water.

Gordon, M. 1988. Review and assessment of a spill response exercise undertaken on the MacKenzie River at Fort Simpson, Northwest Territories on June 24, 1987. Report No. EC/Y/C-WN87/88-8|MICROLOG-88-03678, p. 15.
Key words: northwest teritories, oil spills, oil pollution containment, training, surface waters
On June 24, 1987, Interprovincial Pipe Line (IPL) and Esso Resources Canada held a joint spill recovery training exercise on the northeast shore of the Mackenzie River at Fort Simpson, Northwest Territories. Spill team members included IPL and Esso staff and contracted labourers from Fort Simpson. The scenario for the exercise was the rupture and complete loss of product from the river pipeline crossing. Booms and skimmers were used in containing a simulated spill. Several problem areas were identified which should be corrected by both government and IPL if IPL's effectiveness in resonding to an oil spill is to be fairly evaluated. These include: the need for the NWT Water Board to clarify the reasons for conducting spill exercises and to issue criteria against which company success can be evaluated; the need for time trials to enable the evaluation of IPL's efficiency in spill response; the need for the practice deployment of portable storage facilities for holding recovered material; the need for common training standard for IPL/Esso staff who supervise oil spill crews; and the need for a standing list of experienced and trained individuals available on short notice for emergency duties with IPL and Esso. 7 figs.

Goswami, Dibakar. 1991. 2-D modeling of single component

non-reactive organic (benzene) transport in groundwater of glacial till; a case study. Abstracts with Programs - Geological Society of America. 23(3):14-15.
Key Words: Ground water, pollution, oil spills, environmental geology, models, methods, case studies, transport, two-dimensional models, benzene, aromatic hydrocarbons, hydrocarbons, organic materials, till, clastic sediments.

Goto, Masafumi. 1993. Mathematical model for microbial degradation of spilled oil. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: mathematical, microbial, degradation, oil.

Gottschalk, G. 1987. Fermentations leading to the substrates of methanogenic bacteria. 193. national meeting of the American Chemical Society. vp.
In anaerobic environments methane and carbon dioxide are the final products of the degradation of a large variety of organic materials. Only a few compounds, however, serve as substrates of the methanogenic bacteria. They include H/sub 2/ + CO/sub 2/, methanol, tri-, di- and monomethylamine, formate and acetate.
As a consequence, all organic materials have to be degraded to these few compounds. Many different bacterial species are involved in this process. The pathways along which the methanogenic substrates are formed will be discussed as well as the interrelations between the fermentative microorganisms.
Key words: methane, fermentation, anaerobic conditions, carbon dioxide, alkanes, bacteria, digestion, methanogenic bacteria, substrates, carbon oxides, chalcogenides, digestion, oxygen.

Gough, L.P., S. Asher-Bolinder, L.S. Balistrieri, G.N. Breit, T.J. Casadevall, J.G. Crock, K.I. Cunningham, J.S. Duval, J.A. Erdman, and B.M. Erickson. 1993. Understanding our fragile environment: lessons from geochemical studies. USGS CIRC No. 1105 1993, 34 pp. Key words: Air Pollution, Oil Spill, Water Pollution

Gould, G.J., R.M. Karpas, D.L. Slitor. 1990. Alaska update: September 1988 January 1990. In U.S. Dep Interior MMS OCS Inform Program Rep No MMS 90-0012 1990 (2 Microfiche with 89 Pp; 12 Refs).
Key words: Alaska, legal, Arctic area, Beaufort Sea, oil, disposal

Gould, J.R., and J. Lindstedt-Siva. 1991. Santa Barbara to Mega Borg and beyond: A review of API's spill program and priorities. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, N.4529, pp. 341-48.

Key words: Accident, Additive, Biochemical Reaction, Biodegradation, Business Operation, Contingency Planning, Petroleum Industry

Gould, W.L. Rapidly deployable fluid spill containment and recovery system, with flexible cylindrical boom sections having depending coplanar flexible skirts to form elongated boom assembly to surround fluid. Patent No. US 767385_910930.
Key words: Boom, Diameter Efficiency, Physical Property, Pollution Control, Skimmer

Gould, J.R., S.D. Bach, R.C. Anderson, and E.R. Fidell. 1988. Oil spill studies measurement of environmental effects and recovery. API Health Environ. Sci. Dep. Report, 137 pp.
Key words: Analytical Method, Animal, Beach, Economic Factor, Environmental Impact, Legal Consideration, Pollution Control

Goutx, M., S. Mutaftshiev, J.C. Bertrand. 1987. Lipid and exopolysaccharide production during hydrocarbon growth of a marine bacterium from the sea surface. Mar. Ecol. (Prog. Ser.). (1987): 40.
Key words: chromotography, hydrocarbons, degradation
The marine bacterium Alcaligenes sp. PHY 9 L.86 was isolated from hydrocarbon-polluted sea-surface waters and grown on 0.1% tetradecan in batch cultures. Lipid composition of cell pellets and supernatants were examined throughout growth, using thin layer chromatography coupled with flame ionization detection. Cellular and extracellular carbohydrate and protein contents were estimated. Results stress the role of biosurfactants in the biodegradation of hydrocarbon in the marine environment.

Govind, R., S. Desai and H.H. Tabak. 1990. Determination of monod kinetics of toxic compounds by respirometry for structure-biodegradability relationships. Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab Report No. PB-90-263237/XAB
Key words: Biodegradation, Microorganisms, Water Pollution
The key to the evaluation of the fate of toxic organic chemicals in the environment is dependant on evaluating their susceptibility to biodegradation. Biodegradation is one of the most important mechanisms in controlling the concentration of chemicals in an aquatic system because toxic pollutants can be mineralized and rendered harmless. Experiments using an electrolytic respirometer have been conducted to collect oxygen consumption data of toxic compounds from the list of RCRA and RCRA land banned chemicals (phenols and phthalates). The estimation of Monod kinetic parameters were obtained for all the compounds by a graphical method. The first order kinetic onstants for the substituted phenols were related to the structure of the compounds by the contribution method.

Graf, L. 1989. Shallow Water Modular Boom System. Pct Gaz. 1989(18):4493.
Key Words: Floating barrier, absorbent, containment, depth, oil spill, pollution control, shallow water, sorbent, water depth, world, ballast, body (geometric), chart, contamination, cylinder, diagram, fabric, floating, geometry, Graf (l) & Co. Pty. Ltd., mathematics, module, offshore equipment, water pollution.

Graham ,I.H. Kerley, Erasmus Theuns. 1987. The Management of oiled penguins. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: management, oiled, penguins.

Grahl-Nielsen, O., and T. Lygre. 1990. Identification of samples of oil related to two spills. Marine Pollution Bulletin. 21(4):176-83.
Key words: Crude Oil, Hydrocarbon

Grahl-Nielsen, Otto, Kjell Westrheim, and Svein Wilhelmsen. 1979. Petroleum hydrocarbons in the North Sea. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: petroleum, hydrocarbon, North Sea.

Graves, Nathan A. 1985. A Northern Idaho gasoline spill and cleanup using stream bed agitation. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: Idaho, gasoline, spill, cleanup.

Gray, W.O., C.J. Carven, and G.L. Becker. 1977. International regulation of the tanker industry. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: regulation, tanker.

Gray, William O. 1975. The 1973 IMCO convention: a tanker operator's viewpoint. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: tanker.

Grbic-Galic, D. 1991. Anaerobic microbial degradation of aromatic hydrocarbons. In: Proceedings of the US DOE Microbial Enhancement of Oil Recovery INT Conf, May 27-June 1, 1990, Norman, Ok, pp. 145-161.
Key words: Biodegradation, Bacteria, Groundwater, Microbiology, Microorganism, Oil Spill, Soil Pollution, Water Pollution

Green, David R. and Blair Humphrey. 1983. In situ sampling for

trace hydrocarbons. In: Proceedings of the
1983 Oil Spill Conference (prevention, behavior, control,
cleanup), February 28 March 3, San Antonio, TX.
Key words: in situ, hydrocarbons.

Green, David, Blair Humphrey, and Brian Fowler. 1983. The Use of
flow-through flourometry for tracking
dispersed oil. In: Proceedings of the 1983 Oil Spill Conference
(prevention, behavior, control, cleanup),
February 28 March 3, San Antonio, TX.
Key words: fluorometry, tracking, dispersed, oil.

Green, D.R., and D. Le Pape. 1987. Stability of hydrocarbon
samples n solid-phase extraction columns. Anal.
Chem.(United States). 59:5:699-703.
The stability of hydrocarbon samples sorbed from water onto two
types of solid phases was examined. The
two solid phases, XAD-2 macroreticular resin and octadecane
bonded on silica gel, were found to have a
preservative effect which prevented the breakdown of sorbed
hydrocarbons by bacteria. Hydrocarbons stored
on these solid phases for periods of up to 100 days in the
presence of an oleophilic bacterial population
showed no evidence of biological degradation as indicated by
changes in chromatographic pattern or
degradation of a radiolabeled hydrocarbon. In contrast,
hydrocarbons stored in water samples containing the
same bacteria showed pronounced degradation over much shorter
storage periods. The macroreticular or pore
structure of the solid phases is thought to be the mechanism by
which the extracted hydrocarbons are
preserved from bacterial attack.
Key words: alkanes, sorptive properties, decomposition,
hydrocarbons, preservation, resins-sorptive, surface
properties, polymers, preservation, silica gel, experimental
data, adsorbents, chemical reactions, data,
hydrocarbons, information, petroleum products, petrochemicals.

Greene, Capt. Thomas C. 1991. The Apex Barges spill, Galveston
Bay, July 1990. In: Proceedings of the
1991 Oil Spill Conference (prevention, behavior, control,
cleanup), March 4 7, San Diego, CA.

Greene, G.D. 1979. The Use of deflectors for deployment of oil
booms in rivers. In: Proceedings of the 1979
Oil Spill Conference (prevention, behavior, control, cleanup),
March 19 22, Los Angeles, CA.
Key words: deflectors, oil booms, rivers.

Greenfield, J.H. and R.D. Neufield. 1988. Compartmentalized one
sludge bioreactor for simultaneous
removal of phenol, thiocyanate, and ammonia. In: Proceedings of
the Conference on Biotechnology for
Degradation of Toxic Chemicals in hazardous wastes, August 1986,
Arlington, VA, pp. 316-328.
Key words: Bioreactors, Biodegradation, Industrial Wastes,
Monitoring

Of the processes available for the removal of ammonia form steel industry wastewaters, engineered biological systems are the most pragmatic. The one compartment bioreactor displays 99% removal efficiencies for phenol, thiocyanate, and ammonia when the influence concentrations for all three substrates was approximately 150 mg/L and when the reactor was operated at an actual sludge age of 43 days. When the influent substrate concentrations were raised to values > 200 mg/L/day, both ammonia and thiocayante breakthrough were experienced coupled with bulking conditions. The two compartment bioreactor displays > 99% removal efficiencies for thiocyanate, phenol, and ammonia when the reactor consisted of SCN(-) = 350 mg/L, phenol = 300 mg/L, and NH3 = 200 mg/L at an actual sludge age of 42 days. The biota in this reactor demonstrated excellent settleability characteristics. Experimental results from the three and four compartment reactors at sludge ages of 63 and 57 days respectively, exhibited similar effluent phenol and ammonia concentrations. The steady-state results from the 1-4 compartment reactors displayed > 90% removal of all three substrates in the first compartment with the remaining compartments functioning as final polishing tanks. By utilizing compartmentalized reactors, the working volume of the aeration basin can be reduced by as much as one half without a loss in efficiency.

Grenthe, B. 1987. Sorbent for Oil or Other Liquid Hydrocarbons. Universal Fibers Inc. Patent No. US 4670156, c 6/2/87, f 2/27/84, pr Swed 11/26/79 (Appl 7909748), US 7/14/81 (Appl 285105) and US 3/8/82 (Appl 355370), 7 pp.
Key words: sorbent, absorbent, cleaning, fiber, oil, oil spill, viscous oil, (p) USA, cellulose, change, chart, coast, contamination, control, crude oil, crude oil storage, data^diagram, drying, effluent control, expansion, floating, heat treatment

Grenville, David M. and Captain Jack J. Strong. 1981. OCTU, St. John's Newfoundland: a joint venture training program. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: OCTU, Newfoundland.

Greulich, R.H., and S. Vedby, S. 1990. In-situ/on-site skimming of hydrocarbons from groundwater. In: Proceedings of the Conference on in-situ and on-site remediation of contaminated soil and groundwater, April 4 1990, Lyngby (Denmark), pp. 109 132.
Key words: decontamination, Ground Water, Oil Spills, Hydrocarbons
The paper deals with oil remedy in groundwater with emphasis on free oil recovery using different pumping and separation techniques. The importance of the migration in the capillary fringe and the hydrogeological

boundaries are discussed and typical remedial procedures presented. The paper concludes with descriptions of two in situ/on site techniques using suction with product separation in tanks, and gravity or specific oil skimming scavenging in wells. (author).

Griffiths, Richard A. 1981. On the flow around spill cleanup devices. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: spill, cleanup.

Grigalunas, Thomas A. 1987. The Natural resource damage assessment model for coastal and marine environments(NRDAM/CME). In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: natural resources, damage assessment, model, coastal, marine environment, NRDAM/CME.

Grigalunas, Thomas A. and James J. Opaluch. 1993. Non-use value in natural resource damage assessments: the Nestucca oil spill. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: resource, damage, Nestucca, oil.

Grigalunas, Thomas A. 1987. The Natural resource damage assessment model for coastal and marine environments(NRDAM/CME). In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp. 541 - 546. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Natural Resource, Damage Assessment, Coastal, Marine Environments, NRDAM/CME.

Grigg, N.S. 1989. Fiscal Year 1988 Water Resources Research Inst.: Colorado State Univ, Fort Collins, CO.
49 p.
Key words: Biodegradation, Colorado, Groundwater, Monitoring, Water Pollution
The 25th annual report describes the Institute's progress in research and technology development on priority problems which confront Colorado's water managers. The FY 1988 program included the following research projects: Project 02 - Socio-economic impacts on the basin of origin of rural-to-urban water transfer; Project 03 - Biological denitrification of polluted groundwater; Project 04 - Acid mine drainage: Streambed sorption and microbial uptake of copper and cadmium; Project 05 - Enhanced Microbial reclamation of groundwater polluted with toxic organic chemicals; Project 06 - Efficient estimation of water supply augmentation needs in real-time allocation operations; Project 07 - Urban water-supply reliability: preferences of managers, elected officials and water users; Project 08 - Improved methods

for modeling conjunctive management of surface and ground water; and project 09 - Surface and groundwater pollution potential from herbicide use in Colorado agriculture. The report also describes the Institute's technology transfer program and other research funded by its state appropriation.

Grigson, Stephen and Gordon Baron. 1993. The European approach to the source identification of oil spills: a study of its specificity and reliability. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: European, identification, spills.

Grimalt, J.O., M. Grifoll, A.M. Solanas, and J Albaiges. 1991. Microbial degradation of marine evaporitic crude oils. Geochim Cosmochim Acta. 55(7):1903-1913.
Key words: Biodegradation, Crude Oil, Marine Environment, Hydrocarbon, Bacteria

Groves, M. W., M.D. Smith, and S.R. Smith. 1992. Oil Sorbent. Tryam Trading Inc.World 92/7918, p 5/14/92, f 10/29/91, pr Gr Brit 10/29/90 (Appl 9023487) (c09k-003/32) pct gaz v 1992, no 11, p 5086, 5/14/92 abstract only)
Key words: sorbent, business operation, ethylene homopolymer, fiber, film, layer, oil spill, polymer, salvaging, waste oil recovery, (p) world, cellulose, contamination, control, environmental pollution, pollution control, propene homopolymer sorption, Tryam Trading Inc., water, water pollution, wood, ecology & pollution

Groves, Mark William, Michael David Smith, and Stephen Robert. 1992. Oil sorbent for waters. Patnet No. WO 9207918_A2, 11 pp.
Key words: Fiber Absorbent, Oil Spill Removal, Petroleum

Gruener, K., R. Reuter, and H. Smid. 1992. A new sensor system for airborne measurements of maritime pollution and of hydrographic parameters. In: Proceedings of the CONCAWE - DGMK Remediation of Oil Spills Scientific Seminar, May 18 21 1992, Hamburg, Germany, Proceedings 1.2:15-29.
Key words: Biology, Control Equipment, Economic Factor, Pollution Control

Gruenfeld, Michael. 1973. Identification of oil pollutants: a review of some recent methods. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil, pollutants.

Gruenfeld, Michael and Uwe Frank. 1977. A Review of some commonly used parameters for the determination of oil pollution. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior,

control, cleanup), March 8 10, New Orleans, LA.
Key words: parameters, oil pollution.

Grund, E., B. Denecke, and R. Eichenlaub. 1992. Naphthalene degradation via salicylate and gentisate by Rhodococcus sp. Strain B4. Applied and environmental microbiology. 58(6):1874-1877.
Key words: Biodegradation, Degradation, Bacteria, Hydrocarbons
Rhodococcus sp. strain B4, isolated from a soil sample contaminated with polycyclic aromatic hydrocarbons, grows with naphthalene as the sole source of carbon and energy. Salicylate and gentisate were identified as intermediates in the catabolism of naphthalene. In contrast to the well-studied catabolic pathway encoded by the NAH7 plasmid of Pseudomonas putida, salicylate does not induce the genes of the naphthalene-degradative pathway in Rhodococcus sp. strain B4. The key enzymes of naphthalene degradation in Rhodococcus sp. strain B4 have unusual cofactor requirements.

Grundmann, R., Rehm, H.J. 1991. Biodegradation of Diesel-fuel. Use of free and immobilized mixed cultures in soils. Erdoel und Kohle, Erdgas, Petrochemie (Germany, F.R.) 44:4:0014-0058.
The biological degradation of diesel-fuel in sandy soils was studied, testing thereby the influence of various parameters on the degradation efficiency, especially the effects of an additional inoculation of the soil with microorganisms. In the treated test variants 50%-85% of the total hydrocarbons were utilized within few weeks, depending on the experimental conditions, and then up to 95% were utilized within several months.
With an additional soil inoculation the degradation efficiency increased within the first weeks of the experiments by 10%-17% and the degradation pattern of some selected n-alkanes and isoalkanes changed as well.
Key words: diesel fuels, biodegradation, alkanes, immobilized cells, inoculation, soils.

Guard, Harold E. and Andre B. Cobet. 1973. The Fate of a bunker fuel in Beach Sand. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: fuel, beach.

Gudmundsson, T. 1993. On-line numerical modeling in Danish spill contingency planning. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: on-line, modeling, Danish, spill.

Guenneberg, F. 1992. Laser-excited Fluorescence spectra of oil-emulsions. In: Proceedings of the 1st US Environ Protect Agency et al Remote sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:133-143.

Key words: Fluorescence, Oil in Water, Remote Sensing, Crude Oil, Oil Spill

Guerin, Philippe and Jacques Pichon. 1977. French oil spill policy: the recovery phase. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: French, spill, recovery.

Guerin, W.F., and S.A. Boyd. 1992. Differential bioavailability of soil-sorbed naphthalene to two bacterial species. Applied and Environmental Microbiology (United States). 58:4:1142-1152.
Prediction of the fate of hydrophobic organic contaminants in soils is complicated by the competing processes of sorption and biodegradation. To test the hypothesis that sorbed naphthalene is unavailable to degradative microorganisms, the authors developed a simple kinetic method to examine the rates and extents of naphthalene degradation in soil-free and soil-containing systems in a comparison of two bacterial species.
The method is predicated on the first-order dependence of the initial mineralization rate on the naphthalene concentration when the latter is below the Michaelis-Menten half-saturation constant (K{sub m}) for naphthalene for the organism under study. Rates and extents of mineralization were estimated by nonlinear regression analysis of data by using both a simple first-order model and a three-parameter, coupled degradation-desorption model described for the first time here. Bioavailability assays with two bacterial species (Pseudomonas putida ATCC 17484 and a gram-negative soil isolate, designated NP-Alk) gave dramatically different results. For Np-Alk, sorption limited both the rate and extent of naphthalene mineralization, in accordance with values predicted on the basis of the equilibrium aqueous-phase naphthalene concentrations. For strain 17484, both the rates and extents of naphthalene mineralization exceeded the predicted values and resulted in enhanced rates of naphthalene desorption from the soils. They conclude that there are important organism-specific properties which make generalizations regarding the bioavailability of sorbed substrates inappropriate.
Key words: Naphthalene, biological, biochemical reaction, kinetics, biodegradation.

Guerin, W.F., and G.E. Jones. 1988. Mineralization of phenanthrene by a Mycobacterium sp. Appl. Environ. Microbiol.(United States). 54:4:937-944.
A Mycobacterium sp., designated strain BG1, able to utilize the polycyclic aromatic hydrocarbon phenanthrene as the sole carbon and energy source was isolated from estuarine sediment following enrichment with the hydrocarbon. Unlike other phenanthrene degraders, this bacterium degraded phenanthrene via 1-hydroxy-2-naphthoic acid without accumulating

this or other aromatic intermediates, as shown by high-performance liquid chromatography. degradation proceeded via meta cleavage of protocatechuic acid. Different nonionic surfactants (Tween compounds) solubilized the phenanthrene to different degrees and enhanced phenanthrene utilization. The order of enhancement, however, did not correlate perfectly with increased solubility, suggesting physiological as well as physicochemical effects of the surfactants. Plasmids of approximately 21, 58, and 77 megadaltons were detected in cells grown with phenanthrene but not in those which, after growth on nutrient media, lost the phenanthrene-degrading phenotype. Given that plasmid-mediated degradations of aromatic hydrocarbons generally occur via meta cleavages, it is of interest that the addition of pyruvate, a product of meta cleavage, supported rapid mineralization of phenanthrene in broth culture; succinate, a product of ortho cleavage, supported growth but completely repressed the utilization of phenanthrene. The involvement of plasmids may have given rise to the unusual degradation pattern that was observed.
Key words: bacteria, bioderadation, phenanthrene, mineralization, aromatics, cell constituents, chemical reactions, hydrocarbons, microorganisms, surface waters, condensed aromatics, decomposition, plasmids.

Guerin, W.F., and G.E. Jones. 1989. Estuarine ecology of phenanthrene-degrading bacteria. Estuarine, Coastal and Shelf Science. 29(2):115.
Key words: Bacteria, degradation, Water Pollution

Guerin, W.F. Phenanthrene degradation by estuarine surface microlayer and bulk water microbial populations. Microbial Ecology. (1989): 17(1).
Key words: degradation, estuarine, water, Great Bay Estuary, New Hampshire, bacteria
Paired surface microlayer and bulk water samples from five sites in the Great Bay Estuary, New Hampshire, (U.S.A.), were examined with regard to numbers of bactera, 14C-phenanthrene biodegradation potentials, and organic and inorganic chemical characteristics. Microlayer samples were generally enriched in nutrients (N and P), dissolved organic matter, and culturable heterotrophic bacteria compared with their corresponding bulk waters. Microlayer samples from marina environments were also enriched in aromatic hydrocarbons, as determined by UV spectrophotometric and fluorometric analyses, and demonstrated substantial phenanthrene biodegradation activity in the assay employed. Biodegradation activity of marina bulk water samples ranged from nil to levels exceeding those exhibited by microlayer samples. No diminution of biodegradation activity was observed after filtration (1.2 .mu.m effective retention) of microlayer water, indicating that the responsible organisms were not particle-associated. Henanthrene-degrading bacteria, enumerated by counting

clearing zones in a crystalline phenanthreene overlay after colony development on a phenanthrene/toluene agar (PTA) medium, were superior to epifluorescence direct counts or standard plate counts on PTA or estuarine nutrient agar in predicting 14C-phenanthrene biodegradative activity.

Guiney, P.D., J.L. Sykora, and G. Keleti. 1987. Qualitative and quantitative analyses of petroleum hydrocarbon concentrations in a trout stream contaminated by an aviation kerosene spill. Environ. Toxicol. Chem. 6(2):105-114.
Key words: Kerosene, Oil Spills, Sediments, Fish
Kerosene-range hydrocarbons were monitored in a small central Pennsylvania stream watershed, over two years (1982 to 1984), after a pipeline leak of about 1,310 barrels of aviation kerosene. This study, part of a two-phase program, was designed to detect and quantify hydrocarbon concentrations in freshwater environmental compartments impacted by the spill. Elevated concentrations of hydrocarbons were detected in sediment samples and tissues of fish collected from two impacted bridge locations up to 14 months after the spill occurred. These two bridges were primary boom recovery sites during spill cleanup activities. Bottom sediments from pools near these sites contained approximately two to three times the corresponding hydrocarbon concentrations detected in fish tissues from the same area. This information appears to suggest that these surface sediments may have served as secondary storage sinks for residual, sinking product not recovered during the initial skimming operations. These residues were apparently available for uptake by resident fish.

Gulley, J.R., D.J. Klym. 1992. Wetland treatment of oil sands operation waste waters. In 2nd Environ Issues & Manage of Waste in Energy & Mineral Prod Int Conf (Calgary, Can, 9/1 4/92) .
Key words: disposal, oil, recovery, sand oil

Gumtz, Garth D. 1971. Froth flotation cleaning of oil contaminated beaches. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: Froth, cleaning, oil, beaches.

Gundlach, Erich R. and Geoff M. Harben. 1993. Response planning and environmental risk analysis, state of Alaska. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: response, environmental, risk, analysis, Alaska.

Gundlach, Erich R., Timothy W. Kana, and Paul D. Boehm. 1985. Modeling spilled oil partitioning in nearshore and surfzone areas. In: Proceedings of the 1985 Oil

Spill Conference (prevention, behavior,
control, cleanup), February 25 28, Los Angeles, CA.
Key words: modeling, oil, nearshore, surfzone.

Gundlach, Erich R. 1985. Resource mapping and contingency
planning, PTP pipeline facilities, Panama. In:
Proceedings of the 1985 Oil Spill Conference (prevention,
behavior, control, cleanup), February 25 28, Los
Angeles, CA.
Key words: mapping, contingency, pipeline, Panama.

Gundlach, E. R. 1991. A portable geographic information system
(gis) for spill response Planning and
response. In: Proceedings of the 14th Environ Can Arctic & Mar
Oil Spill Program Tech Seminar, June
12 14, Vancouver, Canada.
Key words: Oil Spill, Contingency Planning, Computer Programming,
Geographic Information System,
Tanker

Gundlach, E. R., and G. M. Marben. 1993. Response planning and
environmental risk analysis, state of
Alaska. In: Proceedings of the 1993 International oil spill
conference: Prevention, preparedness, response,
March 29 April 1, Tampa, FL.
Key words: Oil Spills, Alaska, Remedial Action, Tankers
Under the sponsorship of the Alaska Dept. of Environmental
Conservation (ADEC), a multitasked study was
undertaken to determine the relative risk of noncrude oil
transport (including marine and freshwater), the
status of spill response capability in the state, and the need
and most appropriate locations for siting spill
response deposits. The project used multidisciplinary transport
and environmental data analyzed in a
geographic information system (GIS) to enable various scenarios
and data changes to be easily visualized.
The evaluation concerned (a) designation of significant
environmental risk areas, (b) environmentally
sensitive areas and fish and wildlife likely to be affected, (c)
the level of response capability appropriate for
protecting the environment, (d) the adequacy of current
capabilities for noncrude vessels, (e) the feasibility of
establishing one or more response cooperatives for use by
multiple carriers, and (f) other steps that could be
taken to reduce the risk of a spill and facilitate control and
cleanup.

Gundlach, Erich R. 1987. Oil-holding capacities and removal
coefficients for different shoreline types to
computer simulate spills in coastal waters. In: Proceedings of
the 1987 Oil Spill Conference (prevention,
behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil-holding, removal, shoreine, computer, spills,
waters.

Gundlach, E. 1991. Shoreline surveys at the Exxon Valdez oil
spill: the state of Alaska response. In:

Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: shoreline, Exxon Valdez, spill.

Gundlach, Erich R., Kenneth Finkelstein, and James L. Sadd. 1981. Impact and persistence of Ixtoc I oil on the South Texas Coast. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.

Gundlach, Erich R., Serge Berne, Laurent D'Ozouville, and Jerry A. Topinka. 1981. Shoreline oil two years after Amoco Cadiz: new complications from TANIO. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: shoreline, oil, Amoco Cadiz, TANIO.

Gundlach., Erich R. 1989. Amoco Cadiz Litigation: Summary of the 1988 Court Decision. In Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989 in San Antonio, TX Year.
Key words: Amoco Cadiz, litigation

Gundlach., Bart J. Baca, Thomas E. Lankfrod, Erich R. 1987. Recovery of Brittany coastal marshes in the eight years following the Amoco Cadiz incident. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: marshes.

Gunnison, D. 1991. Evaluation of the potential use of microorganisms in the cleanup of petroleum hydrocarbon spills in soils. Unpublished final report. Vicksburg, MS: Army Engineer Waterways Experiment Station Environmental Lab. 67 pp.
Key words: Biodegradation, Groundwater, Oil Spills, Remedial Action
Soils and sediments at many military facilites have been contaminated with petroleum hydrocarbons (gasoline, lubricating oil, diesel fuel, aviation fuel), often as a consequence of spills occurring during storage and/or active use. Various elements of the military are required to clean up contamination resulting from any activity on lands under their jurisdiction. Leakage occurring in underground storage tanks near groundwater aquifers can be a particularly serious problem, resulting in contamination of groundwater. The presence of petroleum hydrocarbon contaminants in flooded soils and sediments can pose unacceptable toxic hazards to the environment. A study was undertaken to examine the feasibility of using native soil micro-flora to degrade diesel fuels, fuel oil, and motor oils within the soil matrix; to isolate and identify those environmental factors controlling the rate and extent of degradation; and to

develop procedures to optimize the rate and
extent of biodegradation achieved.

Gurevich, Yu. L., V.P. Ladygina. 1991. Effect of protozoa on
bacterial degradation of aromatic
hydrocarbons. Stud. Environ. Sci. (1991): 42:pp.147 53
Key words: bacteria, hydrocarbon, degradation

Guyenne, T. D. and J. J. Hunt. 1988. Session: marine and
oceanographic applications. In: Proceedings of the
1988 International Geoscience and Remote Sensing Symposium, Sept.
12 16, Edinburgh, UK. 3:1077-1103.
Key words: Remote Sensing, Water Pollution, Synthetic Aperture
Radar, Oil
The following topics are dealt with: Norwegian coastal current
circulation prediction; ocean wave and ships'
wake sensing; airborne bathymetric surveying; oil pollution
imaging with synthetic aperture radar; artificial
slick scatterometry; passive microwave remote sensing; SPOT data
acquisition; north-west African upwelling
filament structure and variability; and radiometric problems of
marine thematic mapping.

Haag, F., M. Reinhard, and P.L. McCarty. 1991. Degradation of
toluene and p-xylene in anaerobic
microcosms : evidence for sulfate as a terminal electron
acceptor. Environmental toxicology and chemistry.
10(11):1379-1389.
Key words: Biodegradation, Hydrocarbon

Haas, Thomas J. 1991. Cameo-Valdez: charting the progress of the
spill cleanup. In: Proceedings of the 1991
Oil Spill Conference (prevention, behavior, control, cleanup),
March 4 7, San Diego, CA.
Key words: Cameo-Valdez, spill, cleanup.

Haddock, J.D., Ferry, J.G. 1990. Anaerobic metabolism of aromatic
compounds. Bioprocessing and
biotreatment of coal. Wise, D.L. (Northeastern Univ., Boston, MA
(US). 393-416:744.
Aromatic compounds constitute a class of organic molecules that
are of major importance in the global
storage and cycling of carbon. Petroleum, peat and coal deposits,
lignin, plant phenolics, and proteins contain
a large aromatic fraction. Human activities have increased the
levels of natural and synthetic aromatic
compounds released into the environment through the exploitation
of natural resources and widespread
application of pesticides. While microbial degradation or
alteration of aromatic compounds by aerobic
microorganisms is well known and major degradative pathways have
been elucidated, anoxic degradative
pathways are poorly understood. This is partially the result of
difficulties in working with anaerobic
procedures, but also because the anaerobic metabolism of aromatic
compounds was previously thought to be
a minor degradative route in nature. It has been demonstrated

that a variety of aromatic compounds were degraded under the strictly anaerobic conditions of methanogenic fermentations. Since the first demonstration of anaerobic aromatic degradation in pure cultures, an increasing number of bacteria of diverse physiological types have been shown to degrade a wide variety of aromatic compounds. These organisms generally fall into three physiological groups: photosynthetic bacteria; anaerobic respirers, including dissimilatory sulfate and nitrate reducers; and nonrespiring anaerobes. The later group includes fermentative organisms, obligate proton-reducing acetogens, and those involved in one-carbon metabolism. This review includes studies concerning anaerobic degradation of monoaromatic compounds by mixed as well as pure cultures.
Key words: biotechnology, organic matter, anaerobic digestion, methanogenic, bacteria.

Haffner, D.J. 1992. The environmental compliance audit and its cost. In: Proceedings of the IADC/SPE Drilling Conf, Feb. 18-21, 1992, New Orleans, LA, pp. 679-687.
Key words: Disposal, Legal, Groundwater, Oil Spill, Water Pollution

Haines, J.R., A.D. Venosa, T. Herrington, M. Islam, and K. Strohmeier. 1992. Measurement of the effect of temperature on oxygen uptake. 18. annual Environmental Protection Agency (EPA) risk reduction engineering laboratory research symposium.
The effectiveness of bioremediation products intended for use on spilled petroleum or refined petroleum products must be evaluated prior to a spill occurrence. The need for development of a test protocol for product evaluation has led to initiation of work at RREL in Cincinnati. Biological degradation of petroleum hydrocarbon requires molecular oxygen as a terminal electron acceptor. The current method for testing efficacy of bioremediation products involves monitoring disappearance of oil constituents over time by gas chromatography (GC) and gas chromatography/mass spectrometry (GC-MS), both of which are tedious and expensive. Our laboratory is developing methods by which O[sub 2] consumption and CO[sub 2] production can be correlated with disappearance of oil compounds. This correlation, once established, will permit examination of bioremediation products based on O[sub 2] consumption/CO[sub 2] production with minimal chemical analysis. The goal of this work is to establish reliable methods for assaying potential effectiveness of bioremediation products under various conditions. Protocol development will encompass seawater, freshwater, sediments, beach material, and soils. Various type of crude oil or refined products will be examined as well as the effects of temperature and salinity of the efficacy of bioremediation products.
Oxygen consumption, bacterial numbers, and changes in oil chemistry will be measured over time. When data

collection is completed, the various parameters will be correlated with oil disappearance as measured by gas chromatography, and simpler, less expensive methods will be proposed as a measure of bioremediation product effectiveness. 2 figs.
Key words: biodegradation, temperature, oil spills, biodegradation, oil spills, cleaning.

Halden, K., H.A. Chase. 1991. Methanotrophs for clean-up of polluted aquifers. Water Sci Technol. 24(11):9-17.
Key words: Water Pollution, Decontamination, Biodegradation, Microorganism, Groundwater, Hydrocarbons
Several bacteria have been shown to degrade a range of chlorinated compounds in groundwater, but the most promising cultures appear to be methanotrophs, which are organisms capable of utilizing methane as the sole carbon source. Results are presented from experiments that evaluated the use of the methanotrophic culture Methylosinus trichosporium to degrade a variety of chlorinated compounds in solution. When distilled water was used for growth of the cells, a wide range of compounds was effectively degraded. However, when aquifer water was used, very few compounds were degraded. The maximum degradation rate achieved was 0.6 mmol/h per g of cells. Using trichloroethylene as the test compound, it was found that only traces of oxygen are required for chemical degradation.

Hall, P.J. 1988. Groundwater extraction and disposal program to control off-site migration of soluble petroleum hydrocarbons. 1988 DOE model conference proceedings. Volume 1. 355-366.
Key Words: New Jersey oil spills, oil spills remedial action, benzene, flow rate, geologic models, ground water, hydrology, mathematical models, alkylates aromatics, Federal Region II, hydrocarbons, hydrogen compounds, North America, organic compounds, oxygen compounds, USA.

Hall, E.S., E.L. Tollefson. 1984. Use of hard water for treatment of oil sand tailings. Aostra J Res (1984): 1
Key words: effluent control, disposal, oil, recovery, sand, petroleum, sand oil

Hall, S. M. 1988. Spills from large crude-oil-carrying transmission pipelines an analysis by cause, frequency, and consequence. Pipes Pipelines Int 33(4):15 20
Key words: Oil Spill, Pipeline

Hallberg, C.R. 1971. Should financial limitations upon liability be applied to oil spill removal and damage?.
In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: financial, limitations, liability, spill, removal, damage.

Halley, Wayne and John Latour. 1993. Enhancing Canada's spill response capability: oil spill equipment requirements for a 10,000 ton response capability. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: Canada's, spill, response.

Halmo, Gerd. 1983. Oil degradation and environmental impact of various co-disposal methods. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil, degradation, impact.

Halmo, Gerd. 1985. Enhanced biodegradation of oil. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: biodegradation, oil.

Hamdi, M., A. Brauman, and J.L. Garcia. 1992. Effect of an anaerobic bacterial consortium isolated from termites on the degradation of olive-mill waste-water. Applied Microbiology and Biotechnology (Germany).
37:3:408-410.
A microbial consortium obtained by enrichment culture on syringate of termite gut material was used to improve the anaerobic degradation of olive-mill waste-water (OMW). Addition of the consortium (1/4 v/v) to the control inoculum originating from waste-water sludge, increased methane production by 50% over the control during anaerobic digestion of OMW prefermented by Aspergillus niger. This increase was related to enhanced acetate production in the presence of the consortium. When OMW was not prefermented by A. niger, no improvement in methane production was observed, indicating that the aerobic degradation of inhibitory substances is needed for the consortium to express its potential.
Key words: methane, production, water, chemical, oxygen demand, gas yields, microorganisms, olive oil.

Hamdy, M.K. 1990. Microbial degradation of polychlorinated hydrocarbons. <Augmentation> Aspergillus, Serratia, Bacillus, Pseudomonas. Proceedings of the Society for Experimental Biology and Medicine (USA).
313.
Mutant strains of Asperqillus, Serratia, Pseudomonas, and Bacillus spp. were developed to resist polychlorinated biphenyls (PCBs) 1254. The mutant cells of Serratia and Pseudomonas spp. were not affected after 120 min exposure to 1 000 ppm PCB 1254/ml buffer, and grew well in glucose basal salt broth (GBSB) and 400 ppm PCB. Generation time of Pseudomonas in GBSB was 62 min in absence and 66 min in presence of 200 ppm PCB 1254. Maximal PCB uptake of 39.7% was

noted for Pseudomonas cultures grown in basal salt broth (72 h, 37{degree}C) and most PCB was in lipid fraction of cell walls and membranes. Bioreactor experiments using 122 L of waste (800 mg PCB 1248/L) showed that Pseudomonas and Serratia spp. degraded most of the PCB in 90 - 130 days. PCB dechlorination occurred in Pseudomonas cell walls followed by metabolism to lower chlorinated molecules, CO{sub 2}, and H{sub 2}O in the cytoplasm via oxidative pathway. Activated charcoal (AC) was used to remove PCBs from waste, and repeated hexane extractions recovered the compounds from the AC, suggesting AC adsorption as a possible means for removing low levels of PCBs from industrial waste.
Key words: aspergillus, metabolism, biodegradation, serratia, metabolism, industrial wastes, microorganisms, organic chlorine, decomposition, bacteria, chemical reactions, aromatics, removal.

Hammer, Paul M. 1971. Prevention of marine pollution through understanding. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: marine, pollution.

Hampton, D.R., R.B. Wagner, and H.G. Heuvelhorst, H.G. 1990. A new tool to measure petroleum thickness. National Water Well Association, Dublin, OH (US).1333(p):127-141.
Key Words: Ground water contamination, water pollution monitors field tests, aquifers, oil spills, petroleum, volumetric analysis, water pollution, chemical analysis, energy sources, fossil fuels, hydrogen compounds, measuring instruments, monitors, oxygen compounds, quantitative chemical analysis.

Hampton, D.R. 1991. Interactions of immiscible fluids and wells at equilibrium in glass sand tanks. Eos, Transactions, American Geophysical Union. 72(17):123.
Key Words: Pollution, ground water, experimental studies, water wells, sand, clastic sediments, soils, oil spills, physical models, fluid phase, immiscibility, systhetic materials.

Hampton, Duane R., Marian M. Smith, and Stephen J. Shank. 1991. Further laboratory studies of gravel pack design for hydrocarbon recovery wells. Ground Water Management. 8:615-629.
Key Words: Reclamation, methods, experimental studies, laboratory studies, gravel, clastic sediments, design, hydrocarbons, organic materials, recovery, water wells, pumping, gravel packs, morphology, grain size, pollution, oil spills.

Hampton, D.R., and H.G. Heuvelhorst. 1990. Designing gravel packs to improve separate-phase hydrocarbon recovery: Laboratory experiments. Proceedings of petroleum hydrocarbons and organic

chemicals in ground water: Prevention, detection, and restoration. 664(p): 195-209.
Key Words: Oil spills water pollution abatement, water wells design, water wells-well completion, bench-scale experiments, cleaning, granular bed filters, ground water, hydrocarbons, petroleum, energy sources, filters, fossil fuels, hydrogen compounds, mechanical filters, organic compounds, oxygen compounds, pollution abatement.

Hanby, J.D. 1988. A new method for the detection and measurement of aromatic compounds in water.
National Water Well Association, Dublin, OH (US). 597(p):493-504.
Key Words: Ground water contamination, ground water monitoring, petroleum industry environmental impacts, petroleum industry gas spills, polycyclic aromatic hydrocarbons concentration ratio, field tests, hazardous materials, sensitivity analysis, spectrophotometry, West Virginia, energy sources, Federal Region III, fossil fuels, hydrocarbons

Hancock, John A., and LCDR Donald Jensen. 1975. Waterbone debris in marine pollution incidents. In:
Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: waterbone, pollution.

Hann, Jr., Roy W. 1979. Unit operations, unit processes and level of resource requirements for the cleanup of the oil spill from the supertanker Amoco Cadiz. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA. American Petroleum Institute: Washington, D.C. pp. 147-162.

Hann, Jr., Roy W. and Harry N. Young, Jr. 1981. International oil spill control training program. In:
Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: spill, control, training.

Hann, Jr., Roy W. and Paul L. Malter. 1985. Special skimmer for sub-surface oil recovery. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: skimmer, sub-surface, oil.

Hann, Jr., Roy W. 1977. Fate of oil from the supertanker Metula. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil, supertanker, Metula.

Hanna, B. M., J. A. Hellebust, and T. C. Hutchinson. 1975. Field studies on the phytotoxicity of crude oil to

Subarctic aquatic vegetation. Internation. Vereinig. Theor. Angew. Limnol. Verh. 19:2165 2171.
Key words: Canada, Hydrocarbon, Crude Oil, Water Pollution.

Hannon, L.J., and E.J. Tennyson. 1991. Reactivation of the Oil and Hazardous Materials Simulated Environmental Test Tank (Ohmsett) Facility. US Minerals Manage Serv. In: Proceedings of the 7th Amer Soc Civil Eng Et Al Coastal & Ocean Manage Symp (Coastal Zone 91) (Long Beach, Calif, 7/8-12/91) proc v 3, pp 2474-2478.
Key words: hydrodynamic model, contamination, environment, environmental impact, environmental pollution, model, oil spill, storage facility, tank, water pollution, wave (water), additive, administration, barrier, book, brine, business operation, camera, Canada, cement, cleaning, communication system, concrete, control, crude oil, data acquisition

Hannon, L.J., and A.D. Lucas. 1988. Oil spill risk analysis: central and western gulf of Mexico (Proposed Lease Sales 118 and 122) outer continental shelf. Minerals Management Service, Reston, VA., Report No. OCS/MMS-88/0025, 119 pp.
Key words: Offshore Drilling, Oil Recovery, Water Pollution, Crude Oil, Natural Gas, Contingency Planning
The Federal Government has proposed to offer Outer Continental Shelf lands off the Central and Western Gulf of Mexico for oil and gas leasing. The analysis characterizes the oil-spill risk associated with Gulf of Mexico Lease Sales 118 and 122. The probabilities of oil spill occurrence and contact with land after 30 days for the Proposed Action are quite low. The highest values for the Central and Western Gulf of Mexico are 15% and 9% respectively. The Proposed Action adds very little to the overall estimated risk (probabilities ranging from less than 0.5% to 15% for 30 days).

Hansen, Warren G., David E. Ross, and John R. Sinclair. 1979. Oil spill debris disposal hardware systems: methods for conceptualization and development. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: debris, disposal, development.

Hansen, Warren G. and Peter K. McCormick. 1981. Comprehensive spill management at an oil-fired electric power plant on the Columbia River. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: spill, management, oil-fired.

Hansen, W.G., E. Clements, and E.A. Lundt. 1979. Oil spill prevention and control at naval shoreline activities. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March

19 22, Los Angeles, CA.
Key words: oil spill, prevention, shoreline.

Hanson, R.S., K. Tsuji, C. Bastien, H.C. Tsien, B. Bratina, G. Brusseau, and S. Machlin. 1990. Genetic and biochemical studies of methylotrophic bacteria. Akin, C., Smith, J. 1990. Gas, oil, and coal biotechnology I. 215-233:467.
Methylotrophic bacteria are a diverse morphological and physiological group. We hope to develop molecular methods that will enable us to identify and quantify these bacteria in a variety of samples. Some of the methods illustrated in this manuscript include comparative mapping of isofunctional C{sub 1} genes, sequence variations in genes like the methanol dehydrogenase structural gene found in all gram negative methylotrophs, methanol dehydrogenase gene restriction fragment polymorphisms and the use of phylogenetic probes based on 16S rRNA sequence information. The authors have also attempted to understand the regulation of methanol dehydrogenase synthesis in a facultative methanotroph, Methylobacterium organophilum XX. Twelve genes required for the expression of this activity have been identified in Methylobacterium organophilum XX and Methylobacterium strain AM1. The methanol dehydrogenase gene messenger RNA is relatively unstable although the gene product may represent 15% of the cellular protein. We have observed that Methylosinus trichosporium OB3B oxidized trichloroethylene (TCE) at rates exceeding 2.5 millimoles per gram cells per hour. Cells grown in semicontinuous cultures at densities of approximately 0.8 g.1{sup {minus}1} oxidized TCE. Soluble methane monooxygenase was present in all cells that oxidized TCE. Methane, at 5 to 10% of saturation, present during the degradation of TCE, stimulated the degradation of this compound.
Key words: bacteria, biochemical reaction, biodegradation, methane, genetics, hydrocarbons, methanotrophic, biochemical, kinetics, methanol.

Hanson, James R. and David M. Kochis. 1975. Oakland estuary oil spill cleanup: a review of a major oil spill cleanup in a trash laden estuary emphasizing small boat harbor cleanup. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: Oakland, estuary, oil, cleanup.

Harayama, S., and K.N. Timmis. 1992. Aerobic biodegradation of aromatic hydrocarbons by bacteria: degradation of environmental pollutants by microorganisms and their metalloenzymes. Geneva, Switzerland. Metal ions in biological systems. 28: 99-156.
Key words: aromatic, compound, hydrocarbon, biodegradation, bacteria, aerobiosis, catabolism, enzyme, regulation(control), gene organization, pollutant, review.

Harder, H., and Th. Hopner. 1991. Hydrocarbon biodegradation in sediments and soils: a systematic examination of physical and chemical conditions part 5 moisture. Erdol und Kohle, Erdgas, Petrochemie: Hydrocarbon Technology. 44:329 332.

Harder, H., B. Kurzel-Seidel, and Th. Hopner. 1991. Hydrocarbon biodegradation in sediments and soils: a systematic examination of physical and chemical conditions IV. special aspects of nutrient demand. (Science & Technology). Erdol und Kohle, Erdgas, Petrochemie: Hydrocarbon Technology. 44:59 62.
Key words: oil, petroleum, hydrocatbon, biodegradation, soil

Hardin, B.J. 1989. Process and apparatus for purifying oil contaminated ground water. Patent No. US 4830755890516, 6p.
Key words: Filtration, Groundwater, Pollution Control, Water Pollution, Monitoring, Oil Spill, Waste Oil Recovery

Harding, R., S. Czarnecki, J. Isbister, and S. Barik. 1993. Biogasification of low-rank coal. Electric Power Research Inst., Palo Alto, CA (United States). ARCTECH, Inc., Chantilly, VA (United States). 103.
ARCTECH is developing a coal biogasification technology, the MicGAS Process' for producing clean fuel forms such as methane. The overall objective of this research project was to characterize and construct an efficient coal gasifying capable of converting Texas lignite to methane. The technical feasibility for bioconversion of Texas lignite to methane, volatile fatty acids, alcohols, and other soluble organic products has been demonstrated. Several biogasification were evaluated for their ability to degrade low-rank coals to methane, and Mic-1 a mixed culture derived from a wood-eating-Zootermopsis termite species, was identified as the most active and efficient for biogasification of Texas lignite. Parameters such as pH, temperature, redox potential, coal particle size, coal solids loadings, culture age, nutrient amendments, and biomass concentration were studied to determine the optimum conditions required for efficient biogasification of coal. Analytical methods for monitoring the production of methane, degradation intermediates, and biomass were developed. Most significant achievements were: (1) development of analytical methodology to monitor coal biogasification; (2) confirmation of biogasification efficiency of Mic-1 culture; (3) ability of Mic-1 consortium to retain coal-degrading activity when grown in the absence of coal; and (4) significantly higher (ca. 26%) methane production from micronized coal (ca. 10 gm) than from larger coal particle sizes.
Key words: coal, bioconversion, coal gasification, biotechnology, alcohols, biotechnology.

Hardison, P.M. 1990. Emergency chemical/oil spill curtain for tankers. In: Proceedings of the API 1990 Alternative Tank Vessel Design Forum, June 5 1990, Washington, D.C., Proceedings N.23, 4 pp.
Key words: Air Polllution, Biology, Boom, Bulk, Oil Waste, Pollution Control, Storage

Hardman, David J. 1991. Microbial pollution control: a technology in its infancy. Chemistry and Industry. pp. 244 246.
Key words: oil spills, biotechnology

Harker, A.R., and Y. Kim. 1990. Trichloroethylene degradation by two independent aromatic-degrading pathways in alcaligenes eutrophus JMP134. Applied and Environmental Microbiology (USA). 56:4:1179-1181.
The bacterium Alcaligenes eutrophus JMP134(pJP4) degrades trichloroethylene (TCE) by a chromosomal phenol-dependent pathway and by the plasmid-encoded 2,4-dichlorophenoxyacetic acid pathway. The two pathways were independent and exhibited different rates of removal and capacities for quantity of TCE removed. The phenol-dependent pathway was more rapid (0.2 versus 0.06 nmol of TCE removed per min per mg of protein) and consumed all detectable TCE. The 2,4-dichlorophenoxyacetic acid-dependent pathway removed 40 to 60% of detectable TCE.
Key words: bacteria, metabolism, chlorinated alkaline, biodegradation, biological pathways, pollutants, removal, water pollution.

Harper, John D. 1969. Oil soaked straw harvesting techniques. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: oil, straw, harvesting.

Harper, J.R., D.E. Howes, and P.D. Reimer. 1991. Shore-Zone mapping system for use in sensitivity mapping and shoreline countermeasures. In: Proceedings of the 14th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 12 14 1991, Vancouver, Canada, pp. 509 523.
Key words: Topographic mapping, Contingency Planning, Oil Spill, Economic Factor, Remote Sensing

Harper, John D. 1971. The State's role in oil spill cleanup. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: state's role, oil, cleanup.

Harrald, Lt. Cdr. J.R., Lt. C.M. Stone, and K.R. Karwan. 1977. Prevention of pollution during oil transfer operations: an evaluation of USCG preventive actions. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New

Orleans, LA.
Key words: prevention, pollution, oil, transfer, USCG.

Harrald, Commander John R. and Lieutenant Steve M. Conway. 1981. The Use of decision support aids in the development of an action-oriented contingency plan. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: support, development, contingency.

Harris, C. Federal policies governing used (lubricating) oil: Clear thinking from Washington or EPA's mission impossible? In NPRA 1991 Annual Meeting (San Antonio 3/17 19/91). in Year.
Key words: environment, legal considerations, oils, reclamation, used oil

Harrison, O.R. 1991. An Overview of the Exxon Valdez oil spill. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: overview, Exxon Valdez, spill.

Harrison, P. I. 1991. Harnessing operational experience and learning the lessons; the value of confidential incident reporting schemes. In: Proceedings of the 11th Annu Safety & Rel Soc et al. Symp, Sept. 18-19, Sutton Coldfield, ENGL. Pp. 42-56.
Key words: Oil Spills, Company Report, Safety

Hart, Cdr. Tony E. 1987. Planning for the use of dispersants. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: dispersants.

Hartley, F. 1984.. Operating problems continue at union oil co. (of California's) shale-processing plant. Chemical Engineering (1984): 91
Key words: oil shale, Colorado, industrial plant

Hartley, J.P. and J. Ferbache. 1983. Biological monitoring of the forties oilfield (North Sea). In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: biological, monitoring, North Sea.

Hartmans, S., M.J. Van Der Werf, and J.A.M. De Bont. 1990. Bacterial degradation of styrene involving a novel flavin adenine dinucleotide-dependent styrene monooxygenase. Applied and Environmental Microbiology (USA). 56:5:1347-1351.
By using styrene as the sole source of carbon and energy in concentrations of 10 to 500 {mu}M, 14 strains of aerobic bacteria and two strains of fungi were isolated from various soil and water samples. In cell extracts of

11 of the bacterial isolates, a novel flavin adenine dinucleotide-requiring styrene monooxygenase activity that oxidized styrene oxide (phenyl oxirane) was detected. In one bacterial strain (S5), styrene metabolism was studied in more detail. In addition to styrene monooxygenase, cell extracts from strain S5 contained styrene oxide isomerase and phenylacetaldehyde dehydrogenase activities. A pathway for styrene degradation via styrene oxide and phenylacetaldehyde to phenylacetic acid is proposed.
Key words: bacteria, metabolism, biodegradation, enzyme activity, hydrocarbons, microorganisms, oxireductases.

Harvey, Andrew C. and Vijay K. Stokes. 1973. Evaluation of a unique centrifuge for separation of oil from ship discharge water. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, Washington, D.C. American Petroleum Institute: Washington, D.C. pp. 391 - 402.
Key words: evaluation, separtation, oil, ship, discharge.

Harvie, Will. 1990. Brian Bullock's space trek. (Intera Information Technologies Corp.) (company profile). Alberta Business. 7:10 14.

Harwood, C.S., R.E. Parales, and M. Dispensa. 1990. Chemotaxis of Pseudomonas putida toward chlorinated benzoates. Applied and Environmental Microbiology (USA). 56:5:1501-1503.
The chlorinated aromatic acids 3-chlorobenzoate and 4-chlorobenzoate are chemoattractants for Pseudomonas putida PRS2000. These compounds are detected by a chromosomally encoded chemotactic response to benzoate which is inducible by {beta}-ketoadipate, and intermediate of benzoate catabolism. Plasmid pAC27, encoding enzymes for 3-chlorobenzoate degradation, does not appear to carry genes for chemotaxis toward chlorinated compounds.
Key words: chlorinated aromatic hydrocarbons, physiology, biological, micororganism, organic chlorine compounds, pseudomonas, behavior.

Hasan, M.N., and M.Y. Ismail. 1988. An environmental impact assessment ((EIA)-the first in Malaysia) of the Dulang oilfield development project. In: Proceedings of the 7th SPE (Soc. Pet. Eng.) - South East Asia Pet. Explor. Soc. - Soc. Nav. Archit. Mar. Eng. Offshore South East Asia Conf., February 2 5 1988, Singapore, Proc. N.OSEA 88190, pp. 784 96.
Key words: Accident, Blowout, Boom, Crude Oil

Haubold, Samuel A. 1981. Contingency planning for oil spill litigation. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: contingency, planning, oil, spill, litigation.

Havel, J., and W. Reineke. 1993. Microbial degradation of chlorinated acetophenones. Applied and Environmental Microbiology (United States). 59:8:0099-2240.
Chlorinated acetophenones can originate from several sources: insecticides and as by-products of degradation of chlorosubstituted xanthones, PCPs, ethylbenzene, and styrene. This paper describes the isolation and characterization of a mixed culture which mineralizes 4-chloroacetophenone. Arthrobacter sp., found in the mixed culture, was found to utilize 4-chloroacetophenone for growth and was able to mineralize a broad spectrum of chlorinated acetophenones. 29 refs., 6 figs. 2 tabs.
Key words: acetophenone, biodegradation, bacteria, insecticides, styrene, alkylated, aromatics, chemical reactions, decomposition, hydrocarbons, ketones, microorganisms.

Hawkes, J.A. 1990. Insurance trends in the 1990s. In: Proceedings of the API 1990 Tanker Conference, June 10 13 1990, Pebble Beach, CA, 9 pp.
Key words: API, Bulk Carrier, Cost, Crude Oil, Economic Factor, Pollution Control

Haxby, L.P. 1969. Industry research and response plans. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: research, response.

Hay, Keith G. 1975. The Status of oiled wildlife: research and planning. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oiled, wildlife.

Hayase, N., Kazunar Taira, and Kensuke Furukawa. 1990. Pseudomonas putida KF715 bphABCD operon encoding biphenyl and polychlorinated biphenyl degradation: Cloning, analysis, and expression in soil bacteria. Journal of Bacteriology (USA). 172:2:1160-1164.
The authors cloned the entire bphABCD genes encoding degradation of biphenyl and polychlorinated biphenyls to benzoate and chlorobenzoates from the chromosomal DNA of Pseudomonas putida KF715. The nucleotide sequence revealed two open reading frames corresponding to the bphC gene encoding 2,3-dihydroxybiphenyl dioxygenase and the bphD gene encoding 2-hydroxy-6-oxo-6-phenylhexa-2,4-dienoic acid (ring-meta-cleavage compound) hydrolase.
Key words: chlorinated aromatic hydrocarbons, biodegradation, hydrolases, genes, soils, oxygenases, enzymes.

Hayes, Terence M. 1985. The Tanker Assimi: a case history. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: tanker, Assimi.

Hayes, T.M. 1977. Sinking of tanker St. Peter off Colombia. In: Proceedings of the 1977 Oil Spill
Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: sinking, tanker, St. Peter, Columbia.

Hayes, J.W. 1991. Oil spill planning and preparedness for pipelines: An IPL ((Interprovincial Pipe Line Co)) perspective. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control,
Cleanup Conference, March 4 7 1991, San Diego, CA, (Condensation) API Publication N.4529, pp. 707 8.
Key words: API, Boom, Business Operation, Crude Oil, Oil Waste

Hayes, M.O., J. Michel, and D.C. Noe. 1991. Factors controlling initial deposition and long-term fate of
spilled oil on gravel beaches. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control,
cleanup), March 4 7, San Diego, CA.
Key words: deposition, oil, gravel, beaches.

Hayes, Terence M. and Bin Okamura. 1983. The International Maritime Organization Training Program in
oil spill prevention, control, and response for developing countries. In: Proceedings of the 1983 Oil Spill
Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: International, maritime, training, oil spill, prevention.

Hayes, Miles O., Erich R. Gundlach, and L. D'Ozouville. 1979. Role of dynamic coastal processes in the
impact and dispersal of the Amoco Cadiz oil spill (March, 1978) Brittany, France. In: Proceedings of the
1979 Oil Spill Conference (prevention, behavior, control,
cleanup), March 19 22, Los Angeles, CA.
Key words: coastal, impact, dispersal, Amoco Cadiz, oil, spill.

Hayes, M.O. 1993. Distribution of oil from the Gulf War spill within intertidal habitats: one year later. In:
Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1,
Tampa, Fl.
Key words: Gulf, spill, intertidal, habitats.

Hayes, M.O., R. Hoff, J. Michel, D. Scholz, G. Shigenaka. 1992. Introduction to Coastal Habitats and
Biological Resources for Oil Spill Response. Report No. HMRAD-92-4, 382 pp.
Key words: Marine Biology, Hazardous Materials, Toxicity, Oil Pollution, Environmental Impacts
The report discusses the physical, geological, and biological considerations relevant to oil behavior and oil
spill response and cleanup. The intent is to contribute to an informed and effective oil spill response in coastal
waters.

Haynes, C.D. How to produce shallow, high WOR (Water-Oil Ratio), heavy crude. Petrol Eng Int (1984): 56
Key words: oil recovery, oil disposal, recovery

Hazardous Waste Management Systems: Identification and Listing of Hazardous Waste; CERCLA
Hazardous Substance Designation-Petroleum Refinery Primary and Secondary Oil/Water/Solids Separation
Sludge Listings (F037 and F038). 55:213.
The Environmental Protection Agency (EPA) is today promulgating regulations under the Resource
Conservation and Recovery Act (RCRA) to add two wastes to the list of hazardous wastes under 40 CFR
261.31. These wastes, designated F037 and F038, are generated in the separation of oil/water/solids from
petroleum refinery process wastewaters and oily cooling wastewaters. $EPA is also amending Appendix VII
of 40 CFR 261 to add the organic and inorganic constituents for which these wastes are listed. In addition,
EPA is adding these wastes to the list of hazardous substances under the Comprehensive Environmental
Response, Compensation, and Liability Act (CERCLA) and setting their reportable quantities at the statutory
level of one pound. $EPA is taking this action because these wastes, when improperly treated, stored,
transported, disposed of, or otherwise managed, are potentially capable of posing a substantial hazard to
human health or the environment. Today's rulemaking will extend RCRA and CERCLA coverage to all
oil/water/solids separation sludges and floats generated from wastewaters from petroleum refineries
regardless of the type of device used to separate the wastes from the process wastewaters and oily cooling
wastewaters and regardless of where treatment takes place. $The effect of listing these wastes will be to
subject them to the hazardous waste regulations of 40 CFR 124, 262 through 266, 270, and 271 of this
Chapter; the notification requirements of section 3010 under RCRA; and the notification requirements of
section 103 under CERCLA.

Haztech Canada. 1987. Haztech Canada: Dangerous goods and hazardous waste management conference
proceedings. In: Proceedings of the Haztech Canada: dangerous goods and hazardous waste management
conference, May 12 14 1987, 536 pp.
Key words: Hazardous Materials Meetings, Oil Spills, Waste Management
This conference was called to provide a forum for discussion of safety problems associated with hazardous
materials, the management of emergencies, the monitoring and remediation of hazardous materials spills,
public opinion, insurance and legal aspects. It also dealt with the biological and chemical degradation of
hazardous materials, their chemical analysis in soil, air and water, the decommissioning of industrial plants,

and the reclamation of contaminated soil, ground water and river beds. Separate abstracts have been prepared for 6 papers.

Haztech Canada. Haztech Canada Toronto '89: Environmental control/hazardous waste management conference proceedings. In: Proceedings of the Haztech Canada Toronto '89: environmental control/hazardous waste management conference, May 16 18 1989, Mississauga, 494 pp.
Key words: Emergency Plan Meetings, Hazardous Materials, Waste Management, Oil Spills, Biodegradation
This volume concerns the transport and storage of hazardous wastes, the clean-up of hazardous material spills (including biodegradation), the investigation of hazardous waste sites, the chemical analysis of hazardous substances, the decommissioning of industrial plants, and toxicology. It also discusses the low-level radioactive waste program of Atomic Energy of Canada Limited, the appropriate response to emergency situations, and the informing of the public. Separea abstracts have been prepared for 4 papers from this conference.

Heath, Leon W. 1991. An unique application of a ground water restoration technique during emergency response activities. Abstracts with Programs - Geological Society of America. 23(3):18.
Key Words: Reclamation, natural resources, ground water, environmental geology, techniques, hydrocarbons, organic materials, Mississippi River, pollution, oil spills, environment.

Hedfield, Ellen J. 1989. Oil spill prevention, control and countermeasures for naval shore activities. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil, spill, prevention, shore.

Hegberg, B.A., W.H. Hallenbeck, G.R. Brenniman. 1991. Used-oil management in Illinois. Illinois Univ., Chicago, IL (United States). Center for Solid Waste Management and Research. Sponsored by Illinois Dept. of Energy and Natural Resources, Springfield. Office of Solid Waste and Renewable Resources Report. July 1991.
Keywords: oil, disposal, recovery, Illinois, recycling.
The purpose of the report is to identify the issues surrounding used oil disposal and reuse. The discussion includes lack of government regulation at some levels, too much regulation at other levels, liability of municipalities in used oil disposal, the potentially hazardous (waste) nature of used oil, and the generation of used oil in Illinois. In addition, mechanisms which will increase used oil collection are reviewed: government regulations, mandatory used oil recycling, recovery of oil from

waste oil filters, appropriate levels of permitting for municipal used oil collection facilities, industrial minimization and recycling, government and company involvement, public education, and consumer collection programs. Finally, existing and proposed federal regulations, and Illinois siting requirements are reviewed.

Heinrichs, R., and L.I. Cooper. 1990. (Environmental) law. Research Journal of the Water Pollution Control Federation (Annual Review Issue) 62(4):320-38.
Key words: Acid Rain, Air Quality, Alaska, Crude Oil, Economic Factor, Legal Consideration

Heitkamp, M.A., J.P. Freeman, D.W. Miller, C.E. Cerniglia. 1988. Pyrene degradation by a Mycobacterium sp.: Identification of ring oxidation and ring fission products. Applied and Environmental Microbiology (USA). 54:10:2556-2565.
The degradation of pyrene, a polycyclic aromatic hydrocarbon containing four aromatic rings, by pure cultures of a Mycobacterium sp. was studied. Over 60% of ({sup 14}C)pyrene was mineralized to CO{sub 2} after 96 h of incubation at 24{degree}C. High-pressure liquid chromatography analyses showed the presence of one major and at least six other metabolites that accounted for 95% of the total organic-extractable {sup 14}C-labeled residues. Analyses by UV, infrared, mass, and nuclear magnetic resonance spectrometry and gas chromatography identified both pyrene cis- and trans-4,5-dihydrodiols and pyrenol as initial microbial ring-oxidation products of pyrene. The major metabolite, 4-phenanthroic acid, and 4-hydroxyperinaphthenone and cinnamic and phthalic acids were identified as ring fission products. {sup 18}O{sub 2} studies showed that the formation of cis- and trans-4,5-dihydrodiols were catalyzed by dioxygenase and monooxygenase enzymes, respectively. This is the first report of the chemical pathway for the microbial catabolism of pyrene.
Key words: mycobacterium, pyrene, carbon dioxide, enzyme activity, oxidation, tracer techniques, carbon compounds, aromatics, oxygenases, biological pathways, carbon 14 compounds, bacteria.

Heitkamp, M.A. 1991. Biodegradation of 1-nitropyrene. Archives of Microbiology (Berlin). (1991): 156.
Key words: degradation, bacterium, hydrocarbons
Both the rate and extent of degradation of the ubiquitous environmental pollutant 1-nitropyrene by Mycobacterium sp. were studied. This bacterium proved to be promising for the removal of 1-nitropyrene and other nitropolycyclic aromatic hydrocarbons from contaminated sediments.

Heitkamp, M.A., J.P. Freeman, and C.E. Cerniglia. 1987. Naphthalene biodegradation in environmental

microcosms: estimates of degradation rates and characterization of metabolites. Appl. Environ. Microbiol.(United States). 53:1:129-136.
Naphthalene biodegradation was investigated in microcosms containing sediment and water collected from three ecosystems which varied in past exposure to anthropogenic and petrogenic chemicals. Mineralization half-lives for naphthalene in microcosms ranged from 2.4 weeks in sediment chronically exposed to petroleum hydrocarbons to 4.4 weeks in sediment from a pristine environment. Microbiological analysis of sediments indicated that hydrocarbon-utilizing microbial populations also varied among ecosystems and were 5 to 12 times greater in sediment after chronic petrogenic chemical exposure than in sediment from an uncontaminated ecosystem. Sediment from an ecosystem exposed to agricultural chemicals had a mineralization half-life of 3.2 weeks for naphthalene and showed about a 30-fold increase in heterotrophic bacterial populations in comparison to uncontaminated sediments, but only a 2- to 3-fold increase in hydrocarbon-degrading bacteria. Analysis of organic solvent-extractable residues from the microcosms by high-pressure liquid chromatography detected polar metabolites which accounted for 1 to 3% of the total radioactivity. Purification of these residues by thin-layer chromatography and further analysis by gas chromatography-mass spectrometry indicated that cis-1,2-dihydroxy-1,2-dihydronaphthalene, 1-naphthol, salicylic acid, and catechol were metabolites of naphthalene.
Key words: aquatic ecosystems, biological models, biodegadation, mineralization, gas chromatography, contamination, biological pathways, labelled compounds, mass spectroscopy, microcosms, sediments, tracer techniques, aromatics, chemical reactions, petroleum.

Heitkamp, Michael A., Wirt Franklin, and Carl E. Cerniglia. 1988. Microbial metabolism of polycyclic aromatic hydrocarbons: isolation and characterization of a pyrene-degrading bacterium. Applied and Environmental Microbiology. 54(10):2549.
Key words: Microbiology, Bacteria, Degradation

Heitkamp, M.A., and C.E. Cerniglia. 1990. Polycyclic aromatic hydrocarbon degradation by a mycobacterium sp. in microcosms containing sediment and water from a pristine ecosystem. Appl Environ Microbiol. 55(8):1968-1973.
Key words: Biodegradation, Bacteria, Hydrocarbon, Soil Pollution, Water Pollution

Heitzer, A., J.E. Thonnard, G.S. Sayler, and O.F. Webb. 1992. Specific and quantitative assessment of naphthalene and salicylate bioavailability by using a bioluminescent catabolic reporter bacterium. Applied and Environmental Microbiology (United States). 58:6:0099-2240.
A bioassay was developed and standardized for the rapid,

specific, and quantitative assessment of
naphthalene and salicylate bioavailability by use of
bioluminescence monitoring of catabolic gene expression.
The bioluminescent reporter strain Pseudomonas fluorescens HK44,
which carries a transcriptional
nahG-luxCDABE fusion for naphthalene and salicylate catabolism,
was used. The physiological state of the
reporter cultures as well as the intrinsic regulatory properties
of the naphthalene degradation operon must be
taken into account to obtain a high specificity at low target
substrate concentrations. Experiments have shown
that the use of exponentially growing reporter cultures has
advantages over the use of carbon-starved, resting
cultures. In aqueous solutions for both substrates, naphthalene
and salicylate, linear relationships between
initial substrate concentration an bioluminescence response were
found over concentration ranges of 1 to 2
orders of magnitude. Naphthalene could be detected at a
concentration of 45 ppb. Studies conducted under
defined conditions with extracts and slurries of experimentally
contaminated sterile soils and identical
uncontaminated soil controls demonstrated that this method can be
used for specific and quantitative
estimations of target pollutant presence and bioavailability in
soil extracts and for specific and qualitative
estimations of napthalene in soil slurries.
Key words: Naphthalene, catabolism, pseudomonas, growth,
salicylic acid, catabolism.

Heitzer, A., P.M. DiGrazia, and G.S. Sayler. 1991. Bioluminescent
reporters for catabolic gene expression
and pollutant bioavailability. Oak Ridge National Lab., TN
(United States) 11.
The application of visualized catabolic nah-gene expression using
a luxCDABE gene fusion provides a
valuable method to measure quantitatively and specifically
naphthalene and salicylate bioavailability. It has
been demonstrated that the physiological state of the test
culture together with the intrinsic regulation
mechanisms of the naphthalene degradation pathway as well as the
physiological aspects of the lux gene
fusion have to be taken into account. The method presented
provides a high potential for in situ bioprocess
monitoring. In addition, the results obtained with immobilized
cells provide a basis for the development of
biosensors for environmental applications in specific pollutant
monitoring in waste streams and soil slurry
systems but, as a general method, also for more conventional
biotechnological process control. 8 refs., 2 figs.,
1 tab.
Key words: catabolism, gene regulation, monitoring, Naphthalene,
biological availibility.

Helgeson, H.C., A.M. Knox, C.E. Owens, and E.L. Shock. 1993.
Petroleum, oil field waters, and authigenic
mineral assemblages: are they in metastable equilibrium in
hydrocarbon reservoirs? Geochimica et

Cosmochimica Acta. 57(14):3295-3339.
Key words: Soil Remediation, Bioremediation, Gas Plant, Degradation
Although the presence of carboxylic acids and carboxylate anions in oil field waters is commonly attributed to the thermal maturation of kerogen or bacterial degradation of hydrocarbons during water- washing of petroleum in relatively shallow reservoirs, they may have also been produced in deeper reservoirs by the hydrolysis of hydrocarbons in petroleum at the oil-water interface. To test this hypothesis, calculations were carried out to determine the distribution of species with the minimum Gibbs free energy in overpressured oil field waters in the Texas Gulf Coast assuming metastable equilibrium among calcite, albite, and a representative spectrum of organic and inorganic aqueous species at reservoir temperatures and pressures.
The observations strongly support the hypothesis that homogeneous equilibrium obtains among carboxylate and carbonate species in oil field waters. The calculations also indicate that Ca SUP 2+ , H SUP + , CO SUB 2 , CH SUB 3 COOH, CH SUB 3 COO SUP - , and other aqueous species in oil field waters may be in metastable equilibrium at the oil-water interface with hydrocarbons other than the light paraffins in crude oil, as well as with calcite and other minerals in hydrocarbon reservoirs. It appears that irreversible production of carbonic acid during the hydrolytic disproportionation of the light paraffins in petroleum at the oil-water interface may drive much of the diagenetic process in such basins by lowering the pH of the oil field waters. -from Authors

Hellebust, J.A. 1975. Experimental crude oil spills on a small Subarctic Lake in the Mackenzie Valley, N.W.T.: effects on phytoplankton, periphyton, and attached aquatic vegetation. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: experimental, oil spills, lake, phytoplankton, periphyton, vegetation.

Heller, A. 1993. Application of photocatalytic hollow glass microbeads in the cleanup of oil spills. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: photocatalytic, glass, microbeads, cleanup, oil.

Heller, A., and J.R. Brock. Photoassisted Oxidation of Oil Films on Water. US Doe rep no doe/er/12101-1 (de91000982) Oct 1990 (1 microfiche with 5 pp) 1990.
Key words: oxidation reaction, absorber, alternate energy, catalyst, chemical process, chemical reaction, oil spill, oxide, power, separation equipment, solar energy, titanium oxide, absorbent, absorption, absorption process, adsorbent, adsorption, air, area,

bubble, catalysis, chemistry, cleani ng, contamination, control, crude oil

Helweg, Otto J. September 1992. Migration of spilled oil from ruptured underground crude oil pipelines in the Memphis area. Proc Lifeline Earthquake Eng Cent East US. Publ by ASCE, New York, NY, USA.
140-152.
Key Words: Oil spills, aquifers, groundwater pollution, petroleum pipelines, finite element method, mathematical models, porous materials.

Hemmen, G.H. 1973. Prevention is best. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: prevention.

Henager, C.H. 1971. Study of equipment and methods for removing or dispersing oil from open waters. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: equipment, methods.

Henderson, Thomas. 1989. Assessment of risk to ground water quality from petroleum product spills. Natl.
Water Well. Assoc., Dublin, OH, United States. 321-331.
Key Words: Ground water, California, surveys, environmental geology, reclamation, Pacific Coast, Western U.S., United States, water quality, hydrocarbons, organic materials, oil spills, simulation, xylene, aromatic hydrocarbons, Southern California, soils, water table, unsaturated zone, rates, permeability, organic carbon, biodegradation, aquifers.

Hendrick, Martha S. and Cdr. Thomas R. Reilly. 1993. Evolution of the U. S. Coast Guard's oil identification system. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: Coast Guard, oil, identification.

Henry, Jr., Charles B. and Edward B. Overton. 1993. Chemical composition and source fingerprinting of depositional oil from the Kuwait oil fires. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: chemical, fingerprinting, deposition, oil, Kuwait, oil, fires.

Henrysson, T., and P.L. McCarty. 1993. Influence of the endogenous storage lipid poly-[beta]-hydroxybutyrate on the reducing power availability during cometabolism of trichloroethylene and naphthalene by resting methanotrophic mixed cultures. Applied and Environmental Microbiology (United States).
59:5:1602:1606.
Trichloroethylene (TCE) is one of the most frequently detected

toxic contaminants in ground water. TCE degradation by methanotrophs is a cometabolic process in which methane, but not TCE, is used as the primary substrate for energy and cell carbon. Developing a bioreactor in which cells can degrade TCE without competition is of interest in in-situ treatments. This study determines what relationship might exist between the poly-[beta]-hydroxybutyrate (PHB) content in methanotrophic cells and their naphthalene oxidation rates. In addition, the relationship between TCE transformation rate and capacity and PHB content is examined. Finally, the possibilities for manipulation of the PHB content are examined, as is the effect of PHB on the observed decrease in methane monooxygenase activity with resting aerobic cells. 30 refs., 4 figs., 3 tabs.
Key words: biodegradation, biological pathways.

Hepworth, M.T., W. Reindl, H. Han, and G. Fell. 1992. Rubber tires, a potentially effective sorbent for oil spills. The Journal of Resource Management and Technology. Vol. 20, No. 2 (June) p. 88
Key words: recycling, tire, rubber, sorbent, oil spill

Herbert, C. 1987.Oil Spill Boom. Australian Offic Journal. 1(46):7853.

Herkenberg, W. Thin Flexible Sheet Sorption Material for the Removal of Oil from Oil Spills. World 91/8347, p 6/13/91, f 12/5/90, pr US 12/6/89 (Appl 446761) (E02b-015/04) pct gaz v 1991, no 13, p 5234, 6/13/91.
Key words: pollution control equipmnt, control, ethylene homopolymer, oil spill, pollution control, polymer, sheet, sorbent, (p) world, aperture, bubble, capacity, chart, coast, containment, contamination, diagram, environmental pollution, film, flexibility, layer, lipophilic, mechanical property, physical property, sea, sea water, surface property, water, water pollution, wettability, ecology & pollution

Herman, J.S., W.R. Kelly, A.L. Mills, and G.M. Hornberger. 1992. Modeling geochemical reactions in contaminated aquifers: Transformation of aromatic hydrocarbons by bacteria and concomitant inorganic chemical evolution. Geological Society of America, Abstracts with Programs. 24:7:A127.
The physical environment of groundwater flow and contaminant transport, the chemical environment of contaminant-water-rock interactions, and the biological environment of microbially mediated processes act to influence the fate of groundwater contaminants in a complex and interconnected way. Prediction of the chemical evolution of groundwater in the complex environment of a contaminated aquifer is necessary to address environmental contamination and remediation problems. The authors current experimental work is focused on identifying the stoichiometry and rate of geochemical

reactions that result from microbially
mediated degradation of contaminant aromatic hydrocarbons. In
small-scale, steady-state, flow-through
column experiments, BTX biodegradation and concomitant O[sub 2]
and NO[sub 3] consumption and
CO[sub 2] and H[sup +] production rates were measured. The carbon
balance includes mineralization to
inorganic carbon, generation of intermediate organic compounds,
and growth of bacterial cells. Kinetic
parameters for BTX degradation were determined by fitting data to
a substrate-saturation rate law. An
existing reaction-path code, EQ3/6, was modified to allow
irreversible multi-step biodegradation reactions.
Generation and persistence of intermediate compounds can be
followed over longer times than were possible
experimentally. Geochemically, the evolution of groundwater redox
status as BTX degrades and the resulting
reductive dissolution of iron oxyhydroxides can be predicted.
Simulations of calcite dissolution driven by
CO[sub 2] production have also been made. Calcite dissolution has
been experimentally demonstrated; their
experiments have not yet shown iron solubilization, possibly
because of kinetic restriction. Their work to
quantitatively link biological and chemical reactions in a
predictive model establishes a basis for quantifying
more complex mass-transport reactions in the hydrogeological
environment.
Key words: aquifers, geochemistry, benzene, biodegradation,
ground water, geochemistry, toluene.

Hermann, M., J.-P. Vandecasteele, and D. Ballerini. 1992.
Anaerobic microflora of oil reservoirs.
Microbiological characterization of samples from some production
wells. In: Vially, R. (ed.) Bacterial gas.
Proc. conference, Milan, 1989, pp. 223-233.
Key words: Hydrocarbon, Oil, Bacteria
An assessment of the existence and nature of the anaerobic
microflora of oil reservoirs was carried out in
samples obtained from oil-producing wells covering a wide range
of conditions of temperature (35 to 100
degreesC) and salinity (1 to 170 g.l SUP 1 total salts). The
general approach and the main characteristics of
the bacterial communities observed are presented. The
significance of the results is discussed. In particular,
the possibility of the occurrence a syntrophic association in
which sulfate reducing bacteria would supply
hydrogen to methanogens through fermentative degradation of
organic compounds is considered. -from
Authors.

Hernandez, B.S., F.K. Higson, R. Kondrat, D.D. Focht. 1991.
Metabolism of and inhibition by
chlorobenzoates in Pseudomonas putida P111. Applied and
Environmental Microbiology (United States).
57:11:0099-2240.
Pseudomonas putida P111 was isolated by enrichment culture on
2,5-dichlorobenzoate and was also able to

grow on 2-chloro-, 3-chloro-, 4-chloro-, 2,3-dichloro-, 2,4-dichloro-, and 2,3,5-trichlorobenzoates. However, 3,5-dichlorobenzoate completely inhibited growth of P111 on all ortho-substituted benzoates that were tested. When 3,5-dichlorobenzoate was added as a cosubstrate with either monochlorobenzoate alone. Moreover, resting cells of P111 grown on 4-chlorobenzoate released chloride from 3,5-dichlorobenzoate and produced no identifiable intermediate. In contrast, resting cells grown on 2,5-dichlorobenzoate metabolized 3,5-dicholorobenzoate without release of chloride and accumulated a degradation product, which was identified as 1-carboxy-1, 2-dihydroxy-3,5-dichlorocyclohexadiene on the basis of gas chromatography-mass spectrometry confirmation of its two acid-hydrolyzed products., 3,5- and 2,4-dichlorophenol. Since 3,5-dichlorocatechol was rapidly metabolized by cells grown on 2,5-dichlorobenzoate, it is apparent that 1-carboxy-1,2-dihydroxy-3,5-dichlorocyclohexadiene is not further metabolized by these cells. Moreover, induction of a functional dihyrodiol dehydrogenase would not be required for growth of P111 on other ortho-chlorobenzoates since the corresponding chlorodihydrodiols produced from a 1,2-dioxygenase attack would spontaneously decompose to the corresponding catechols. In contrast, growth on 3-chloro-, 4-chloro-, or 3,5-dichlorobenzoate requires a functional dihydrodiol dehydrogenase, yet only the two monochlorobenzoates appear to induce for it.
Key words: chlorinated aromatic hydrocarbons, biodegradation, metabolism, substrates, bacteria.

Hershner, Carl and Kenneth Moore. 1977. Effects of the Chesapeake Bay oil spill on salt marshes of the Lower Bay. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: effects, Chesapeake Bay, oil spill, marshes.

Hess, Kurt W. and Christopher L. Kerr. 1979. A Model to forecast the motion of oil on the sea. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: forecast, oil, sea.

Hess, Kathryn M., William N. Herkelrath, and Hedeff I. Essaid. 1992. Determination of subsurface fluid contents at a crude-oil spill site. Journal of Contaminant Hydrology. 10(1):75-96.
Key Words: Beltrami County Minnesota, Bemidji Minnesota, boreholes, groun water, Minnesota, oil spills, pollution, soils, solution transport, United States.

Hess, T.F., S.K Schmidt, J Silverstein, and B Howe. 1990. Supplemental substrate enhancement of 2, 4-dinitrophenol mineralization by a bacterial consortium. Applied

and Environmental Microbiology.
56(6):1551 1558.
Key words: bacteria, microorganism, biodegradation
A Janthinobacterium sp. and an actinomycete, both capable of mineralizing 2,4-dinitrophenol (DNP), were used to construct a consortium to mineralize DNP in nonaxenic bench-scale sequencing batch reactors (SBRs). Average Km values for DNP mineralization by pure cultures of the Janthinobacterium sp. and the actinomycete were 0.01 and 0.13 .mu.g/ml, respectively, and the average maximum specific growth rate (.mu.max) values for them were 0.06 and 0.23/h, respectively. In the presence of NH4Cl, nitrite accumulation in pure culture experiments and in the SBRs was stoichiometric to initial DNP concentration and the addition of nitrogen enhanced DNP mineralization in the SBRs. Mineralization of 10 .mu.g of DNP per ml was further enhanced in SBRs by the addition of glucose at concentrations of 100 and 500 .mu.g/ml but not at 10 .mu.g/ml. Possible mechanisms for this enhanced DNP mineralization in SBRs were suggested by kinetic analyses and biomass measurements. Average .mu.max values for DNP mineralization in the presence of 0, 10, 100, and 500 .mu.g of glucose per ml were 0.33, 0.13, 0.42, and 0.59/h, respectively. In addition, there was greater standing biomass in reactors amended with glucose. At steady-state operation, all SBRs contained heterogenous microbial communities by only one organism, an actinomycete, that was capable of mineralizing DNP. This research demonstrates the usefulness of supplemental substrates for enhancing the degradation of toxic chemicals in bioreactors that contain heterogeneous microbial communities.

Heydari, E., Moore, C.H. 1989. Post-hydrocarbon migration deep burial diagenesis of Smackover Formation, Black Creek field, Wiggins arch, Mississippi salt basin. AAPG (Am. Assoc. Pet. Geol.) Bull.(United States).
73:3:363.
The Smackover Formation is buried to over 6 km in Black Creek field and exhibits diagenetic phases unique to deep burial. These include replacement of sulfates by calcite, pore-fill calcite cement, silicification, and elemental sulfur as cement. The above diagenetic products are the result of thermal reduction of sulfates and thermal degradation of hydrocarbons and have formed at temperatures greater than 140/degrees/C. Calcite replaces anhydrite in two textural forms, one of which is pseudomorphic. Pore-fill calcite cement contains inclusions of pyrobitumen and heals cracks formed in the pyrobitumen due to high thermal maturity. This indicates that calcite cement postdates bitumen formation. Silicification is a major deep burial event. Micron to millimetersize crystals of quartz replace the host carbonate rock as well as other deep burial diagenetic phases. Elemental sulfur occurs as inclusions in incompletely destroyed sulfates and as pore-fill cement. In

both cases it exhibits extensive bubble-shaped cavities similar to pumiceous texture found in volcanic rocks.
This indicates that elemental sulfur was possibly crystallized rapidly from a liquid sulfur while the cores were being taken. Similar diagenetic products are formed by low-temperature (< 80/degrees/C) bacterial reduction of sulfates and bacterial degradation of hydrocarbons. However, carbon isotopic composition of calcite, sulfur isotopic composition of elemental sulfur, and textural characteristics of elemental sulfur produced by the two diagenetic processes are significantly different.
Key words: natural gas deposits, reservoir rock, petroleum deposits, geologic formations, porosity, sulfates, oxygen, calcite, alkaline earth metal compounds, calcium carbonates, federal region.

Heyseth, E.N. and K. Ostgaard. 1985. Application of In-situ dialysis cultures in studies of phytotoxicity of North Sea crude oils. Water Res. 19(3):383 391.
Key words: North Sea, Oil Spills, Phytotoxicity, Dialysis, Water Pollution
The three marine planktonic diatoms Skeletonema costatum (clone Skel-5), Thalassiosira pseudonana (clone 3H) and Phaeodactylum tricornutum (clone Pheo) were grown in dialysis cultures i outdoor tanks exposed to seawater extracts of Ekofisk and Statfjord crude oils and to sea water collected below an artificial oil spill with Statfjord crude oil at Haltenbanken. The effects on growth rate and photosynthetic capacity were similar to those observed in laborator batch cultures, and so was the difference in sensitivity among the algae, with Skeletonema being the most sensitive species. The in situ dialysis culture technique served well as a link between the laboratory and the field situations, and may be used as a monitor of phytotoxic effects in an oil spill situation.

Hickey, W.J., D.D. Focht. Degradation of mono-, di-, and trihalogenated benzoic acids by Pseudomonas aeruginosa JB2. Applied and Environmental Microbiology (USA): 56:12:0099-2240.
Pseudomonas aeruginosa JB2 was isolated from a polychlorinated biphenyl-contaminated soil by enrichment culture containing 2-chlorobenzoate as the sole carbon source. Strain JB2 was subsequently found also to grow on 3-chlorobenzoate, 2,3- and 2,5-dichlorobenzoates, 2,3,5-trichlorobenzoate, and a wide range of other mono- and dihalogenated benzoic acids. Cometabolism of 2,4-dichlorobenzoate was also observed.
Chlorocatechols were the central intermediates of all chlorobenzoate catabolic pathways. Degradation of 2-chlorobenzoate was routed through 3-chlorocatechol, whereas 4-chlorocatechol was identified from the metabolism of both 2,3- and 2,5-dichlorobenzoate. The initial attack on chlorobenzoates was oxygen dependent and most likely mediated by dioxygenases. Although plasmids were not detected in strain JB2,

spontaneous mutants were detected in 70% of glycerol-grown colonies. The mutants were all of the following phenotype: benzoate{sup +}, 3-chlorobenzoate{sup +}, 2-chlorobenzoate{sup {minus}}, 2,3-dichlorobenzoate{sup {minus}}, 2,5-dichlorobenzoate{sup {minus}}. While chlorocatechols were oxidized by the mutants at wild-type levels, oxidation of 2-chloro- and 2,3- and 2,5-dichlorobenzoates was substantially diminished. These findings suggested that strain JB2 possessed, in addition to the benzoate dioxygenase, a halobenzoate dioxygenase that was necessary for the degradation of chlorobenzoates substituted in the ortho position.
Key words: chlorinated aromatic hydrocarbons, metabolism, biodegradatioan, bacteria, organic compounds.

Hickey, W.J., Searles, D.B., Focht, D.D., Riverside. 1993. Enhanced mineralization of polychlorinated biphenyls in soil inoculated with chlorobenzoate-degrading bacteria. Applied and Environmental Microbiology (United States). 59:4:1194-1200.
An Altamont soil containing no measurable population of chlorobenzoate utilizers was examined for the potential to enhance polychlorinated biphenyl (PCB) mineralization by inoculation with chlorobenzoate utilizers, a biphenyl utilizer, combinations of the two physiological types, and chlorobiphenyl-mineralizing transconjugants. Biphenyl was added to all soils, and biodegradation of 14C-Aroclor 1242 was assessed by disappearance of that substance and by production of 14CO2. Mineralization of PCBs was consistently greatest (up to 25.5%) in soils inoculated with chlorobenzoate degraders alone. Mineralization was significantly lower in soils receiving all other treatments: PCB cometabolizer (10.7%); chlorobiphenyl mineralizers (8.7 and 14.9%); and mixed inocula of PCB cometabolizers and chlorobenzoate utilizers (11.4 and 18.0%). However, all inoculated soils had higher mineralizationthan did the uninoculated control (3.1%). PCB disappearance followed trends similar to that observed with the mineralization data, with the greatest degradation occurring in soils inoculated with the chlorobenzoate-degrading strains Pseudomonas aeruginosa JB2 and Pseudomonas putida P111 alone. While the mechanism by which the introduction of chlorobenzoate degraders alone enhanced biodegradation of PCBs could not be elucidated, the possibility that chlorobenzoate inoculants acquired the ability to metabolize biphenyl and possibly PCBs was explored. When strain JB2, which does not utilize biphenyl, was inoculated into soil containing biphenyl and Aroclor 1242, the frequency of isolates able to utilize biphenyl and 2,5-dichlorobenzoate increased progressively with time from 3.3 to 44.4% between 15 and 48 days, respectively. Since this soil contained no measurable level of chlorobenzoate utilizers yet did contain a population of biphenyl utilizers, the possibility of genetic transfer between the latter

group and strain JB2 cannot be excluded.
Key words: polychlorinated, biphenyls, biodegradation, mineralization.

Hicks, B.N., and J.A. Caplan. 1993. Bioremediation: A natural solution. Pollution Engineering (United States). 25(2):30-33.
Key words: Groundwater, Biodegradation, Soil Pollution, Microorganisms, Oil Spills, Monitoring
Bioremediation is an attractive remediation alternative because most full-scale bioremediation projects involve cost-effective contaminant treatment on-site. Recently, large scale bioremediation projects have included cleanups of ocean tanker spills, land-based chemical spills, and leaking chemical and petroleum storage tanks. Contaminated matrices have included beaches, soils, groundwater, surface waters (i.e., pits, ponds, lagoons), process waste streams and grease traps. Bioremediation is especially cost-effective when both soil and groundwater matrices are impacted because one remediation treatment system can be design to treat both media simultaneously in place. The primary advantages of in situ bioremediation include: on-site destruction of contaminants; accelerated cleanup time; minimal disruption to operations; lower remediation costs; and reduction of future liability.

Hielscher, A.L., K.A. Froelich, and D.H. Dale. 1991. Cameo SSC and Cameo MSO: new tools for planning and initial response. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: Cameo MSO, Cameo SSC, planning, response.

Higging, J. 1993. Spill sorbents: A comparison of water and oil sorbency. Hazardous Materials Management Journal (United States). 5(4):12-16.
Key Words: Adsorbernt-comparative evaluations, oil pollution containment, oil spills, sorbent recovery systems, sorptive properties, hydrogen compounds, oxygen compounds, pollution control, surface properties.

Higgins, J. 1993. Spill sorbents: A comparison of water and oil sorbency. Hazardous Materials Management Journal (United States)5(4):12-16. ETD (Energy Technology Data Exchange), INF (non-US Atomindex input via DOE)
CANM (Canada (sent to DOE from))Canada
Sorbents for oil spills come in three general classes: organic, such as peat moss, sawdust, and paper fibre; inorganic, such as clay, vermiculite, and diatomaceous earth; and synthetic, including a variety of materials made from polymers such as polyethylene and polypropylene. The water and oil sorptive properties of various sorbents are listed and their characteristics are described. In spill remediation, most synthetic adsorbents are oleophilic with some degree of hydrophobic

properties to prevent them from taking up water as they clean up the oil. In some situations, such as maintenance spills where aqueous liquids are also encountered, universal sorbents which have both oleophilic and hydrophilic properties are used. Sorbents are sold in a variety of product configurations, including powders, beads, rolls, ropes, and booms. Melt blown polypropylene is widely used since it is inexpensive, easy to apply, a good insulator, relatively inert, non-hazardous, and available in a wide variety of configurations. Its approximate oil sorbency is 20-30 times its own weight while its water sorbency is 0.0-0.1 times its own weight. In the Canadian market, sorbent products are available from importers, packagers, and manufacturers. The market is dominated by a few large companies that provide a range of high- and low-tech products in addition to ancillary products such as drums and skimmers. 2 tabs.

Higson, F.K. 1991. Degradation of xenobiotics by white rot fungi. Reviews of Environmental Contamination and Toxicology (United States). 122:0179-5953.
White rot fungi such as P. chrysosporium degrade the nonrepeating, nonstereoselective, insoluble polymer lignin under conditions of nutrient limitation. The attack on lignin principally involves extracellular peroxidases (ligninases) and hydrogen peroxide. Hydroxyl radicals may also make a significant contribution.
The ligninolytic system lends itself to the degradation of xenobiotics, since these often have limited solubility in water and are not readily available in soil to intracellular metabolism. A nonspecific attack should proceed at a rate independent of the target's concentration and the fungal system would be expected to remediate soil contaminated with a mixture of compounds. This contrasts with the need for induction and problems with simultaneous metabolism encountered with bacterial inoculation. The P. chrysosporium system has been found active against such diverse substrates as DDT, lindane, PCBs, TNT and crystal violet, with substantial mineralization in many cases. Some like biphenyl and triphenylmethane dyes are structurally related to lignin substructures while others bear groups such as nitro (TNT) or halogen (PCP) that are absent from the natural polymer. The fate of transformed targets varies: pentachlorophenol is incorporated into soil organic matter as a result of fungal ligninase action, whereas highly lipophilic Aroclor PCBs are converted to water-soluble metabolites. Normally less toxic intermediates are generated: for example, with benzo(a)pyrene, mutagenic arene oxides do not appear in the white rot fungal system. In certain cases, purified ligninases were also active in degrading pollutants such as PCP, benzo(a)pyrene or triphenylmethane dyes. Methods of optimizing ligninase activity in fungal reactors have been described. 257 references.
Key words: benzopyrene, biodegradation, hydrocarbons,

decontamination.

Higson, Frank K., and Dennis D. Focht. 1990. Bacterial degradation of ring-chlorinated acetophenones. Appl Environ Microbiol. 56(12):3678-3685.
Key words: Biodegradation, Microorganism, Hydrocarbons, Soil Contamination
Two bacterial strains, one each isolated from acetophenone and 4min-hydroacetophenone enrichments, cometabolized a range of chlorinated acetophenones (CAs) generated by the degradation of certain insecticides. A biological Baeyer-Villiger reaction transforms the CA to chlorophenyl acetate, a conversion evident only in the presence of an esterase inhibitor. The CA is normally rapidly hydrolyzed to a chlorophenol that has the same substitution pattern as the original ketone. The oxygenase that attacks the ketone uses NADPH in the incorporation of one atom of oxygen-18 and is strongly inhibited by phenols that bear an ortho - or meta -, chlorine or bromine.

Hildebrand, M. 1992. HazWoper: Current issues and compliance problems. In: Proceedings of the NPRA National Safety Conference, May 18 19 1992, San Antonio, TX, Paper N.NSC-92-101, 23 pp.
Key words: Business Operation, Economic Factor, Legal Consideration, Pollution Control

Hildebrandt, W.W., and S.B. Wilson. 1990. On-site remediation of organically impacted soils on oilfield properties. In: Proceedings of the 60th Annu Spe Calif Reg Mtg, April 4 6, 1990, Ventura, Calif. pp. 401 406.
Keywords: biodegradation, environmental impact, oil waste, soil pollution, bacteria, California, disposal, cleanup, Environmental Protection Agency, Texas, waste disposal

Hildebrandt, W.W., and S.B. Wilson. 1991. On-site bioremediation systems reduce crude oil contamination. In: Proceedings of the 65th Annu Spe Tech Conf, September 23 26, 1990, New Orleans, LA. J Petrol Technol 43(1):18 22
Keywords: bioremediation, bacteria, biodegradation, soil pollution, California, environmental impact, legal consideration, oil spill, oil waste, Texas

Hill, G.A., M.A. Tomusiak, B. Quail, and K. Van Cleave. 1990. Bioreactor design effects on biodegradation capabilities of VOC's in wastewater. In: Proceedings of AIChE 1990 Summer National Meeting, August 19 22, San Diego, CA, Preprint N. 80d, 41 pp.
Key words: water pollution, biodegradation, pollution control, water pollutant

Hill, D.L., T.J. Phelps, A.V. Palumbo, D.C. White, G.W. Strandberg, T.L. Donaldson. 1988. Bioremediation of polychlorinated biphenyls: degradation

capabilities in field lysimeters. 10. symposium on
biotechnology for fuels and chemicals. 19.
The degradation of 4-chlorobiphenyl (4CB) was compared in field
lysimeters containing 60 Kg of soil
contaminated with 5-10 mg/Kg of polychlorinated biphenyls.
Alcaligenes A5, a bacterium carrying a plasmid
for 4CB degradation, was inoculated into three lysimeters. When
compared to an untreated control, soil
samples from water, mineral and yeast extract treated lysimeters
with and without a bacterial inoculum
exhibited greater than TO fold increases in the rate of (1-/sup
14/)C-acetate incorporation into lipids and /sup
14/CO/sub 2/ production from (U-/sup 14/C-)4-chlorobiphenyl. Gene
probe analyses for the 4CB plasmid
and most-probable number enumerations demonstrated the presence
of biodegradative populations in
lysimeters and the probable survival of the added Alcaligenes A5.
17 refs., 2 figs., 2 tabs.
Key words: lysimeters, polycyclic aromatic hydrocarbons,
bacteria, plasmids, fields tests, tracer techniques,
soil, chemical reactions, biodegradation, cell constituents,
decomposition, dissolution.

Hillman, Sharon O. and Richard V. Shafer. 1983. ABSORB: a three
year update in Arctic spill response. In:
Proceedings of the 1983 Oil Spill Conference (prevention,
behavior, control, cleanup), February 28 March 3,
San Antonio, TX.
Key words: ABSORB, Arctic, spill, response.

Hillman, Sharon O. 1989. Endicott: a clean act. In: Proceedings
of the 1989 Oil Spill Conference (prevention,
behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: endicott.

Hillman, Sharon O. 1993. Environmental aspects of contingency
planning and spill response. In: Proceedings
of the 1993 Oil Spill Conference (prevention, preparedness,
response), March 29 April 1, Tampa, FL.
Key words: environmental, contingency, spill response.

Hillman, Sharon O. 1985. Arctic spill response inprovements: a
1985 review of arctic research and
development. In: Proceedings of the 1985 Oil Spill Conference
(prevention, behavior, control, cleanup),
February 25 28, Los Angeles, CA.
Key words: Artic, spill, response, research, development.

Hinchcliffe, P.R. 1989. Application of the technology in the
United Kingdom. In: Proceedings of the Inst
Petrol London Remote Sensing of Oil Slicks Int Mtg, May 17 18
1988, London, England, pp. 29-31.
Key words: Remote Sensing, Oil Spill, Pollution Control

Hinchee, R. E. and R. F. Olfenbuttel. 1991. In Situ
Bioreclamation. Butterworth Publishers: Stoneham, MA,
611 p.

Key words: In Situ Bioreclamation, Oil Spills, Remedial Action, Water Pollution
This book discusses m-situ bioreclamation and its application and investigations for hydrocarbon and contaminated site remediation. Topics covered include: biodegradation of hydrocarbons; field studies; bacteria; and soils.

Hinchee, R.E., and D.C. Downey. 1998. The role of hydrogen peroxide in enhanced bioreclamation. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:715-722.
Key words: Biodegradation, Oil Spill, Bacteria, Groundwater, Microorganism, Soil Pollution, Water Pollution

Hinchee, R.E., Olfenbuttel, R.F. 1991. On-site bioreclamation. Stoneham, MA (United States). Butterworth Publishers. 483-492:527.
The use of specialized bacterial strains, which are able to degrade organic pollutants such as polychlorinated biphenyls (PCBs) and pesticides, is becoming increasingly important in the decontamination of polluted soils, sludges, and groundwaters. However, about 50 percent of polluted sites also contain inorganic pollutants such as heavy metals. These heavy metals can inhibit the activity of native organisms or the introduced organic compound degraders. Moreover, sometimes the heavy metals themselves are important contaminants that render the soil, even after degradation of the organics, unusable. To overcome such problems, the construction of bacteria that are able to degrade organic pollutants and, at the same time, resist multiple heavy metals could be environmentally important. Alcaligenes sp. are known to be resistant to heavy metals or to degrade chloroaromatic compounds. Therefore, heavy metal resistant PCB-degrading Alcaligenes sp. strains were constructed. The construction and characterization of these new strains are presented along with initial results of applications.
Key words: biphenyl, biodegradation, environment, pollution control, ground water.

Hinchee, R.E., Downey, D.C., Beard, T. 1989. Enhancing biodegradation of petroleum hydrocarbon fuels through soil venting. National Water Well Association, Dublin, OH (US). 698(p):235-248.
Key Words: Gas spills biodegradation, gas spills water pollution abatement, oil spills biodegradation, oil spills water pollution abatement, aquifers, contamination, ground water, injection wells, oxidation, chemical reactions, decomposition, hydrogen compounds, pollution abatement.

Hinchee, R.E., D.C. Downey, J.K. Slaughter, D.A. Selby, and M.S. Westray. 1989. Enhanced bioreclamation

of jet fuels: A full-scale test at Eglin AFB, Florida. Final report, November 1986-November 1988. 179(p).
Key Words: Jet engine fuels biodegradation, oil spills biodegradation, contamination, field tests, Florida, ground water, hydrogen peroxide, land pollution, land reclamation, military facilities, progress report, recommendations, site characterization, water pollution, chemical reactions, document types, Federal Region IV, hydrogen compounds, North America, oxygen compounds, USA.

Hirst, C. 1984. How Sullom Voe terminal fights oil spills. Petrol Rev (1984): 38
Key words: port facility, oil spill, Shetland Islands

Hiyama, Yoshio. 1979. Survey of the effects of the Seto Inland Sea oil spill in 1974. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: Seto, Sea, Spill.

Hodges, H.I., D.W. Jackson, and K. Kline. 1992. Soil treatment technologies: comparison of field experiences. In: Proceedings of the Pennwell Conf & Exhibit co Petro-Safe 92 Conf, January 27-29, 1992, Houston, TX, pp. 759-773.
Key words: Oil Spill, Soil Pollution, Cleanup, Disposal, Groundwater, Legal, Microorganism, Water Pollution

Hodgins, D.O., J.H. Huang, and M.F. Fingas. 1992. Oil spill modelling using remote sensed surface currents. In: Proceedings of the Environment Canada 15th Arctic and Marine Oil Spill Technical Seminar, June 10 12 1992, Edmonton, Alberta, Proceedings pp. 381-405.
Key words: Oil Waste, Radar

Hodgins, Donald O. 1991. New capabilities in real-time oil spill and fate prediction using HF radar remote sensing. In: Proceedings of the Environ Canada Arctic & Marine Oil Spill Program 14th Technical Semin, June 12 14 1991, Vancouver, BC, pp. 527 539.
Key words: Remote Sensing, Oil Spill Detection, Pollution Forecasting, Emergency Planning
High-frequency (HF) radar remote sensing provides a practical means of obtaining surface current maps that cover enough of the shelf seas to be useful for oil spill motion modeling. This measurement technique is explained, followed by a description of recent advances in HF radar instrumentation and its use in emergency response to spills. The utility of the HF radar system using direction-finding technology in recording real-time surface currents for oil spill modeling was demonstrated near Vancouver, BC, Canada.

Hoest-Madsen, J. December 1990. Immiscible multi-phase flow in porous media. DTH-ISVA-Series Paper-

49. 171(p).
Key Words: Multiphase flow bench-scale experiments, multiphase flow numerical analysis, porous materials multiphase flow, aquifers, ground water heterogeneous effects, hydraulics, hysteresis, interfaces, oil saturation, oil spills, petroleum, subsurface environments, surface tension, energy sources, fluid flow, fluid mechanics, fossil fuels, hydrogen compounds, mathematics, oxygen compounds saturation, surface properties.

Hoff, R.Z. 1993. Bioremediation: an overview of its development and use for oil spill cleanup. Mar Pollut Bull. 26(9):476-481.
Key words: Bioremediation, Contamination, Environmental Pollution, Oil Spill, Remediation, Biodegradation, Prince William Sound

Hoff, R.Z., G. Shigenaka, C.B. Henry Jr. 1993. Salt marsh recovery from a crude oil spill: Vegetation, oil weathering, and response. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 307-311.
Key words: Wetland, Oil Spill, Remediation, Biology, Crude Oil, Pollution Control

Hoffman, E.R. 1991. Separation scheme for cleaning oily waste. In: Proceedings of the CIM Petrol. Soc. & AOSTRA Tech. Conf., April 21 24 1991, Banff, Can, Preprints 1, Pap. No. 91-37, 12 pp. Petroleum Abstracts ABSTR. NO. 520,695 32(10).
Key words: Abstract, Accumulating, Canada, Hydrocarbon, Pollution Control

Hoi-Chaw, Lai and Feng Meow-Chan. 1985. Field and laboratory studies on the toxicities of oil to mangroves. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: field, laboratory, toxication, mangroves.

Holba, C., M. McGee, and P. Thompson. 1993. Oil spill public information center: its role in the flow of information on the Exxon Valdez oil spill. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: information, Exxon Valdez.

Holcomb, Jay. 1991. Overview of bird search and rescue and response efforts during the Exxon Valdez oil spill. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: overview, bird, Exxon Valdez, oil spill.

Hollingsworth, Wayne. 1991. Contingency planning: implementation is the key. In: Proceedings of the 1991

Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: contingency.

Hollis, C.L., and J.L. Taylor. 1988. Oil skimming apparatus. Patent No. US 4842735.
Key words: skimmers, offshore operations, oil spills, petroleum, removal, ships
An oil skimming apparatus is described for removing oil from the oil-covered surface of a water body, comprising: (a) a watercraft capable of mounting on a trailer for transportation and adapted for launching and floating on the water body; (b) a skimming boom slidably mounted on one end of the watercraft in angular relationship, the skimming boom having an oil-collecting end an oil-dispensing end, whereby the oil-collecting end of the skimming boom is at least partially immersed in the oil-covered surface of the water body to a selected depth; (c) a skimming plate provided in upward-standing relationship on the oil-collecting end of the skimming boom for skimming the oil from the oil-covered surface of the water body; and (d) a pair of conveyor chains rotatably carried by the skimming boom in spaced, substantially parallel relationship, the conveyor chains oriented substantially parallel to the longitudinal axis of the watercraft; at least one paddle means carried by the conveyor chains and spanning the skimming boom in transverse relationship.

Holloway, M., and J. Horghan. 1991. Soiled shores. Scientific American, 265(4) 80 94. Aqualine Abstracts ABSTR. NO. 91-4695 7(26).
Key words: Abstract, Accident, Air Pollution, Biochemical Reaction, Bioremediation, Biodegradation, Crude Oil, Economic Factor, Pollution Control

Holmes, P.D. 1977. A model for the costing of oil spill clearance operations at sea. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil spill, sea.

Holmes, David B., Campbell, Kenneth W. 1991. Contaminant stratification at a deeply penetrating multiple component DNAPL site. Abstracts with Programs - Geological Society of America. 23(3):18.
Key Words: Ground water, pollution, hydrocarbons, environmental geology, oil spills, dense non-aqueous phase liquids, organic materials, distribution, reclamation, experimental studies, polluted water, hydrogeology.

Holt, Capt. W.F. Biff. 1993. Implementing the OPRC: translating diplomatic concepts into reality. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1,

Tampa, FL.
Key words: OPRC.

Holt, LCDR William F. and Fred N. Ribel. 1981. Federal/state cooperation in oil pollution control. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: pollution, control.

Honey, F.R., and P.J. Pomeroy. 1992. Laserfluorescence offshore oil pollution sensor - loops. In: Proceedings of the Pennwell Conf & Exhibit Co Petro-Safe 92 Conf, January 27 29 1992, Houston, TX, 2:459-469.
Key words: Leak Detector, Oil Spill, Pollution Control Equipment, Contamination, Pollution Control, Remote Sensing

Hoppe, D.G., M.K. Witte, R.G.L. McCready. Microbial degradation of carbonaceous material in a copper molybdenum concentrate. In SP86-9, Proc. Annu. Gen. Meet. BIOMINET, 3rd, 1986. in Year.
Key words: bacteria, hydrocarbon, biodegradation

Horn, Stuart A. and Captain Phillip Neal. 1981. The Atlantic Empress sinking: a large spill without environmental disaster. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: Atlantic Empress, spill, environmental.

Hornig, A.W. 1977. Development of an oil in water content monitor. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil, monitor.

Hornstein, Bernard. 1973. The visibility of oil-water discharges. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil-water, discharges.

Horowitz, J. 1969. Identification of oil spills: comparison of several methods. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: identification, spills.

Horstad, I. N. Mills, and S.R. Larter. 1992. A quantitative model of biological petroleum degradation within the Brent group reservior in the Gullfaks field, Norwegian North Sea. Organic Geochem. 19(1-3):107-117.
Key words: North Sea, Biodegradation, Bacteria, Degradation, Oil Spill, Water Pollution, Hydrocarbon

Horvat, E.I. 1988. Passive controls. Refinery groundwater

conference/workshop. Info-Tech, Calgary Alberta.
11(p).
Key Words: Ground water-water pollution control, petroleum refineries environmental impacts, hydrology, oil pollution containment, oil spills, water pollution, hydrogen compounds, industrial plants, oxygen compounds, pollution control.

Hostage, Barbara and Gerain Perry. 1993. Federal notification requirements for releases of oil and hazardous substances. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: notification, requirements, oil.

Houghton, J.P., A.K. Fukuyama, D.C. Lees, W.B. Driskell, G. Shigenaka, and A.J. Mearns. 1993. Impact on intertidal epibiota: Exxon Valdez spill and subsequent cleanup. In: Proceedings of the 13th Bien API et al oil spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 293-300.
Key words: Marine Ecology, Alaska, Cleaning, Oil Spill, Environmental Pollution

Houghton, J.P., D.C. Lees, W.B. Driskell, A.J. Mearns, and Exxon Valdez. 1991. Impacts of the Exxon Valdez (oil) spill and subsequent cleanup on intertidal biota: 1 year later. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp. 467-75.
Key words: Alaska, Animal, Bulk Carrier, Crude Oil, Diaster Control, Physical Separation

Hover, G.L. 1992. Evaluating interim upgrades to the U.S. Coast Guard's oil spill remote sensing capabilities. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17, New Orleans, LA, 1:127-132.
Key words: Remote Sensing, Oil Spill

Hover, G. L. 1993. Evaluating technologies of oil spill surveillance. Sea Technology 34(7): 45 53.
Key words: Oil Spills, Remote Sensing, Coast Guard, Monitoring, Synthetic Aperture Radar
Surveillance and monitoring of oil in the marine environment imposes a broad spectrum of remote sensing requirements. At the US Coast Guard Research Development Center, the environmental safety branch is sponsoring oil spill remote sensing research in four areas of technology: synthetic aperture radar (SAR), frequency-scanning microwave radiometry (FSR), laser fluorosensing (LFS), and forward-looking infrared (FLIR) imagers. SAR technology uses sophisticated signal processing to overcome prior limitations, providing images of higher and more uniform spatial acuity, which may enable interpreters to more readily

distinguish petroleum slicks from others. The ability to determine the distribution of oil thickness within a slick is necessary when an estimate of oil volume is desired. Scientists at MIT have formulated a new approach to radiometric oil thickness measurement that takes advantage of recent advances in electronic component technology. The initial data collected with a prototype FSR instrument have validated the FSR concept and more work is ongoing. The Coast Guard is co-funding a program to demonstrate and evaluate the capabilities of an airborne laser fluorosensor to support oil spill response operations. During a controlled test, the instrument successfully demonstrated an ability to detect oil on water, ice, and various beach surfaces. Additional testing included different oil types and allowed for weathering. Data analysis is ongoing. Recent developments in infrared imager technology have produced a wide variety of off-the-shelf, portable cameras that could potentially provide a rapid-response spill assessment capability. The R D Center has been involved in the testing of many of these sensors.

Hovis, Warren A. and Donald R. Jones. 1977. Satellite sentinel for oil spills in 1978?. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: satellite, oil spills.

Howard, S., J.M. Baker, and K. Hiscock. 1989. The effects of oil and dispersants on seagrasses in Milford Haven. Dicks, B. Ecological impacts of the oil industry. In: Proceedings of the International meeting on ecological impacts of the oil industry, November 4 5 1987, London, pp. 61-96.
Key words: Oil Spills, Environmental Impacts
Seagrasses are flowering plants which occur in truly marine habitats extending from the intertidal zone into the sublittoral region. They occur in all the world's oceans and are particularly abundant in estuaries, bays and shallow lagoons. Seagrasses fulfil three major functions in estuarine and nearshore ecosystems, namely: they contribute significantly to the food web; provide a habitat and shelter for many organisms; and stabilize sediments. Because of their location, seagrass beds are at high risk from oil pollution. In recent years this has led to research being carried out into the effects of oil pollution and clean-up procedures, particularly dispersants, on temperate and tropical seagrass species. Studies have included laboratory, field and real-spill investigations. This paper presents the results of field experiments conducted in Milford Haven on two Zostera species. The field experiments involved application of oil and dispersants to determine their effect on the survival and growth of Zostera, with the objective of identifying preferred clean-up procedures. Results from the Milford Haven experiments are compared with those from similar experiments conducted in tropical

and temperate latitudes. (author).

Howard J. Teas, Eirik O. Duerr, and J. Ross Wilcox. 1987. Effects of South Louisiana crude oil and dispersants on Rhizophora mangroves. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: Louisiana, oil, dispersants, mangroves.

Howard, S. and D.I. Little. 1987. Biological effects of low-pressure seawater flushing of oiled sediments. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: biological, seawater, flushing, sediments.

Howard, S. and D.I. Little. 1987. Effect of infaunal burrow structure on oil penetration into sediments. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: infaunal, oil, penetration, sediments.

Howes, D.E., and J. Bones. 1991. West coast oil spills: British Columbia Initiatives. In: Proceedings of the 14th Environ Can Arctic & Mar oil spill program tech seminar, June 12 14 1991, Vancouver, Canada, pp. 177 189.
Key words: Contingency Planning, British Columbia, Legal Consideration, Oil Spill

Howlett, E., K. Jayko, andM. Spauding. 1993. Interfacing real-time information with oil map. In: Proceedings of the Environment Canada 16th Arctic and Marine Oil Spill Technical Seminar, June 7-Sept., Calgary, Canada, VI, pp. 539-548.
Key words: Water Pollution, Real-Time, Oil Spills, Contingency Planning

Hoyle Marine Ltd. 1990. Hydraulic motors for new offshore booms. Marine Pollution Bulletin. 21(8):406-7.
Key words: Bearing, Boom, Compounds, Offshore, Oil Waste, Pollution Control, Equipment

Huang, James C. 1983. A Review of the state-of-the-art oil spill fate/behavior models. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: review, oil spill, models.

Huang, H. D. and K. Purnendu. 1990. Amperometric microsensor for water. Anal. Chem. 62(18):1935 1942.
Key words: Sensors

Hubbard, J.F. and T.E. Allen. 1979. Clean Atlantic associates: an oil spill cleanup cooperative for the Atlantic offshore area. In: Proceedings of the 1979 Oil Spill

Conference (prevention, behavior, control,
cleanup), March 19 22, Los Angeles, CA.
Key words: Atlantic, oil spill, cleanup, offshore.

Hubbert, Graeme D. 1993. Oil spill trajectory modelling with a fully three-dimensional ocean model. In:
Proceedings of the 11th Australasian Conference on Coastal and Ocean Engineering, Clownsville,
Queensland, Australia, 2(93):4.
Key words: Oil Spills, Ocean Currents
A three-dimensional primitive equation regional ocean model has been developed to study and predict ocean
currents. In this paper the major features of the model are described and its application to real-time oil spill
trajectory forecasting under contract to a number of operators on the Australian north-west shelf is described.
Initial verification of the system was carried out with a simulation of a ?mat' tracking exercise by LASMO
Oil near the Muiron Islands in Exmouth Gulf. For this exercise the three-dimensional model with eight
vertical levels was used to predict particle trajectories on a horizontal grid with a resolution of 700 m. Good
agreement was obtained between actual and simulated tracks using the surface currents from the
three-dimensional model. Three-dimensional model simulations for two other ?mat' tracking exercises by
Command Petroleum in the Onslow-Barrow Island region also were in good agreement with observed tracks.
The performance of two- and three-dimensional models in simulating surface ocean currents is explored
through comparisons with current data at the LASMO exploration site. The poor agreement obtained with the
two-dimensional model is discussed and it is shown that such models are quite inappropriate for modelling
the surface flows required for this type of work. (Author abstract) 4 Refs.

Huehnerfuss, H., W. Alpers, and F. Witte. 1989. Layers of different thicknesses in mineral oil spills detected
by grey level textures of real aperture radar images.
International journal of remote sensing.
10(6):1093-1099.
Key words: Pollution, Hydrocarbons, Radar Methods, Remote Sensing

Huet, J.Y., J.P. Belluteau, C. Such, Y. Naour, C. Bocard, and D. Vaillant. 1989. Operational use of a mobile
sand-washing plant for cleaning pebbles: The Amazzone oil spill.
In: Proceedings of the 1989 API - EPA -
USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ.
N.4479, pp. 149-53.
Key words: Beach, Economic Factor, Hydrocarbon Solvent, Inorganic Solvent, Organic Solvent, Physical
Separation, Pollution Control Equipment, US Environmental Protection Agency

Huey-Min, HWANG, R.E. Hodson, and D.L. Lewis. 1989. Microbial

degradation kinetics of toxic organic
chemicals over a wide range of concentrations in natural aquatic
systems. Environmental toxicology and
chemistry. 8(1):65 74.
Keywords: biodegradation

Huffrod, G.L., Lt. Cdr. I.M. Lissauer, and MST-2 B.D. Thompson.
1977. Storm related oil spill movement
on the Beaufort Sea Shelf. In: Proceedings of the 1977 Oil Spill
Conference (prevention, behavior, control,
cleanup), March 8 10, New Orleans, LA.
Key words: oil spill, movement, Beaufort.

Hugo, K., and H. Lizama. 1991. Bacterial degradation of oil based
mud cuttings. In: Proceedings of the 4th
CADE/CAODC Spring Drilling Conf, April 10-12, 1991, Calgary, CAN,
11pp.
Key words: Waste Disposal, Bacteria, Canada, Hydrocarbon,
Microorganism, Soil Remediation, Water
Pollution

Hull, Clark R. and Thomas McCloskey. 1989. The Formulation of a
comprehensive marine wildlife
protection program. In: Proceedings of the 1989 Oil Spill
Conference (prevention, behavior, control,
cleanup), February 13 16, San Antonio, TX.
Key words: marine, wildlife, protection.

Hult, Marc F., and Rolland R. Grabbe. 1988. Distribution of gases
and hydrocarbon vapors in the unsaturated
zone. Open-File Report (United States Geological Survey. 1978).
C21-C25.
Key Words: Minnesota, geochemistry, organic materials, Beltrami
County Minnesota, USGS, Midwest,
United States, northwestern Minnesota, Bemidji Minnesota, oil
spills, pollution, ground water, aquifers, crude
oil, unsaturated zone, gases, chromatograms, carbon dioxide,
hydrocarbons, outwash, clastic sediments, soils.

Hult, Marc F., Matthew K. Landon, and Hans-Olaf Pfannkuch. 1991.
Field validation of conceptual models
of mobilization and transport of volatile petroleum derivatives
in the unsaturated zone near Bemidji,
Minnesota. Water-Resources Investigations. 621-626.
Key Words: Minnesota, pollution, environmental geology, oil
spills, field studies, USGS, Midwest, United
States, North-Central Minnesota, Bemidji, Minnesota, Beltrami
County, Minnesota, ground water, transport,
unsaturated zone, theoretical models.

Hult, Marc F. 1991. Overview of research on contamination of the
subsurface by crude oil at the Bemidji,
Minnesota, toxic substances research site. Water Resources
Investigations. 611-613.
Key Words: Minnesota,pollution, ground water, environmental
geology, oil spills, field studies, USGS,
Midwest, United States, north-central Minnesota, Bemidji

Minnesota, Beltrami County Minnesota.

Hum, Suling. 1977. The Development and use of resource sensitivity maps for oil spill countermeasures. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: development, sensitivity, maps, oil spill.

Humphrey, B., E.H. Owens, and G. Sergy. 1991. Long-term results from the BIOS shoreline experiment: surface oil cover. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: results, BIOS, shoreline, surface oil.

Humphrey, B., E. Owens, and G. Sergy. 1993. Development of a stranded oil in coarse sediment (SOCS) model.In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: development, oil, sediment, SOCS, model.

Hung, Stephen C. 1991. Seaway emergency response plan. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: seaway, response.

Hunt, Kenneth. 1987. Pictoral review of two oil spills on the Trans-Alaska pipeline. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: review, oil spills, Trans-Alaska, pipeline.

Hunt, P.G. 1973. Terrestrial oil spills in Alaska: environmental effects and recovery. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil spill, Alaska, environemental, effects, recovery.

Hunt, G. 1975. The evaluation and development of passive tagging procedures for the identification of crude oil spilled on water. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: development, oil spilled, water.

Hunter, M. 1989. Biological remediation of contaminated groundwater systems. Pollution Engineering. 21(7):44,46,48,50.
Key words: water pollution, bacteria, biodegradation, ground water, microorganism, pollution control, soil

Hunter, Steve. 1993. The Oiling of ICS. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.

Hura, Lt. Cdr. M. and S. Finger. 1977. U.S. Navy r&d efforts in support of oil pollution abatement strategies. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil, pollution, abatement, Navy, r&d

Hurford, N. and I. Buchanan. 1989. Results of the 1987 forties crude oil trial in the North Sea. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil, North Sea.

Hurford, N. 1989. Remote sensing techniques for detecting oil slicks at sea. Hydrographic Journal. 51:15-19.
Key words: Oil Slicks, Sea, United Kingdom
The paper describes the airborne remote sensing system currently in use in the UK for oil slick detection. The aircraft is used to supply objective information to the oil spill response team dealing with major oil spillage. In addition aerial surveillance patrols are taking place in order to detect discharges of oil from shipping and off-shore installations. The role to be played by satellite-borne sensors in complementing and extending information from aerial surveys is considered. -Author.

Hurford, N. 1989. Review of remote sensing technology. In: Proceedings of the INST Petrol London Remote Sensing of Oil Slicks Int Mtg, May 17 18 1988, London, England, pp. 7-16.
Key words: Remote Sensing, Oil Spill, Contamination, Pollution Control

Hurford, N., and D. Tookey. 1990. Use of airborne remote sensing equipment for detecting discharges of oil from offshore installations. Oil Chem Pollut, 6(1):69-80.
Key words: Remote Sensing, Oil Spill, Contamination, Pollution Control

Hurford, N. 1990. The use of a satellite-tracked buoy to monitor the movement of an oil slick at sea. Oil Chem Pollut, 6(2):101-112. Key words: Oil Spill, Contamination, Water Pollution, Remote Sensing

Hus, L. 1990. Remote sensing of oil spills in thermal infrared : contour line effect. In: Proceedings of the IGARSS 91 : international geoscience and remote sensing symposium, June 3 6 1991, Espoo, 3:1315-1317.
Key words: Remote Sensing, Pollution

Hutchins, S. R., W. C. Downs, J. T. Wilson, G. B. Smith and D. A. Kovacs. 1991. Effect of nitrate addition on biorestoration of fuel-contaminated aquifer: field demonstration. Ground Water 29(4):571 580.
Key words: Biodegradation, Michigan, Oil Spills, Water Pollution

A spill of JP-4 jet fuel at the U.S. Coast Guard Air Station in Traverse City, Michigan, contaminated a water-table aquifer. An infiltration gallery (30 ft x 30 ft) was installed above a section of the aquifer containing 700 gal JP-4. Purge wells recirculated three million gallons of groundwater per week through the infiltration gallery at a rate designed to raise the water table above the contaminated interval. Groundwater containing ambient concentrations was first recirculated for 40 days. Concentrations of benzene in monitoring wells beneath the infiltration gallery were reduced from 760 to greater than 1 micrograms/1. Concentrations of toluene, ethylbenzene, m,p-xylene, and o-xylene were reduced from 4,500 to 17,840 to 44,2600 to 490, and 1400 to 260 micrograms/1, respectively. Average core concentrations of benzene, toluene, ethylbenzene, m,p-xylene, and o-xylene were reduced from 0.84 to 0.032, 33 to 0.13, 18 to 0.36, 58 to 7.4, and 26 to 3.2 mg/kg, respectively. Groundwater amended with nitrate (10 mg/1 nitrate-nitrogen) and nutrients was then recirculated for 76 days. Final core concentrations of benzene, toluene, ethylbenzene, m,p-xylene, and o-xylene were 0.017, 0.036, 0.019, 0.059, and 0.27 mg/kg, respectively. Final aqueous concentrations were greater than 1 micrograms/1 for benzene and toluene, 6 micrograms/1 for ethylbenzene, and 20 to 40 micrograms/1 for the xylene isomers, in good agreement with predicted values based on residual fuel content and partitioning theory. Although alkylbenzene concentrations have been substantially reduced, the test plot is still contaminated with the weathered fuel. Based on stoichiometry, approximately 10 times more nitrate was consumed than could be accounted for by BTX degradation alone, indicating that other compounds were also degraded under denitrifying conditions.

Hutchins, S.R., S.W. Moolenaar, and D.E. Rhodes. 1992. Column studies on BTEX biodegradation under microaerophilic and denitrifying conditions. Environmental Protection Agency, Ada, OK. Robert S. Kerr Environmental Research Lab. Report No. PB-93-158962/XAB, 22p.
Key words: Biodegradation, Groundwater, Water Pollution, Hydrocarbons, Michigan, Oil Spills, Underground Storage, Monitoring
Two column tests were conducted using aquifer material to simulate the nitrate field demonstration project carried out earlier at Traverse City, Michigan. The objectives were to better define the effect nitrate addition had on biodegradation of benzene, toluene, ethylbenzene, xylenes, and trimethylbenzenes (BTEX) in the field study, and to determine whether BTEX removal can be enhanced by supplying a limited amount of oxygen as a supplemental electron acceptor. Columns were operated using limited oxygen, limited oxygen plus nitrate, and nitrate alone. In the first column study, benzene was generally recalcitrant compared to the alkylbenzenes (TEX), although some removal did occur. In the second column

study, nitrate was deleted from the feed to the column originally receiving nitrate alone and added to the feed of the column originally receiving limited oxygen alone. Although the requirement for nitrate for optimum TEX removal was clearly demonstrated in these columns, there were significant contributions by biotic and abiotic processes other than denitrification which could not be quantified.

Hutchins, S.R., D.H. Kampbell, M.L. Cook, F.M. Pfeffer, and R.L. Cosby. 1993. Combining treatability studies and site characterization for rational design of in situ bioremediation using nitrate as an electron acceptor. In: Proceedings of the Conference on Hazardous Waste Research, Boulder, CO., June 1-2, 1993, pp. 90-99.
Key words: Biodegradation, Groundwater, In-situ, Microcosms, Oil Spills, Pollution Control
Rational design relates laboratory treatability studies at field scale to the distribution of contaminants and to the residence time of remedial fluids. The electron acceptor is usually the limiting factor in bioremediation. Ideally, the electron acceptor should not be depleted as water or air moves across the region contaminated with oily phase material. When all of the contaminated mass receives adequate supplies of electron acceptor, the course of remediation should parallel that established in the laboratory study. If regions of the contaminated mass are not adequately supplied, the course of remediation at field scale is not predicted in any straightforward way from the laboratory study. Rational design compares the residence time and concentration of electron acceptor at field scale to the demand demonstrated for the electron acceptor in the laboratory to ensure that the engineered implementation of in situ bioremediation is adequate.

Hutchins, S.R.,Downs, W.C.,Smith, G.B.,Wilson, J.T.,Hendrix, D.J. Mar 1991. Nitrate for biorestoration of an aquifer contaminated with jet fuel. Rept. for Jun 88-Sep 90. 64(p).
Key Words: Benzene materials recovery, drinking water decontamination, ground water decontamination, jet engine fuels biodegration, tolune materials recovery, xylenes materials recovery, aquifers, nitrates, oil spills, remedial action, water pollution control, alkylated aromatics, chemical reactions, cleaning, control, decomposition, hydrocarbons

Hutchinson, J.D. 1989. Restoration and recovery. The Fate and Effects of Oil in Freshwater, pp. 227-257.
Key words: Remediation, Contamination, Control, Environmental Pollution, Biology, Real Time Monitoring

Hutchinson, Thomas C. 1979. Relationship of hydrocarbon solubility to toxicity in algae and cellular membrane effects. In: Proceedings of the 1979 Oil Spill

Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: hydrocarbon, toxicity, algae.

Hutchinson, T.C. and W. Freedman. 1975. Effects of experimental crude oil spills on Taiga and tundra vegetation of the Canadian Arctic. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: experimental, oil, Taiga, tundra, vegetation, Arctic.

Hutchison, John H. and Bernard L. Simonsen. 1979. Cleanup operations after the 1976 SS Sansinena explosion: an industrial perspective. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: cleanup, Sansinena, industrial.

Hwang, H.M., R.E. Hodson, and D.L. Lewis. 1989. Assessing interactions of organic compounds during biodegradation of complex waste mixtures by naturally occurring bacterial assemblages. Pub. in Environmental Toxicology and Chemistry, Vol. 8, No. 3, 209-214(Mar 1989).
Selected organic chemicals were tested to determine the minimum concentrations at which complete inhibition of microbial degradative processes occurred. Complete inhibition did not occur at less than 2 g/L phenol, 10 g/L toluene or n-butanol, and 100 g/L acetone, benzene or methanol. Consequently, microbial degradative processes may play a significant role in the abatement of even very high organic pollutant concentrations.
Glucose utilization and thymidine uptake rates were tested as indicative of the toxic effects of organic pollutants. Both methods accurately indicated the concentrations of organic pollutants required to cause cessation of degradative activities and could serve as indicators of degradative inhibition, in lieu of degradation studies, when analytical processes for test organics are expensive or unavailable. degradation kinetics of the high organic chemical concentrations followed typical multiphasic kinetic patterns, which tended to yield pseudo-first-order degradation rates over a wide range of chemical concentrations, except when chemical concentrations were sufficiently high to elicit metabolic inhibition.
Key words: aquatic organisms, microorganisms, biodegradation, industrial, tolerance, phenols, water pollution, methanol, acetone, benzene, butanols, lakes, metabolism, phenols.

Hyland, Jeffrey. 1989. Environmental effects of the Pac Baroness oil and copper spill. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: environmental, Pac Baroness, oil, spill.

Hyland, J.A., P.F. Rogerson, and G.R. Gardner. 1977. A Continuous flow bioassay system for the exposure
of marine organisms to oil. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control,
cleanup), March 8 10, New Orleans, LA.
Key words: flow, bioassay, marine, organisms, oil.

Hyland, John R. 1969. National multiagency oil and hazardous materials pollution contingency plan. In:
Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: pollution, contigency, oil.

Hyland, Jeffery L. and Don C. Miller. 1979. Effects of No. 2 fuel oil on chemically-evoked feeding behavior
of the mud snail, Ilyanassa obsoleta. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior,
control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil, chemically-evoked, feeding, snail, Ilyanassa obsoleta.

Hyung-min, Choi, and R.M. Cloud. 1992. Natural sorbents in oil spill cleanup. Louisiana state univ.
agricultural cent., school human ecology, Louisiana agricultural exp. stn.Baton Rouge LA 70803USA.
Environmental science & technology. 26(4):772-776.16 ref,
PSerial, Aanalytic, USA.
Milkweed (Asclepias) fiber and cotton fiber sorbed significantly higher amounts of crude oil than
polypropylene fiber and polypropylene web from the surface of an artificial sea water bath containing crude
oil and from a crude oil bath. Milkweed sorbed approximately 40 g of crude oil/g of fiber at room
temperature. The oil sorption capacity of kenaf
core material was comparable with that of polypropylene web with high-viscosity Bunker C oil. Only a slight
variation was observed in the oil sorption of the natural fiber sorbent by Soxhlet extraction and
water-soaking treatments before the sorption process.
Key words: water pollution, seawater, spill, crude oil, decontamination, pollution control, sorbent, natural
fiber, performance evaluation pollution eau, eau mer, deversement, petrole brut, decontamination, lutte
antipollution, sorbant, fibre naturelle, evaluation performance

Ibrahim, H., A. R. Loulou, A. Youssef, S. Nasri and T. Zaza. 1990. Remote sensing application for
environment in Syria. In: Proceedings of the 23rd International Symposium on Remote Sensing, Apr. 18 25,
Bangkok, Thailand. Environmental Research Institute of Michigan: Ann Arbor, MI, pp. 415 425.
Key words: Remote Sensing, Oil Leakage, Syria, Landsat TM
The environment of Syria is exposed to different types of pollution. Air is polluted by smoke and particles of
smoke produced from combustion processes in factories, furnaces, power generating stations, and vehicles'
exhausts. Streams and interior lakes are also exposed to

pollution due to the dumping of sewage and residuals of the factories constructed along the rivers and lakes. Besides, the Syrian coast is exposed to pollution caused mainly by oil slicks produced from oil refining, storing, and shipping. Special attention has been given to detect and monitor this pollution using R. S. techniques. CCTs of Landsat-5 (TM bands 1,2, and 6) were used to study the pollution along the Syrian coast. The digital processing (stretch enhancement and color coding) was carried out to enchance the sea water. B/W and color images were produced. These images were visually interpreted. In the images of bands 1 and 2 (the visible bands), a pollution plume is hardly detected due to the existing clouds. Whereas in the images of band 6 (thermal band), this plume is easily detected. The field trip to the coast showed that the plume is formed due to the sewage dumping, oil leakage and slicks, dust of phosphate shipping and cement industry. The applied techniques have proven the importance of R. S. to detect and monitor the pollution along the coasts. It emphasizes the suitability of thermal bands for similar studies.

Ichinose, Masaru, Yoshimatsu Echizenya, Mitsuhiro Kamata, Eiji Kawai, Norihisa Hiromoto, Seiho Uratsuka, and Masaharu Fujita. 1988. SIR-B experiments in Japan. II. surface activity. 1. sensor claibration experiment. a. disused akita airport test site. Journal of the Radio Research Laboratories (Japan). 35(Special Issue 2):3-10.
Key words: Remote Sensing, Water Pollution, Oil Spills
A sensor calibration experiment was proposed as part of SIR-B experiments in Japan, together with the rice crop experiment and the ocean oil-pollution detection experiment. This sensor calibration experiment was intended (1) to establish a transfer function from image data to radar backscattering characteristics, (2) to evaluate 3-dB resolutions, (3) to verify the ability to resolve two closely-spaced targets, and (4) to clarify sidelobe structures due to range and azimuth compressions. The disused Akita Airport was chosen as the main test site for the calibration experiment on the first three objectives. This paper describes the test site, the design of the corner reflectors, and briefly predicts the results. (Author abstract) 10 refs.

IEEE Service Center. 1987. IGARSS '87, volume 1, remote sensing: Understanding the earth as a system. In: Proceedings of the IGARSS '87: international geoscience and remote sensing symposium - understanding the earth as a system, May 18 1987, Ann Arbor, MI, pp. 1625.
Key words: Earth Atmosphere, Remote Sensing, Oil Spills, Biological Effects, Air Pollution, Water Pollution
This book collects papers given at a conference on remote sensing. Topics include side-looking airborne radar, air and water pollution, aerial monitoring of oil spills, and remote detection of pollution effects on

vegetation.

Ignasiak, T., C. Kulik, K. Szymocha, D. Carson, and B. Ignasiak. 1991. Clean Soil Process...Treatment of oily/tarry wastes. In: Proceedings of the AWMA 84th Annual Meeting, June 16 21 1991, Vancouver, B.C., Proceedings 11:N.91-17.6, 11P.
Key words: Accuracy, Alberta, Aromatic Hydrocarbon, Crude Oil, Economic Factor

Ignasiak, T., K. Szymocha, W. Pawlak, D. Carson, and B. Ignasiak. 1990. Clean-up of soil contaminated with tarry/oily organics. In: Proceedings: Fourteenth annual EPRI conference on fuel science, May 18 19 1989, Palo Alto, CA, pp. 13.1-13.10.
Key words: Coal, Soils, Decontamination, Chemical Composition, Oil Spills, Petroleum Products
This paper summarizes the results of batch-scale studies on clean-up of soils contaminated with tarry/oily organics. The clean-up process utilizes coal as a cleaning agent, and is based on the principles of oil agglomeration with tarry/oily contaminants acting as the bridging liquid. On the basis of sample evaluation, it is concluded that the outlook for commercialization of the process is promising.

Ignasiak, T., A.A. Turak, W. Pawlak, B.L. Ignasiak, and C.R. Guerra. Method of Recovery of Hydrocarbons from Contaminated Soil or Refuse Materials Patent No.2018121, p 12/2/90, f 6/1/90, pr US 6/2/89 (Appl 360313) (B03b-009/02; b03d-001/02; b03d-001/001) (21 pp; 10 claims)
Key words: soil remediation, business operation, coal, contamination, environmental pollution, flotation, gravitational separation, oil spill, physical separation, remediation, salvaging, soil pollution, waste oil recovery, p) Canada, additive, adsorbent, adsorption, air injection, Alberta Research Council, bitumen, char, cleaning

Iguchi, T. and I. Hideyuki. 1988. SIR-B experiment in Japan. iv. experimental results. 3. oil pollution experiment. Journal of the Radio Research Laboratories (Japan) 35(2 Mar):85 104.
Key words: Water Pollution, Oil Spills, Remote Sensing, Synthetic Aperture Radar
During the Shuttle Imaging Radar (SIR-B) mission in October 1984, Synthetic Aperture Radar images were taken off the coast of Japan. An artificial oil slick was produced within the SAR swath to investigate its effect on the backscattered signal. Not only the slick but also the long-wave pattern was visible in the images. Image data were anayzed to examine how well wave spectra could be deduced from them and how much the oil slick reduced the backscattered signal. Wave spectra derived from SIR-B images were compared with simultaneous wave-buoy observations. Waves at the time of flight were nearly

perpendicular to the SAR flight direction,
and were composed of two major systmes: a swell of about 200-m
wavelength and wind waves with 70-m
wavelength.

Ijah, U.J.J., and L. Ukpe. 1992. Biodegradation of crude oil by
Bacillus strains 28A and 61B isolated from oil
spilled soil. Waste management. 12(1): 55-60.
Key words: petroleum, biodegradation, bacillus, soil pollution,
spill, hydrocarbon, optimization, nitrogen,
microorganism growth.

Illman, Deborah L. 1993. Hazardous waste treatment using fungus
enters marketplace. Chem Eng News.
71(28):26 29.
Keywords: biodegradation
White rot fungus, +i Phanerochaete chrysoporium+r , secretes
enzymes that break down wood lignin into
carbon dioxide and water. The fungus also indiscriminately
mineralizes herbicides, creosote, coal tars, and
heavy fuels in the process. The commercial application of the
fungus in bioremediation projects is under
study at several sites. The fungus is cultivated on wood chips,
which are then applied to contaminated soil.
Hyphae grow from the chips into the soil, where they transform
hazardous chemicals to harmless products.
Although laboratory results have been promising, the application
of the fungus into a field environment has
not been perfected.

Imbach Biological Services Ltd. 1989. New answer to oil spills.
Marine Pollution Bulletin. 20(12):637.
Key words: Animal, Bacteria, Biochemical Reaction,
Biodegradation, Crude Oil, Pollution Control

Imbrie, Lt. Cdr. Robert J. and Kirk R. Karwan. 1979. Computer
searching for pollution cleanup equipment.
In: Proceedings of the 1979 Oil Spill Conference (prevention,
behavior, control, cleanup), March 19 22, Los
Angeles, CA.
Key words: computer, pollution, cleanup, equipment.

IMO. 1991. IMO (Persian) Gulf clean-up funds run low. Marine
Pollution Bulletin 22(10):480.
Key words: Animal, Boom, Coastal Area, Diaster Control, Economic
Factor, Pollution Control

Indergard, Lantz M., and Edward F. Hagan. 1991. Geophysical and
bail-down test investigation of capillary
fringe free phase hydrocarbons. Ground Water. 29(5):755.
Key Words: Ground water, pollution, well-logging, monitoring,
radioactivity, applications, oil spills,
hydrocarbons, organic materials, capillary fringe, neutron
methods.

Inkster, D.R., J.R. Rossiter, R. Goodman, M. Galbraith, J.L.
Davis. 1989. Ground penetrating radar for

subsurface environmental applications. Proceedings of the Thematic Conference on Remote Sensing for Exploration Geology. 7:127-140.
Key words: Pollution, Geophysical Methods, Radar, Hydrocarbons, Oil Spills

Installation Restoration Program Toxicology Guide. Volume 3. June 1987. Little (Arthur D.), Inc., Cambridge, MA (USA). 562.
Key Words: Drinking water-water pollution, ground water-water pollution, military facilities oil spills, military facilities waste disposal, oil spills water pollution, petroleum products water pollution, waste disposal water pollution, water pollution health hazards, hazardous materials, laboratories, toxicity, water wells, hydrogen compounds, oxygen compounds, waste management.

International Tanker Owners Pollution. Busy (Oil Spill-Response) year for ITOPF (International Tanker Owners Pollution Federation). Mar. Pollut. Bull. 19(5):195-96.
Key words: Accident, Additive, Bulk Carrier, Damage, Economic Factor, Pollution Control

International Journal of Remote Sensing. 1991. European symposium on the role of aerospace technology in oceanology. In: Proceedings of the European Symposium on the Role of Aerospace Technology in Oceanology, November 28 December 1 1988, Valletta, Malta, Publ by Taylor & Francis, New York, NY, pp. 667-871.
Key words: Remote Sensing, Water Pollution, Oil Spills, Marine Biology
This issue of the journal contains 14 papers. Topics covered include: tracking of marine animals by satellite; an objective analysis scheme for AVHRR imagery; AVHRR visible - IR detection of diurnal warming events; multi-temporal water depth mapping by means of landsat TM; aero-spatial remote sensing as catalyst of an operational marine fishery (halieutic) science; measurement of suspended particulate concentrations from remotely sensed data; optical pay load of second - generation METEOSTAT; ROSIS imaging spectrometer and its potential for ocean parameter measurements; forecasting models for tuna fishery; and, marine remote sensing information system. Individual papers are abstracted and indexed separately.

Intevep, S.A. Improved floating barriers for containing oil spills, have double PVC coated containment skirts of woven nylon thread with low density polyurethane foam floats. Patent No. US 393931_890815.
Key words: Activity, Boom, Chlorohydrocarbon, Corrosion Control, Oil Waste, Pollution Control

Irons, Denis E. 1973. Case studies of the USN supervisor of salvage, salvage related oil pollution incidents. In: Proceedings of Joint Conference on Prevention and Control of

Oil Spills, March 13 15, Washington, D.C.
Key words: USN, salvage, oil, pollution.

Isaac, R.A., E.R.F. Lord. Evaluation of the operating characteristics of a shovel and truck fleet on the clearwater formation overburden. In 4th UNITAR/UNDP Et Al Heavy Crude & Tar Sands Int Conf
(Edmonton, Can, 8/7 12/88) Preprints in Year.
Key words: oil, mining, Canada, oil, disposal, petroleum

Israel, S.A., M.E. Duncan, W.R. Johnson, V.S. Whitehead. 1991. Observations and analysis of oil spills
using polarized imagery. In: Proceedings of the eighth thematic conference on geologic remote sensing, April
29 May 2 1991, Denver, CO, pp. 945-954.
Key words: Barges, Leaks, Oil Spills, Remote Sensing, Pollution Control
On Saturday, July 28, 1990, a train of barges collided with the Greek tanker Shinoussa in Galveston Bay off
Red Fish Island near Texas City, Texas. The first barge sank and the second began to leak while the third
barge in the chain and the Shinoussa both escaped without damage. The NASA Flight Science Support Office
sponsored a Graduate Student from SUNY - College of Environmental Science and Forestry and a student
from Texas A M, Galveston, to survey the damage. The purpose of this paper is to correlate aircraft base data
with orbital data obtained during the Space Shuttle Polarization Experiment and existing laboratory data to
evaluate the potential for an application such as oil spill monitoring and mapping. NASA has no charter with
the local response agencies to support oil spill monitoring and cleanup.

Ivancic, William A., Russell H. Barnes, Daniel R. Grieser, Gilbert Addis. 1990. PCB/mineral oil spill outline
fluorescence video monitor. Proc. Am. Power Conf. 52,1:446-8.
Key words: spectrochemical analysis, fluorometric, accidental spill detection, transformer oil contg.
polychlorinated biphenyls, hygiene, industrial

Jackson, R.E., M.W. Priddle, and S. Lesage. 1990. Transport and fate of CFC-113 (1,1,2-Trichloro-
1,2,2,-Trifluoroethane) in ground water. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in
Ground Water : Prev, Detection, & Restoration Conf, October 31 November 2, 1990, Houston, TX. Ground
Water Manage No 4:129 142.
Keywords: biodegradation, California, Canada, disposal, soil pollution, underground storage facility, waste
disposal

Jackson, Lynette Francis and Steven Richard Lipschitz. 1985. Sensitivity mapping: an aid to contingency
planning on southern African shores. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior,
control, cleanup), February 25 28, Los Angeles, CA.

Key words: sensitivity, mapping, contingency, African, shores.

Jackson, J., N. Thomey, and L.F. Dietlein. 1992. Degradation of hydrocarbons in soil samples analyzed within accepted analytical holding times. In: Proceedings of the 5. national outdoor action conference on aquifer restoration, ground water monitoring, and geophysical methods, May 13-16, 1991, Las Vegas, NV, pp. 567-576.
Key words: Hydrocarbons, Decomposition, Soil Pollution, Oil Spills, Monitoring
Samples which are collected in conjunction with subsurface investigations at leaking petroleum storage tank sites and petroleum refineries are routinely analyzed for benzene, toluene, ethylbenzene, xylenes (BTEX), and total petroleum hydrocarbons (TPH). Water samples are preserved by the addition of hydrochloric acid and maintained at four degrees centigrade prior to analysis. This is done to prevent bacterial degradation of hydrocarbons. Chemical preservation is not presently performed on soil samples. Instead, the samples are cooled and maintained at four degrees centigrade. This study was done to measure the degree of degradation of hydrocarbons in soil samples which are analyzed within accepted holding times. Soil samples were collected and representative subsamples were prepared from the initial sample. Subsamples were analyzed in triplicate for BTEX and TPH throughout the length of the approved holding times to measure the extent of sample constituent degradation prior to analysis. Findings imply that for sandy soils, BTEX and TPH concentrations can be highly dependent upon the length of time which elapses between sample collection and analysis.

Jackson, Jr., Roy D. 1975. Offshore oil pollution: law and enforcement. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: offshore, oil, pollution, enforcement.

Jacobs, James A., R. Traver, and O.T. Jacobs. 1991. Overview of environmental investigations and remediations of leaks and spills in oil and gas fields. AAPG Bulletin. 75(3):601.
Key Words: Reclamation, environment, oil spills, environmental geology, oil and gas fields, pollution, soils, water quality, hazardous materials, history, ground water, regulations, practice.

Jacobson, A. 1993. Automatic detection system of oil spillage into sea waters. Patent No. US 5208465930504.
Key words: Hydrocarbon, Contamination, Oil Spill, Water Pollution, Pollution Control Equipment

Jacobssen, Mans. 1987. The Notion of Pollution Damage, with

particular regard to damage to the marine
environment. In: Proceedings of the 1987 Oil Spill Conference
(prevention, behavior, control, cleanup), April
6 9, Baltimore, MD.
Key words: pollution, damage, marine, environment.

Jacobsson, Mans. 1991. Future of the International Conventions on
Liability and Compensation for Oil
Pollution Damage. In: Proceedings of the 1991 Oil Spill
Conference (prevention, behavior, control, cleanup),
March 4 7, San Diego, CA.
Key words: international, conventions, compensation, oil
pollution.

Jacobsson, Mans. 1993. The Rio Orinoco and the Haven: two major
cases from a legal point of view. In:
Proceedings of the 1993 Oil Spill Conference (prevention,
preparedness, response), March 29 April 1,
Tampa, FL.
Key words: Rio Orinoco, Haven.

Jacobsson, Mans. 1989. The International oil pollution
compensation fund: ten years of claims settlement
experience. In: Proceedings of the 1989 Oil Spill Conference
(prevention, behavior, control, cleanup),
February 13 16, San Antonio, TX.
Key words: oil, pollution, compensation, claims.

Jadamec, M.P., and J.W. Johnson. 1992. Alarming oil spills...with
a Fluorometer. Sea Technol.
33(9):67-68,70-71.
Key words: environment, transport & storage, health, water
pollution control

Jadamec, J. Richard. 1983. A Portable instrument for screening
spill and source oil samples. In: Proceedings
of the 1983 Oil Spill Conference (prevention, behavior, control,
cleanup), February 28 March 3, San
Antonio, TX.
Key words: screening, spill, oil.

Jaffe, P.R., S.W. Taylor, N.H. Baek, P. Christopher, and D.
Milly. 1988. Biodegradation of trichloroethylene
and biomanipulation of aquifers. Technical report (Final).
Princeton Univ., NJ (USA). Dept. of Civil
Engineering and Operations Research. 198.
Three distinct aspects of the biodegradation process in a porous
media were addressed. The effect of the
trichloroethylene(TCE) concentration on bacterial activity was
investigated. The results showed that the
dissolved-phase concentration directly affects the bacterial
activity. For aerobic soils, LD50 for water
concentrations ranged between 200-300 mg/l for CO/sub 2/
evolution, and 80 to 150 mg/l fordehydrogenase
activity. The degradation of TCE and its intermediates by mixed
cultures containing fermenters and
methanogens was investigated. Results showed that fermenters play

an important role in this process and that
the degradation rate correlates with the methanogenic activity.
It was shown that TCE can be degraded by
these mixed cultures via 1,1-dichloroethylene to vinyl chloride,
to chloroethane which is readily degradable.
Kinetic rates were obtained for this degradation process and
normalized with respect to the methane
production. The effect of biomass production in porous media on
the permeability and dispersivity was
investigated. Experimental results showed that the permeability
of a sandy media depends on the biomass if
the biomass is less than 0.4 mg of organic carbon/cu cm, and
becomes independent of the biomass for higher
values. Changes in permeability and dispersivity as a function of
the biofilm thickness were modeled
successfully using a modified cut-and-random-rejoin-type model.
Key words: aquifers, water pollution, ground water, hydrocarbons,
soils, toxicity, water supply, methanogenic
bacteria, biodegradation, permeability.

Jagger, H. 1969. United Kingdom oil industry research and plans
to deal with sea pollution by oil. In:
Proceedings of Joint Conference on Prevention and Control of Oil
Spills, December 15 17, New York, NY.
Key words: United Kingdom, oil, sea pollution.

Jahns, H.O., J.R. Bragg, L.C. Dash, and E.H. Owens. 1991. Natural
cleaning of shorelines following the
Exxon Valdez spill. In: Proceedings of the 12th Bien API et al
Oil Spill (Prev, Behav, Contr, Cleanup) Int
Conf, March 4 7 1991, SanDiego, CA, pp. 167-176.
Key words: Natural Remediation, Alaska, Beach, Cleaning, Oil
Spill, Biodegradation, Bioremediation,
Contamination, Environmental Pollution

Jain, D.K., Lee Hung, and J.T. Trevors. 1992. Effect of addition
of Pseudomonas aeruginosa UG2 inocular or
biosurfactants on biodegradation of selected hydrocarbons in
soil. Journal of industrial microbiology.
10(2):87-93.
Key words: Biodegradation, Hydrocarbon, Pollutant, Soils,
Bacteria

James C. Clow, Lt. Cdr. 1979. The National response center of the
U. S. coast guard. In: Proceedings of the
1979 Oil Spill Conference (prevention, behavior, control,
cleanup), March 19 22, Los Angeles, CA.
Key words: response, center, Coast Guard.

James R. Asker. 1992. Commercial Remote Sensing Faces Challenges
on Three Fronts. Aviation Week &
Space Technology. 137(2):57.

Janiyani, K.L., S.R. Wate, and S.R. Joshi. 1993. Morphological
and biochemical characteristics of bacterial
isolates degrading crude oil. J Environ Sci Health-Environ Sci
Eng. A28(6):1185-1204.

Key words: Bacteria, Biodegradation, Microorganism, Degradation, Hydrocarbons, Soil Contamination, Oil Spills
Soil that had been contaminated with crude oil for 1 yr was collected from the Gandhar oil field, in India, and used as the enrichment inoculum source for hydrocarbon degrading bacteria. The ability of the inoculum to degrade pure hydrocarbons, consisting of a series of compounds from heptane to octacosane, and a model petroleum mixture of ten pure hydrocarbons, as well as crude oil collected from the oil field was measured. The hydrocarbon degrading bacteria were generally motile rods that were positive in catalase and cytochrome oxidase tests. All but one of the 11 isolates were gram-negative. Four bacterial species were positively identified as efficient degraders of all the types of hydrocarbons tested. These were Pseudomonas stutzeri, P. aeruginosa, P.fluorescens, and Bacillus cereus.

Janiyani, K.L., S.R. Wate, S.R. Joshi. Solubilization of hydrocarbons from oil sludge by synthetic surfactants. Journal of Chemical Technology and Biotechnology, Chemical Technology (1993): 56
Key words: bacteria, hydrocarbons
The solubilization of hydrocarbons by the addition of Tween-80 is investigated. The degree of solubilization and the effects of agitation, contact time, and pH are examined. The results show that a significant increase in solubility can be achieved at a 1:10 ratio of sludge to surfactant. Hydrocarbon-utilizing bacteria now can use the hydrocarbons effectively in water suspension.

Janssen, John H. and Douglas L. Kane. 1987. The Underground oil spill at Kotzebue, Alaska: unknown cause, elusive cure. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: underground, oil, Alaska.

Janssen, D.B. 1989. Cloning of 1,2-dichloroethane degradation genes of xanthobacter-autotrophicus GJ10 and expression and sequencing of the dhlA gene. Journal of Bacteriology. (1989): 171(12).
Key words: degradation, hydrocarbon, bacterium
A gene bank from the chlorinated hydrocarbon-degrading bacterium Xanthobacter autotrophicus GJ10 was prepared in the broad-host-range cosmid vector pLAFR1. By using mutants impaired in dichlorethane utilization and strains lacking dehalogenase activities, several involved in 1,2-dichloroethane metabolism were isolated. The haloalkane dehalogenase gene dhlA was subcloned, and it was efficiently expressed from its own constitutive promoter in strains of a Pseudomonas sp., Escherichia coli, and a Xanthobacter sp. at levels up to 30% of the total soluble cellular protein. A 3-kilobase-pair BamHI DNA fragment on which the dhlA gene is localized was sequenced. The haloalkene dehalogenase

gene was identified by the known
N-terminal amino acid sequence of its product and found to encode
a 310-amino-acid protein of molecular
weight 35,143. Upstream of the dehalogenase gene, a good
ribosome-binding site and two consensus E. coli
promoter sequences were present.

Janssen, D.B. 1988. Purification and characterization of a
bacterial dehalogenase with activity toward
halogenated alkanes alcohols and ethers. European Journal of
Biochemistry. (1988): 171(1 2).
Key words: hydrocarbons, bacterium, degradation
An enzyme that is capable of hydrolytic coversion of halogenated
aliphatic hydrocarbons to their
corresponding alcohols was purified from a
1,6-dichlorohexane-degrading bacterium. The dehalogenase was
found to be a monomeric protein of relative molecular mass 28000.
The affinity for its substrates was
relatively low with Km values for short-chain haloalkanes in the
range 0.1 0.9 mM. The aliphatic
dehalogenase showed a much broader substrate range than has been
reported for halidohydrolases so far.
Novel classes of substrates include dihalomehtanes, C5 C9
1-halo-n-alkanes, secondary alkylhalides,
halogenatd alcohols and chlorinated ethers. Several of these
compounds are important enviroment pollutants,
e.g. methylbromide, dibromomethane, 1,2-dibromoethane,
1,3-dichloropropene, and bis(2-chloroethyl)ether.
The degradation of chiral 2-bromoalkanes appeared to proceed
without stereochemical preference. Optically
active 2-bromobutane was converted with inversion of
configuration at the chiral carbon atom, suggesting
that the dehalogenase reaction proceeds by a nucleophilic
substitution involving a carboxyl group or base
catalysis.

Janssen, D.B., G. Grobben, R. Hoekstra, R. Oldenhuis, B. Witholt.
1988. Degradation of
trans-1,2-dichloroethene by mixed and pure cultures of
methanotrophic bacteria. Appl. Microbiol.
Biotechnol.(Germany, Federal Republic of). 29:4:392-399.
Out of seven chlorinated aliphatic hydrocarbons tested, only
trans-1,2-dichloroethene was relatively non-toxic
for a mixed methanotrophic culture. The compound was degraded at
a rate of 0.4..mu.mol/mg protein.h/sup
-1/ and liberation of inorganic chloride was observed.
Trans-2,3-dichlorooxirane was formed as an
intermediate which was converted further only by chemical
transformation with a half life of 31 h. From the
consortium, a pure culture was isolated and found to be capable
of degradation of trans-1,2-dichloroethene
when grown in the presence of methane or methanol. The ability of
cometabolic degradation of this
compound was not specific for this isolate, since Methylomonas
methanica NCIB11130 and Methylosinus
trichosporium OB3b also showed degradation of
trans-1,2-dichloroethene when grown with methane as sole

carbon source.
Key words: chlorinated aliphatic hydrocarbons, cell cultures, methanotrophic bacteria, chemical analysis, organic compounds, toxicity, culture media, environmental effects, biodegradation.

Janssen, D.B., R. Oldenhuis, A.J. van den Wijngaard. 1989. Degradation of xenobiotic compounds by microorganisms.
Biological waste gas purification. Practical experience and new developments. Proceedings. Colloquium and poster session on biological waste gas purification: practical experience and new developments. 735. 25-39.
To achieve biological removal of potentially harmful chemicals from waste gas, it is necessary that the compounds of interest are biodegradable by microorgansims that can be stably maintained in a suitable treatment system. Many bacterial cultures that degrade volatile organics and use these as carbon source for growth have been isolated and investigated. Even for xenobiotic compounds such as the chlorinated aliphatic hydrocarbons, which are often assumed to be poorly degradable, specialized bacterial cultures that give degradation have been obtained. The increased knowledge about the metabolism of chlorinated compounds and the mechanisms involved in dehalogenation help to understand why compounds with only slight differences in structure may vary strongly in their susceptibility to microbial turnover, and what strategies should be followed to obtain improved degradation. One possibility to achieve degradation of otherwise recalcitrant compounds is to use methanotrophic bacteria that can cooxidize several chlorinated hydrocarbons that do not support bacterial growth. degradation is strictly cometabolic, however, requiring the presence of another oxidizable substrate.
Key words: gaseous wastes, purification, biochemical reaction kinetics, dechlorination, methanotrophic bacteria, wastes, organic chlorine compounds, pseudomonas, dehalogenation, microorganisms, reaction kinetics.

Jansson, B., and J. Johansson. 1991. Sweden seeking new technology to combat oil spills. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp. 667-71.
Key words: Atmospheric Deposition, Crude Oil, Diaster Control, Economic Factor, Pollution Control

Jardim, George M. 1991. Improving Chevron's oil spill prevention, preparedness, and response capabilities.
In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: Chevron's, oil spill, prevention, preparedness, response.

Jardin, George M. and Henry J. McDermott. 1993. Organizing company specialists for rapid and effective response. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: specialists, rapid, response.

Jason, N.H. 1989. In: Proceedings of the Alaska Arctic Offshore Oil Spill Response Technology Workshop, November 29 December 1 1988, Anchorage, Alaska, 211 pp.
Key words: Offshore drilling, Oil Pollution, Alaska, Water Pollution
The Proceedings of the Alaska Arctic Offshore Oil Spill Response Technology Workshop contains papers by keynote speakers on the following topics: Mechanical Containment and Recovery; Chemical Treatment; In-Situ Burning; Readiness; the Technology Assessment and Research Program and the OHMSETT Program; the Arctic and Marine Oil Spill Program; the Canadian Environmental Science Revolving Fund; the Alaskan Clean Seas Research and Development Program; the NOFO Program. These papers served as a stimulus to the discussions that followed in the various Panel sessions. The Panels were organized into broad research areas: Mechanical Containment; Mechanical Recovery; Chemical Treatment; In-Situ Burning; Readiness. Each Panel summary is included in the Proceedings and these recommendations reflect the combined input from experts in the field. The Proceedings will serve as a working document to the Minerals Management Service (MMS) to identify their future research program.

Jayko, K., M.L. Spaulding, E. Howlett, W. Knauss, T. Isaji, E.L. Anderson, R. Goodman, and B. McKenzie. 1991. Personal computer oil spill response model: canadian beaufort sea. In: Proceedings of the 12th Bien API et al oil spill (Prev, Behav, Contr, Cleanup) INT conf, March 4 7 1991, San Diego, CA, pp. 607 618.
Key words: Oil Spill, Contamination, Petroleum

Jeffery, A.M. 1973. Large-scale experiments on the spreading of oil at sea and its disappearance by natural factors. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: experiments, oil, sea.

Jeffery, P.G. 1971. Development of test procedures for the assessment of efficiency in beach cleaning. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: test, assessment, beach, cleaning.

Jenkins, J.T. Oil recovery system with inflatable boom wall and inflatable storage tanks, has oil catchers

adjacent to each tank with some attached to boom wall and others being free-floating attached to tanks by flexible lines. Patent No. US 596779_901012.

Jenkins, M.B., and L.W. Lion. 1993. Mobile Bacteria and transport of polynuclear aromatic hydrocarbons in pourus media. Appl Environ Microbiol. 59(10):3306-3313.
Key words: Aromatic Hydrocarbon, Bacteria, Contamination, Ecology, Oil Spill, Pollution Control

Jensen, J. R., E. W. Ramsey III, J. M. Holmes, J. E. Michel, B. Savitsky, and B. Davis. 1990. Environmental Sensitivity Index (ESI) Mapping for Oil Spills Using Remote Sensing and Geographic Information System Technology. Int. J. Geogr. Inform, Syst. 4(2):181 201.
Key words: Oil Spills, Water Pollution, Mapping, Remote Sensing, Contingency Planning

Jensen, John R., Sunil Narumalani, Oliver Weatherbee, Jacqueline Michel, Miles O. Hayes, Maylo Murday, Walter J. Sexton, Bruce Davis, A. Green, and J. Colin. 1992. Utilization of remote sensing and GIS technologies for oil spill planning and response: Case studies in Florida, United Arab Emirates, and Saudi Arabia. In: Proceedings of the 1st Thematic Conference on Remote Sensing for Marine and Coastal Environments, New Orleans, LA, 1930(1):145 158.
Key words: Oil Spills, Remote Sensing, Informational Retrieval Systems
In March 1989 and January 1991, the world witnessed severe ecological impacts caused by two major oil spills. These spills have increased concern among nations to have systems in place which can provide information to oil-spill response coordinators on the environmental sensitivity of the potential areas of impact. Such information can be used to ensure prompt action, thus minimizing the adverse effects on human activities as well as the environment. Environmental sensitivity mapping, through the integration of remote sensing and GIS technologies, can aid in the development of a comprehensive computerized database that can be readily accessed by personnel in charge of clean-up operations. This paper describes case studies for Florida and the United Arab Emirates (UAE), where remote sensing has been used to map the environmental sensitivity of these areas. These data are then input into a GIS where they can be readily queried to provide information for oil-spill planning and response activities. The same technologies can also be used to identify environmental degradation resulting from oil spills as is demonstrated by a case study for Saudi Arabia.
(Author abstract) 15 Refs.

Jensen, Capt. Donald S. and Lt. Cdr. Peter A. Tebeau. 1991. Coast Guard research and devlopment for the 1990s. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7,

San Diego, CA.
Key words: Coast Guard, research, development.

Jensen, LCDR D. S. 1975. Energy dissipative devices to control oil slicks in fast current environments. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: dissipative, control, oil, slicks.

Jensen, Commader Donald S. 1981. U.S. Coast Guard Atlantic Strike Team training program. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA. American Petroleum Institute: Washington, D.C. pp. 103 108.
Key words: Coast Guard, Atlantic.

Jensen, Capt. D.S., Cdr. R. Pond, and Cdr. M.H. Johnson. 1993. Response to a spill of national significance. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: response, spill.

Jerbo, Allan. 1973. Two types of oil spills in Swedish inland waters: tests of new materials, ideas and methods. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil, spills, Swedish, waters.

Jerry N. Nwankwo, Jacqueline Michel, and Maylo Murday. 1987. Environmental baseline studies for oil pollution control in Nigeria. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: environmental, baseline.

Jewell, W.J., Y.M. Nelson, D.E. Fennell, S. Underhill, and M.S. Wilson. 1990. Methanotrophs for biological pollution control: Feasibility of developing an attached microbial-film reactor and kinetics of TCE removal. Final report, July 15, 1987-March 31, 1989. Phase 1 and Phase 2. New York State Coll. of Agriculture and Life Sciences, Ithaca, NY (USA). Dept. of Agricultural and Biological Engineering. 238.
The group of aerobic bacteria that use methane gas as an energy source grow rapidly and have simple nutrient requirements. They have been shown to be capable of biodegrading a wide range of toxics. The two-phase effort defined the potential for combining a high rate attached film reactor, the expanded bed (MAFEB), with applications for trichloroethylene (TCE) and nutrient removals from wastewater. The MAFEB reactor resulted in a highly stable biological reactor capable of operating at hydraulic retention times of several minutes. The methanotrophic films were thin and dense, especially

for an aerobic system. Microbial film densities exceeded 100 gVS per liter of attached film and the concentration of microorganisms exceeded 25 gmVS per liter of expanded bed reactor. TCE degradation kinetics were examined in numerous batch trials. The degradation rates approach the higher literature values of 20 mg/gVS-d, with resulting maximum removal rates of 800 mg TCE/L-d. A relatively high value of KS of 3 mgTCE/L was estimated. The use of the MAFEB system was tested for potential use as a tertiary treatment system. Denitrification was not found to occur at measurable levels with methane as an energy source. Nutrient assimilation via cell yield showed promise as a method to remove dissolved nitrogen and phosphorus from wastewater.
Key words: bacteria, growth, chlorinated water, biodegradation, catabolism, aerobic, denitrification.

Jewell, W.J., D.E. Fennell, Y.M. Nelson, S.E. Underhill, T.E. White. 1991. Methanotrophs and methanogens for pollution control: PCE, TCE removal from ground water and macro-nutrient removals from waste water. Annual report, April 1, 1989-March 31, 1990. Cornell Univ., Ithaca, NY (United States). 275.
The study is the second phase of a large effort to utilize aerobic bacteria that use methane gas as an energy source to degrade toxics often found in contaminated groundwater. The focus of the effort was on the attached microbial film expanded bed reactor as a bioreactor that would accumulate large concentrations of bacteria. During the past year, most experiments included continuously flowing bioreactor parametric definition at 35 C with trichloroethylene. Earlier work had defined good potential for the methanotrophic attached film expanded bed (MAFEB) for establishing high microbial concentrations that would enable high flow rate treatment of water. It was found that the maximum specific substrate removal rate was 0.54 mgTCE/gVS-d and the half rate coefficients, K(sub s), was 3.7 mgTCE/L. These values were similar for batch and continuous operations with slightly lower K(sub s) values determined for the continuous operations. The relatively high value of K(sub s) indicates that the methanotrophic system has some difficulty rapidly degrading TCE. For this reason, an anaerobic first stage system was considered. This was tested and found to be feasible with the degradation rates greater than 100 times that of the methanotrophic system. The disadvantage of the AAFEB using the methanogenic system was that the final product was vinyl chloride. This was found to be rapidly degraded by the MAFEB step.
Key words: chlorinated aliphatic hydrocarbons, ground water, growth, environmental effects.

Jian-er, Lin, H.Y Wang, and R.F. Hickey. 1991. Use of coimmobilized biological systems to degrade toxic organic compounds. Biotechnology and bioengineering. 38(3):273

279
Keywords: toxic, biodegradation
The concept of coimmobilizing cell mass (and/or enzyme) and adsorbent in a hydrogel matrix for biodegradation of toxic organic chemicals was introduced. Under defined experimental conditions, the coimmobilized system using activated carbon and Phanerochaete chrysosporium was compared with nonimmobilized systems for the degradation of pentachlorophenol (PCP). It was demonstrated that the coimmobilized system degraded PCP more effectively than the nonimmobilized system. A solid substrate included in the coimmobilized system could support the biodegradation.

Jin, Derong. 1988. The GWL series of oil booms and their applications. Mar. Sci. Bull. 1(2):243-246.
Key words: Floating Barriers, Performance Assessment, Oil Removal, Oil Pollution, Pollution Control, Oil Spills
Some properties of the (GWL) series of oil booms produced by the Qinhuangdao Environmental Protection Equipment Plant are described and their applications to the interception of spilled oil in seas and rivers, enclosing oil tankers in harbours and protecting bathing beaches and fish farms are discussed. These oil booms have the advantages of great strength, small storage volume, high stability, excellence in riding waves and ease of handling.

Johannessen, J. A., L. P. Roed, O. M. Johannessen, G. Evensen, B. Hackett, L. H. Pettersson and P. M. Haugan. 1993. Monitoring and modeling of the marine coastal environment. Photogrammetric Eng. & Remote Sens. 59(3):351.
Key words: Monitoring, Remote Sensing, Pollution Forecasting, Infrared Sensing, Algal Blooms, Oil Spills
The need for closer monitoring of coastal areas that are particularly susceptible to pollution is being addressed by a Norwegian modeling program. The system under development combines atmospheric and oceanic models that use field and remote sensing data to predict unexpected pollution events such as oil spills and algal blooms. The models are validated by infrared and synthetic aperture radar remote observations. Examples of the system in operation include forecasting of a toxic algal drift and water quality modeling of a Norwegian fjord.

Johansen, Oistein. 1987. DOOSIM: a new simulation model for oil spill management. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: DOOSIM.

Johnson, P.C., and D.A. Weingaertner. 1993. In-Situ Thermal Desorption of Contaminated Surface Soil.

Patent No. US 5193934, c 3/16/93, f 5/23/91 (Appl 705712),6 pp.
Key words: soil remediation, air injection, blanketing, gas injection, heating, injection, oil spill, piping system, remediation, system (assemblage), p) USA, absorption, activated charcoal, adsorbent, adsorption, carbon, catalysis, catalyst, charcoal, chart, chemical process, combustion, condensation, containment, contamination

Johnson, L.A. Jr., and B.C. Sudduth. 1989. Contained recovery of oily waste. Patent No. US 4848460890718, 12p.
Key words: Waste Oil Recovery, Groundwater, Salvaging, Water Pollution, Bacteria, Biodegradation, Oil Spill

Johnson, Walter R. and Robert P. LaBelle. 1991. Comparison of modeled Lagrangian trajectory statistics. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: Lagrangian, trajectory, statistics.

Johnson, Lt. Richard C. 1993. The National response system: where do we go from here? In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: response.

Johnson, Richard A., Lewis R. Brown, and W. Graham Wells. 1979. The Tidal simulation system for estuarine ecosystem research. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: tidal, estuarine.

Johnson, W. B., Jr., and K.V.B. Jennings. 1990. Evaluating the effectiveness of corrective actions involving groundwater. Soc. Pet. Eng., Richardson, TX, United States. 407-418.
Key Words: Ground water, pollution, water treatment, oil spills, water quality, wells, hydrocarbons, organic materials.

Johnson, P.C., and D.A. Weingaertner. 1992. In-Situ Soil Decontamination Process with Sub- Surface Vapor Recovery. Patent No. US 5169263, c 12/8/92, f 5/23/91 (Appl 705708), 6 pp.
Key words: soil remediation, conservation, contamination, decontaminating, economic factor, environmental pollution, heating, phase behavior, phase change, remediation, soil pollution, vapor recovery, vaporization, p) USA, activated charcoal, adsorbent, adsorber, adsorption, air flow, buried, burner, catalysis, catalyst, charcoal

Johnston, A.J., M.R. Fitzmaurice, and R.G.M. Watt. 1993. Oil

spill containment: Viscous oils. 1993
International oil spill conference: Prevention, preparedness, response. American Petroleum Institute.
Washington, DC (United States). 931(p):89-94.
Key Words: Oil pollution containment system failure analysis, oil retention booms system failure analysis, oil spills containment, oil spills viscosity, flow models, hydrodynamics, shear properties, fluid mechanics, mathematical models, mechanical properties, organic compounds, other organic compounds, pollution control, pollution control equipment, systems analysis.

Jointe, P. 1987. Pollution prevention at the Port of Marseilles authority. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: pollution, prevention, Marseilles.

Jones, P. 1991. Mediterranean oil spills. Marine Pollution Bulletin. 22(6):260-61.
Key words: Accident, Fire, Beach, Boom, Cleaning, Oil Waste

Jones, M., R.A. Bagnall. 1987. An evaluation of the API (American Petroleum Institute) oil/water retort apparatus and procedure for monitoring oil in offshore discharges. In: Proceedings of the SPE/IADC Drilling Conf (New Orleans, La, 3/15 18/87).
Key words: disposal, oil, Alaska, California, gulf, offshore

Jones, Mark K., Barbara J. Mickelson, Hassan K. Chamseddin, and Larry R. Freeberg. 1990. A practical application for unsaturated zone fate and transport modeling using Sesoil for risk assessments at fuel-contaminated sites. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:797-810.
Key Words: California, environmental geology, reclamation, Pacific Coast, Western U.S., United States, Southern California, unsaturated zone, transport, risk assessment, oil spills, Sesoil, soils, pollution, site exploration, El Segundo Sand Hills, models, benzene, aromatic hydrocarbons, hydrocarbons, organic materials.

Jones, P. 1991. (Arabian) Gulf oil spill. Marine Pollution Bulletin. 22(4):164.
Key words: Accidental Fire, Biodegradation, Boom, Economic Factor, Ocean, Oil, Pollution Control, Water Treating

Jones, M.A., R.L. Butts, J.R. Lindsay, B.S. McCully, T.H. Pickering. 1993. Hurricane Andrew causes major oil spill at Florida Power Light Company's Turkey Point Power Plant, Homestead, Florida. American Petroleum Institute. Washington, DC (United States). 931(p):891-892.
Key Words: Electric utilities operation, oil spills remedial

action, remedial action cost, residual fuels oil spills, Florida fossil-fuel power plants, developed countries, fuel oils, liquid fuels, North America, petroleum products, power plants, public utilities, thermal power plants, USA.

Jones, W.J., E.S.K. Chain. 1988. Biological degradation of low-rank coal. In: Proceedings of the eight annual gasification and gas stream cleanup systems contractors review meeting: Volume 2. Kothari, V.P., Longanbach, J.R. (eds.) 8. annual gasification and gas stream cleanup systems. 555-561.
The primary goal of this research is to assess the potential for the anaerobic bioconversion of coal to fuel products. Initial experiments were conducted to assess the potential for anaerobic bioconversion of selected model compounds, including phenol, 2-naphthol, 9-phenanthrol, and dibenzothiophene; these compounds were selected as representative constituents of low-rank coals based on available literature of low-rank coal chemistry. Experiments were designed to enhance anaerobic bioconversion of selected recalcitrant substrates via coupling to CH{sub 4} production (use of methanogenic consortia) or via nitrate reduction. Coupling bioconversion to CH{sub 4} production has been demonstrated for a variety of organic substrates and is advantageous because of production of a desirable end product (CH{sub 4}) and because of thermodynamic considerations. Importantly, the biologically mediated reduction of CO{sub 2} by H{sub 2} to CH{sub 4} provides a mechanism for maintaining low partial pressures of H{sub 2}, resulting in favorable thermodynamic reaction kinetics for the H{sub 2}-producing species. The paper discusses analytical methods for biodegradation assessment, results from biodegradation experiments on model compounds and on low-rank coal extracts, and toxicity studies.
Key words: biodegradation, coal extracts, anaerobic digestion, biosynthesis, gas chromatography, phenol, bioconversion, methane, alkanes, aromatics, time dependence, toxicity, decomposition, heterocyclic compounds.

Jones, Frank E. 1989. Limitations on underground storage tank leak detection systems. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX. Key words: limitations, Key words: underground, tank, detection.

Jones, Mark A. and Jeffrey H. Greenfield. 1991. In-situ comparison of bioremediation methods for a number 6 residual fuel oil spill in Lee County, Florida. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: in-situ, bioremediation, oil spill, Florida.

Jones, Maurice and Gordon H. Otto. 1987. An evaluation of EPA

sheen tests for drilling fluid discharge. In:
Proceedings of the 1987 Oil Spill Conference (prevention,
behavior, control, cleanup), April 6 9, Baltimore,
MD.
Key words: evaluation, EPA, drilling.

Jones, M.A. 1993. Enhancing spill prevention and response
preparedness through quality control techniques.
In: Proceedings of the 1993 Oil Spill Conference (prevention,
preparedness, response), March 29 April 1,
Tampa, FL.
Key words: spill, prevention, response.

Jones, Lt. Richard G. 1975. Disposal of oil-spill debris. In:
Proceedings of the 1975 Conference on
Prevention and Control of Oil Pollution, March 25 27, San
Francisco, CA.
Key words: disposal, oil-spill, debris.

Jones, Donald R., R. Landers, and A. Pressman. 1977. Aerial
photographic applications in support of oil spill
cleanup, control, and prevention. Proceedings of the 1977 Oil
Spill Conference (prevention, behavior, control,
cleanup), March 8 10, New Orleans, LA.
Key words: oil, spill, cleanup, control, prevention.

Jones, D. A. 1988. Risk assessment : pipeline safety
considerations. In: Proceedings of the Pipes Pipelines Int
& Aberdeen Univ Pipelines & the Environ Conf. March 8 10,
Bournemouth, England.
Key words: Oil Spill, Risk Assessment, Pipeline

Jones, J.A. 1989. Substance for the Sorption of Oil and Related
Compounds Spilled on Water and Other
Substrates. Patent No. Gr Brit 2211496a, p 7/5/89, f 10/26/87
(Appl 8724979) (b01d-015/00) (3 pp; 11
claims).
Key words: solid adsorbent, adsorbent, adsorption, heat
treatment, heating, oil spill, oil water separation,
physical separation, sorbent, sorption, wood (p) Great Britain,
adsorption capacity, bacteria, biodegradation,
business operation, centrifuging, compression, container,
contamination, control, decontaminating,
distillation, ecology, environment

Jones, M.A., and J.H. Greenfield. 1991. In-Situ comparison of
bioremediation methods for a number 6
residual fuel oil spill in Lee County, Florida. In: Proceedings
of the 12th Bien API et al Oil Spill (Prev,
Behav, Contr, Cleanup) Int Conf, March 4-7, 1991, San Diego, CA,
pp. 533-540.
Key words: Bioremediation, Florida, Oil Spill, Soil Pollution,
Bacteria, Biodegradation, Groundwater, Water
Pollution

Jorgenson, M. T., L.W. Krizan, M.R. Joyce. 1990. Bioremediation
and tundra restoration after an oil spill in

the kuparuk oilfield, alaska. Alaska biological res inc, arco alaska inc. In: Proceedings of the 14th environ can arctic & mar oil spill program tech seminar (vancouver, can, 6/12-14/91) proc pp 149-154, 1991.
Key words: bioremediation, contamination, control, environmental pollution, oil spill, plain, pollution control, remediation, soil pollution, soil remediation, tundra.

Juhasz, Ferenc. 1979. Economic evaluation of the environmental effects of oil pollution: a practical lesson Using three case histories. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: economic, evaluation, environmental, oil, pollution.

Juutilainen, H. 1989. Method of and a means for protecting shores against oil pollutants. Patent No. CA 1250441.
Key words: oil retention booms, shores, oil pollution containment, design, oil spills, textiles, equipment, pollution control
In a method of protecting shores against oil pollutants, a web-like oil-retaining textile is lowered into the water in parallel with the shore, and the textile is drawn in the transverse direction up on the shore over a strip of land that is in danger of getting polluted in such a manner that a longitudinal edge of the textile remains in the water. The oil that is thrown towards the shore by the waves adheres to the textile and is thereby prevented from contacting the strip of land. A means for protecting shores against oil comprises a web-like oil-retaining textile, one longitudinal edge of which is provided with a heavy foot rope and the other longitudinal edge of which is provided with floats and cords for drawing the textile up on the shore in the transverse direction. The textile preferably is a needled fibrous felt having a width of 4 to 8 meters.

Juwarkar, A., and D.G. Khirsagar. 1991. Emulsification and oil degradation by marine bacteria. Indian journal of marine sciences. 20(1): 78-79.
Key words: crude oil, hydrocarbon, emulsification, biodegradation, bacteria, marine environment, microorganism growth, microorganism culture, culture medium, seawater.

Juwarkar, A. 1993. Application of biosurfactant in oil spill management. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: biosurfactant.

Kabrick, R. M., and L.A. Rogers. 1992. Innovative treatment alternatives for oily wastes generated during the exploration and production of oil and gas. Remediation technol inc. In: Proceedings of the 67th annu spe tech conf Washington, D.C., October 4-7 proc (drilling)

Key words: oil waste, biodegradation, contamination, decomposition, environmental pollution, heat treatment, heating, metabolic behavior, sludge, soil pollution, tank bottoms, thermal decomposition, waste material.

Kado, R. 1993. Influence of a big oil spill during the Gulf War on intertidal invertebrates. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill, Gulf War, intertidal, invertebrates.

Kaestner, M. 1989. Biodegradation of volatile chlorinated hydrocarbons. Biochemical engineering, environmental biotechnology, recovery of bio-products, safety in biotechnology. Lectures. Behrens, D., Driesel, A.J. 1989. <Original Series/Collective> DECHEMA biotechnology conferences. 7. DECHEMA annual meeting on biotechnology and 58. meeting of the European Biotechnology Federations, and joint meeting of Society for Industry Microbiology (SIM). 3:909-912, 587.
In a screening program with specialized methods different bacterial cultures were isolated from contaminated sites which are able to degrade volatile chlorinated hydrocarbons CHC. Pure cultures were found for the mineralization of dichloromethane, 1,2-dichloroethane and cis-1,2-dichloroethylene. 1,1-dichloroethane, 1,1,1-trichloroethane, chloroform, carbon tetrachloride, vinylchloride, tri- and tetrachloroethylene were degraded by several mixed cultures. In the second part of the examinations these cultures were tested in different laboratory scale continous flow reactors to investigate their degradation rates of CHC from contaminated waters. The process schemes of the reactors were adapted from technical scale plants of water works and sewage treatment plants in order to minimize the problems of scale up. The presented results show that already existing full scale technology is usable for the biological treatment of waters contaminated with CHC.
Key words: chlorinated aliphatic hydrocarbons, purification, microorganisms.

Kaiser, R. 1971. The Recovery of oil from water with magnetic liquids. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: recovery, oil, water.

Kaiser, R.D. and H.D. Van Cleave. 1971. Methods and procedures for preventing oil pollution from onshore and offshore facilities. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: methods, oil, pollution, onshore, offshore.

Kaiser, Robert, Donald Jones, and Howard Lamp'l. 1973. Tropical

storm Agnes: Pennsylvania's Torrey
Canyon. In: Proceedings of Joint Conference on Prevention and
Control of Oil Spills, March 13 15,
Washington, D.C.
Key words: Agnes.

Kaiser, T. 1987. Canadian-U.S. spill response cooperation along
the Great Lakes. In: Proceedings of the
1987 Oil Spill Conference (prevention, behavior, control,
cleanup), April 6 9, Baltimore, MD.
Key words: Canadian, U.S. spill, response.

Kakacek, K.C. 1990. Environmental risk management issues. In:
Proceedings of the Dallas Energy Counc et
al Dallas Energy Symp, January 23, 1990, Dallas, TX.
Keywords: environmental impact, liabilty, biodegradation,
disposal, legal consideration, remediation, soil
pollution, tanker, water pollution

Kalinsky, J. L. 1970. Report on U.S. Navy Environmental
Protection Program. In Naval Material Command
Washington D.C., 73p. 21.
Key words: oil pollution, waste oil, disposal, Navy, water
pollution
This report defines the Environmental Protection Problems of the
U.S. Navy, ashore and afloat, and sets forth
meaningful RDT and E requirements for each pollution problem
area. After listing the major operational
problems, the existing state-of-the-art approaches and technology
are described, and where applicable, a
technical appraisal is rendered for short range and long range
solutions. Major Navy problems considered are:
shipboard sanitary waste treatment and disposal systems; oil
pollution of water resulting from pumping of
bilges, deballasting of fuel or cargo oil tanks, pumping of tank
slop, accidental and deliberate fuel (JP-5
contamination) spillage; aircraft engine exhaust emissions and
noise; and ordnance material (explosive,
propellants, pyrotechnics, and Otto fuel) reprocessing and
reclamation. Other problem areas included are:
industrial, galley, and trash wastes from ships; shore and ship
destruction of classified material; ships'
anti-fouling paints; aircraft cleaning and stripping; shipboard
noise abatement; and waste oil disposal.
(Author)

Kalmykov, A.I., S.A. Velichko, V.N. Tsymbal, Yu.A. Kuleshov, J.A.
Weinman, and I. Jurkevich. 1993.
Observations of the marine environment from spaceborne
side-looking real aperture radars. Remote Sensing
of Environment. 45(2):193-208.
Key words: Oceanography, Remote Sensing, Radar
Real aperture, side looking X-band radars have been operated from
the Soviet Cosmos-1500, -1602, -1766
and Ocean satellites since 1984. These radar systems observe a
475 km wide swath with 1-2 km horizontal
spatial resolution. Wind velocities were inferred from sea

surface radar scattering for speeds ranging from approximately 2 m/s to those of hurricane proportions. The wind speeds were within 10-20% of the measured in situ values, and the direction of the wind velocity inferred from the radar measurements agreed with in situ direction measurements within 20-50 degree . Various atmospheric mesoscale eddies and tropical cyclones were thus located, and their strengths were inferred from sea surface reflectivity measurements. Rain cells were observed over both land and sea with these spaceborne radars. Algorithms to retrieve rainfall rates from spaceborne radar measurements were also developed. Spaceborne radars have been used to monitor various marine hazards. For example, information derived from those radars was used to plan rescue operations of distressed ships trapped in sea ice. Icebergs have also been monitored. Because oil films reduce the sea surface roughness and thereby alter the radar reflectivity, oil spills were also mapped. Tsunamis produced by underwater earthquakes were also observed from space by the radars on the Cosmos-1500 series of satellites. The Cosmos-1500 satellite series have provided all weather radar imagery of the earth's surface to a user community in real time by means of a 137.4 MHz Automatic Picture Transmission (APT) channel. This feature enabled the radar information to be used in direct support of Soviet polar maritime activities. (Author abstract) 55 Refs.

Kalocsai, G.IZ. .1992. Reversible Transformation of Hydrocarbons. Skylab International Ltd. World 92/7917, p 5/14/92, f 10/29/91, pr Austral 11/2/90 (Appl 3135) (c09k-003/32; a26d-001/00; c09k-003/12; e21b-035/00) pct gaz v1992, no 11, p 5086, 5/14/92 (issn 02507757; abstract only) (ao)
Key words: phase reversal, business operation, compound, fire fighting, handling, hydrocarbon compound, oil spill, phase behavior, salvaging, waste oil recovery, p) world, absorbent, absorption process, acetate, acid, additive, chemical process, combustion, containment, contamination, control, crude oil, distillation, elasticity

Kamely, D., A. Chakrabarty, and G.S. Omenn. 1990. Advances in Applied Biotechnology Series. Volume 4. Biotechnology and Biodegradation. Gulf Publishing Co.: Houston, TX, 505 pp.
Key words: bacteria, biotechnology, microorganisms, pollutants

Kampbell, D. H., J. T. Wilson and, C. J. Griffin. 1992. Bioventing approach to remediate a gasoline contaminated subsurface. In: Emerging Technologies for Hazardous Waste Management: 1991 Book of Abstracts for the Special Symposium, Oct. 1 3, Atlanta, GA. Industrial and Engineering Chemistry Division, American Chemical Society: Washington DC, 6 pp.
Key words: Oil Spills, Biodegradation, Bioventing

Bioventing is a subsurface process using an air stream to enhance biodegradation of oily contaminants. Two pilot-scale bioventing systems were installed at a field site. Process operations began in October 1990. The field site is located at an air station. A spill in 1969 of about 100,000 kilograms aviation gasoline was caused by a broken underground transfer line. A major portion of the spilled product still persists as an oily-phase residue in a 80x360 meter plume. The subsurface is a uniform beach sand with the groundwater level near five meters. Prior to startup of the venting systems, a grass cover was established and a nutrient solution was dispersed throughout the unsaturated subsurface. Subsurface air flow patterns are being determined with a tracer gas of sulfur hexafloride. Soil gas, core material, and underground water are being monitored to determine the extent of remediation. Objectives of the study are to demonstrate that surface emissions of gasoline are nominal, oily residue will be reduced to greater than 100 mg fuel carbon/Kg core material, and the process will be applicable to full-scale remediation. Flow rate is based on a calculated residence time of 24 hours. Surface emission of fuel hydrocarbons have not exceeded 1 micrograms /liter soil gas.

Kampbell, D.H., J.T. Wilson, D.W. Ostendorf. 1991. Simplified soil-gas sensing techniques for plume mapping and remediation monitoring. Pub. in Petroleum Contaminated Soils, v3 p125-139, Sep 90. Prepared in cooperation with Massachusetts Univ., Amherst. Dept. of Civil Engineering.
Key Words: Ground water contamination, hydrocarbons ecological concentration, soils contamination, biodegradation, environmental transport, gasoline, land pollution, mapping, monitoring, oil spills, plumes, remedial action, water pollution control, water tables, chemical reactions, decomposition, hydrogen compounds, liquid fuels, mass transfer, organic compounds, oxygen compounds, petroleum products, pollution control.

Kampbell, D.H., B.H. Wilson. 1993. Bioremediation of chlorinated solvents in the vadose zone. Pub. in In situ and On-Site Bioreclamation. The International Symposium (2nd), San Diego, CA., April 5-8, 1993.
Subsurface aeration can remove solvent spills by air stripping. The waste air streams that originate can be cleansed by sorption, combustion, or biodegradation. Laboratory soil microcosms once acclimated to gasoline vapors showed an enhanced mineralization of trichloroethylene and vinyl chloride. The biological cometabolism indicates that a potential exists for degradation of chlorinated solvent vapors in the soil vadose zone or in prepared soil bed bioreactors.
Key words: soils, remedial action, solvents, biodegradation, aeration, air water interactions, bacteria, bioreactors, chemical reactions, chlorides, chlorine compounds,

combustion, contamination.

Kampbell, D.H., J.T. Wilson, S.R. Hutchins, L.G. Kennedy, and B.H. Wilson. 1992. Geochemical indicators of anaerobic biodegradation of BTEX. In: Proceedings of the Conference on Hazardous Waste Research, Boulder, CO., June 1-2, 1992 p563-575.
Key words: Oil Spills, Biodegradation, Groundwater, Kansas, Pipelines, Water Pollution, Weathering
A pipeline leak released refined petroleum to the subsurface at a Kansas flood plain site. Variable depth cluster wells from the water table to the bottom of the aquifer and single wells screened across the contaminated interval were installed at the site. Dissolved concentrations of alkylbenzenes, methane oxygen, and organic acids were used to locate what parts of the subsurface have acclimated to anaerobic biodegradation. Natural biological weathering has occurred at the site. Most predominant was that major fractions of the contaminant mass was removed by passive bioremediation.

Kana, Timothy W., LCDR James T. Paskewich and Lt. Edmond P. Thompson. 1981. Oceanographic surveys of tidal inlets for oil spill response. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: oceanographic, inlets, oil, spill, response.

Kanfi, Yacov. 1989. Groundwater contamination by oil in Israel's coastal plain aquifer. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.

Kanfi, Y. 1992. Contamination of the Coastal Plain Aquifer by oil installations in Ashdod region. Annual Meeting - Israel Geological Survey. 1992:77.
Key Words: Aquifers, Ashod Israel, Asia, Coastal Plain Aquifer, ground water, hydrocarbons, Israel, Israeli Coastal Plain, Middle East, models, movement, oil spills, organic materials, pollution, risk assessment, soils, Western Israel.

Kangeter III, Lt. Edward B. 1977. Hiatusport: an on-scene coordinator role playing exercise. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: on-scene, role-playing.

Kanter, R., D. Straughan, and W. Jessee. 1971. Effects of exposure to oil on Mytilus Californianus from different localities. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: exposure, oil, Mytilus Californianus.

Kappesser, S., A. Weiss. 1992. Technical modifications to the

biodegradation process in laboratory scale
models. Soil Decontamination Using Biological Processes. (1992):
6 9 December.
Paper given at Int. Symp. Soil Decontamination using Biological
Processes, Karlesruhe, D, 6 9.12.92.
Key words: biodegradation, degradation, hydrocarbon
Silty soil contaminated by lubricating and engine oil
hydrocarbons is studied in model clamp reactors for the
effects of aeration, mineral salts, inoculation, and compost.
Salts show no effect on degradation. Maximum
degradation of 88.9% is with 7.5x10(exp 10) cfu bacteria,
aeration and compost.

Kapuscinski, R.B. 1987. Fates and stability of Bioaugmentation
products in natural and engineered
ecosystems. In: Proceedings of the 194th American Chemical
Society National Meeting, August
30 September 4, 1987, New Orleans, LA.
Key words: microorganisms, biodegradation, water pollution, soil
pollution

Karafir, Y.P., and F. Luhulima. 1987. Environmental condition and
management at the petromer trend
corporation oil and gas exploration and exploitation area,
Kasim-sele, Sorong, Irian Jaya. In: Proceedings of
the 16th Annu Indon Petrol ass Conv, October 20-22, 1987,
Jakarta, Indon, 2:273-279.
Key words: Environmental Impact, Eurasia, Soil Pollution, Water
Pollution, Groundwater, Oil Spill

Karev, V.I., A.K. Popov, G.K. Nosov, R.A. Memukhim, M.V.
Zarbailov, B. Slezin. 1992. Device for
Installation of a Floating Boom Barrier on Water Surface. USSR
Agency. 14(pp).
Key Words: Floating barrier, aerial transportation, coupling
(electrical), electrical equipment, helicopter,
latch, pollution control equipment, transportation, Great
Britian, anchor (marine), buoyancy, cable, circuit,
contact (electrical)

Kasan, H.C., and A.A.W. Baecker. 1991. Microbial ecology of an
activated sludge process treating
petrochemical effluents. In: Proceedings of the 3RD Inst Gas
Technol (Chicago) Gas, Oil, Coal, & Environ
Biotechnol Int Symp, December 3 5, 1990, New Orleans. pp. 149
161.
Keywords: bacteria, biodegradation, bioremediation,
microorganism, remediation, water treating

Kasbohn, P. L., D. A. Heely, and E. S. Werk. 1991. In situ soil
ventilation. In: Proceedings of Hazmat '91
International: the Ninth Annual International Hazardous Materials
Management Conference, June 12 14,
Atlantic City, NJ. Tower Conference Management Company: Wheaton,
IL, pp. 571 579.
Key words: Groundwater, Oil Spills, Soil Ventilation, In-Situ
This paper reports on a release of gasoline from an underground

storage tank as a gasoline service station on Cape Cod, Massachusetts, which resulted in separate-, dissolved-, and adsorbed-phase petroleum hydrocarbons in the subsurface soils and groundwater. Initially, one recovery well was installed at the site to limit downgradient migration of dissolved-phase petroleum hydrocarbon compounds. A soil ventilation system and an additional recovery well were subsequently installed to recover separate- and adsorbed-phase petroleum. Over a 2-year period, this system recovered approximately 1,689 gallons of separate- and adsorbed-phase petroleum through soil ventilation, and 64 gallons of dissolved-phase petroleum through groundwater extraction. Operation of this system resulted in the removal of separate-phase petroleum from subsurface soils wihin 6 months, and a decrease in dissolved-phase petroleum in the groundwater over the two year operation period. Concentrations of carbon dioxide in soil gas samples also decreased during this time period, indicating a diminishing food supply (carbon) for indigenous hydrocarbon utilizing bacteria. Petroleum recovery utilizing a combination of soil ventilation and groundwater extraction techniques was accomplished at a cost of approximately $250 per gallon.

Kasevich, R.S. 1992. (R) Electromagnetic method and apparatus for the decontamination of hazardous material-containing volumes. U.S. Patent No. US 5152341921006. Keywords: biodegradation, bioremediation, environmental pollution, equipment, inground tank, in-situ, remediation, soil pollution, water pollution

Kator, H., C.H. Oppenheimer, and R.J. Miget. 1971. Microbial degradation of a Louisiana crude oil in closed flasks and under simulated field conditions. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C. Key words: microbial, degradation, Louisiana, oil.

Kator, Howard and Russell Herwig. 1977. Microbial responses after two experimental oil spills in an Eastern coastal plain estuarine ecosystem. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA. Key words: microbial, oil spills, coastal, ecosystem.

Kaufman, A.K., Krueger, C.C. 1989. Bioremedial cleanup technology. Pennwell Conferences and Exhibitions Company, Houston, TX (USA). 811(p):761-786. Key Words: Ground water contamination, oil spills environmental impacts, soils contamination, biodegradation, land relcamation, petroleum, remedial action, resource recovery acts, site characterization, water reclamation, chemical reactions, decomposition, energy sources, fossil fuels, hydrogen compounds, laws, oxygen compounds.

Kaufmann, S. 1983. A $1 million spill drill and two tons of oranges. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: spill drill.

Kaufmann, S. 1992. Control of Oil Spill Fire Hazards. Sunshine Technology Corp. In: Proceedings of the Pennwell Conf & Exhibit Co Petro-Safe 92 Conf (Houston, 1/27-29/92) Proc book 3, pp 881-887, 1992 (4 refs)
Key words: oil spill, additive, control, dispersant, explosion, fire fighting, fire hazard, hazard, pollution control, absorbent, administration, business operation, case history, chemical process, cleaning, cleanup cost, combustion, cost, data, dispersing, Eastern US, economic factor, environment protect agency, evaporation, fire, foam

Kaufmann, S. 1989. Crisis in response training. Flaherty, L.M. (ed.). Oil dispersants: New ecological approaches. American Society for Testing and Materials: Philadelphia, PA, p.90.
Key words: oil spills, mitigation, surfactants, efficiency, planning, skimmers, training, water pollution, equipment, pollution control
The need for training of first responders, contractors, government agencies, and insurance companies to use chemical dispersants effectively is demonstrated by the loss of opportunities both to reduce cleanup costs and to gain helpful data in evaluating the advantages of using dispersants. As important as learning the legal basis for dispersant use, is the hands-on training whereby a trainee assists in: (1) layout of the training area; (2) creation of a training spill; (3) detection and measurement of spills; (4) demonstration of physical equipment; (5) types of dispersant application equipment; (6) types of chemical countermeasures; (7) hands-on involvement of trainees; and (8) polishing of the spill area following the drill, using dispersant, sorbent, and boom cleanup and recovery. This interest in a new method of training in the use of chemical countermeasures emphasizes the need to be prepared to use them on actual spills as they occur. 7 refs., 6 figs.

Kauss, P. 1973. The Toxicity of crude oil and its components to freshwater algae. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: toxicity, oil.

Kay, Garnet H. 1977. Canadian approach to oil spill training. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: Canadian, oil spill training.

Kaylor, J.B. 1991. Skimmer and Method for Its Use. Patent No. US 5200083, c 4/6/93, f 10/16/91 (Appl 778295) (e02b-015/04) (12 pp; 19 claims; assigned J. C. Kaylor)
Key words: oil skimming, adsorbent, business operation, collector, oil spill, oil water separation, oil water separator, physical separation, salvaging, separation equipment, solid adsorbent, sorbent, waste oil recovery, (p) USA, anode, buoyancy, carbon, carbon black, channel, chart, circuit, circular motion, cleaning, coating material

Kazmierczak, Leon J. and Thomas A. Crawford. 1985. Results of a full-scale surprise test of Sun's major spill response plan. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: test, spill, response.

Kazmierczak, Leon J. and T.A. Crawford. 1983. Results of a full-scale surprise test of Sun's major spill response plan. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: results, test, spill response.

Kazmierczak, L.J., J.H. Bates, and N.G. Tatman. 1981. Results of a surprise test of SunTransport Company's oil spill response plan. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: SunTransport, spill, response.

Kazmierczak., Leon J. 1979. Major spill response planning for tanker operations. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: spill, response, tanker.

Keech, D.A. 1988. Hydrocarbon thickness on groundwater by dielectric well logging. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, pp. 275-289.
Key words: Water Pollution, Groundwater, Oil Spill

Keevil, Benjamin E. and Rene O. Ramseirer. 1975. Behavior of oil spilled under floating ice. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil, spilled, ice.

Keith, Virgil F. 1993. Double hull oil tankers: how effective are they? In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: double hull, oil, tanker.

Keith, Virgil F. 1991. The Exxon Valdez oil spill: prevention methods, effectiveness, and cost. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: Exxon Valdez, oil, spill, prevention, effectiveness, cost.

Keith, V.D. and J.D. Porricelli. 1973. An Analysis of oil outflows due to tanker accidents. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: analysis, oil, tanker.

Keller, Brian D. 1989. On evaluating ecological effects of a major oil spill on the Caribbean Coast of Panama. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: evaluating, ecological, spill, Panama.

Kelley I., J.P. Freeman , F.E. Evans, C.E. Cerniglia. 1991. Identification of a carboxylic acid metabolite from the catabolism of fluoranthene by a Mycobacterium sp. Applied and environmental microbiology. 57(3):636-641.
A Mycobacterium sp. previously isolated from oil-contaminated estuarine sediments was capable of extensively mineralizing the high-molecular-weight polycyclic aromatic hydrocarbon fluoranthene. A carboxylic acid metabolite accumulated and was isolated by thin-layer and high-pressure liquid chromatographic analyses of ethyl acetate extracts from acidified culture media.
Key words:mycobacterium, fluoranthene, catabolism, mineralization, metabolite, carboxylic acid, characterization, biodegradation, hydrocarbon, pollutant, mycobacteriaceae, mycobacteriales, actinomycetes, bacteria, mycobacterium.

Kelley, I., J.P. Freeman, F.E. Evans, and C.E. Cerniglia. 1993. Identification of metabolites from the degradation of fluoranthene by Mycobacterium sp. strain PYR-1. Applied and environmental microbiology. 59(3):800-806.
Key words: Biodegradation, Pollutant, Microorganism, Hydrocarbons
Mycobacterium sp. strain PYR-1, previously shown to extensively mineralize high-molecular-weight polycyclic aromatic hydrocarbons in pure culture and in sediments, degrades fluoranthene to 9-fluorenone-1-carboxylic acid. In this study, 10 other fluoranthene metabolites were isolated from ethyl acetate extracts of the culture medium by thin-layer and high-performance liquid chromatographic methods.

Kelly, Jr., Frank J., Roy W. Hann, Jr., and Harry N. Young.

1981. Surveillance, tracking, and model correlation of the spill from the tanker Burmah Agate. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.

Key words: surveillance, tracking, spill, Burmah Agate.

Kelsey, R. J. 1991. What's new in sensors? Food & Drug Packaging (Feb.):14.
Key words: Sensors
Vendors of sensors have suddenly discovered the packaging field. In a remarkably short time, they have come up with specialized devices to meet line requirements for miniaturization and to resist unfavorable environments. Some also come equipped with built-in flexibility to adapt to different product and packaging colors and textures. Others possess a new, simple control intelligence that can handle a great number of packaging-line problems. Primarily, the new generation still employs four classic methods of gathering data: photoelectric, laser, proximity and ultrasonic detection of product and packaging targets as these elements cross their path. But there is more to it than that, today, plus a clutch of newcomers, which don't follow traditional rules.The trend to ever-smaller sensors is perhaps of paramount importance to packagers, particularly in retrofitting existing and space-cramped lines with new electronic-control systems. Another way of attacking the space problem is the use of fiberoptic extensions that reach into the action to pick up the signals, then relay them to the photodiode sensor, located in an out-of-the-way and more spacious location.
Another advantage is that such fiberoptic cables are inherently easy and economical to seal against such unfriendly environments as wash-down areas in food plants. Lots of difficult sensing jobs have been accomplished by custom-design integrators who put together photoeye matrixes that can even differentiate among products.The technique creates a crude vision system in which each photoelectric sensor is a pixel.
There is a demand for such simple means to tell one shape from another.

Kelso, D.D., M. Kendziorek. 1991. Alaska's response to the Exxon Valdez oil spill. Environmental Science & Technology. 25(1):16-23.
Key Words: Spill response, clean up method, oil spill, Exxon Valdex, water pollution, environmental impact, USA, Alaska, Prince William Sound.

Kemerer, Lt. Jack A., MK1 Terrence McGuigan, and DC1 Douglas Campbell. 1987. Cleanup and effects of crude oil and fuel oil spills in Osito Canyon: a comparison. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: cleanup, spills, Osito Canyon.

Kemerer, Lt. Jack A., Nancy Hendrickson, and Robert Mullinax. 1985. A Case history: oil spill onto the Prado flood control basin, a freshwater wetlands cleanup. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: oil, spill, flood, wetlands, cleanup.

Kemp, A. J., and G. Bayer. 1990. The safe and successful abandonment/removal of an offshore platform in Brunei. In: Proceedings of the 8th SPE et al. Offshore South East Asia Conf, December 4 7, SINGAPORE.
Pp. 203 214.
Key words: Oil Spills, Abandonment, Brunei, Contingency Planning, Well Plugging

Kennedy, L. G. and S. R. Hutchins. 1993. Applied geologic, microbiological, and engineering constraints of in-situ btex bioremediation. Remediation 3(1):83-110.
Key words: In-Situ, Bioremediation, Water Pollution,
An in-situ bioremediation project has been designed and constructed for a site in south-central Kansas just north of Wichita. A pipeline leaked an unknown quantity of refined fuels in the 1970s. The spill was undetected until hydrocarbons were found in a nearby municipal water supply well. Of concern, from a regulatory perspective, are the alkylbenzene components found in the groundwater, including benzene, toulene, ethylbenzene, and xylene (BTEX). Initial abatement procedures, including free product removal and pumping, had become ineffective. In-situ bioremediation was selected to complete the restoration process.
The project emphasizes the need for a strong understanding of the geologic and hydrogeologic conditions prevalent under the site. Site studies were conducted to determine the distribution and mass of the contaminant and the hydraulic regime. Laboratory microbial studies were used to determine the efficacy of nitrate as a primary electron acceptor. Information from site studies was used to design a treatment system tailored to the requirements of the site. The treatment system is designed to deliver the maximum amount of nutrient-enriched water to the contaminated zone while maintaining hydraulic control of the site.

Kennedy, J.M. and E.G. Wermund. 1971. The Physical behavior of oil on water derived from airborne infrared and microwave radiometric measurements. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: oil, water, microwave, radiometric.

Kennicutt II, M.C. 1991. The Fate of diesel fuel spilled by the Bahia Paraiso in Arthur Harbor, Antarctica. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San

Diego, CA.
Key words: fuel, spilled, Bahia Paraiso, Antartica.

Kennicutt, M.C., and Bahia Paraiso. 1990. Oil spillage in Antarctica. Initial report of the National Science Foundation-sponsored Quick Response Team on the grounding of the Bahia Paraiso. Environmental Science & Technology. 24(5):620-24.
Key words: Accident, Animal, Beach, Bird, Containment, Environmental Impact, Pollution Control

Kennicutt, M.C. II, I.R. MacDonald, T. Rogne, C. Giammona, and R. Engelhardt. 1992. The Tenyo Maru oil spill: A multi-spectral scanning and sea-truth experiment. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar, June 10 12 1992, Edmonton, Canada, pp. 349-356.
Key words: Oil Spills, Remote Sensing, Chemical Analysis
The sinking of the Tenyo Maru fish processing ship off the Washington state coast caused an initial oil spill of ca 100,000 gal. After response operations had contained and removed most of the spill, continued leakage from the sunken wreck provided an offshore source of freshly spilled oil at a known location. Remote sensing overflights, coordinated with the collection of sea-surface slick samples, were conducted in an effort to test whether a multi-spectral scanner could accurately image a marine oil spill. Oil content in the sea truth samples ranged from undetectable to 180 mg, depending on slick thickness. This variability was readily apparent in both the infrared and ultraviolet bands of the scanner data and was detectable on a scale of meters. Chemical analysis identified two unique oils in the slick, one containing enhanced concentrations of toxic polycyclic aromatic hydrocarbons. However, distinct signatures for these oils were not successfully extracted from scanner data. An integration of the data from multiple flight paths provided an overview of the distribution of thick and thin slick components in the vicinity of the wreck and illustrated the effect of an oceanographic front on controlling the dispersion of the slick. 5 figs.

Kerambrun, Loic, and Georges Peigne. 1991. Analysis of oil recovery vessels used worldwide. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, 1991 in San Diego, CA.
Key words: analysis, oil, recovery.

Kerfoot, William B. 1990. Soil venting with pneumatically-installed ''shield screens''. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:571-586.
Key Words: Soils, Massachusetts, pollution, reclamation,

environmental geology, Barnstable County
Massachusettes, oil spills, unsaturated zone, gaseous phase,
benzene, aromatic hydrocarbons, hydrocarbons,
organic materials, Falmouth Massachusetts, New England, toluene.

Kerfoot, William B. and Jon R. Soderberg. 1989. Pneumatic hammer
soil vapor probes and miniature
piezometers for gasoline spill delineation and cleanup. In:
Proceedings of the 1989 Oil Spill Conference
(prevention, behavior, control, cleanup), February 13 16, San
Antonio, TX.
Key words: soil, vapor, probes, cleanup.

Kerry, E. 1993. Bioremediation of experimental petroleum spills
on mineral soils in the Vestfold Hills,
Antarctica. Polar Biology (United States). 13:3:0722-4060.
The effect of nutrient and water enhancement on the
biodegradation of petroleum was tested in Antarctic
mineral soils. Nitrogen, phosphorus and potassium were applied in
solution, with or without gum xanthan or
plastic covers, to sites artificially contaminated with
distillate. The effectiveness of these procedures was
assessed by measuring changes in total petroleum hydrocarbons
heptadecane/pristane and
octadecane/phytane ratios; in concentrations of major hydrocarbon
components and in microbial numbers and
activity. Significantly lower hydrocarbon concentration were
recorded after one year in soils treated with
fertilizer solutions, but only in the surface 3 cm. These soils
also showed lowered heptadecane/pristane and
octadecane/phytane ratios and had the highest levels of microbial
activity relative to other plots. Soils treated
with gum xanthan or covered with plastic had the highest residual
hydrocarbon levels. Both treatments
inhibited evaporative loss of hydrocarbon, and there were
indications that gum xanthan was utilized by the
microbiota as an alternative carbon source to distillate. Higher
temperatures were recorded under the plastic
but no stimulation of biodegradation was detected. Estimated
numbers of metabolically active bacteria were
in the range 10[sup 7] to 10[sup 8] g[sup [minus]1] dry weight of
soil, with an estimated biomass of 0.03 to
0.26 mg g[sup [minus]1] soil. Estimated numbers of amoebae were
in the range 10[sup 6] 10[sup 7] g[sup
[minus]1] soil (biomass of 2 to 4 mg g[sup [minus]1]). The
highest populations were recorded in fertilized,
contaminated soils, the only soils where petroleum degradation
was demonstrated. 23 refs., 1 fig., 4 tabs.
Key words: Antarctica, contamination, oil spills, environmental
effects, soils.

Ketchel, Cdr. Robert J. and H.D. Smith. 1971. Development of an
air deliverable antipollution transfer
system. In: Proceedings of Joint Conference on Prevention and
Control of Oil Spills, June 15 17,
Washington, D.C.
Key words: antipollution, transfer.

Ketchel, Cdr. R.J. and A.T. Edgerton. 1973. Development of U.S. Coast Guard prototype airborne oil surveillance system. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.

Key words: solid adsorbent, adsorbent, adsorption, decontaminating, flora, oil spill, plant (botany), powder, sorbent, sorption

Khalimonov, Oleg N. and Sergey M. Nunuparov. 1989. Development of national marine pollution control administration for the U. S. S. R. in 1987 1988. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: marine, pollution, U.S.S.R.

Khalimonov, O., S. Nunuparov, and Antonio Gramsci. 1991. National oil spill response planning in the USSR: Principal conceptions and objectives. In: Proceedings of the API - EPA - USCG 1991 Oil Spill Prevention, Behavior, Control, Cleanup Conference, March 4 7 1991, San Diego, CA, API Publication N.4529, pp. 3-5.
Key words: Accident, Blowout, Bulk Carrier, Business Operation, Contingency Plan, Crude Oil, Economic Factor, Legal Consideration

Khan, A.A., I. Chang-Yen, and L. Chatergoon. 1989. Source identification of an oil spill on Trinidad's East Coast. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil, spill, Trinidad.

Khan, A.A., and S.K. Walia. 1992. Usefulness of DNA probes for the isolation of efficient PCB-degrading bacteria from toxic chemicals contaminated environment. In: Proceedings of the 92nd General Meeting of the American Society for Microbiology, May 26 30, 1992, New Orleans, LA, p. 369.
Key words: polychlorinated biphenyls, biodegradation, bacteria

Khan, N.A. 1992. Impacts of the giant intentional oil-spill on Jubail, Saudi Arabia. Environ. Conserv. 19(3).
Key words: Pollution Effects, Oil Spills
During the Gulf War, on 23 January 1991, a huge quantity of crude oil was deliberately dumped into the Arabian Gulf. This 'spill' of unprecedented magnitude has no equal in modern times - firstly because it was a deliberate act of people with the intention of harming Mankind and the environment, and secondly because it happened at a time when nothing could be done to stop it. The slick massed, grew in size, and started to drift in kilometres-long ribbons southwards along the eastern shores of

Saudi Arabia. Every industry and community along those shores was in peril. Their lifeline of potable water from converted saline water from the Gulf was facing total stoppage. On the afternoon of 16 February 1991, this oil-spill from Al-Ahmadi, Kuwait, believed to be the biggest in history, finally arrived near Jubail Industrial City by reaching the coastline of the northern beaches of the Community Harbour near Al-Gurmah Island and some parts of the Abu Ali Island (see Fig. 1). The spill, creating a major environmental disaster, was of great concern to the Saudi Government. There is no question that it had damaged the Gulf waters, its coastlines, and practically all the ecological communities that were in any way involved. Vital industrial facilities were threatened in and around Jubail because of the sea-water cooling system for primary industries being affected and likewise the sea-water fed to desalination plants for making potable water. A massive oil-slick impacting the intake canal of the Royal Commission's sea-water cooling facilities would cause a complete paralysis of operations at the oil refinery, petrochemical plants, and other major industrial plants dependent on the oil refinery for their cooling water. And, of course, shrimp spawning-grounds, fish, and turtle and bird sanctuaries, would not be spared from this premeditated genocide.

Khorfan, Saad. August 1993. Influence of pollution on desalination. Desalination. 93(1-3):443.
Key Words: Water pollution, desalination, water supply, thermal pollution, reverse osmosis, evaporation, electrodialysis, salinity measurement, water quality, oil spills.

Kia, Sheila F., Abdul S. Abdul. 1990. Retention of diesel fuel in aquifer material. Journal of Hydraulic Engineering. 116(7):881-894.
Key Words: Pollution, ground water, soils, experimental studies oil spills, seepage, aquifers, porosity, grain size.

Kidd, Donald F., Randall R. Miller. 1989. Project life estimation for remediation of a gasoline contaminated aquifer. Natl. Water Well. Assoc., Dublin, OH, United States. 307-320.
Key Words: Ground water, pollution, reclamation, natural resources, oil spills, aquifers, factors, random-walk models, models, adsorption, sorption, benzene, aromatic hydrocarbons, hydrocarbons, organic materials, two-dimensional models, calibration.

Kiebala, Leo. 1983. Risk control management for oil spills. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: management, oil, spills.

Kiesling, R.W., and S.K. Alexander, and J.W. Webb. 1988.

Evaluation of Alternative Oil Spill Cleanup Techniques in a Spartina Alterniflora Salt Marsh. Second Author Address: Department of Marine Biology,Texas AM University at Galveston, Galveston, Texas 77553-1675, USA 1988.
Key words: Environmental Pollution

Cleanup techniques, implemented 18 -24 h after oiling, were not effective at removing oil after sediment penetration. When oil remained on the sediment surface, flushing techniques were most effective at removal, reducing levels of added oil by 73 -83%. Addition of dispersant to the flushing stream only slightly enhanced oil removal.Clipping of Spartina alterniflora followed by sorbent pad application to sediment was moderately effective, reducing added oil by 36 -44%. Burning increased amount of oil in sediment by 27 -72%.

Althoughflushing and clipping were effective at oil removal, neither technique reduced initial damage to plants or enhanced long-term recovery. Whileflushed plots sustained no additional plant damage due to cleanup,clipped and burned plots sustained additional initial plant damage.First consideration should be given to natural tidal flushing as the means to remove oil, especially in marshes subject to ample tidal inundation.

Low pressure flushing may be warranted when fuel oils or large quantities of crude oil impact salt marshes subject to reduced tidal flushing. Flushing, when warranted, should be initiated prior to oil penetration into the substrate. Clipping may be considered as a cleanup response only when heavy oil cannot be effectively removed from vegetation by flushing. -from Authors

Key words: oil spill, cleanup, salt marsh, Spartina alterniflora, (Ecology)

Killops, S.D. 1991. Novel aromatic hydrocarbons of probable bacterial origin in a Jurassic lacustrine sequence. Organic geochemistry. 17(1): 25-36.

Novel series of aromatic hydrocarbons, apparently bacterially derived, were detected by GC-MS analysis of an oil and three samples of its source rock. In addition to high levels of known bacterial marker compounds (hopanes, benzohopanes and D-ring monoaromatic 8,14-secohopanoids), all samples exhibited a new series of aromatic secohopanoids which appeared to comprise pairs of C SUB 2 SUB 8 -C SUB 3 SUB 1 demethylated counterparts of the regular D-ring monoaromatic 8,14-secohopanoids, lacking either the C-27 or, more probably, the C-28 methyl group. Further new series appeared to be composed of C SUB 2 SUB 8 6c SUB 3 SUB 0 analogues of the regular and demethylated monoaromatic secohopanoids with and additional C=C bond in the E-ring. Alkylnaphthalene distributions in the rock samples were dominated by 1, 1, 5, 6-tetramethyl-1, 2, 3, 4-tetrahydronaphthalene, 1, 2, 5-trimethylnaphthalene and 1, 2, 5, 6-tetramethylnaphthalene, deriving from degradation of aromatic 8, 14-secohopanoids. Three prominent

phenanthrene analogues of these naphtalene derivatives appeared to be present, exhibiting similar relative abundance trends in the rock samples, which suggest common bacterially derived precursors.
Key words: Korea, lacustrine, environment, chromatogram, bacteria, aromatic hydrocarbons, chromatograms, paleoenvironment.

Kim, H.Y., Y.B. Lim, Y.N. Lee. 1987. Characterization of SAL plasmid isolated from pseudomonas-putida.
Korean Journal of Microbiology. (1987): 25(1).
Key words: bacteria, hydrocarbons, degradation
Three strains of bacteria utilizing salicylate, KU801(pKU5 pKU8), KU803 (pKU6, pKU9), and KU806(pKU7 pkU10), were selected from the isolates and identified as Pseudomonas putida. By agarose gel electrophoresis, it was found that the strains had two plasmids each. All three strains were resistant to antibiotics such as ampicillin, tetracyclin, and chloramphenicol, and did not utilize other aromatic and aliphatic hydrocarbons examined except salicylate. The plasmids(pKU5, pKU6, and pKU7) of larger molecular weight were cured by treatment with mitomycin C and frequencies of curing were 0.4%, 1.67%, and 0.75%, respectively. Cured strains did not degrade salicylate and still had antibiotic resistances, which were identical with wild strains. The genes for salicylate degradation were proved to be encoded on their plasmids. The molecular weights of pKU5 and pKU6 were estimated as 10.35 Md, and that of pKU7 and 101 Md. The new SAL plasmids, pKU5, pKU 6, and pKU 7 were transferred to P. putida and P. aeruginosa, but not to Escherichia coli.

King, J.M.H., J. Sanseverino, P.M. DiGrazia, B.M. Applegate, and G.S. Sayler. 1991. Molecular bioanalytical methods for monitoring polynuclear aromatic hydrocarbon biodegradation in manufactured-gas-plant soils. Volume 2. Final report, September 1987-August 1991. Tennessee Univ., Knoxville, TN (United States).88.
The objectives of work described in the report were to provide fundamental information on the microbiology and biochemistry of polynuclear aromatic hydrocarbon (PAH) biodegradation, and to continue development and initiate applications for molecular techniques in providing needed information for biodegradation process monitoring and control. A significant portion of the effort was in support of research studies on dynamic systems analysis for PAH (presented in Volume I, GRI-91-0193). Specific work included: (1) Analyzing and developing a PAH degradative mixed bacterial culture for standardized bioreactor operation; (2) Developing a bacterial culture collection of organisms involved in PAH degradation; (3) Applying molecular techniques, principally DNA gene probe technology, for environmental diagnostic assessment of PAH bioremediation

potential and biodegradation processes performance evaluation; (4) Development and application of reporter strain bioluminescent technology to improve capabilities of analysis for enzyme expression and/or bioavailability.
Key words: bacteria, monitoring, coal gasification.

King, V.M. 1987. Survival of added bacterial species and metabolism of toxic compounds in natural environments. Memphis State Univ.,Memphis, TN. 150.
Bacteria able to degrade either 2,4-dichlorophenol (DCP) or phenanthrene (PHEN) were isolated from polluted freshwater environments. Two isolates able to degrade each compound were tested for mineralization with a sensitive /sup 14/C assay and for survival in lake water and sewage using a selective medium. One DCP isolate was identified as Alcaligenes paradoxus and the other as Alcaligenes sp. One PHEN isolate was identified as Pseudomonas fluorescens and the other as Pseudomonas sp. All four isolates survived and grew in sterile environments which indicated that starvation would not be a factor in survival of these strains. The number of organisms declined immediately in number in nonsterile lake water. However, they did survive or even grow in nonsterile sewage for a short period before declining in number. Biotic factors appeared to be influential for survival and mineralization of target compounds in many environments. The removal of protozoa, which prey on bacteria, improved survival of the added cells, but had no influence on the mineralization of 10 ..mu..g DCP/L. In comparison, degradation of 10 and 25 mg DCP/L stopped after a few days. Yeast nitrogen base appeared to overcome the lack of nutrient regeneration, a function attributed to protozoa. The additional nutrients increased toxicant mineralization, especially when seeded with appropriate species. Thus, protozoa may limit growth of added cells but appear to be needed for mineralization of higher concentrations of DCP.
Key words: bacteria, survival time, phenanthrene, biodegradation, carbon 14 compounds, pseudomonas, radioassay, water, fresh water, mineralization.

King, Kerryn. 1969. Opening remarks. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.

Kinney, P.J., D.K. Button, and D.M. Schell. 1969. Kinetics of dissipation and biodegradation of crude oil in Alaska's Cook Inlet. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: dissipation, biogradation, oil, Alaska.

Kirby, Shaunagh. January 30, 1993. The Thick Black Line. New Science. 137(1858):24(2).
Key Words: Oil spill, cleanup, marine pollution control, oil

spills, dispersants, Prince William Sound,
Shetland Islands, oil spill incidents,
biodegradation-microorganism, marine pollution,
hydrocarbons-water,
Alaska, oil skimmers.

Kleij, Antonius M. and Jozef M. Gubbens. 1985. Case history of a South Holland oil spill: organization and cooperation. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: oil, spill.

Klein, R.D. 1988. Pinellas Plant Spill Prevention Control and Countermeasures Plan. Report No. GEPP-SP-1122, 35pp.
Key words: Oil Spills, Control, Mitigation
This Spill Prevention Control and Countermeasures Plan (SPCC) manages emergency response cleanup efforts for the release of oil and petroleum products. A separate document, GEPP-SP-1104, ''The Pinellas Plant Contingency Plan for the Hazardous Waste Management Facility,'' manages emergency response cleanup efforts for the release of hazardous substances. 4 figs., 3 tabs.

Klein, D.A. 1982. Environmental effects on microbial mobilization of arsenic from retorted oil shale. In Rep No DOE/EV/10298--3, Pp IV1-IV36, 1982 ($27 00) (Oil Shale Environmental Research and Coordination Progress Report, 1979 1982).
Key words: microbiology, oil, disposal, U.S. Dept. of Energy

Klokk, Terje. 1983. Ecological mapping and cleanup of oil spills onshore. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: ecological, mapping, cleanup, oil, spills.

Knap, A.H., T.D. Sleeter, and I.W. Hughes. 1985. Case history: the grounding of the M/T Tifoso, 1983: a test of Bermuda's contingency plan. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: grounding, M/T Tifoso, Bermuda, contingency.

Knap, Anthony H. 1985. The Effects of chemically and physically dispersed oil on the brain coral diploria strigosa: a summary review. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: effects, chemically, physically, dispersed, oil, coral, diploria strigosa.

Knoll, G., J. Winter. 1989. Degradation of phenol via carboxylation to benzoate by a defined, obligate syntrophic consortium of anaerobic bacteria. Appl. Microbiol.

Biotechnol.(Germany, Federal Republic of).
30:3:318-324.
An obligate syntrophic culture was selected in mineral medium with phenol as the only carbon and energy source. The consortium consisted of a short and a long rod-shaped bacterium and of low numbers of Desulfovibrio cells, and grew only in syntrophy with methanogens, e.g. Methanospirillum hungatei. Under N/sub 2//CO/sub 2/, phenol was degraded via benzoate to acetate, CH/sub 4/ and CO/sub 2/, while in the presence of H/sub 2//CO/sub 2/ benzoate was formed, but not further degraded. When 4-hydroxybenzoate was fed to the mixed culture, it was decarboxylated to phenol prior to benzoate formation and subsequent ring cleavage. Isolation of pure cultures of the two rod-shaped bacteria failed. Microscopic observations during feeding of either 4-hydroxybenzoate, phenol or benzoate implied an obligate syntrophic interdependence of the two different rod-shaped bacteria and of th methanogen. The non-motile rods formed phenol from 4-hydroxybenzoate and benzoate from phenol, requiring an as yet unknown co-substrate or co-factor, probably cross-fed by the short, motile rod. The short, motile rod-shaped bacterium grew only in syntrophy with methanogens and degraded benzoate to acetate, CO/sub 2/ and methane. Desulfovibrio sp., present in low numbers, apparently could not contribute to the degradation of phenol or 4-hydroxybenzoate.
Key words: phenol, anaerobic digestion, benzoic acid, carbon dioxide, cell cultures, carboxylic acids, chemical reactions, decomposition.

Wood, F.S., and H. Whittaker. 1993. Oil Spill and Hazardous Substance Response Equipment and Systems Standardization Program. U.S. Coast Guard and Environment Canada 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf (Tampa, Fla, 3/29/93 4/1/93) Proc Pp 591 593.
Key words: Oil spill, Cleaning, control, pollution control, pollution control equipmnt, response, spill, standardization, additive, administration, ASTM, ASTM specification, barrier, beach, bioremediation, business operation, Canada, cargo, chemical process, classification, coast, combustion, communication, contamination, contingency planning, crude oil

Knoll, G., G. Dietrich, P. Vogel., J. Winter. 1988. Anaerobic degradation of aromatic and halogenaromatic compounds in waste water. Technology of biological processes - safety in biotechnology - applied genetic engineering. Lectures. 5. DECHEMA annual meeting of biotechnologists (DJB-5) and 22. meeting of Europaeische Foerderation Biotechnologie. 1:409-414.
Growth of pure cultures of methanogens belonging to the genus Methanobacterium and Methanobrevibacter was only affected by high concentrations of phenol. Methanospirillum was more sensitive and most sensitive

were members of the genus Methanococcus and Methanosarcina. In mixed consortia present in sewage sludge phenol, o-chlorophenol and cresol could be completely degraded after a short lag for the selection of suitable organisms. The maximum degradation rates obtained for phenol were in the range of 1 g/(lxd), those or o-chlorophenol 0.18 g/(lxd). Dechlorination was faster than the degradation of the intermediate phenol. A mixed population for the degradation of o-chlorophenol was enriched to contain only 3-4 different microorganisms and will be further characterized.
Key words: aromatics, biodegradation, waste water, dechlorination, enzyme inhibitors, methanogenic, bioconversion, chemical bacteria, phenol, pseudomonas, sewage sludge, toxicity, bioconversion.

Knorr, J.R. 1991. The Interagency shoreline cleanup committee: a cooperative approach to shoreline cleanup: the Exxon Valdez spill. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: shoreline, cleanup, Exxon Valdez, spill.

Knuutila, T., E. Mykkanen, and N. Vase. 1993. Navigation system for Finnish oil recovery vessel. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: navigation, Finnish, oil, recovery, vessel.

Kobayashi, T., T. Hashinaga, E. Mikami, and T. Suzuki. 1989. Methanogenic degradation of phenol and benzoate in acclimated sludges. Water Science and Technology (UK). 21:4-5, 55-65.
Anaerobic phenol and benzoate degrading consortia were cultivated by acclimation of methanogenic sludges to be capable of degrading completely to CO{sub 2} and CH{sub 4} 1,000 mg/1 of phenol within 5-7 days, and 3,000 mg/1 of benzoate within 5-7 days, respectively. By using the acclimated sludges, the effect of gaseous atmospheres (H{sub 2}:CO{sub 2}/80:20 and N{sub 2}:CO{sub 2}/80:20) on the biodegradability and the degradation pathways of phenol and benzoate were examined. Although the anaerobic degradation of phenol was accelerated in the H{sub 2}/CO{sub 2} atmosphere compared with the N{sub 2}/CO{sub 2} atmosphere, benzoate was accumulated. Degradations of benzoate and butyrate were inhibited in the H{sub 2}/CO{sub 2} atmosphere under stirred conditions, but not under static conditions. Through a series of biodegradation tests by using several intermediates in phenol degradation reported previously, the anaerobic degradation pathway of phenol in the N{sub 2}/CO{sub 2} atmosphere was suggested to be phenol yields benzoate yields cyclohezane carbozylate (or 1-cyclohexene carboxylate) yields fatty acids yields CO{sub 2},CH{sub 4}.

Key words: benzoic acid, anaerobic digestion, industrial wastes, phenol, sludges, hydrogen compounds, monocarboxlyic acids, digestion, alkanes, aromatics, hydrogen compounds.

Koblanski, John. 1985. Design improvements in a sonic burner for the in situ combustion of oil spills. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: design, sonic, burner, in situ, oil spills.

Koblanski, John N. 1983. An Acoustical method of burning and collecting oil spills on cold open water surfaces. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: acoustical, burning, collection, oil, water.

Koch, A.K., O. Kappeli, A. Fiechter, and J. Reiser. 1991. Hydrocarbon assimilation and biosurfactant production in pseudomonas aeruginosa mutants. Journal of bacteriology. 173(13): 4212-4219.
Key words: strain, biodegradation, biosynthesis, uptake, metabolism, mutation, pseudomon aeruginosa, surfactant, hydrocarbon, hexadecane, glycolipid, alkane, pseudomonadaceae, pseudomonadales, bacteria.

Koegler, S.S., T.M. Brouns and R. Hicks. 1989. Development of a biological process for destruction of nitrates and carbon tetrachloride in Hanford groundwater. Pacific Northwest Lab., Richland, WA. Report No. PNL-SA-16928. Environmental Toxicology and Chemistry, 8(1):65-74.
Key words: Disposal, Hanford, Microorganisms, Soil
Liquid wastes have been generated by 40 years of Hanford Site operations. Previously, some of these wastes, which contain radioactive, hazardous and regulated chemicals (including nitrates and organics), have been discharged to the soil column. Current Department of Energy (DOE) policy prohibits the disposal of contaminated liquids directly to the environment. Biodenitrification using facultative anaerobic microorganisms is a promising technology for removing nitrates from contaminated aqueous streams. This paper summarizes the results of biodenitrification studies performed by the Pacific Northwest Laboratory (PNL) in FY 1988 and FY 1989 to determine the applicability of biological denitrification and organic contaminant destruction to groundwaters.

Koehler, A., D. Bryniok, B. Eichler, D. Freier-Schroeder, H.J. Knackmuss. 1990. Use of surfactants and aliphatic hydrocarbons to accelerate degradation of phenanthrene. Biochemical engineering - Stuttgart. Reuss, M., Chmiel, H., Gilles, E.D., Knackmuss, H.J. 1991. 2. international symposium on biochemical engineering.
The present study deals with the limiting factors of the

microbial degradation of phenanthrene. In aqueous systems as well as in aqueous/organic systems the velocity of substrate transfer appears to limit the growth of the bacteria. The velocity of solubilization directly depends on the area of diffusion. Thus, in aqueous systems the degradation of phenanthrene can be accelerated with decreasing particle size of the substrate. The rate of degradation can be increased again by solubilization of phenanthrene in an organic solvent. A further acceleration of the degradation of phenanthrene and the corresponding growth of the microorganisms can be achieved by the increase of the area of substrate diffusion due by the use of nonionic surfactants.
Key words: alkanes, additives, phenanthrene, biodegradation, surfactants, microorganisms.

Koh, S., J.P. Bowman, G.S. Sayler. 1993. Soluble methane monooxygenase production and chlorinated aliphatic hydrocarbon degradation by a type I methanotroph Methylomonas methanica 68-1. Abstracts of the Annual Meeting of the American Society for Microbiology (United States). 378.
Key words: chlorinated, aliphatic, hydrocarbons, biodegradation, methanotrophic, bacteria, bioassay, oxygenases, bacteria, chemical reactions, decomposition, enzymes, halogenated aliphatic, hydrocarbons, microorganisms, organic chlorine compounds, organic compounds, organic halogen compounds, oxidoreductases, proteins.

Kohler, H.P.E., D. Kohler-Staub, D.D. Focht. 1988. degradation of 2-hydroxybiphenyl and 2,2 prime -dihydroxybiphenyl by Pseudomonas sp. strain HBP1. Applied and Environmental Microbiology (USA). 54:11:2683-2688.
Pseudomonas sp. strain HBP1 was found to grow on 2-hydroxy- and 2,2{prime}-dihydroxy-biphenyl as the sole carbon and energy sources. The first step in the degradation of these compounds was catalyzed by an NADH-dependent monooxygenase. The enzyme inserted a hydroxyl group adjacent to the already existing hydroxyl group to form 2,3-dihydroxybiphenyl when acting on 2-hydroxybiphenyl and to form 2,2{prime},3-trihydroxybiphenyl when acting on 2,2{prime}-dihydroxybiphenyl. To be substrates of the monooxygenase, compounds required a 2-hydroxyphenyl-R structure, with R being a hydrophobic group (e.g., methyl, ethyl, propyl, sec-butyl, phenyl, or 2-hydroxyphenyl). Several chlorinated hydroxybiphenyls served as pseudosubstrates by effecting consumption of NADH and oxygen without being hydroxylated.
Further degradation of 2,3-dihydroxy- and 2,2{prime},3-trihydroxybiphenyl involved meta cleavage, with subsequent Base, FL (USA)).

Kohler-Staub, D., and H.P.E. Kohler. 1989. Microbial degradation of ..beta.. -chlorinated four-carbon

aliphatic acids. Journal of Bacteriology (USA). 171:3:1428-1434.
Alcaligenes sp. strain CC1 is able to grow on several
{alpha}-chlorinated aliphatic acids (2-chlorobutyrate,
2-chloropropionate, and chloroacetate), as well as on the
{beta}-chlorinate four-carbon aliphatic acids
trans-3-chlorocrotonate, cis-3-chlorocrotonate, and
3-chlorobutyrate as sole carbon and energy sources.
Dehalogenation of {alpha}-chlorinated acids could be measured by
using resting cells grown on all the
different carbon sources, whereas dehalogenation of
{beta}-chlorinated four-carbon acids could be detected
only by using resting cells grown on four-carbon compounds. A
constitutive 2-haloacid dehalogenase, which
did not show any activity with {beta}-chlorinate four-carbon
acids, was detected in cell extracts. Cell extracts
of crotonate-grown cells additionally contained a {beta}-haloacid
dechlorination activity, which acted on
trans-3-chlorocrotante, cis-3-chlorocrotonate, and
3-chlorobutyrate and was strictly on coenzyme A, ATP,
and Mg{sup 2+}. Dechlorination of {beta}-chlorinate four-carbon
acids takes places after activation of the
acids to their coenzyme A derivatives and seems to be independent
of the constitutive 2-haloacid
dehalogenase.
Key words: growth, chlorinated aliphatic, biodegradation,
dechlorination, magnesium compounds, chemical
reaction, alkaline earth metal compounds, decomposition,
dehalogenation, enzymes, ATP, halogenated
aliphatic hydrocarbons.

Kollmeyer, Capt. R.C. and Cadet M.E. Thompson. 1977. New York
harbor oil drift prediction model. In:
Proceedings of the 1977 Oil Spill Conference (prevention,
behavior, control, cleanup), March 8 10, New
Orleans, LA.
Key words: New York, harbor, oil, drift, prediction.

Kolpack, Ronald L. 1977. Priorities in fate of oil spill
research. In: Proceedings of the 1977 Oil Spill
Conference (prevention, behavior, control, cleanup), March 8 10,
New Orleans, LA.
Key words: oil, spill, research.

Kolta, P., and I. Koncz. 1991. Process and Device for Removing
Oil Impurities from Water. World 91/5738,
p 5/2/91, f 10/11/89 (Appl 89/046) (c02f-001/40; C09k-003/32) pct
gaz v 1991, no 10, p 3655, 5/2/91 (issn
02507757; abstract only) (ao)
1991
Key words: oil water separation, collecting agent,
contamination, control, elastomer, environmental
pollution, oil spill, physical separation, pollution control,
water pollution, p) world, absorbent, absorption,
aperture, business   operation

Komery, D.P., R.M. Ritcey. 1990. The Aostra Taciuk process
technology for oil field clean up of tank

bottoms and E.O.R. production wastes. In: Proceedings of the 2nd Aostra Et Al Can-China Heavy Oil
Technol Symp (Beijing, China, 10/29/90 11/1/90).
Key words: oil, recovery, disposal, tank, hydrocarbon

Konrad, J., A. Schmid, H. Tiltscher. 1992. Development of strategies for continuous inoculation with
microorganisms to degrade xenobiotics in soil. Soil Decontamination Using Biological Processes. (1992):
6 9 December.
Key words: bacteria, biodegradation, hydrocarbon, degradation
Arthrobacter species for p-nitrophenol (PNP) mineralization are immobilized on porous carrier pellets.
Native apatite improves PNP degradation. Laboratory bioreactor tests show satisfactory bacteria release and
different ways of PNP decomposition immediately after pellet charging and after microbial release and
growth. Paper given at Int. Symp. Soil Decontamination using Biological Processes, Karlesruhe, D,
6 9.12.92.

Koons, Charles B. and James P. Thomas. 1979. C15+ Hydrocarbons in the sediments of the New York bight.
In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los
Angeles, CA.
Key words: C15+, hydrocarbons, sediments, New York.

Koons, Charles Bruce. 1977. Distribution of volatile hydrocarbons in some Pacific Ocean waters. In:
Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New
Orleans, LA.
Key words: hydrocarbons, Pacific Ocean.

Koops, W., F.J. Sanders, and J.M. Gubbens. 1985. The Katina oil spill 1982, combating operation at sea. In:
Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los
Angeles, CA.
Key words: Katiana, oil, spill.

Koops, Wierd. 1985. The oil spill slide rule to predict the fate of an oil spill. In: Proceedings of the 1985 Oil
Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.

Kordyban, E. June 1990. The Behavior of the Oil-Water Interface at a Planar Boom. Energy Resources
Technology. 112(2):90-95.
Key Words: Oil water contact, containment, floating barrier, gradient, instability, interfact, physical property,
pressure gradient, stability, area, business opeartion, collector, contamination, diagram, distribution,
experimental data, fluid flow, kerosine, oil spill, oil spreading, petroleum fraction, photograph, plane
(geometric), pollution control, pressure distribution, pressure

measuring, prevention, salvaging, surface area,
surface water, waste oil recovery, water pollution, wave (wave).

Kordyban, E. March 1992. The Effect of Waves on the Oil Slick at a Retention Boom. Energy Resources Technology. 114(1):31-37.
Key Words: Floating barrier, containment, hydrodynamic model, interface, oil spill, oil water contact, wave (water), approximation, environmental pollution, experimental data, flow pattern, flow visualization, hydrodynamics (mechanics), instability, kerosine, kinematics, laboratory testing, mathematical analysis, mathematical model, motion pictures

Korreck, W.M., J.M. Armstrong, and R.H. Douglass. 1992. Integrated enhanced bioremediation and vacuum extraction for remediation of a hydrocarbon release in resposne to oscillating hydrologic conditions traverse co-bio-vac. In: Proceedings of the Pennwell Conf & Exhibit co Petro-Safe 92 Conf, January 27-29, 1992, Houston, TX, pp. 839-853.
Key words: Bioremediation, Oil Spill, Soil Pollution, Bacteria, Cleanup, Groundwater, In-situ, Microorganism, Monitoring, Water Pollution

Korte, F.W., S.W. Korte, and S.M. Norman. 1987. Environmental profile analysis. In: Proceedings of the American Chemical Society national meeting, August 30, 1987, New Orleans, LA, pp. 193 194.
Key words: biodegradaton, environmental impact, Germany, fishes, Europe
The Institute for Ecological Chemistry of the GSF in Munich, West Germany, developed a test system to evaluate the potential environmental hazard of chemicals. This so-called Environmental Profile Analysis is a test system for the screening of chemicals for their environmental behavior. The test system consists of the following five tests: (1) bio-accumulation in algae; (2) bio-accumulation in fish; (3) retention, dispersion, and excretion in rats (warm-blooded animals); (4) degradation, transformation and accumulation in activated sludge (microbial process); (5) photomineralization (abiotic process). The test system involves the use of radio-labeled test materials. This allows the use of scintillation counting as the universal analytical method and avoids the significant analytical limitations other methods are faced with. Also, the very sensitive method of scintillation counting allows the detection of traces of test materials and/or transformation products.
Difficulties and risks of the use of radioactive materials can be eliminated by following strictly the procedures of the guidelines. A series of more than one hundred compounds belonging to widely different classes of compounds and displaying widely different application patterns and physicochemical properties has been tested so far. The test data for all the parameters of the five tests can be graphically presented creating a

profile of parameters. The profile of the unknown materials is compared with the profile of compounds which are known to impose a burden on the environment. Potentially hazardous material is identified by similarities of the profiles and additional investigation should be performed. Through this comparison of profiles, the ecotoxicological profile analysis allows a quick recognition of potentially hazardous chemicals.

Kosinkiewicz, B., J. Lubczynska.1988. Interaction of polycyclic aromatic hydrocarbons and the products of their transformation with the herbicide Ro-Neet. Acta Microbiologica Polonica. (1988): 37(3 4).
Key words: bacterial, hydrocarbons
The bacterial strain Arthrobacter sp., isolated from soil contaminated with industrial dust containing polycyclic aromatic hydrocarbons, utilized anthracene. The bacteria were incubated in the medium enriched with the herbicide Ro-Neet (10 ppm). Anthracene uptake by the bacteria was 0.014 mg/l mg of bacterial protein, but when the bacteria were incubated in the medium enriched with the herbicide, the anthracene uptake was higher (0.017 mg/l mg of bacterial protein). Anthracene penetrated into the insoluble fraction of bacterial cells but in the presence of Ro-Neet its amount in bacterial cells was higher. The fluoranthene and the aliphatic compound of its biotransformation did not react with Ro-Neet. Anthracene added into the soil was degraded but in the presence of Ro-Neet its decomposition rate was faster and correlated with the number of microbial cells. During the decomposition of anthracene in soil the phenolic compounds were formed. In the soil teated with Ro-Neet the accumulation of simple phenols was noted.

Koskinen, K.V.K., and O.O. Backman. 1988. Apparatus and method for separating liquids. Pct Gaz. 1988(24):5279.
Key words: Oil Skimming, Crude Oil, Oil Spill, Petroleum

Kosky, K.F., and C.R. Neef. 1988. Innovative biological degradation system for petroleum hydrocarbons treatment. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:811-821.
Key words: Biodegradation, Bioremediation, Bacteria, hydrocarbon, Microorganism, Soil Pollution, Water Pollution

Kostecki, P. T. and E. J. Calabrese. 1991. Unique problems of hydrocarbon contamination for ports. In: Proceedings of the Annual West Coast Conference on Hydrocarbon Contaminated Soils and Groundwater, Feb. 1990, Newport Beach, CA. Lewis Publishers: Chelsea, MI, pp. 71 76.
Key words: California, Groundwater, Oil Spills, Water Pollution

Since the early 1900s, port facilities in the United States have been involved in the import and export of petroleum products. The WORLDPORT L.A. is a 7,000 acre land and water area that is administered by the Department of the City of Los Angeles under a tidelands grant from the State of California for the purposes of commerce, navigation, and fisheries. Over half of the oil-refining of California lies within 20 miles of WORLDPORT L.A. It is therefore not surprising that the port is a major hub for the handling of crude oil and petroleum products, including gasoiline, aviation gas/jet fuel, and marine fuels. This paper reports that it is also not surprising that port facilities, given their long history of handling petroleum products, contain areas where soils and groundwater are contaminated with hydrocarbons. This contamination is localized but can be extensive. Petroleum and petrochemical products are handled at terminal facilities that are leased to oil companies.

Koster, C.A. Oil spill recovery vessel, removing water surface oil spills and storing collected oil. Patent No. US 498726_900326.
Key words: Baffle, Boom, Hydraulic System, Oil Waste, Pollution Control, Pump, Storage

Kovaletz, M.P. 1993. PETROLEUM ABSTRACTS. Method for Dispensing a Fluidic Media for Treatment of Waterborne Spilled Petroleum. 18 pp; 12 Claims.
Key words: Pollution control equipmnt, Adsorbent, aerial, Transportation, aircraft, contamination, decontaminating, environmental, Pollution, helicopter, oil spill, solid adsorbent, sorbent, spill, transportation, water pollution
USA, 1,3-Butadiene, homopolymer, adsorption, air, applying, chart, compressed, gas, compressor, container, control

Kowalski, Tadeusz. 1993. Oil spill cleanup in severe weather and open ocean conditions. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil, spill, cleanup, weather, ocean.

Krahn, M.M, G.M. Ylitalo, J. Joss, S.L. Chan, and Exxon Valdez. 1991. A rapid, semi-quantitative screening of sediments for aromatic compounds using sonic extraction and HPLC/fluorescence analysis. Marine Environmental Research. 31(3):175-96.
Key words: Accident, Alaska, Aromatic Hydrocarbon, Crude Oil

Krahn, M.M. 1993. Screening methods for assessing damage to natural resources following the Exxon Valdez oil spill. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: screening, assessing, damage, resources, Exxon Valdez,

spill.

Kratzel, R. Oil boom barrier, has 4 foam grid screen sections connected by hinged links. Patent No. DE 43517_900206.
Key words: Boom, Crude Oil, Oil Waste, Pollution Control, safety, Water Pollutant

Kraus, S.P., J.E. Estes, and R.R. Vollmers. 1977. Comparative evaluation of real and synthetic aperture radars for the detection of oil pollution in the Santa Barbara channel. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.: American Petroleum Institute: Washington, D.C. pp. 203 208.
Key words: evaluation, radars, detection, oil, pollution, Santa Barbara channel.

Krebs, Charles T. and Christopher E. Tanner. 1981. Restoration of oiled marshes through sediment stripping and Spartina propagation. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: restoration, oiled, marshes, sediment, Spartina.

Kreider, R.E. 1971. Identification of oil leaks and spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: identification, oil, leaks, spills.

Kretschmer, D. and J. Odgers. 1985. Combustibility and incineration of Beaufort Crude-seawater emulsions. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: combustibility, incineration, Beaufort, crude-seawater, emulsions.

Kreysa, G., A.J. Driesel. 1992. Bioprocess engineering, monitoring and controlling, applied genetics and safety, low molecular weight metabolites, environmental biotechnology. DECHEMA biotechnology conferences. 5:1061-1067.
The kinetics of the microbial degradation of two chlorinated hydrocarbons, dichloromethand (DCM) and 1,2-dichloroethane (DCA), has been investigated using pure cultures of different bacterial strains. It could be shown that substrate, oxygen and product are growth inhibitory factors under certain conditions. Experiments were carried out in special ''Fed-Batch''-fermenters, where not only a constant substrate concentration could be maintained during the whole fermentation time but also the used oxygen could be quantified. This system can mathematically be described by combined balance equations, and different kinetic parameters concerning the growth dependence of the bacteria on the substrate concentration can be calculated. (orig.).

Key words: chlorinated aliphatic, hydrocarbons.

Krieg, R.K., and J.A. Drumheller. 1991. Method and Apparatus for containment of hazardous material migration in the Earth. Patent No. US 5050386910924, 23p.
Key words: Containment, Groundwater, Oil Spill

Krishnayya, A.V., M.J. O'Connor, J.G. Agar, and R.D. King. 1988. Vapor extraction systems : factors affecting their design and performance. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:547-569.
Key words: Groundwater, Oil Spill, Soil Pollution, Vadose Water

Kritler, C. W., M. S. Akhter, and A. C. A. Donnelly. 1990. Hydrologic hydrochemical characterization of Texas Frio Formation used for deep-well injection of chemical wastes. Environmental Geology and Water Sciences. 16(2):107 120.
Key words: Biodegradation, Disposal, Microorganisms, Monitoring, Water Pollution
Hydrologic hydrochemical investigations were conducted to determine the long-term fate of hazardous chemical waste disposed in the Texas Gulf Coast Tertiary Frio Formation: a shallow fresh to moderately saline water section in the upper 3,000 4,000 ft; an underlying 4,000 5,000 ft section with moderate to high salinites. The complexity of the hydrologic environment is enhanced due to extensive depressurization in the 4,000 8,000 ft depth interval, which presumably results from the estimated production of over 10 billion barrels of oil equivalent and associated brines from the Frio in the past 50 years. Because of the higher fluid density and general depressurization in the brine hydrostatic section, upward migration of these brines to shallow fresh groundwater should not occur. Depressurized oil and gas fields, however, may become sinks for the injected chemical wastes. Water samples appear to be in approximate oxygen isotopic equilibrium with the rock matrix, suggesting that active recharge by continental waters is not occurring. In the northern Texas Gulf Coast region salt dome dissolution controls water chemistry. In the central and southern Frio Formation, brines from the deeper geopressured section may be leaching into the hydrostatic section. The lack of organic acids and the alteration of Frio oils from samples collected from depths shallower than approximately 7,000 ft suggest microbial degradation of organic material. This has useful implications for degradation of injected chemical wastes and needs to be investigated further.

Kroll, W. 1979. Waste oil as a fuel. 2. International recycling congress CRE/MER. Berlin, F.R. Germany. 1 Oct. 1979.
Keywords: disposal, waste oil, recycling, Germany, recovery.
The potential of waste oil from motors, turbines, transmissions

and other industrial sources as a heating fuel is examined. Possibilities for the reutilization of waste oil are considered, and problems associated with second refining and the combustion of waste oil to generate heat in large-scale plants are pointed out. The principles of waste oil furnaces for use in small-scale plants for the generation of heat for small and medium-sized businesses are outlined, and the savings in fuel oil and disposal costs brought about by waste oil incineration are pointed out. Consideration is given to the levels of emissions from waste oil furnaces and applications of the furnaces in the area of material recycling. It is concluded that waste oil definitely has a future as a fuel and this use can represent a partial solution to the problem of waste oil disposal.

Kronberg, Hans. 1992. Land reclamation and redevelopment at blekholmstorget. UK Soc of Chemical Industry/et al Contaminated Land Treatment Technologies Int Conf, London, UK (Elsevier). pp.252-269.
Key words: Stockholm, Bacteria, Biodegradation, Microorganisms, Hydrocarbon, Soil Contamination
The rehabilitation of the Blekholmstorget area of Stockholm, Sweden, is described. The site had been used as a dump for 200 yr, and had been the location of a gas works during the 1850s, with the addition of a facility for manufacturing products from gas tar in the 1860s. A proposal to build homes, offices, and other structures on the site during the 1980s led to the discovery of creosote and PAHs in the soil. Contamination was contained by installation of screens of steel sheets and a concrete and ash filler. Upward mobility of contaminants was prevented by installation of cover materials. At the same time, a method of bioremediation was used to exploit the degradation of creosote by natural bacteria. Slightly more than halfway through the remediation process, it is not possible to know whether the target value of 200 ppm creosote can be attained at the site. The PAH levels remain unaffected by treatment.

Kruk, Keith F. 1983. Air curtain incinerator tests. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: incinerator.

Krupp, Friedhelm and Omar Khushaim. 1993. The Establishment of a marine wildlife sanctuary following the 1991 Gulf War oil spill. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: marine, wildlife, sanctuary, Gulf War, oil, spill.

Kruth, Lt. David J., Edward Overton, and John Murphy. 1987. Protecting an island's drinking water and desalinization plant. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control,

cleanup), April 6 9, Baltimore, MD.
Key words: island, water, desalinization.

Krutz, Michael and Hildegard Krutz. 1985. A Computerized information system on crude oils. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA. Key words: information, system, oils.

Kuhlmeier, P.D. April 1987. Environmental Assessment Plan: K-1414 area diesel fuel release within the Oak Ridge Gaseous Diffusion Plant. Geraghty and Miller, Inc., Oak Ridge, TN (USA), Oak Ridge Gaseous Diffusion Plant, TN (USA). 53.
Key Words: Oil spills mitigation, tanks reliability, compliance, diesel fuels, environmental policy, ground water, land pollution control, ORGDP, polycyclic aromatic, hydrocarbons, site characterization, subsurface environments, surface waters, Tennessee, well drilling, aromatics, Federal Region IV, gaseous diffusion plants, government policies, hydrogen compounds

Kuhn, E.P., J.M. Suflita. 1989. Microbial degradation of nitrogen, oxygen, and sulfur heterocyclic compounds under anaerobic conditions: Studies with aquifer samples. Pub. in Environmental Toxicology and Chemistry, Vol. 8, No. 12, 1149-1158(Dec 1989).
The potential for anaerobic biodegradation of 12 heterocyclic model compounds was studied. Nine of the model compounds were biotransformed in aquifer slurries under sulfate-reducing or methanogenic conditions. The nitrogen and oxygen heterocyclic compounds were more susceptible to anaerobic biodegradation than those compounds containing a sulfur deteroatom. In contrast, only small amounts of methane were detected in aquifer slurries amended with compounds containing an oxygen heteroatom, even though a decrease in the parent substrate concentration occurred. Pyridine, 2-picoline and 4-picoline were biotransformed within three months under sulfate-reducing conditions. However, longer incubation times were required for the degradation of these substrates in methanogenic aquifer slurries. A literature survey reveals the widespread contamination of ground waters with heterocyclic compounds from waste management practice and fossil-fuel-related industries.
Key words: ground water, decontamination, biodegradation, environmental transport, hazardous, heterocyclic.

Kuhn, E.P., and J.M. Suflita. 1989. Anaerobic biodegradation of nitogen-substituted and sulfonated benzene aquifer contaminants.Hazardous Waste & Hazardous Materials. 6(2):121 134.
Key words: microorganism, disposal, biodegradation, soil
A literature survey of ground water contaminants indicated that aquifers are repositories for hazardous wastes, including N- and S-substituted benzene derivatives. We

therefore examined the susceptibility of several anilines, benzamides, benenesulfonic acids and benenesulfonamides to anaerobic metabolism by aquifer microorganisms. Under sulfate-reducing and methanogenic conditions the carboxylated anilines were biotransformed within 1 to 3 months while unsubstituted or methylated anilines required longer incubation times. Benzamide as well as an aryl methyl and an N-methyl derivative were biodegraded under both redox conditions. The anaerobic degradation of the N-methylated benzamide was favored in sulfate-reducing rather than methanogenic incubations. However, the addition of a second N-alkyl group rendered the resulting compounds resistant to anaerobic decay. Only 1 of 7 benzenesulfonates and 2 of 5 benzenesulfonamides proved amenable to anaerobic metabolism. We found 37 75% of the theoretically expected amount of methane from aquifer slurries amended with the aminobenzoic acids, benzamide, and p-toluamide. In sulfate-reducing aquifer slurries 89-100% of the ozidized benzamide, p-toluamide and N-methylbenzamide could be accounted for by sulfate reduction. These results help indicate which harzardous waste constituents will likely persist in anoxic aquifers and the types of chemical substitution patterns that favor anaerobic biotransformation.

Kuiper, J. 1985. The Use of large-scale outdoor marine model ecosystems to assess the fate and effects of crude oil and dispersant-treated crude oil. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA. Key words: marine, model, ecosystems, assess, effects, oil, dispersant.

Kuivilla, K.M., J.W. Murray, A.H. Devol. 1990. Methane production in the sulfate-depleted sediments of two marine basins. Geochimica et Cosmochimica Acta (USA). 54:2:403-411.
Rates of methane production via both acetate fermentation and CO{sub 2} reduction were directly measured with radiotracer techniques in the sulfate-depleted sediments of Saanich and Princess Louisa Inlets. Comparison of measured and modeled rates suggests that these two pathways account for the majority of methane produced below the sulfate reduction zone in the sediments of both basins. Methane production via CO{sub 2} reduction was slightly more important than acetate fermentation with 57-58% of the methane in Saanich Inlet and 52-57% in Princess Louisa Inlet being produced from bicarbonate. The results from Saanich Inlet, a seasonally anoxic basin, are compared with Princess Louisa Inlet, with a permanently oxic hypolimnion. Although the two basins have comparable organic-carbon rain rates, the rates of methanogenesis are much lower in Princess Louisa Inlet. This decrease in methane production can be

attributed to the consumption of organic carbon via aerobic respiration occurring in the surface sediments of Princess Louisa Inlet, thereby decreasing the actual input of organic carbon to the zone of methane production. The relative importance of CO{sub 2} reduction and acetate fermentation in the production of methane was the same in both basins, suggesting that prior aerobic degradation of the organic matter has little influence on the pathways of methane production. The results from this study in the two marine systems (high sulfate) are also compared to published studies in freshwater environments (low sulfate) where acetate fermentation is the predominant pathway of methane production.
Key words: methane, carbon dioxide, fermentation, methanogenic, bacteria, organic compounds, isotope, oxygen compounds.

Kukor, Jerome J., Ronald H. Olsen. 1990. Diversity of toluene degradation following long term exposure to BTEX in-situ. Adv. Appl. Biotechnol. Ser. (1990): 4
Key words: hydrocarbons, degradation, petroleum

Kulik, C.J., H.E. Lebowitz, T. Ignasiak, and L. Ignasiak. 1991. EPRI/ARC clean soil process. In: Proceedings of the AIChE 1991 Summer National Meeting, August 18 21 1991, Pittsburgh, PA, N.87f, 6 pp.
Key words: Clay Mineral, Coal-Water Mixture, Concentration, Petroleum

Kulisch, G.P., V.L. Vilker. 1991. Application of Pseudomonas putida PpG 786 containing P-450 cytochrome monooxygenase for removal of trace naphthalene concentrations. Biotechnology progress. 7(2): 93-98.
This study explores the potential for a bacterial monooxygenase to remove polynuclear aromatic hydrocarbons from aqueous solutions at high rates. This is part of a larger effort to test the versatility of the cytochrome P-450 SUB c SUB a SUB m monooxygenase enzyme system for detoxification of industrial process wastewaters that contain trace quantities of hazardous compounds like PAHs or halocarbons.
Key words: Naphthalene, biodegradation, cytochrome P450, inhibition, antibacterial agent, polycyclic aromatic compound, enzyme, pseudomonas putida.

Kulp, T.J. 1990. Oil spill imaging with the BAGI (Backscatter Absorption Gas Imaging) active imager. Calif Univ, Livermore, Report No. UCRL-CR-106319, 32 pp.
Key words: Oil Spill, Contamination, Water Pollution, Remote Sensing

Kumura, B, M. Murakami, and H. Fujisawa. 1990. Utilization of hydrocarbon substrates by heavy oil-degrading bacteria isolated from the sea water of oil-polluted bisan seto. Nippon Suisan Gakkaishi. 56(5):771-776.
Key words: Hydrocarbon, Bacteria, Degradation

Kurz, G.E. 1993. Pollution risk from marine casualties. Sea Technol. 34(4):21-25.
Key words: Tanker, Oil Spill, Contamination, Remote Sensing

Kusunoki, N., and T. Saito. 1989. Recent activities of the private oil spill cooperative in Japan. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 247 52.
Key words: Accident, Boom, Crude Oil, Emergency, Oil Waste, Pollution Control Equipment

Kuwait Oil Co. 1991. Mideast well fire, oil spill plans taking shape. Oil & Gas Journal. 89(12):39.
Key words: Accidental Fire, Biochemical, Biodegradation, Crude Oil, Pollution Control

Kyeheon, Oh., and O.H. Tuovinen. 1991. Bacterial degradation of phenoxy herbicide mixtures 2,4-D and MCPP. Bulletin of Environmental Contamination and Toxicology (United States). 47:2:0007-4861.
The phenoxy herbicides 2,4-dichlorophenoxyacetic acid (2,4-D) and 2-(2-methyl-4-chlorophenoxy)propionic acid (MCPP) have auxin-like growth regulating properties and are extensively used for the control of broad-leaf angiosperm weeds. The microbiological degradation of 2,4-D by pure and mixed cultures has been examined in a number of studies. The authors have previously evaluated the concurrent microbiological degradation of 2,4-D and MCPP in stirred tank reactors. For the present paper, they examined the utilization of the two substrates by three mixed cultures that had a previous history of growth with the respective single phenoxy herbicide.
Key words: chlorinated aliphatic hydrocarbons.

La Belle, R. P., A. Nakassis, and K. J. Lanfear. 1983. An oil spill risk analysis for the gulf of Alaska/Cook Inlet lease offering (October 1984). US Geol Surv Open-File Rep No. 83 882.
Key words: Oil Spill, Alaska Gulf, Cook Inlet

Labelle, R. P., K. J. Lanfear, A. D. Banks, and R. M. Karpas. 1984. An oilspill risk analysis for the Southern California lease offering (February 1984). US Geol Surv Open-File Rep No. 83-563.
Key words: Oil Spill, Risk Assessment, Southern California

Labelle, R. P. 1990. Risk assessment of offshore oil spills. In: Proceedings of the13th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 6 8, Edmonton,Canada. Pp. 231-242.
Key words: Risk Analysis, Oil Spills, Water Pollution

LaBelle, Robert P. and Margie G. Hegy. 1993. Oil spill trajectory analysis for U. S. coastal waters. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil, spill, U.S., coastal, waters.

Labrie, P., and B. Cyr. 1990. Biological remediation of shoreline oily waste from marine spills. In: Proceedings of the 13th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 6 8 1990, Edmonton, Canada, pp. 387-399.
Key words: Bioremediation, Biodegradation, Oil Spill, Aromatic Hydrocarbon, Contamination, Crude Oil, Pollution Control

Lacaze, J.C. 1976. Influence of illumination on phytotoxicity of crude oil. Mar. Pollut. Bull. 7(4):73 76.
Key words: Phytotoxicity, Oil Spills, Biodegradation, Water Pollution
Petroleum products discharged at the water surface are rapidly modified under the effect of physicochemical and biological transformations, themselves closely dependent on ecological factors. The role of some of these, such as illumination, may be particularly significant. This report deals with the effect of this parameter on the phytotoxicity of Kuwait crude oil on the primary production of a microalga (Phaeodactylum tricornutum) and marine plankton communities. The result of these investigations indicates that the toxicity of extracts made from a crude oil is about two to three times greater when the latter is previously subjected to illumination of sufficient intensity and duration. The incorporation of a chemical dispersant (Corexit 8666) magnifies this phenomenon. In the case of a weathered crude oil mixed in equal parts with the dispersant, illumination raises the toxicity of the extracts by a factor of about 30.

Ladousse, A., C. Tallec, and B. Tramier. 1987. Progress in enhanced oil degradation. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.

Key words: oil, degradation.

Ladousse, Alain, and Bernard Tramier. 1991. Results of 12 years of research in spilled oil bioremediation: inipol EAP 22. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: research, spilled, oil, bioremediation, Inipol EAP 22.

Lafargue, E., and C. Barker. 1988. Effect of water washing on crude oil compositions. AAPG Bull. (United States). 72:3:263-276.
Crude oils from Venezuela, Oklahoma, and New Mexico were water washed in the laboratory at terical model based on the equation of diffusion. Predicted oil-water ratios were in good agreement with the experimental values for the light ends, and the model suggests that water washing is very fast in the subsurface. Comparison of oils that appeared to have been water washed in nature with the equivalent unwashed oils showed the expected compositional trends. Water washing is probably the dominant process affecting crude oil composition in the subsurface when water flows past oils under conditions where bacterial degradation is precluded by temperature (> 80/sup 0/C) or by lack of dissolved oxygen, and the temperatures are too low for thermal cracking. 19 figures, 7 tables.
Key words: New Mexico, petroleum, chemical composition, chemical properties, temperature dependence, elements, energy sources, chromatography, developing countries.

Lafave, J.I. 1989. The effect of an intermittent stream on a shallow groundwater system and the implications for groundwater remediation. In: proceedings of the third national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods. National Water Well Association outdoor action conference. 1161(p):719-732.
Key Words: Aquifers hydrology, ground water contamination, oil spills environmental transport, fluid flow, goelogy, leaks, mitigation, remedial action, sandstones, water pollution abatement, water tables, hydrogen compounds, mass transfer, oxygen compounds, pollution abatement, sedimentary rocks.

Lafay, W.T., and W.F. Meistrell. 1990. Oil Absorption Method. Patent No. US 4919820, c 4/24/90, f 4/17/89 (Appl 339259) ,5 pp.
Key words: floating barrier, absorbent, barrier, business operation, collecting agent, oil spill, oil water separation, physical separation, salvaging, sorbent, waste oil recovery, (p) USA, aperture, cable, cavity, chart, compression, connector, container, containment, contamination, control, coupling (mechanical), diagram, ecology, environment, fitting, float, floating, lake, liquid solid separation, mounting, ocean, ocean environment, physical property, pollution control, pore, pore size, porosity, recycling, sea, suspension device, water pollution, ecology & pollution

Laha, S. 1992. Solubilization and biodegradation of polycyclic aromatic hydrocarbon compounds in soil-water suspensions with surfactants. Carnegie-Mellon Univ., Pittsburgh, PA (United States). 147.
Hydrophobic organic compounds (HOCs) sorb strongly onto soil and sediment material, and the effectiveness of microbial treatment can be diminished by HOC phase partitioning and decreased substrate accessibility to microorganisms. Surfactant addition has been suggested as a technique for decreasing the interfacial tension and partitioning of the HOC with soil, and thereby increasing HOC mobility and bioavailability. However, this study indicates that nonionic surfactant solubilization of HOCs from soil may not be beneficial for the enhancement of soil bioremediation. The solubilization and microbial degradation of phenanthrene, a three-ring polycyclic aromatic hydrocarbon (PAH) compound, was examined in various soil-water systems with commercially-available surface-active agents. This was accomplished by a series of batch tests using radiolabeled techniques. The purpose of surfactant addition was to assess the effect of surfactant solubilization of PAHs on their biodegradation. For soil-water suspensions without surfactant approximately 50-60% of the phenanthrene was mineralized over the course of ten weeks. The addition of nonionic surface-active agents was observed not to be beneficial for microbial mineralization of phenanthrene in the soil-water systems, and for supra-CMC surfactant doses phenanthrene mineralization was completely inhibited for all the surfactants tested. Sub-CMC levels of surfactant in the soil-water systems generally did not have an inhibitory effect on phenanthrene mineralization, but neither did such doses serve to enhance the rate of *degradation*, which proceeded most rapidly in the absence of any surfactant. Companion tests suggest that the supra-CMC inhibitory effect is not a

toxicity phenomenon, per se, of the surfactant or micellized PAH. An assessment of the results from the various experiments suggest that the inhibitory effect is probably related to a reversible physiological surfactant micelle-bacteria interaction.
Key words: polycyclic aromatic, hydrocarbons, biodegradation, sediments, remedial action, soils.

Lahar, D.H.,and S.B. Lahar. Improved method and containment system controlling oil spill, from aquatic vessel carrying containment appts. inboard, capable of quick deployment surrounding entire vessel with boom. Patent No. US 824348_920123
Key words: Anchoring, Containment, Pollution Control, Equipment, Waste Material

Lake, James L. and Carl Hershner. 1977. Petroleum sulfur-containing compounds and aromatic hydrocarbons in the marine mollusks modiolus demissus and crassostrea virginica. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: petroleum, sulfer, hydrocarbons, marine, mollusks.

Lam, T., and V.L. Vilker. 1987. Biodehalogenation of bromotrichloromethane and 1,2-dibromo-3-chloropropane by Pseudomonas putida PpG-786. Biotechnol. Bioeng.(United States). 29:1:151-159.
Biodehalogenation of 10/sup -5/M concentrations of bromotrichloromethane (BTM) and 1,2-dibromo-3-chloropropane (DBCP) was studied in static cultures of Pseudomonas putida PpG-786. Measurements of bromide ion release were found to be approximately consistent with the amounts of halocarbon degraded. Gas chromatography/electron capture detection measurements of hydrocarbon degradation products as a function of incubation time showed the transitory appearance of chloroform and bromodichloromethane from BTM and the transitory appearance of lower boiling but unidentified products from DBCP. The degradation of BTM to trihalomethanes and halide ion is consistent with the enzymatic reductive dehalogenation by cytochrome P-450 reported by others. The dependence of initial conversion rates on halocarbon concentration and cell mass concentration was determined by measuring the decline of parent halocarbon in stirred batch cell suspensions. The rate of DBCP conversion was up to 10-fold higher than the rate of BTM conversion. When the intracellular, enzyme-catalyzed conversion of BTM is analyzed by the effectiveness factor of heterogeneous catalysis, the initial conversion rates measured suggest that intrinsic enzyme kinetics, rather than halocarbon permeation of the cell membrane or other diffusive processes, is rate limiting.
Key words: chlorinated aliphatic hydrocarbons, growth, biodegradation, pseudomonas, decomposition, halogenated aliphatic hydrocarbons, chemical reactions, chromatography, microorganisms, separation processes, organic compounds, separation processes, organic halogen compounds.

Lambert, R.A., J.T. Bortell, D.C. Carmer, B.E. Morey, D.F. Paskausky, and M. Fisher. 1992. Recommending remote sensing requirements to the United states Coast Guard. In: Proceedings of the 1st US Environ Protect agency et al remote sensing for mar &

coastal environ thematic conf, June 15 17 1992, New Orleans, LA, 1:191-204.
Key words: Remote Sensing, Business Operation, Contingency Planning, Oil Spill Planning, Laser

Lamp'l, Howard J. 1973. Lake Champlain: a case history on the cleanup of #6 fuel through five feet of solid ice at near-zero temperatures. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: Lake Champlain, cleanup, ice, temperatures.

Lamp'l, Howard J. and Ralph L. Rhodes. 1969. Beach cleanup. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: beach, cleanup.

Lancelot, F., H. Londiche, and G. De Marsily. 1990. Experimental results on the influence of electric fields on the migration of oil, ionic species and water in porous media. Journal of petroleum science & engineering. 4(1):67-74.
Key words: Water Pollution, Groundwater, Pollution Control, Surfactant, Oil Spill
Development and quantification of a method for the use of electric currents to recover a fraction of petroleum products trapped by capillarity in the pores of aquifers where they cannot be recovered by gravitational pumping. The development of this method is part of the search for new means of combating aquifer contamination by petroleum products. The method can be used for cleansing of aquifers polluted by ionic species.

Land, W.R. 1980. Used oil management. In: Procedings of the Natl. Pet. Refiners Assoc. Annu. Meet. (New Orleans 3/23 25/80) Pap. N.Am-80-23 20P.
Key words: incineration, legal, recycling, used oil, disposal

Landais, Patrick. 1989. Evidence for bacterial degradation of hydrocarbons in uranium deposits. Terra Nova. 1(2):163-171.
Key words: Mineral Deposits, Bacteria, Degradation, Hydrocarbons

Lande, S.S., M.T. Elnabarawy, E.A. Reiner, A.N. Welter, and R.R. Robideau. 1987. Laboratory assessment of environmental impact of phthalazine. Bull. Environ. Contam. Toxicol.(United States). 38:2:332-336.
Several approaches to the environmental safety assessment of chemicals have been reported. The basic principles involved in predicting environmental behavior combine degradation kinetics and the partitioning/distribution of chemicals in the environment. The transport mechanisms within the environment can be modeled as partitioning/distribution which are essentially functions of the physico-chemical properties of the chemical. Phthalazine (2,3-Benzodiazine, C8H6N2) is a component of a specialized paper product. The major route for environmental entry of phthalazine is through land disposal of waste paper. Information available on phthalazine chemistry is consistent with behavior of heterocyclic aromatic hydrocarbons. Several laboratory test methods and QSAR estimation procedures were used to measure key environmental properties of phthalazine. This assessment examines the

environmental release of phthalazine, and its partitioning and distribution in the environment. It predicts the probable fate and possible biological effects of phthalazine.
Key words: phthalazines, biodegradation, toxicity, algae, fishes, maize, partition, tomatoes, activity relationships, grass, invertebrates, plants, cereals, branch iopods, animals, aquatic organisms, decomposition, organic nitrogen compounds, crustaceans, azines.

Landon, Matthew K., and Marc F. Hult. 1991. Evolution of physical properties and composition of a crude oil spill. Water-Resources Investigations. 641-645.
Key Words: Minnesota, pollution, environmental geology, oil spills physical properties, USGS, Midwest, United States, North-Central Minnesota, Bemidji, Minnesota, Beltrami County, Minnesota, ground water.

Landowne, Robert A. and Ralph B. Wainright. 1971. A Chemical tagging system for use in the prevention of oil spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: chemical, prevention, oil, spills.

Lane, Patricia A. Lane. 1987. Impact of experimentally dispersed crude oil on vegetation in a Northwestern Atlantic salt marsh: preliminary observations. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: impact, dispersed, oil, vegetation, marsh.

Lane, P.A., M.J. Crowell, D.G. Patriquin, and J.H. Vandermeulen. 1987. Impact of experimentally dispersed crude oil on vegetation in a northwestern atlantic salt marsh - preliminary observations. In: Proceedings of the 10th bien api et al oil spill (prev, behav, contr, cleanup) conf (baltimore, 4/6-9/87) proc pp 509-514, 1987 (12 refs).
Key words: additive, crude oil, dispersant, field testing, flora, oil spill, petroleum, testing, vegetation

Lane, S. 1983. Lime coagulation and stabilization of total Oil Sands tailings. In: Proceedings of the 34th Annu Cim Petrol Soc & Can Ass Drilling Eng Tech MTG (BANFF, Can, 5/10 13/83) Preprint 17 PP. in Year.
Key words: recovery, oil, disposal, hydrocarbon

Lane, P.A., M.J. Crowell, D.G. Patriguin, and I. Buist. 1987. The use of chemical dispersants in salt marshes. Environmental studies research funds, No.070. Environmental Research Ltd., Ottawa, Ontario (Canada). Report No. LA-8705, 116 pp.
Key words: Land Pollution, Coastal Regions, Environmental Effects
This report documents the results of a study of the environmental impacts and efficiency of dispersing stranded oil in a north-western Atlantic coast salt marsh. The impacts of oil, dispersant, and oil plus dispersant treatments on vascular plants, algal-bacterial communities, sediment properties, and the chemical fate of the oil in the sediment where examined. Parallel experiments were conducted in both the field and in a greenhouse.

In both field and greenhouse experiments a stratified random design was used. Control, oil, despersant, and oil plus dispersant treatments were incorporated into the design. Both oil and dispersant were applied by back-pack sprayer following wetting of the salt marsh *vegetation* with seawater. Experimental effects were observed at the community level and where possible, at the species and cellular levels. Hypotheses developed for the various parameters were tested using two-way analysis of variance and the Student-Newman-Keuls multiple range test. The results of this study indicate that dispersion of stranded oil in salt marshes using the application technique studied here, is not a viable oil spill clean-up measure. The dispersant appeared to be ineffective in removing the oil from the vegetation and proved to be more toxic to the vasular plant communities than the oil alone. Other dispersant fomulations or application techniques might provide better results, and should be investigated. 27 refs., 24 tabs., 37figs.

Lanfear, K. J., and D. E. Amstutz. 1983. A reexamination of occurrence rates for accidental oil spills on the U.S. outer continental shelf. In: Proceedings of the 8th BIEN API, EPA & US Coast Guard Oil Spill (Prev, Behav, Contr, Cleanup) Conf, February 28 March 3, San Antonio, Texas. Pp. 355 359.
Key words: Oil Spill, Continental Shelf

Lang, D.J., and S.T. Joyce. 1990. Land treatment of petroleum contaminated soils with sewage sludge. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection, & Restoration Conf, October 31 November 2, 1990, Houston, TX. Ground Water Manage No 4:443 448.
Keywords: soil remediation, bacteria, biodegradation, bioremediation, soil pollution, waste material

Lange, Rolf. 1985. A 100 tons experimental oil spill at Halten Bank, off Norway. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: experimental, oil, spill, Norway.

Langlois, Jr., A. Edward. 1969. Portland harbor evaluation. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: Portland, harbor, evaluation.

Langston, J. V. 1969. Training program to improve well control operations. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: training, improve, well, control.

Lantz, R. M. 1991. Methods used to determine the efficacy of in situ bioremediation at hazardous waste sites. In: Proceedings of Northeast Conference and Exhibition on Hazardous Materials Control HMCRI) '91, July 10 12, 1991, Greenbelt, MD, pp. 257 261.
Key words: Biodegradation, In-Situ, Monitoring, Petroleum, Pollution Control, Soil
In recent years, the use of in-situ bioremediation to restore sites contaminated with hazardous organic chemicals has received much attention. In this paper, three methods are described which are

used to determine the efficacy of in-situ bioremediation at hazardous waste sites. In order of increasing complexity these methods are: Brubaker's Screening Criteria for Contaminated Aquifers; Field Measurement of Biodegradation Products and Terminal Electron Acceptors; and Remote Detection of Soil Gas Carbon Dioxide. The types of contaminants found in groundwater can affect the feasibility of in-situ bioremediation. In general, lower molecular weight compounds degrade more rapidly than higher molecular weight compounds. Thus, simple hydrocarbons and light petroleum distillates, such as gasoline, kerosene and diesel fuel, are quite biodegradable. Simple aromatic hydrocarbons, such as benzene, toluene and ethylbenzene are also readily biodegradable. Polynuclear aromatic hydrocarbons, chlorinated hydrocarbons, such as tetrachloroethane (PCD) and different polychlorinated biphenyl aroclors (PCBs), have been shown to be only moderately biodegradable during in-situ bioremediation field tests.

Laperriere, F., H. Whittaker, M. Yanagisawa, I. Suzuki. 1987. High Pressure Water Jet Testing for Oil Containment in Simulated Environmental Conditions.Env Canada Arctic & Marine Oilspill 10th Sym, Edmonton. 209(14).
Key Words: Oil spill cleanup, marine pollution equipment, oil booms, Arctic waters, ocean currents, containment.

Lapham, Scott M. 1987. Hydrocarbon recovery; closed-loop hydrocarbon flushing system. Midwest Ground Water Conference. 32.
Key Words: Ground water, pollution, oil spills, water quality, methods.

Lapinskas, John. 1989. Bacterial degradation of hydrocarbon contamination and groundwater. Chemistry & Industry-UK. (23):784-789.
Key words: Biodegradation, Microorganism, Groundwater, Soil Pollution, Hydrocarbons, Bacteria
Parameters for successful biochemical treatment of contaminated soil and groundwater is outlined. The natural activity of bacteria breaks down hydrocarbons into cell biomass, water, and carbon dioxide if fundamental growth criteria are satisfied. To remediate polluted soil and subsurface groundwater aquifers these parameters need to be optimized to enhance this carbonoclastic activity. For each site the process steps include: contamination identification, quantification, solubility, and biodegradability, and soil permeability transmissivity, nutrient availability, oxygen availability, temperature profile, moisture content, pH profile, and toxicity and inhibition determination. Applications for engineered soil banks, enhanced land farming, and in situ restoration schemes are given.

Lapinskas, J. 1989. Bacterial degradation of hydrocarbon contamination in soil and groundwater. Society of Chemical Industry (London), Monograph (UK). 23:784-789.
This article explains how 'nature's workforce' can be harnessed to clean up hydrocarbon-based contaminants in soil and groundwater. The biochemical parameters for successful treatment are outlined and applications in enhanced land farming, engineered soil banks and in situ restoration schemes discussed. (author).
Key words: land pollution, biodegradation, land pollution control,

ground water, soils, pollution control, oxygen compounds.

Largeau, C., and S. Derenne. 1993. Relative efficiency of the selective preservation and degradation recondensation pathways in kerogen formation. Source and environment influence on their contributions to type I and II kerogens. Organic Geochem. 20(5):611-615.
Key words: Hydrocarbon, Degradation, Bacteria

Larkin, J.C. 1989. Emergency Preparedness and Response : The Buckeye Approach In: Proceedings of the API Pipeline Conf (Dallas, 4 17-18/89) proc pp 337-344, 1989.
Key words: pollution control, administration, business operation, control, employee relations, management, oil spill, pipeline, planning, safety, training program accident, adsorbent, Buckeye Pipe Line Co., cleaning, communication, communication system, containment, contamination, data, economic factor, electric generator, electric power source, emergency, emergency ship, energy source, environment, fluid loss, government, hazard, health, land, leak

Larrabee, Lt. Richard M. and Russell Ward. 1977. Fast surface delivery system for pollution response equipment. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: surface, delivery, pollution, response.

Larsson, U., O. Linden, A. Hagstroem. Pelagic bacterial and phytoplankton production in a subtropical marine environment exposed to chronic oil contamination. Oil and Chemical Pollution (United Kingdom). 7:2:0269-8579.
The abundance and production of pelagic bacteria, phytoplankton primary production and chlorophyll content were studied in coastal waters receiving the effluent from an oil refinery in the Arabian Gulf. The area also receives unknown amounts of other effluents rich in organic matter and nutrients. The abundance of bacteria was measured by epifluorescent direct counts, and productivity was estimated by {sup 3}H-thymidine uptake measurements. The results showed a clear stimulation of the primary productivity as well as elevated amounts of chlorophyll a in the area receiving the effluent. Both bacterial abundances and production were an order of magnitude higher in a small area close to the refinery outlet, but dropped rapidly and reached background values outside an impacted area of c. 10 km{sup 2}. These data, plus the low petroleum hydrocarbon concentrations found in the sediments and in bivalves outside the impacted area, suggest that bacterial degradation of the petroleum hydrocarbons from the refinery could be a major process restricting the area impacted by oil pollution. (author).
Key words: bacteria, abundance, oil spills, petroleum refineries, oil spills, production, waste water, carboxylic.

Lasiter, L.A. 1992. Overview of environmental protection measures for oil and gas exploration and production. In: Proceedings of the 8th Petrobras et al latin amer drilling congr, October 14 16 1992, Rio De Janerio, Brazil, 1:511-520.
Key words: Pollution Control, Contamination, Environmental Pollution, Oil Spill

Laskowski, Stanley L. and Thomas C. Voltaggio. 1989. The Ashland oil spill of January 1988: an EPA perspective. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: Ashland, oil, spill.

Laube, T., E. Heinz, and H.J. Kutzner. 1992. Degradation of aromatic hydrocarbons by commercial selected bacteria and activated sludges.
Key words: Bioprocess engineering, monitoring and controlling, applied genetics and safety, low molecular weight metabolites, environmental biotechnology. DECHEMA biotechnology conferences. 5:1113-1116,642.
With the aid of the semi-continuous fill-and-draw-method, two activated sludges and three 'Dried Bacterial Cultures' (DBC's) currently avaible on the market for the improvement of aerobic waste water treatment processes were tested for their potential to degrade the following aromatic hydrocarbons: toluene, phenol, benzoic acid and various chlorinated benzoic acids. From these enrichment cultures, bacteria of the genera Pseudomonas, Acinetobacter and Alcaligenes were isolated and found to be able to utilize the respective aromatic components as the sole source of carbon and energy. The results indicate that the activated sludges were superior to the commerical Dried Bacterial Cultures'. (orig.).
Key words: aromatics, biodegradation, bench scale.

Lauch, R.P., J.G. Herrmann, W.R. Mahafeey, A.B. Jones, M. Dosani, and J. Hessling. 1992. Removal of creosote from soil by bioslurry reactors. Environmental progress. 11(4):265-271.
Key words: Biodegradation, Soil Pollution, Bacteria
Biological slurry reactors were tested for removal of polynuclear aromatic hydrocarbons (PAHs) from creosote contaminated soil. Five bioslurry reactors, operated in parallel, kept the soil aerated, partially suspended and well mixed. The reactors were inoculated with indigenous microbes of the Genus Pseudomonas. Nutrients were added to maintain the optimum ratio of carbon, nitrogen, and phosphorus. Temperature within the reactors was approximately 25 SUP o C. The slurry consisted of approximately 30% contaminated soil.

Laughlin, Jr., Roy B. and J.M. Neff. 1979. The Interactive effects of temperature, salinity, and sublethal exposure to Phenanthrene, a petroleum-derived polycyclic aromatic hydrocarbon (PAH) on the respiration rate of juvenile mud crabs, Rhithropanopeus harrisii. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: temperature, salinity, phenanthrene, petroleum, hydrocarbon, crabs.

Layton, A.C., J. Sanseverino, W. Wallace, C. Corcoran, G.S. Sayler. 1992. Evidence for 4-chlorobenzoic acid dehalogenation mediated by plasmids related to pSS50. Applied and Environmental Microbiology (United States). 58:1:0099-2240.
The potential for polychlorinated biphenyl biodegradation is of environmental interest because of the toxicity and bioaccumulation of these compounds. Biodegradation studies on 4-chlorobiphenyl

(4CB), a model for polychlorinated biphenyl degradation, have focused mainly on the genes and enzymes that permit the degradation of 4CB to 4-chlorobenzoate (4CBA). Most biphenyl- and polychlorinated biphenyl-degrading strains accumulate the corresponding chlorobenzoic acids without degrading the chlorobenzoate to CO{sub 2}. The study demonstrated that the 4-chlorobiphenyl-degrading Alcaligenes sp. strain ALP83 can degrade 4-chlorobenzoate to 4-hydroxybenzoate. The dehalogenase activity is correlated with a 10-kb fragment carried on plasmid pSS70.
Key words: bacteria, metabolism, chlorinated, aromatics.

Le Guen, Y.J.F., M. Brussieux, and R. Burkhalter. 1987. Real-time processing of oil spill remote sensing data. In: Proceedings of the 10th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Conf, April 6 9 1987, Baltimore, MD, pp. 71-73.
Key words: Oil Spill, Computer, Crude Oil, Dispersion, Pollution Control

Le Guen, Y. 1987. Development of a great rate oily water separating system. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.

Key words: oily, water, separating.

Le-Khac, B. 1991. Oil-absorbent compositions. 24 Aug 1993 pg ([10] Patent and Trademark Office, Box 9, Washington, DC 20232 (United States) ETD (Energy Technology Data Exchange), INS (US Atomindex input)
IMS (DOE contractor).
A composition useful as an organic-liquid absorbent is described, said composition comprising an interpolymer formed by polymerizing an alkylated styrene in the presence of from about 4 to about 50 weight percent based on the total weight of the composition of a rubber, and an amount of a crosslinking agent within the range of about 0.15 to about 0.50 mole percent based on the amount of polymerizable monomers used.
Key words: adsorbents, chemical composition, oil spills, cleaning, absorption,chemical preparation, cross-linkin, monomers, polymers, rubbers chemical reactions, elastomers, organic compounds, organic polymers, polymerization, polymers, sorption, synthesis

Leahy, Joseph G., Charles C. Somerville, Kelly A. Cunningham, Grammenos A. Adamantiades, Jeffrey J. Byrd, and Rita R. Colwell. 1990. Hydrocarbon mineralization in sediments and plasmid incidence in sediment bacteria from the Campeche bank. Applied & Env Microbiology. 56(6):1565-1570.
Key words: Mexico, Biodegradation, Microorganism, Hydrocarbon, Degradation, Offshore
Radiolabeled hydrocarbon degradation rates and incidence of bacterial plasmid DNA were studied in sediments collected from the Campeche Bank, Gulf of Mexico. Overall rates of carbon 14-labeled hexadecane and phenanthrene mineralization were negligible. The low mineralization rates were attributed to nutrient limitations and to lack of adaptation by microbiota to hydrocarbon contaminants. Plasmid frequency data for sediment bacteria also showed no correlation with proximity to local oil fields, but showed correlation with water column depth at each sampling site.

Leahy, J.G., and R.R. Colwell. 1990. Microbial degradation of hydrocarbons in the environment. Microbiol Rev. 54(3):305-315.
Key words: Bacteria, Biodegradation, Hydrocarbon, Microorganism, Oil Spill, Soil Pollution, Water Pollution

Leal, D.R., and M.D. Copeland. 1991. Oil Spills. Amer Oil Gas Reporter. 34(6):105-106,126.
Key words: Oil Spill, Biodegradation, Cleaning, Environmental Impact, Decomposition, Economic Factor, Petroleum, Pollution Control

Leathard, P. 1990. Cleanup efforts at the Alaskan oil spill...Past, present, and future. In: Proceedings of the NPRA Refinery and Petrochemical Plant Maintenance Conference, May 23 25 1990, San Antonio, TX, Paper N.MC-90-78, 24pp.
Key words: Alaska, Beach, Biochemical Reaction, Biodegradation, Crude Oil, Pollution Control, Skimmer

Leavitt, M. 1990. New Mexico's regulatory approach to corrective action at lust sites. National Water Well Association, Dublin, OH (US). 664(p):265-268.
Key Words: Ground water-water pollution abatement, petroleum underground storage, storage facilities environmental effects, storage facilities pollution regulations, New Mexico, oil spills, regulatory guides, state government, document types, energy sources, Federal Region VI, fossil fuels, hydrogen compounds, North America, oxygen compounds, pollution abatement, USA.

Lee, Richard F., and Ronald Hoeppel. 1991. Hydrocarbon degradation potential in reference soils and soils contaminated with jet fuel. Battelle In Situ Bioreclamation Symp, San Diego, CA, pp.570-580.
Key words: Biodegradation, Microorganism, Soil Contamination, Petroleum, Hydrocarbons
Test wells at a Maryland naval air station, drilled near a fuel farm and a jet fuel pump station, indicated soil contamination with petroleum compounds. Contaminants included the VOCs benzene, toluene, ethylbenzene, and xylenes, and the chemicals have seeped into area streams. Rates of microbial degradation of hydrocarbons at the contaminated site were determined, using the hydrocarbon degradation potential technique, which is based on the property that soils previosuly exposed to petroleum have an enhanced microbial capacity to degrade its compounds. Instead of adding unneeded hydrocarbon-degrading microbes to such contaminated sites, remediation efforts should enhance *degradation* by monitoring moisture, oxygen, and nutrients.

Lee, Kenneth and Eric M. Levy. 1989. Enhancement of the natural biodegradation of condensate and crude oil on beaches of Atlantic Canada. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: biodegradation, oil, beaches, Atlantic, Canada.

Lee, Richard F. 1981. Polycyclic aromatic hydrocarbons in oysters (Crassostrea virginica) from Georgia coastal waters: analysis by high-pressure liquid chromatography. In: Proceedings of the 1981

Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: polycyclic, hydrocarbons, oysters, Georgia, coastal, waters, chromatography.

Lee, Kenneth and Eric M. Levy. 1987. Enhanced biodegradation of a light crude oil in sandy beaches. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: biodegradation, oil, beaches.

Lee, K., G.H. Tremblay, and E.M. Levy. 1993. Bioremediation: application of slow-release fertilizers on low- energy shorelines. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: bioremediation, fertilizers, shorelines.

Lee, M. 1981. The Use of dispersants on viscous fuel oils and water in crude oil emulsions. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: dispersants, oils, water, emulsions.

Lee, Richard F. 1975. Fate of petroleum hydrocarbons in marine zooplankton. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: petroleum, hydrocarbons, marine, zooplankton.

Lee, Richard F. 1977. Fate of petroleum components in estuarine waters of the southeatern United States. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: petroleum, estuarine, waters, United States.

Lee, Roger, W. 1989. Determination of the extent of gasoline contamination of a shallow sand aquifer using soil gas analyses for volatile organic compounds in Jackson, Tennessee. Open-File Report (United States Geological Survey. 1978. 50pp.
Key Words: Tennessee, environmental geology, pollution, Madison County Tennessee, USGS, Southern U.S., United States, southwestern Tennessee, Jackson Tennessee, ground water, aquifers, oil spills, polluted water, volatiles, organic materials, gases, soils, soil gases.

Lee, D.B. 1989. Tragedy in Alaska waters. Nat. Geogr. 176(2):260-263.
Key words: Abstract, Accident, Alaska, Boom, Crude Oil, Pollution Control, Equipment, Tanker

Lee, M.D., K.P. Garon, and R.L. Raymond. May 1990. Remediation of petroleum contaminated soil and groundwater using in-situ bioreclamation. AAPG Bulletin (American Association of Petroleum Geologists) (USA). 74(5):702.
Key Words: Petroleum biodegradation, dontamination, ground water, land pollution, oil spills, remedial action, water pollution, water tables, chemical reactions, decomposition, energy sources, fossil fuels, hydrogen compounds, oxygen compounds.

Lee, K., and E.M. Levy. 1991. Bioremediation: waxy crude oils stranded on low- energy shorelines. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 541-547.
Key words: Bioremediation, Biodegradation, Crude Oil, Petroleum, Contamination

Leech, M.V., A. Tyler, and M. Wiltshire. 1993. OSIS: a PC-based oil spill information system. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: OSIS, oil, spill.

Leendertse, P. and M. Scholten. 1987. The Effects of oil on interacting salt marsh plants. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: effects, oil, marsh, plants.

Lees, D.C., J.P. Houghton, and W.B. Driskell. 1993. Effects of shoreline treatment methods on intertidal biota in prince william sound. In: Proceedings of the 13th Bien API et al oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 345-354.
Key words: Toxic Effect, Alaska, Cleaning, Crude Oil, Oil Spill, Petroleum

Lees, Joseph E. 1993. Contingency planning, contractor requirements, and Oil Pollution Act of 1990 implementation. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: planning, oil, Pollution, Act, implementation.

Legg, C.A. 1991. The Arabian Gulf oil slick, January and February 1991. Int. J. Remote Sens. 12(9):1795-1796.
Key words: Remote Sensing, Oil Spills, Pollution
A large oil slick in the north-western Arabian Gulf, resulting from the deliberate release of crude oil from a terminal off the Kuwait coast, was one of the many environmental disasters associated with the recent Gulf war. Near-real-time monitoring of this slick was required in order to provide estimates of the extent and movement of the slick, which threatened huge desalination plants in Saudi Arabia and Bahrain, as well as a range of unique habitats along the gulf coastline. Satellite remote sensing provided an appropriate monitoring tool, especially in a war situation where independent airborne monitoring was difficult.

LeGore, Steve. 1989. Effect of chemically dispersed oil on Arabian Gulf corals: a field experiment. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: chemically, dispersed, oil, Arabian Gulf, corals.

Lehr, William J. and Murat S. Belen. 1983. The Fate of two large oil spills in the Arabian Gulf. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup),

February 28 March 3, San Antonio, TX.
Key words: oil, spills, Arabian Gulf.

Lehr, Cdr. W.E. and J.O. Scherer, Jr. 1969. Design requirements for booms. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: design, booms.

Leigh, J.T. and William C. Park, III. 1983. Mobile command and communications systems. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: communications.

Leigh, LCDR James T. 1973. Oil recovery on the high seas. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil, recovery, seas.

Lenhard, R. J. and J. C. Parker. 1990. Estimation of free-hydrocarbons volume from fluid levels in monitoring wells. Ground Water 28(1):13.
Key words: Remedial Action, Oil Spills, Underground Storage, Water Pollution
Under the assumption of local vertical equilibrium, fluid pressure distributions specified from well fluid levels in monitoring wells may be used to predict water and hydrocarbon saturation profiles given expressions for air-water-hydrocarbon saturation-pressure relations. Vertical integration of the oil-saturation profile yields the actual oil volume in porous media per unit area adjacent to the well. Three-phase fluid distributions are predicted using a scaling procedure which requires knowledge of two-phase air-water saturation-pressure relations, hydrocarbon density, and hydrocarbon surface tension. Results reveal that whereas the distance above and oil-water table at which oil saturation become zero may be independent of soil type, estimated light nonaqueous phase liquid (LNAPL) volumes per unit area may differ substantially. Hence, estimates of LNAPL volume cannot be inferred directly from soil LNAPL thickness or well LNAPL thickness data without consideration of effects of soil properties. Furthermore, it is demonstrated that no simple linear conversion scheme can be employed to relate the height of LNAPL in a monitoring well to the LNAPL volume in porous media. Effects of grain-size distribution and well LNAPL thickness on the ration of actual LNAPL thickness in the aquifer to well LNAPL thickness are shown.

Lennox, R. 1993. Frogmat used to combat huge oil spill in the Shetlands.
Key words: environment, transport & storage, health

Lennox, R. 1991. Frogmat: an innovative system for oil spill control. BMT Abstracts. ABSTR. NO. 92010083 V47 N.1
Key words: Health, Environment, Water Pollution Control, Equipment, Crude Oil

Leonard, Donald J. 1971. Development of tank vessel overfill alarm instruments. In: Proceedings of Joint Conference on Prevention and

Control of Oil Spills, June 15 17, Washington, D.C.
Key words: tank, overfill, instruments.

Leotta, J. and W.A. Wallace. 1975. The United States Coast Guard's pollution incident reporting system: its use in program management. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: United States, Coast Guard, pollution, reporting, management.

Leotta, LTJG J.V. and LCDR A.J. Taylor. 1973. Coast Guard transfer monitoring program. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.

Key words: Coast Guard, transfer, monitoring.

Lepera, M.E., G. Debono. 1977. An investigation of waste (crankcaase oil disposal by direct incineration.) J Air Pollut Control Assoc. (1977): 27
Key words: crankcase, oil, disposal, incineration

Lepke, P., and W. Troesch. 1988. Processes for the anaerobic treatment of waste water with a high organic content - development and state of the art.Bioreactors, downstream processing, process and reactor modelling, bioprocesses. Lectures. 22. exhibition and congress ACHEMA '88 - international meeting on chemical engineering and biotechnology. 2:421-439.
A description of the metabolic principles behind anaerobic waste water treatment processes elucidates the degradation chain according to which organic substances are broken down by anaerobic microorganisms; and provides a comparison of their metabolism with that of the aerobic variety active in conventional treatment plants. The carbon balance and energy yield for both aerobic and anaerobic processes are depicted in the accompanying diagrams. It is demonstrated that in many cases the dual-stage operation that characterizes the Uhde/Schwarting process leads to increased treatment efficiency, whilst at the same time considerably reducing the volume compared to equivalent single-stage installations. Test results from various types of waste water show the differences in terms of residence time, spatial load, gas yield and degradation rates. Photographs of operational plants based on the Uhde/Schwarting process provide an illustration of the transfer of theory into practice. The paper ends with a comprehensive list of process applications.
Key words: waste water, anaerobic digestion, bench-scale experiments, water treatment plants, bioconversion, chemical reactions, bacteria, alkanes, hydrogen, organic wastes, pH value, liquid water, microorganisms.

Lesko, G.L. 1983. Environmental planning of the syncrude project. In: Proceedings of the Can Petrol Ass Et Al Int Environ Planning for Large-scale Develop Proj Workshop (Whistler, B.C., Can, 10/2 5/83).
Key words: oil recovery, oil disposal, environment, petroleum, Canada, in-situ

Leuterman, Arthur J.J., Fredrick V. Jones, John E. Candler. 1988.

Drilling fluids and reserve pit toxicity. Journal of Petroleum Technology (Nov 1988): 40
Key words: disposal, oil, environmental impact, toxicity, hazardous waste standards
Concerns regarding reserve pit contents and disposal practices have resulted in state and local governmental regulations that limit traditional methods of construction, closure, and disposal of reserve pit sludge and water. A great deal of attention and study has been focused on drilling fluids that eventually reside in reserve pits. In-house studies show that waste from water-based drilling fluids plays a limited role (if any) in possible hazards associated with reserve pits. Reserve pit water samples and pit sludge were analyzed and collated. Analyses show that water-soluble heavy metals (Cr, Pb, Zn, and Mn) in reserve pits are generally undetectable or, if found in the total analysis, are usually bound to clays or organics too tightly to exceed the limitations as determined by the EPA toxicity leachate test. The author experience is that most contamination associated with reserve pits involves high salt content from produced waters and/or salt formations, lead contamination from pipe dope, or poorly designed pits, which could allow washouts into surface waters or seepage into groundwater sources. The author analyses show that reserve pits associated with water-based drilling fluid operations should not be classified as hazardous; however, careful attention should be paid to reserve pit construction and closure to help avoid any adverse environmental impact. (Edited author abstract) 12 Refs.

Leuterman, Arthur J.J., and Ian Still. 1993. North Sea harmonization ahead for tests of drilling fluids. Offshore. 53:42 44.
Key words: oil petroleum, drilling, offshore, equipment

Leveille, T.P. 1991. The Mega Borg fire and oil spill: a case study. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 273-278.
Key words: Oil Spill, Pollution Control, Contingency Planning

Levine, Edwin and Dean Dale. 1989. Computer mapping capabilities for oil spill planning and response. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: computer, mapping, oil, spill, planning, response.

Levine, R.A. 1987. A discussion of the operational aspects of the response to the arco Anchorage oil spill, port angeles, Washington. In: Proceedings of the 1987 API - EPA - U.S. Coast Guard Oil Spill Prev. Behavior Control Cleanup Conf., March 6 9 1987, Baltimore, MD, API Publ. N.4452, pp. 3-7.
Key words: Alaska, Boom, Crude Oil, Pollution Control, Environmental Protection Agency

Levine, R.A. 1988. Oil spill recovery apparatus. Patent No. US 4840729.
Key words: oil spills, water pollution control, equipment, petroleum, removal
This patent describes an apparatus for removing oleaginous

substances such as an crude oil or refined petroleum products from entrapment in coarse bottom sediments such as submerged sand beds covered by bodies of water or forming the bottom of a holding pond. The apparatus consists of tractor means for traversing the sand bed in a pattern which will substantially cover the area in which the substances are entrapped, the tractor means including a movable boom for supporting pump means for withdrawing water from the body of water; motor driven pump means supported by the *boom* spaced from the tractor means for intake of water from the body of water; means mounted on the tractor means for mechanically plowing the sand bed to a depth sufficient to overturn the sand bed which has been saturated with the substances; and hydraulic jet nozzle means in communication with the pump means for discharging a high velocity flow stream of water adjacent to the means for plowing to agitate the overturned to free the substances from the grains of sediment for flotation of the substances to the surface of the body of water.

Lewandowski, G., D. Adamowitz, P. Boyle, L. Gneiding and K. Kim. 1988. Comparison of the microbial response of mixed liquors from different treatment plants to industrial organic chemicals. In: Proceedings of the Conference on Biotechnology for Degradation of toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 260-274.
Key words: Biodegradation, Bioreactors, Hydrocarbons, New Jersey, Wastewater
As the first stage of an effort to determine the ability of publicly owned treatment works (POTWs) to detoxify industrial organic chemicals, several compounds were added individually to the mixed liquors from two very different treatment plants - the Livingston (NJ) municipal wastewater treatment plant, and the Passaic Valley Sewerage Commissioners plant in Newark, NJ. The former handles 2.5 million gallons/day (mgd) of domestic sewage, while the latter handles 250 mgd of wastewater with aa 55% industrial component (on a biological oxygen demand (BOD) basis). An aerated batch reactor was used, and the chemicals were: phenol, 2-chlorophenol, 2,6-dichlorophenol, and 2,4-dichlorophenoxyacetic acid, Substrate disappearance was determined by gas chromatography, and the microbial systems characterized microscopy and plating techniques. Although the two mixed liquors came from very different systems, their response to the industrial chemicals added, as well as the initial and final microbial populations, were very similar. This suggests that the phenoma observed might be generalized to many other POTWs.

Lewandowski, G., B. Baltzis and C.P. Varuntanya. 1988. Use of pure cultures as a means of understanding the performance of mixed cultures in biodegradation of phenolics. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 292-315.
Key words: Bioreactors, Biodegradation, Microorganisms, Monitoring, New Jersey, Wastewater
Eleven dominant bacterial species were isolated from a phenol-acclimated mixed liquor obtained obtained originally from the Passaic Valley Sewerage Commissioners wastewater treatment plant in Newark, NJ. However, of these eleven species, only three (Klebsiella pneumoniae, Serratia Liquefaciens, and Pseudomonas

putida) were able to degrade phenol. Therefore, the remaining eight species must have survived by utilizing the metabolic products of the three primary phenol degraders. regarding the three primary phenol degraders, when the same species were purchased from commercial suppliers, they could not degrade phenol, which underlines the importance of the strain as well as the species. Using the kinetic parameters from the single species experiments, a simple competitive model was tested for phenol utilization by any two of the three primary phenol degraders. This model was able to predict the rate of total biomass growth fairly well, but was much less accurate in predicting the rate of substrate utilization. This indicates that simple competition for the same substrate is not an adequate physical model for the mixed culture system. For example, one (or both) of the organisms may be producing an inhibitory agent for the growth of the competing organism.

Lewandowski, G., B. Baltzis, C.P. Varuntanya, S.T. Kolaczkowski, and B.D. Crittenden (eds.). 1987. A study of biodegradation using pure species kinetics to model the performance of mixed populations. Management of Hazardous and Toxic Wastes in the Process Industries. pp. 466 475.
In an effort to gain a more fundamental understanding of the performance of mixed microbial cultures in the biodegradation of toxic organic chemicals, studies have been conducted using three phenol degrading species isolated from a municipal treatment plant. The rate of phenol degradation was investigated for each of the three pure phenol degrading species, and various combinations of the three species. A simple competitive model was used to predict the behavior of the mixed cultures by using the pure culture Monod rate constants. The model fit the growth data for total biomass very well, although the fit of the phenol degradation data was less accurate.

Lewis, A., D.C. Byford, and P.R. Laskey. 1985. The Significance of dispersed oil droplet size in determining dispersant effectiveness under various conditions. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: dispersed oil, dispersant.

Lewis, T.A., R.L. Crawford. 1993. Physiological factors affecting carbon tetrachloride dehalogenation by the denitrifying bacterium Pseudomonas sp. strain KC. Applied and Environmental Microbiology (United States). 59:5:1635-1641. Carbon tetrachloride (CT) is a carcinogenic, ozone-depleting, toxic, xenobiotic compound found in ground water, listed as a priority pollutant by the US EPA. In aqueous solution, CT is not readily hydrolyzed and has an estimated half-life of 7,000 years. Since CT resists spontaneous degradation, conditions favorable for dehalogenation must be created to effect remediation of CT contamination. This paper describes studies of CT transformation aimed at determining the potential of Pseudomonas sp. strain KC as a bioaugmentation strain and describes a search for KC-type CT transformation activity in samples from regional aquifers. 11 refs., 9 figs., 1 tab.
Key words: aquifers, biodegradation, carbon tetrachloride, pseudomonas, biological pathways.

Lexander, Jorgen. 1991. Exploitation and protection of marine resources in the Baltic region. Proceedings of Oceans '91, October 1 3 1991, Honolulu, HI, 1:521-524.
Key words: Environmental Protection
The author discusses exploration and exploitation activities in the Baltic Sea, major pollution problems, and the scientific research and investigations connected with the Baltic monitoring program. The technical research and development efforts combined with the marine exploitation and protection methods are considered. Examples are given of technology development combined with the exploitation and protection activities such as oil spill combat and recovery methods, remote sensing instrumentation for airborne surveillance and mapping, multi-parameter measurement instrumentation, and testbed vehicles for the automated underwater vehicle technology development. 13 Refs.

Li, K., T. Caron, M. Landriault, J.R.J. Pare, and M. Fingas. 1992. Measurement of volatiles, semi-volatiles and heavy metals in an oil burn test. In: Proceedings of the 15. Arctic and Marine Oilspill Program Technical Semin., June 10 12 1992, Edmonton, Alberta, pp. 561-573.
Key words: Oil Spills, Pollution Control, Volatile Hydrocarbons
In-situ burning is one of the many countermeasures to combat oil spills. The primary advantage of burning is rapidity: in some favourable cases it can remove as much oil in one day as would be removed in one month by mechanical removal. Damage to shoreline and biota can thus be minimized. In addition it requires much less equipment and man-power resources. In remote areas where the logistics of cleanup equipment is insurmountable, in-situ burning may be the only practical means of oil removal. On the other hand, burning produces large volume of smoke and, until there is a clear understanding of the constituents of the emitted smoke/soot and the remaining residue, in-situ burning is not likely to win public acceptance. In this paper, the detailed analytical work employed to analyze the burn samples is outlined and discussed.

Li, W.T., and S. Goodwin. 1993. Anaerobic degradation of aromatic hydrocarbons by Geobacter metallireducens. Abstracts of the Annual Meeting of the American Society for Microbiology (United States).l, 356.
Key words: bacteria, biochemical reaction, kinetics, toluene, biodegradation, hydroxylation, oxidation., alkylated aromatics, aromatics, chemical.

LI Business News. 1993. Roux Associates Inc: Long Island's environmental experts for Superfund, RCRA, UST, and other hazardous waste problems. (Resource Conservation and Recovery Act of 1976; underground storage tanks)(includes related article) (Pull Out: LI Realty & Environment) (Company Profile). LI Business News. pp. 24 25.

Lichatowich, J.A. 1973. Development of methodology and apparatus for the bioassay of oil. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: methodology, bioassay, oil.

Lichte, H.W. 1979. Skimming barrier performance evaluation:

offshore version and harbor version. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: skimming barrier, offshore, harbor.

Lichte, H.W. and M. Borst. 1983. Applying OHMSETT data to spill contingency plans. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: OHMSETT, spill, contingency.

Lichte, M.W., M. Borst, and G.F. Smith. 1981. Open ocean skimmer performance tests. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: ocean, skimmer, performance.

Lichtenthaler, Rainer G. and Per S. Daling. 1985. Aerial application of dispersants: comparison of slick behavior of chemically treated versus non-treated slicks. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: aerial, application, dispersants, slick, chemically.

Lichtenthaler, Rainer G. and Per S. Daling. 1983. Dispersion of chemically treated crude oil in Norwegian offshore waters. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: dispersion, chemically, oil, Norwegian, offshore.

Lin, Jian Er. 1990. Biodegradation of toxic chemicals using the co-immobilization approach. Univ. Michigan, Ann Arbor, MI, 186 pp.
Key words: biodegradation, co-immobilization

Lin, Jian-Er, Henry Y. Wang, and Robert F. Hickey. 1991. Use of coimmobilized biological systems to degrade toxic organic compounds. Biotechnology and Bioengineering, 38(3):273 279.
Key words: soil pollution, biodegradation, bacteria
The concept of coimmobilizing cell mass (and/or enzyme) and adsorbent in a hydrogel matrix for biodegradation of toxic organic chemicals was introduced. Under defined experimental conditions, the coimmobilized system using activated carbon and Phanerochaete chrysosporium was compared with nonimmobilized systems for the degradation of pentachlorophenol (PCP). It was demonstrated that the coimmobilized system degraded PCP more effectively than the nonimmobilized system. A solid substrate included in the coimmobilized system could support the biodegradation. Isolation of the degrading agents from a model interrupting microorganism by the coimmobilized capsule membrane reduced the interference on the biodegradation In simulated contaminated soil extract and sand, the coimmobilized system also exhibited higher degradative ability and stability than the nonimmobilized systems. (Author abstract) 18 Refs.

Lin, C. 1989. Biodegradation of selected phenolic compounds in a simulated sandy surficial Florida aquifer. Florida Univ., Gainesville, FL (USA). 196.
In this research the sorption and biodegradation of phenol,

2,4-dichlorophenol (2,4-DCP) and pentachlorophenol (PCP) were investigated. The soil materials used were characterized as fine grained sands with negligible organic carbon contents. Freundlich sorption coefficients of 0.0158 for phenol and 0.0547 for 2,4-DCP were found. Pentachlorophenol was more strongly adsorbed with an adsorption coefficient to 1.12. In multi-compound systems competitive sorption was evident, and adsorption capacities were reduced by a margin ranging from 709S, for phenol to 309 for both DCP and PCP. All three compounds exhibited nonlinear sorption behavior with a range of exponent values from 0.56 to 0.7. Desorption coefficients showed little difference from adsorption for phenol and 2,4-DCP, but were significantly different for PCP, indicating hysteresis of PCP sorptions. The retardation factors were 1.03 for phenol, 1.16 for 2,4-DCP and 2.26 for PCP. In batch biodegradation studies using indigenous soil bacteria phenol degraded quickly t{sub {1/2}} = 12 hours and was completely destroyed within three days. 2,4-DCP was also completely degraded but had taken 23 days (t = 7 days). PCP was resistant to biodegradation with an average half-life of 120 days. In multi-compound systems, phenol gradation rates dropped off to O.4 day{sup {minus}1} (t{sub {1/2}} = 1.7 days) but PCP degradation rates increased to 0.008 day{sup {minus}1} (t{sub {1/2}} = 86 days). Biodegradation rates in column studies were obviously greater than in batch experiments, with the rate increase for PCP degradation being especially noticeable (t{sub {1/2}} = 12 days), because of larger bacterial population and the dynamic flow conditions made the substrates more available to the bacteria.
Key words: aquifers, decontamination, biodegradation, water pollution, aromatics, chemical reaction, bacteria.

Lindblom, Gordon P. 1979. Logistic planning for oil spill chemical use. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: logistic, oil, spill.

Lindblom, Gordon P., and Bryan S. Cashion. 1983. Operational considerations for optimum deposition efficiency in aerial application of dispersants. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: deposition, efficiency, dispersants.

Lindblom, Gordon P., Bruce D. Emery, and Ing. Miguel A. Garcia Lara. 1981. Aerial application of dispersants at the IXTOC I spill. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: dispersants, IXTOC I.

Lindblom, G.P. 1987. A review of dispersant chemicals in oil spill response. In: Proceedings of the AICHE 1987 Spring Natl. Meet., March 29 April 2 1987, Houston, TX, Prepr. N.89A, 21 pp.
Key words: Cleaning, Contingency Plan, Economic Factor, Pollution Control

Lindblom, Gordon P. 1983. Flight tests of a self-contained dispersant spray system for cargo aircraft. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup),

February 28 March 3, San Antonio, TX.
Key words: dispersant.

Lindblom, G.P. 1987. Measurement and prediction of depositional accuracy in dispersant spraying from large airplanes. In: Proceedings of the 10th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Conf, April 6 9 1987, Baltimore, MD, pp. 325-328.
Key words: Dispersant, Contamination, Crude Oil, Oil Spill, Pollution Control, Petroleum, Remote Sensing

Lindemann, K. 1990. Anatomy of an oil spill: Waging war on Norway(PRIME)s west coast. Veritas Forum 13, pp. 16-17. Petroleum Abstracts ABSTR. NO. 487,612, 30(35).
Key words: Accident, Animal, Beach, Boom, Bulk Carrier, Business Operation, Economic Factor, Pollution Control

Lindemann, Peter, and Harm-Hinrich Muente. 1987. Methods, techniques and equipment for the protection of maritime environment. Marine Technology/Meerestechnik. 18(2):67-72.
Key words: Water Pollution, Oil Spills, Decontamination, Pollution Control
For the removal of sea contamination by oil and other hydrocarbon substances, new methods and techniques must be developed and suitable equipment and vessels must be provided. The system described in this paper has been successfully employed for pollution control and oil recovery in various types of special vessels and multi-purpose boats to fight and control spontaneous as well as latent contaminants on the high seas as well as in harbors and on inland waters. (Edited author abstract)

Linden, Olof, Jan Mattsson, and Mats Notini. 1983. A spill of light fuel oil in the Baltic Sea. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: spill, oil, Baltic Sea.

Linden, O. 1985. Ecological effects of oil versus oil plus dispersant on the littoral ecosystem of the Baltic Sea. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: ecological, oil, dispersant, ecosystem.

Lindsey, Alfred W. and Kurt Jakobson. 1993. An Overview of the EPA oil spill research program. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: EPA, oil spill, research.

Lindstedt-Siva, June. 1979. Ecological impacts of oil spill cleanup: are they significant? In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: ecological, oil, spill, cleanup.

Lindstedt-Siva, June. 1987. Advance planning for dispersant use. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.

Key words: planning, dispersant.

Lindstedt-Siva, June. 1991. U.S. oil spill policy hampers response and hurts science. In: Proceedings of the 1991 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 4 7, San Diego, CA.
Key words: U.S., oil spill, response.

Lindstedt-Siva, June. 1977. Oil spill response planning for biologically sensitive areas. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil, spill, response, biologically.

Lindstedt-Siva, J., D.W. Chamberlain, and, E.R. Mancini. 1987. An analysis of the environmental aspects of the ARCO anchorage oil spill, Port Angeles, Washington. In: Proceedings of the API - EPA U.S. Coast Guard oil spill prev. behavior control cleanup conf., April 6 9 1987, Baltimore, MD, API PUBL. N.4452, pp. 407 10.
Key words: Alaska, Arctic, Bioindicator, Concentration, Crude Oil, Pollution Control

Lindstedt-Siva, June, Dilworth W. Chamberlain, and Eugene R. Mancini. 1987. Environmental aspects of the Arco Anchorage oil spill, Port Angeles, Washington. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: environmental, Arco Anchorage, oil spill.

Lingle, J., and G. Addis. 1988. POSSM: a tool for risk assessment of PCB spills sites. In: Proceedings of the Electric Power Research Institute PCB seminar, October 6 1987, Kansas City, MO, pp. 5.9-5.13.
Key words: Chlorinated Aromatic Hydrocarbons, Risk Assessment
POSSM, the PCB On-Site Spill Model, was developed for the Electric Power Research Institute by Brown and Boutwell in order to assist electric-utility personnel in understanding and evaluating the risks associated with spills of oil from electrical equipment. Spills of PCB or askarel-type fluids such as from PCB capacitors, as well as low-concentration PCB-contaminated mineral oil from distribution transformers can be evaluated using POSSM. The model utilizes spill information such as the volume of fluid lost, area of the spill, soil type, cleanup actions taken, soil concentrations, meteorological conditions, and other data in order to calculate the fate of the PCBs over time. POSSM was used to conduct a human-health risk assessment of two transformer oil spills and two PCB-capacitor spills that occurred over the last three years in the Wisconsin Electric system. Site-specific data were used as POSSM input in order to determine the fate of the PCBs in the soil, air, and rainfall runoff. Initial PCB loadings to the soil and *vegetation* were calculated based on the volume and concentration of PCBs spilled. PCB soil concentrations measured after site cleanup were used as input data to the model for the time period following cleanup. Airborne concentrations of PCBs downwind of the spill site were calculated using the PTDIS gaussian dispersion model. 3 references, 1 figure, 3 tables.

Lingo, L. Jr. 1990. Method and system for recovering free floating

liquids from ground water. Patent No. US 4954266900904, 6p.
Key words: Groundwater, Oil Spill, Water Pollution, Soil Pollution, Storage Facility

Linstedt-Siva, June, Bart J. Baca and Charles D. Getter. 1983. MIRG environmental element: an oil spill response planning tool for the Gulf of Mexico. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: MIRG, environmental, oil spill, response, Gulf of Mexico.

Lissauer, Ivan M. and Joseph W. St. Martin. 1987. Surface current measurements for validation of an oil spill tracking model for the Beaufort Sea. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.

Lissauer, Ivan M. and Denise A. Baird. 1983. Aerial photographic surveys analyzed to deduce oil spill movement during the decay and break-up of fast ice, Prudhoe Bay, Alaska. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: aerial, surveys, oil spill, ice, Prudhoe Bay, Alaska.

Lissauer, Lt. Cdr. I.M., Lt. Cdr. J.C. Bacon, and M.C. Miller. 1977. A Computer simulation technique for oil spills off the New Jersey-Delaware coastline. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: computer, oil spills, New Jersey-Delaware, coastline.

Lissauer, Ivan M., Denise A. Baird. 1983. Aerial Photographic Surveys Analyzed to Deduce Oil Spill Movement During the Decay and Break-up of Fast Ice, Prudhoe Bay, Alaska. In Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. in San Antonio, TX Year.
Key words: surveys, oil spill, movement, ice, Prudhoe Bay, Alaska

Lissauer, Ivan M. and Donald L. Murphy. 1979. Oil spill forecasting: where is it going?. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil, spill, forecasting.

Lissauer., Robert J. Meyers, J. Larry Payne, Ivan M. 1987. Arctic oil spill response planning guide. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD. American Petroleum Institute: Washington, D.C.
Key words: Arctic oil spill response.

Literathy, P. 1992. Environmental consequences of the gulf war in Kuwait: impact on water resources. Water Science & Technology . 26(1-2):21-30.
Key words: Environmental Impact, Oil Spill, Gulf war, Water Pollution
As a result of the Iraqi occupation and the armed conflict in Kuwait 6 to 8 million barrels of crude oil were spilled into the

marine environment, and about 2 to 3 million barrels of crude oil, burnt and unburnt, were being emitted daily (during about 300 days) into the environment from the burning or gushing oil wells. International efforts of UN agencies and other organizations started immediately to assess the extent of the environmental pollution and to mitigate the adverse effects. In additon to the public health concerns of the air pollution caused by the burning wells, long- term environmental risk should be considered as a result of the oil spill into the marine and coastal environment, and the atmospheric fall-out, eg, acid rain and petroleum related compounds associated with airborne particulates, in the marine and terrestrial areas. Particularly serious contamination of the desert ecosystem occurred around the damaged oilfields in Kuwait. The deposited crude oil and airborne particulates in the terrestrial areas may also affect the ground-water aquifer. Air quality, marine and desert soil pollution surveys provided data for a preliminary assessment and helped the formulation of mitigation and rehabilitation programmes, however, implementation of an integrated survey programme will ensure the final impact assessment on the environment, particularly on the marine and subsurface water resources.

Little, D.I. and D.L. Scales. 1987. The Persistence of oil stranded on sediment shorelines. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil, sediment, shorelines.

Little, D.I. 1987. Oiled sediments in the humber estuary following the SIVAND incident. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oiled, sediments, humber, SIVAND.

Little, D.I. and A.E. Little. 1991. Estuarine oil spill effects in the context of dispersant use changes. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: estuarine, oil spill, effects, dispersants.

Little, D.I. and D.L. Scales. 1987. Effectiveness of a type III dispersant on low-energy shorelines. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: dispersant, low-energy, shorelines.

Little, D.I. 1987. Oiled sediments in the Humber Estuary following the Sivand incident. In: Proceedings of the 10th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Conf, April 6 9 1987, Baltimore, MD, pp. 419-426.
Key words: Oil Spill, Crude Oil, Estuary, Pollution Control

Little, D.I., R.W. Pritchard, and J. Smith. 1993. Biodegradation of oil under a range of shoreline energy levels. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 april 1 1993, Tampa, FL, pp. 455-468.
Key words: Bioremediation, Biodegradation, Cleaning, Crude Oil,

Petroleum, Contamination

Little, D.I., E.H. Owens, and R. Marty. 1992. Peat shorelines protection, cleanup and disposal guidelines. In: Proceedings of the 15. arctic and marine oilspill program technical seminar Edmonton (Canada)10-12 Jun 1992. pg 801-818. g (818 p). PC Environment Canada Departmental Library, Att: Pierre Trudel, Acquisitions, 351 St. Joseph Blvd., 2nd Fl., Ottawa, ON, CAN K1A 0H3, MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC ERA (Energy Research Abstracts), ETD (Energy Technology Data Exchange), INF (non-US Atomindex input via DOE) CANM (Canada (sent to DOE from)) Canada
Peat shorelines are common along the margins of the Arctic Ocean and form ca 70% of the Beaufort Sea coast of Alaska. They consist of peat-covered beaches, beaches with peat slurries immediately offshore, peat islands and spits, tundra scarps, and low-lying peat shores. Guidelines have recently been developed for spill responses in this type of coastal environment. Few conventional shoreline cleanup techniques apply to peat shorelines, so that protection (containment and exclusion booming) before stranding assumes a high priority. Vacuum systems, rope-mop skimmers, *sorbents* (including peat itself), and manual removal can be considered for shoreline cleanup. Many peat shorelines are in an erosional state, so that natural cleaning is a viable option in many instances. Cleanup operations on peat shorelines may generate large volumes of material for disposal, and in most instances combustion or incineration would be the preferred disposal method. 12 refs., 2 figs., 4 tabs.
Key words: oil spills, -land pollution control, shores, oil pollution containment, arctic regions, peat, recommendations, coastal regions, control, cryosphere, energy sources, fossil fuels, fuels, matter, organic matter, polar regions, pollution control

Liu, Hsien-Ta and Jung-Tai Lin. 1979. Effects of an oil slick on wind waves. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil, slick, waves.

Liu, D., R.J. Maguire, G.J. Pacepavicius, and E. Nagy. 1992. Microbial degradation of polycyclic aromatic hydrocarbons and polycyclic aromatic nitrogen heterocyclics. Environ. Toxicol. Water Qual. 7(4):355-372.
Key words: Biodegradation, Hydrocarbon
Fermentor studies were conducted to examine the microbial degradation of polycyclic aromatic hydrocarbons (PAHs; naphthalene, phenanthrene, anthracene) and a polycyclic aromatic nitrogen heterocyclic (quinoline) using a mixed bacterial culture capable of utilizing these compounds as the sole carbon and energy source for growth. Half-lives for the three PAHs in the cyclone fermentor system ranged from 1 day for naphthalene to 4 days for anthracene. Several major metabolites during the biodegradation of PAHs were also identified. These included 2-hydroxybenzoic acid and 1-naphthalenol (for naphthalene); 1-phenanthrenol and 1-hydroxy-2-naphthalenecarboxylic acid (for phenanthrene); and 3-hydroxy-2-naphthalenecarboxylic acid (for anthracene). Thus our

bacterial culture biodegraded the three PAHs by initial hydroxylation of the molecule followed by the eventual cleavage of the ring to yield the ortho- or meta-cleavage intermediates, which would be further metabolized via conventional metabolic pathways. However, biodegradation of the nitrogen-containing polycyclic aromatic hydrocarbon compound quinoline by our culture resulted in the accumulation of 4-5 metabolites, one of which has been identified as 2-quinolinol. Work is in progress to identify the other metabolites from quinoline degradation.

Lively-Diebold, B., W. Driscoll, P. Ameer, and S. Watson. 1993. Storage of oil above ground or underground: regulations, costs, and risks. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: storage, oil, regulation.

Lloyd, Jones G., and P.W. Trudgill. 1989. The degradation of alicyclic hydrocarbons by a microbial consortium. International biodeterioration. 25(1-3): 197-206.
Alicyclic hydrocarbon-utilizing consortia have been isolated from oil refinery soil. A three-organism consortium was selected for detailed study and shown to consist of Rhodococcus. Flavobacterium and Pseudomonas spp. Evidence has been presented for the involvement of unstable plasmids in growth on methylcyclohexane, loss of the plasmids being concomitant with loss of metabolic competence.
Key words: hydrocarbon, biodegradation, isolation, soils, refinery, plasmid, xenobiotic, cyclohexane, derivatives, enzyme, metabolism, microorganism culture, microorganism, flavobacterium, pseudomonas, rhodococcus.

Lodge, A.E. 1989. The remote sensing of oil slicks. New York, NY: John Wiley and Sons Inc. 350 pp.
Key words: Offshore Operations, Oil Spills, Remote Sensing, Data Analysis, Technology Assessment
This book presents papers which together comprise a guide to obtaining and interpreting data on oil spills by means of remote sensing devices. It discusses the monitoring and regulatory use of existing and future remote sensing systems for oil detection in inshore and offshore environments. Covers technical, operational, and legislative aspects, including airborne sensors, international experiences in the application of remote sensing technology, how general principles of evidence can be applied to remote sensing data, and what the future holds for remote sensing.

Loehr, R.C., J.R. Ryan, and J.E. Rucker. 1987. Land treatment is viable technology for reducing petroleum-waste toxicity and migration potential. Oil Gas J. 85(44):40 43.
Keywords: waste disposal, biodegradation, Environmental Protection Agency, legal, soil pollution

Loehr, R.C., D.C. Erickson, L.A. Rogers, and D.M. Kelmar. 1990. Mobility and degradation of residues at hazardous waste land treatment sites at closure. Univ. of Texas, Dallas, TX. Final Report No. PB-90-212564/XAB, 183 pp.
Key words: Biodegradation, Hydrocarbons, Laws, Monitoring, Planning, Pollution, Regulations, Soils, Transport, Weathering

Soil treatment systems that are designed and managed based on a knowledge of soil-waste interactions may represent a significant technology for simultaneous treatment and ultimate disposal of selected hazardous wastes in an environmentally acceptable manner. These soil treatment systems cease operations for various reasons and undergo a closure process. The process is performed to minimize the long-term migration of waste constituents from the soil treatment system. Decisions pertaining to the closure process often center around the various closure scenarios. There is currently a lack of scientifically derived fate and transport information for the wide range of hazardous chemicals for which such decisions can be made. The report presents information pertaining to the quantitative evaluation of mobility and persistence of organic and inorganic waste constituents which have accumulated over a long-term period in soil treatment systems under various closure scenarios. The information will be useful in the development of soil treatment closure decisions which will be protective of human health and the environment.

Loeset, S. January 1993. Some aspects of floating ice related to sea surface operations in the Barents sea. Dissertation or Thesis. 169(p).
Key Words: Arctic regions-icebergs, accidents, bench-scale experiments, experimental data, mathematical models, offshore platforms, oil retention booms, oil spills, skimmers, temperature distribution, cryosphere, ice, numerical data, polar regions, pollution control equipment.

Logan, W.J. 1975. Oil spill countermeasures for the Beaufort Sea. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil spill, Beaufort Sea.

Londry, K.L., and P.M. Fedorak. 1993. Use of fluorinated compounds to detect aromatic metabolites from m-cresol in a methanogenic consortium: Evidence for a demethylation reaction. Applied and Environmental Microbiology (United States). 59:7:2229-2238.
m-Cresol is one of the most abundant phenols in wastewater from hydrocarbon processing and coal conversion processes and at creosote-contaminated sites. The study of the anaerobic degradation of m-cresol has been hampered by the long acclimation time required to obtain active cultures as well as the difficulty of maintaining cultures. Fluorine can be introduced into a biologically active molecule to block metabolism, and fluorophenols are effective tools for studying phenol degradation. This study uses fluorinated analoges of phenol and m-cresol to help elucidate the pathway of m-cresol degradation under methanogenic conditions (anaerobic sewage sludge with a methanogenic m-cresol-degrading consortium). 49 refs., 7 figs.
Key words: cresols, biodegradation, methanogenic, bacteria, biological pathways.

Long, B.F., and J.H. Vandermeulen. 1983. Geomorphological impact of cleanup of an oiled salt marsh (Ile Grande, France. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: geomorphological, cleanup, oiled, marsh, France.

Long, B.F.N., J.H. Vandermeulen, and L. D'Ozouville. 1981. Geomorphological alteration of a heavily oiled saltmarsh (Ile Grande, France) as a result of massive cleanup. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: geomorphological, saltmarsh, France, cleanup.

Long, Bernard F., J.H. Vandermeulen, and T.P. Ahren. 1981. The Evolution of stranded oil within sandy beaches. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: stranded, oil, beaches.

Long, G. M. 1991. Handbook of Environmental Bioremediation. Lewis Publishers: Chelsea, MI, 300 p.
Key words: Bioremediation, Biodegradation, Groundwater, Oil Spills
This is the first book to cover the fundamentals of field application of bioremediation. The concepts presented have been tested and demonstrated successfully in dozens of applications. Topics covered include: discovery of hydrocarbon-degrading microbes, applied bioremediation, oil spills, soils, sludges and groundwater site characterization, bioassessment testing, hydrologic modeling, microbial nutrition and environmental requirements, microbial degradation of organic compounds, biooxidation in wastewater treatment: applications to polluted soils and groundwater.

Loostroem, B. 1987. The Swedish airborne remote sensing system for maritime surveillance. Oil Chem. Pollut. 3(3):209-29.
Key words: Water Pollution Control, Oil Waste, Real Time, Waste Material

Lord, D.A. 1987. The Kapodistrias grounding and oil spill Cape Recife, South Africa. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: Kapodistrias, grounding, oil spill, Cape Recife, South Africa.

Lorenz, W.T. 1990. Where the money is going. Hydrocarbon Processing 69(8):65 70.
Key words: biodegradation, oil, pollution control, water pollutant

Lorenzo,T. 1993. Environment Canada's oil spill response equipment test facility. Environment Canada 16th Arctic and Marine Oil Spill Technical Seminar (Calgary 6/7-9/93) Proceedings V1 511-15 (1993).
Key word: adsorbent, adsorption, process, biochemical reaction, biodegradation, bioremdiation, Canada, colloid, dispersion, continuous, current, emulsion, equipment testing, fluid flow, meeting paper, North Americal, oil waste oil, physical property.

Loset, S., T. Carstens, and H. Jensen. 1992. Deflection of open pack ice in an oil spill recovery area. In: Proceedings of the 14th Environ. Can. Arctic & Mar. Oil Spill Program Tech. Seminar, June 12 14 1991, Vancouver, Canada, pp. 495-507.
Key words: health, environment, water pollution control, boom, ice

Loset, S., and G.W. Timco. 1993. Laboratory testing of a flexible boom for icen management. In: Proceedings of the 11th ASME et al. Offshore Mech. & Arctic Eng. Int. Conf., June 7 12 1992, Calgary, Can, 33(11).

Louisiana Water Resources Research Inst., Baton Rouge. 1987. Fiscal Year 1985 Program Report: Louisiana Water Resources Research Institute. Geological Survey, Reston, VA. Water Resources Div. Report No. USGS/G-1020-01, 34 pp.
Key words: water pollution, groundwater, biodegradation
Water resources problems were addressed relating to flood technology, ground water, water resources planning, and hazardous waste contamination. Project 02 identified the effects of chlorinated hydrocarbons on the water transmission properties of cohesive deposits which are common to large portion of Louisiana's industrial area. Project 03 initiated biodegradation studies of hazardous chemical waste including PCB and Dioxin. Techniques which had enhanced the degradation of chlorinated hydrocarbons were not effective with dioxin. Project 04 involved using a thermal stratification model to evaluate the design and operation of a proposed flood control reservoir. Project 05 evaluated a groundwater model as a management aid in planning for lignite mining in northwestern Louisiana. The model was used to develop strategies which would enable lignite miners to minimize the adverse effects of their operations on groundwater quality. Project 06 utilized entropy to determine multivariate distributions of flood variables given limited data or information. These distributions were tested using real-world flood data.

Love, L.S. 1988. Potential for anaerobic treatment of high sulfur wastewater in a unique upflow-fixed film-suspended growth reactor. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 449-462.
Key words: Biodegradation, Industrial Wastes, Monitoring, Wastewater
The Sydlo anaerobic reactor Sydlo, Inc., Mississauga, Canada has been designed specifically to remove large quantities of biogas as it is generated within the reactor. Because of this feature it is ideally suited for the treatment of high sulfur wastewater. The degree of soluble sulfide removal can be controlled by selecting the appropriate recycle rate. Simple, adjustable weirs are provided on the gas separators, for this purpose. The advantage of this technology is that it will substantially reduce daily operating costs. Although this reactor is particularly well suited for the treatment of high sulfur wastewaters, it may also be used, with considerable advantage, when treating other wastewaters where sulfide toxicity is not a problem.

Lowe, M.A., E.R. Mancini, D.W. Chamberlain, G.R. Albright. 1993. Environmental considerations in a high desert, crude oil pipeline spill. In: Proceedings of the 8th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 159-164.
Key words: Pipeline Leak, Contamination, Environmental Pollution, Oil Spill, Pollution Control

Lu, M.Z. 1989. Oil spill prevention and treatment in offshore oil industry of China. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 235 38.
Key words: Additive, Boom, Crude Oil, Economic Factor, Pollution Control, Equipment, Skimmer, Oil Spill

Lucas, J.E. Marine oil spill clean-up method, is acheived by using slidable fasteners and support legs extending from floatable unit to hold skimmer unit in relatively fixed horizontal position. Patent No. US 704823_910523.
Key words: Boom, Containment, Displacement, Oil Waste, Pollution Control, Skimmer, Separation, Water Pollutant.

Luckianow, B. J., and W.C. Burkett . 1991. Bertram c. Overview of environmental concerns for siting of coalbed methane facilities. Taurus exploration inc, dames & moore. Gri, ala univ et al coalbed methane symp (tuscaloosa, ala, 5/13-17/91) proc pp 1-11, 1991 (4 refs)|
Key words: environmental impact,Administration, black warrior basin, business operation, coalbed methane, control, eastern U.S., economic factor, environment, government, legal consideration, natural gas, north america, petroleum, pollution control, regulation, regulatory agency.

Ludvigsen, P.J., D.K. Asante-Duah, D.H. Chen, C.C. Stanley, D. Draney. 1989. Decision support software to assist in underground storage tank management. The proceedings of the petroleum hydrocarbons and organic chemicals in ground water: Prevention, detection and restoration. 698(p):281-290.
Key Words: Ground water contaminaion, oil spills, water pollution abatement, computer codes, computerized simulation, decision making, leak detectors, underground storage, energy sources, fossil fuels, hydrogen compounds, oxygen compounds, pollution abatement.

Luehr, H. P. Economic aspects of oil pollution. Water Sci Tech 14(9 11):1171 1183.
Key words: Oil Spill, Water Pollution, Cost Control

Lund, N.C., J. Swinianski, G. Gudehus, D. Maier. Laboratory and field tests for a biological in situ remediation of a coke oven plant. Hinchee, R.E., and R.F. Olfenbuttel. In situ bioreclamation; This paper reports that for a biological in situ remediation of soils polluted with hydrocarbons, a geotechnical treatment has been developed. The treatment was examined in a large-scale sample test, where the biodegradation of hydrocarbons which are typical for coal tar processing products has been investigated. During this test an ozone-injection was made to pre-oxidize the hydrocarbons in order to increase their biological availability. At present, the treatment is tested in situ at a heavily contaminated part of an abandoned coke oven plant.

Lundin, L. 1987. A Boom for an Oil-Spill-Combating System. Europe Pat Bull. 1987(23):205.
Key Words: Oil skimming, oil water separation, physical separaton, Europe, OY Lundin (L) Patent AB.

Lundin, L. 1988. Oil-spill-combatting water craft. Patent No. CA 1247534.
Key words: oil spills, water pollution, skimmers, design, operation, separation equipment, ships
An oil-spill-combatting water craft is provided with at least one protruding boom but most suitably one on each side of the craft. Each boom directs surface water and oil present in it into a conduit inside the craft, the inlet and the outlet of the conduit being located in the side of the craft. The purpose is to provide a simple, high-capacity arrangement in which the flow is, nevertheless, relatively calm even when the sea is rough. With this in mind, the conduit has been implemented as a circulation conduit, the outlet of which is situated nearer the bow than the inlet and in which the water flows automatically owing to the water-raising and water-guiding effect of the boom. Separating means for water and oil, fitted inside the conduit, is a rotating arrangement that allows water to flow through and is, for example, made up of rows of bristles. In front of the outlet of the conduit there is fitted a baffle that extends obliquely outwards and backwards.

Lundy, D., and T. Gogel. 1988. Capabilities and limitations of wells for detecting and monitoring liquid phase hydrocarbons. National Water Well Association, Dublin, OH (US). 597(p):343-362.
Key Words: Ground water contamination, ground water monitoring, petroleum water pollution, water pollution monitors design, hydrocarbons, oil spills, permeablility, underground storage, water tables, water wells, energy sources, fossil fuels, hydrogen compounds, measuring instruments, monitors, organic compounds, oxygen compounds
When wells are properly placed and constructed, they are fully capable of detecting releases of liquid petroleum products from underground fuel storage tanks. However, there are some hydrogeologic environments in which the use of wells is limited. Important factors that affect the ability of wells to detect new or old releases are the magnitude and distribution of fluid transmitting properties and the position and movement of the water table. The ideal condition would be one in which the well is placed within a homogeneous engineered backfill around the tanks, where the native earth materials have significantly smaller permeabilities, and where the water table is near the base, and within, the excavation zone. Wells are somewhat less effective when placed outside the excavation zone depending on the amount of natural and/or anthropogenic heterogeneities, water-table depth and range of water-table fluctuations.

Lunel, Tim. 1993. Dispersion: oil droplet size measurements at sea. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: dispersion, oil, sea.

Lupo, M.J. 1991. Soil vapor transport of volatile organic compounds commonly found in petroleum industry wastes. In: Proceedings of the Pennwell Conf & Exhibit co Petro-Safe 91 Conf, Feb. 6-8, 1991, Houston, TX, 3:963-982.

Luthi, R.B., L.B. Burlington, E. Reinharz, and S.K. Shutler. 1993. The Second generation of natural resource damage assessments: lessons learned?. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, Florida.
Key words: resource, damage, assessment.

Luthy, R.G. 1991. Microbial mineralization of coal-derived hydrophobic organic contaminants: The role of bio-surfactant/emulsifier and solubilization. Abstracts and research accomplishments of university coal research projects. 77-78:207.
This research addresses physico-chemical and biochemical solubilization and mineralization reactions for polycyclic aromatic hydrocarbon (PAH) compounds in coal tar. The emphasis of the investigation is on understanding the rate-controlling processes for microbial degradation of organic-phase PAH in the environment and in wastewater treatment processes through determination of the kinetics of solute solubilization and rates of mineralization. The project will evaluate abiotic and biotic solubilization phenomena, and explore possible synergistic interactions between PAH-degrading bacteria and bio-surfactant/emulsifier-producing organisms that have been shown to be potentially useful in coal biotechnology. PAH-degrading microorganisms have been cultured and prepared for use in mineralization tests. Bio-surfactant producing microorganisms have been procured and cultured. A protocol for assessing coal tar solubilization rates has been developed; this procedure is being evaluated.
Key words: microorganisms, biochemical reactions, aromatic hydrocarbons, decontamination.

Lyle, d. gulf coast oil world v 9, no 1, pp 20-44, jan-feb 1991 (issn 08847967; 19 pp)
Key words: control, environment, ocean environment, oil spill, petroleum industry, prevention, terrestrial environment

Lyman, W.J., and D.C. Noonan. 1990. Assessing UST (Underground Storage Tank) corrective action technologies: site assessment and selection of unsaturated zone treatment technologies. U.S. Environ Protect Agency Report No. EPA/600/2 90/011, 99pp.
Keywords: soil remediation, oil spill, biodegradation, disposal

Lyman, W.J., D.C. Noonan, and P.J. Reidy. 1990. Cleanup of petroleum contaminated soils at underground storage tanks. Noyes data Corp: Park Ridge, NJ, 224p.
Key words: Soil Remediation, Soil Pollution, Underground Storage Facility, Bioremediation, Groundwater, Monitoring, Oil Spill

Lyondell Petrochemical Co. 1990. Offshore Texas has third oil spill of summer (1990). Oil & Gas Journal. 88(34):38.
Key words: Accident, Barge, Boom, Oil Waste, Pollution Control

Lysyj, Ihor. 1981. Distribution of aromatic hydrocarbons in Port Valdez, Alaska. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.

Key words: hydrocarbon, Port Valdez, Alaska.

Lysyj, Ihor. 1979. Effectiveness of large-scale ballast treatment process. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: ballast, treatment.

Lysyj, Ihor. 1981. Effectiveness of Offshore Produced Water Treatment. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: effectiveness, offshore, water.

Lytle, Julia S., and Thomas F. Lytle. 1983. Potential damage of oil wastes in coastal estuary sediments. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: damage, oil, wastes, coastal, estuary, sediments.

Lytle, Julia S. 1975. Fate and effects of crude oil on an estuarine pond. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil, estuarine.

Lytle, Thomas F. 1989. Chemical/biological behavior of water-borne aromatic hydrocarbons. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: chemical/biological, water-borne, hydrocarbons.

Lytle, Julia S., and Thomas F. Lytle. 1987. The Role of juncus roemerianus in cleanup of oil-polluted sediments. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: juncus roemerianus, cleanup, oil-polluted, sediments.

Ma, Y. 1989. An oil spill identification system (has been) established in China. Mar. Pollut. Bull. 20(2):54.

Ma, Y.A. 1990. China(PRIME)s on-scene law enforcement programme (for oil spill detection and identification). Marine Pollution Bulletin. 21(1):4.
Key words: Crude Oil, Economic Factor, Water Pollution

Mabile, N.J., and R. Helinski. 1992. North Slope mobile technology and its application to (oil) spill response. In: Proceedings of the Environment Canada 15th Arctic and Marine Oil Spill Technical Seminar, June 10 12 1992, Edmonton, Alberta, p. 497-503.
Key words: health, environment, land pollution, water pollution control, Alaska, Boom

Macaskie, L.E., A.C.R. Dean. 1990. Trimethyl lead degradation by free and immobilized cells of an Arthrobacter sp. and by the wood decay fungus Phaeolus schweinitzii. Applied microbiology and biotechnology. 33(1): 81-87.
This investigation explores the feasibility of using microorganisms to catalyse the rate-limiting step of trimethyl

lead degradation to dialkyl lead. An Arthrobacter sp. and a wood decay macrofungus, Phaeolus schweinitzii provide novel evidence for metabolic trimethyl lead (Me SUB 3 Pb SUP+) degradation.
Key words: biological degradation medium effect, industrial waste, hydrocarbon, free form, entrapped microorganism, microorganism culture, fungi, bioreactor, arthrobacteria.

MacCraith, B.D. 1991. Fiber-optic based instrumentation for water and air monitoring. In: Proceedings of the Instrument Society of America (ISA) International European region conference on environmental protection, control, and monitoring, May 22 24 1991, Birmingham (United Kingdom), pp. 89 98.
Key words: Air Pollution, Hydrocarbons, Oil Spills, Water Pollution, Pollution Control Equipment
In this paper real-time in-situ water and air monitoring capabilities based on fiber-optic sensing technology are described. This relatively new technology combines advances in fiber optic and optoelectronics with chemical spectorscopic techniques to enable field environmental monitoring of sub ppm quantities of specific pollutants. The advantages of this technology over conventional sampling methods are outlined. As it is the more developed area the emphasis is on water quality monitoring rather than air. Examples of commercially available, soon-to be available and laboratory systems are presented. One such example is a system used to detect hydrocarbon spills and leaking of underground hydrocarbon storage tanks.

Macgillivray, A.R., and M.P. Shiaris. 1993. Biotransformation of polycyclic aromatic hydrocarbons by yeasts isolated from coastal sediments. Appl Environ Microbiol. 59(5):1613 1618.
Keywords: biodegradation, hydrocarbon, remediation, soil pollution, water pollution

MacGregor, C. and A.Y. McLean. 1977. Fate of crude oil spilled in a simulated arctic environment. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil, spilled, Arctic.

Mackay, Donald, Alex Watson, Cecelia Ng, and Stuart Nadeau. 1979. The Behavior and effectiveness of dispersants at sea and at shorelines. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: dispersants, sea, shorelines.

Mackay, Donald and Foon Szeto. 1981. The Laboratory determination of dispersant effectiveness: method development and results. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: laboratory, dispersant, development.

Mackay, Donald, Warren Stiver, and Lt. Cdr. Peter A. Tebeau. 1983. Testing of crude oils and petroleum products for environmental purposes. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.

Key words: oil, petroleum, environmental.

Mackay, Donald and Peter G. Wells. 1983. Effectiveness, behavior, and toxicity of dispersants. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: toxicity, dispersants.

Mackerron, C.B. 1988. Industry, EPA grapple with water rules. Chemical Engineering. 95(11):47,51,52 54.
Key words: biodegradation, legal, pollution control, waste water, water pollutant

MacKinnon, M., and A. Sethi. 1993. A comparison of the physical and chemical properties of the tailings ponds at the Sycrude and Suncor Oil Sands plants. In: Proceedings of the Environ Can Oil Sands - Our Petrol Future Conf (Edmonton, Can, 4/4 7/93) Proc Pap No F2, 1993 (33 Pp; 19 Refs).
Key words: disposal, oil, recovery, sand oil, bacteria, biodegradation,Canada

MacKinnon, M., R. Smith. 1993. Source, distribution, and fate of toxic components in Oil Sands waste waters. In: Proceedings of the Environ Can Oil Sands - Our Petrol Future Conf (Edmonton, Can, 4/4 7/93) Proc Pap No F11, 1993 (1 P; Abstract only) (AO) .
Key words: disposal, oil, recovery

Macklin, J.T. 1992. The imaging of oil slicks by (airborne/spaceborne) synthetic-aperture radar. GEC J. Res. 10(1):19-28.
Key words: Synthetic Aperture Radar, Oil Spills, Remote Sensing, Pollution Monitoring
The present understanding of the way in which oil slicks are imaged by synthetic-aperture radar (SAR) is reviewed. The damping of surface waves is considered, and the properties of the resonant-type damping, known as the Marangoni effect and of particular importance over monomolecular films, are discussed. The prediction of the change in radar backscatter between a slick and the surrounding sea is examined, on the basis of the first-order, Bragg-scattering model. Previous observations of oil slicks with airborne and spaceborne SAR systems are reviewed, and results are obtained from image-processing schemes in an attempt to demonstrate the automatic detection of slick boundaries on SAR imagery. A qualitative assessment is made of the relative merits of various spaceborne SAR systems, including ERS-1, for slick detection.

MacNeil, M.R. 1985. Dispersant tests in a wave basin. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: wave basin, dispersant.

MacNeill, M.R. 1985. Dispersant Tests in a Wave Basin. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. in Los Angeles, CA Year.
Key words: dispersant tests

Macquarrie, K.T.B., and E.A. Sudicky. 1990. Simulation of biodegradable organic contaminants in groundwater : PT.2: plume behavior in uniform and random flow fields. Water Resources Res. 26(2):223 239.
Keywords: water pollution, ground water, bacteria, biodegradation, microorganism

Macquarrie, K.T.B., E.A. Sudicky, and E.O. Frind. 1990. Simulation of biodegradable organic contaminants in groundwater : PT.1 : numerical formulation in principal directions. Water Resources Res. 26(2):207 222.
Keywords: water pollution, biodegradation, ground water

Maddin, C.M. 1991. Marine toxicity and persistence of surfactants used in the petroleum industry. In: Proceedings of the 1ST SPE et al. Health, Safety & Environ in Oil & Gas Explor & Prod Int Conf, November 11 14, 1991, the Hague, Netherlands. 2:339 348.
Keywords: biodegradation, dispersant, environmental impact, fish, legal, offshore, regulations, water pollution

Madsen , E.L., J.L. Sinclair , and W.C. Ghiorse. 1991. In-situ biodegradation: microbiological patterns in a contaminated aquifer. Science: (Washington, DC). 252(5007): 830-833.
Conventional approaches for proving in situ biodegradation of organic pollutants in aquifers have severe limitations. In the approach described here, patterns in a comprehensive set of microbiological activity and distribution data were analyzed. Measurements were performed on sediment samples gathered at consistent depths in aquifer boreholes spanning a gradient of contaminant concentrations at a buried coal tar site. Microbial adaptation to polyaromatic hydrocarbons (PAHs) was demonstrated by mineralization of naphthalene and phenanthrene in samples from PAH-contaminated, but not adjacent pristine, zones.
Key words: water pollution, microorganism, survival, freshwater environment, aquifers, biodegradation, pollutant, adaptation, polycyclic aromatic compound, in-situ, bacteria, fungi, protozoa., thallophyta.

Magoon, Orville T., Hugh Converse, Virginia Tippie, Thomas L. Tobin, and Delores Clark. (eds). 1991. Proceedings of the 7th Symposium on Coastal and Ocean Management. In: Proceedings of the 7th Symposium on Coastal and Ocean Management Part 1 (of 4), July 8 12 1991, Long Beach, CA, 1(1991).
Key words: Coastal Zones, Marine Pollution, Oil Spills, Contingency Planning
This conference proceedings consists of 70 papers on coastal zone management and marine environment protection. Topics discussed include shore protection, beach erosion control, ocean outfall water quality monitoring, offshore oil terminals, remote sensing of marine environments, urban waterfront revitalization, wetlands habitat restoration, coastal resource mapping, coastal golf course development, oil spill contingency planning, beach nourishment
project evaluation, the design of marinas and small boat harbors, tidal inlet management, the effectiveness of state coastal management programs, Pacific Rim Nation coastal management,

intergovernmental coastal management conflicts, offshore platform earthquake hazard control, and regional water body management.

Magoon, Orville T., Hugh Converse, Dallas Miner, L. Thomas Tobin, Delores Clark, and George Domurat. 1987. Coastal Zone '87, proceedings of the fifth symposium on coastal and ocean management. In: Proceedings of the Fifth Symposium on Coastal and Ocean Management, May 26 29 1987, Seattle, WA, 2457 pp.
Key words: Coastal Zones, Ecology, Wetlands Management
This conference proceedings in 4 volumes contain 422 papers. The papers are grouped under general topics that include oil spills; international coastal zone management; estuarine management and restoration; deep draft navigation planning and design, services and information for the public; remote sensing, surveying, and mapping; coastal methods; progress in coastal engineering; nuclear and hazardous wastes; institutional planning and coordination; ports, harbors, and marihas; pollution, water quality, and disposal, coastal zone management at work; shoreline research and stabilization; managing coastal resources in Latin America. Puget Sound; what are doing to clean it up; dreding and related issues; dune stabilization and restoration; shoreline problems; The Albemarle-Pamlico Sound System; coastal and urban waterfront development; coastal vegetation and plant communities; citizen participation through education and conservation activities; geotechnical advances and solutions; living resources assessment; pollution and water quality; barrier islands; exclusive economic zone and territorial sear management; and poster papers.

Magoon, Orville T., Wilson W. Stanley, Hugh Converse, and Tobin L. Thomas. 1993. Coastal Zone'93. In: Proceedings of the Eighth Symposium on Coastal and Ocean Management, Part 1 (of 2), New Orleans, LA.
Key words: Oil Spills, Geographic Information System,
This conference proceedings contain 100 papers. Topics covered include: strategic environmental assessments; estuarine management and research; energy policies affecting coastal zone management; use of GIS information systems analysis; international solutions to shoreline problems; assessing environmental impacts of coastal development; recreation in coastal areas; international approaches to coastal mangement; fisheries management and aquaculture; sedimentary processes; coastal monitoring and bioeffects assessment; wetland loss in Louisiana; beach nourishment; impact of sea level rise; history of shoreline protection methods; oil spills; develping a database for GIS mapping; case studies in coastal and wave activities; watershed development, habitats, and living marine resources scientific findings; water quality management; offshor oil and gas - regulatory administration and development; Louisiana's national estuary program; legal issues along the coast; environmental programs and studies; estuary contaminants and resulting effects; hazardous materials response and assessment; San Francisco bay wetlands restoration and mitigation; integrated coastal zone management plans; programs and models for estuaries; habitat conservation and endangered species; and, marine resources and coastal restoration.

Mah, R., and T. Ferguson. 1987. Methanogenic bacteria. Chynoweth, D.P., Isaacson, I. 1987. Anaerobic digestion of biomass. Elsevier Science Pub. Co., Inc. 49-64:280.
The methanogenic (methane-producing) bacterial carry out the terminal steep in the formation of biogas from the anaerobic decomposition of biomass. Methane is the final product of mineralizing the organic materials in digesters and most anaerobic, freshwater habitats. Most of the chemical in the starting materials (substrates) actually ends up in the methane released by these anaerobic bacteria. In direct contrast, aerobic bacterial metabolism releases most of the chemical energy in the starting substrates by oxidizing them to carbon dioxide and water; bacterial cells are also produced. Anaerobic processes not only form an energy-rich product but also make less cell material and are consequently doubly useful in the degradation of biomass. The biology of the methanogenic bacteria has been extensively reviewed during the past decade. In this chapter, the methanogens are discussed in terms of anaerobic digestion, and the growing list of methanogens is updated.
Key words: bacteria, biochemistry, biomass, methane, production, alkanes, bioconversion.

Mah, R.A., and D.R. Boone. 1988. Factors affecting acetate degradation in anaerobic digesters. 25.
Acetate is the major source of methane produced in anaerobic digestion, accounting for about two thirds of all the methane produced. The major methanogenic bacteria responsible for this reaction are)ital Methanosarcina barkeri) and)ital Methanosarcina mazei). One strain of each of these bacteria was selected for this study, in which the effect of molecular hydrogen on acetate dissimilation was examined. We examined the effects that hydrogen concentration had on the active growth of aceticlastic (acetate-splitting) cultures. We found that, during steady-state growth, each of these methanogens ()ital M. barkeri) or)ital M. mazei)) could tolerate a wide range of hydrogen concentrations with little change in their rates of acetate degradation. At hydrogen partial pressures as low as 2 Pa and as high as 800 Pa no change was detected in the growth rate or acetate degradation rate of either of these methanogens. However, we also showed that small amounts of hydrogen were produced or consumed by)ital Methanosarcina) in order to bring the hydrogen concentration in their environment to a pressure of 16 to 92 Pa, similar to that found in anaerobic digestors.
Key words: acetates, anaerobic digestion, catabolism, hydrogen, methane, alkanes, hydrocarbons, nonmetals, waste processings, carboxylic acid salts, nonmetals, bacteria.

Mahaffey, W.R., M. Nelson, J. Kinsella, G. Compeau. 1991. Developing strategies for PAH and TCE bioremediation. Water Environment amp Technology (United States). 3:10:1044-9493.
Bioremediation is the controlled use of microbes, commonly bacteria and fungi, to reclaim soil and water contaminated with substances that are deleterious to human health and the environment. The organisms used often naturally inhabit the polluted matrix; however, they may inhabit a different environment and be used as seed organisms because of their ability to degrade a specific class of substances. It is because

of the wide diversity of microbial metabolic potential that bioremediation is possible. Polyaromatic hydrocarbons (PAHs) are organic compounds that are ubiquitous in the environment. They are present in fossil fuels and are formed during the incomplete combustion of organic material. PAHs exhibit low volatility and low aqueous solubility. As the molecular weight of these compounds increases, there is an exponential decrease in solubility and volatility. PAHs tend to adsorb onto soils and sediments because of their hydrophobic character, which is an intrinsic function of molecular size. The microbial degradation of individual PAHs by pure cultures and mixed populations occurs under a wide range of soil types and environmental conditions. Generally, the factors having the greatest influence on PAH biodegradation rates are soil moisture content, pH, inorganic nutrients present, PAH loading rates, initial PAH concentrations, and the presence of an acclimated microbial population. Feasibility studies are essential for developing a bioremediation strategy and are performed in a phased testing program that is designed to accomplish a number of objectives. These objectives include establishing an indigenous microbial population that will degrade specific contaminants, defining the rate-limiting factors for enhanced PAH degradation and the optimal treatment in terms of rates and cleanup levels attainable, and developing design parameters for field operations.
Key words: ground water, decontamination, biodegradation, hydrocarbon.

Mahaffy, Lynn A. 1991. Some external effects of oil upon water birds: problems in reestablishing water-repellency. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: oil, water, birds, water-repellency.

Mahmood, S.K., and P.R. Rao. 1993. Microbial abundance and degradation of polycyclic aromatic hydrocarbons in soil. Bull Environ Contamination Toxicol. 50(4):486-491.
Key words: Bioremediation, Biodegradation, Hydrocarbon, Bacteria, Microorganism

Maier, W.J. 1989. Kinetics-dynamics of biodegradation of potentially toxic organic chemicals. Bell, J.M. (ed.). In: Proceedings of the Industrial Waste Conference Purdue University, 43; May 10 12, West Lafayette, IN, pp. 257 266.
Key words: water pollution, soil pollution, biodegradation, microorganisms

Majid, A., B.D. Sparks. 1991. Settling behaviour of syncrude sludge pond tailings after removing residual organics and oil phase solids by an agglomeration technique. In: Proceedings of the 5th Unitar Et Al Heavy Crude & Tar Sands Int Conf (Caracas, Venezuela, 8/4 9/91).
Key words: oil, disposal, petroleum, sand oil

Major, R.A., N.R. Gray, and T.F. Marucci. 1993. Dispersant application by fire monitor. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.

Key words: dispersant.

Major, D.W. 1987. Biodegradation of benzene, toluene and xylenes (BTX) under denitrifying conditions in sand from a shallow aquifer: A microcosm study. Univ. of Waterloo. 166.
Pollutants found in ground water that has been contaminated with gasoline. The purpose of this thesis was to explore the biodegradation of BTX in sand from a shallow aquifer and to investigate mechanisms to alleviate persistence of BTX after development of anoxic conditions were used. Anaerobic or aerobic microcosms containing aquifer sand, ground water, and each of the components BTX at a concentration of were used and were amended with combinations of nitrate, acetate,AV- MF National Library of Canada, lactate, or formate. The major limitation of rapid BTX biodegradation was the availability of a suitable electron acceptor and nitrate served as an alternate electron acceptor to oxygen. Evidence for this included accumulation of nitrous oxide after acetylene blockage denitrification as well as an observed limitation of nitrous oxide accumulation and BTX biodegradation with a limiting amount of nitrate. Identification of breakdown products from BTX during denitrifyingAB- Benzene, toluene and xylenes (BTX) are the main water-soluble conditions were in agreement with expected intermediates. Radiolabelled benzene was mineralized to CO{sub 2} under denitrifying conditions. Natural organic compounds associated with the sand may have served as a significant source of reducing power for denitrification, thus competing with benzene as a carbon source. Addition of gasoline stimulated benzene degradation by denitrification. Significant benzene mineralization occurred in the absence of nitrate or oxygen after sufficiently long incubation periods. Production of H{sub 2}S indicated that sulfate reducing bacteria may have been responsible.
Key words: benzene, biodegradation, toluene, xylenes, time dependence, labelling, dentification, aquifers, sand.

Makansi, J. 1987. World's largest fluid-bed wood gasifiers supply clay dryers. Power. 131(7):69-70.
Key words: Clays, Drying, Gasification, Industrial Plants
In a period when many alternative-energy projects are on the corporate-budget chopping block or no indefinite hold, Southern Electric International (SEI), Atlanta, a subsidiary of The Southern Co. Birmingham, Ala, has successfully started up what it believes are the world's largest fluidized-bed gasifiers fueled by wood and wood-waste. The units supply 150-Btu/scf fuel gas to two fluid-bed clay dryers. The dryers, located at a major industrial clay producer's facility, have been retrofitted with special low-Btu gas burners. The firm makes several products from attapulgite clay-including pet litter, petroleum drilling mud, agricultural fertilizer, and oil-spill cleanup materials.

Maki, A.W. 1991. The Exxon Valdez oil spill: Initial environmental impact assessment. Environmental Science and Technology. 25(1):24-29.
Key words: oil spills, environmental effects, gulf of Alaska, water pollution control
The March 24, 1989, grounding of the Exxon Valdez on Bligh Reef in Prince William Sound, Alaska, was unprecedented in scale. So

too was Exxon's response to the oil spill and the subsequent shoreline cleaning program, including the employment of more than 11,000 people, utilization of essentially the entire world supply of containment booms and skimmers, and an expenditure of more than two billion dollars. In the days immediately following the Valdez spill, Exxon mobilized a massive environmental assessment program. A large field and laboratory staff of experienced environmental professionals and internationally recognized experts was assembled that included intertidal ecologists, fishery biologists, marine and hydrocarbon chemists. This field program to measure spill impacts and recovery rates was initiated with the cooperation of state and federal agencies. Through the end of 1989, this program has resulted in well over 45,000 separate samples of water, sediment, and biota used to assess spill impacts. This paper provides initial observations and preliminary conclusions from several of the 1989 studies. These conclusions are based on factual, scientific data from studies designed to objectively measure the extent of the impacts from the spill. Data from these studies indicate that wildlife and habitats are recovering from the impacts of the spill and that commercial catches of herring and salmon in Prince William Sound are at record high levels. Ecosystem recovery from spill impacts is due to the combined efforts of the cleanup program as well as natural physical, chemical, and biological processes. From all indications this recovery process can be expected to continue.

Malinky, Greggory and David G. Shaw. 1979. Modeling the Association of Petroleum hydrocarbons and sub- Arctic sediments. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: petroleum, hydrocarbons, sub-Arctic, sediments.

Maltezou, S.P. 1977. Economic determinants of waste-oil recycling. New York University,New York. 1977.
Key words: oil, disposal, waste oil, recycling, government, soil pollution, water pollution
Waste oil may result from accidents (crude oil spills) or may be incidental to the production and consumption of lubricating oils (refinery losses, machine wastes). Depending on the methods by which these waste oils are disposed and reused, they may become either sources of environmental pollution or net additions to the stock of oil resources. In assessing the waste-oil situation, the analysis has shown that: the supply and demand conditions in the virgin oil markets influence waste-oil disposal methods and the supply and demand conditions in the waste-oil markets; the key actor in the waste-oil allocation process is the waste-oil collector; the government has been ineffective in dealing with the environmental effects of waste oil and has played a detrimental role in dealing with the recycling and marketing of waste-oil products. Because the market mechanism fails to internalize environmental externalities, many have concluded that the government should act to control the operation of the waste-oil market; in this regard, various government policy alternatives were examined. The objective of these policies in whatever form they are exercised is to increase recovery, to increase the quantity of waste oil that is re-refined, and to reduce the quantity of waste oil that is burned under

uncontrolled conditions. It is concluded that only by providing direct incentives can policymakers be assured that increased waste oil recycling will be achieved.

Mancini, Eugene R., June Lindstedt-Siva, and Dilworth W. Chamberlain. 1989. Environmental impacts of the 1985 Arco Anchorage oil spill: 1988 conclusions. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: environmental, Arco Anchorage, oil spill.

Mancini., June Lindstedt-Siva; Dilworth W. Chamberlain; Eugene R. Environmental Aspects of the Arco Anchorage Oil Spill, Port Angeles, Washington. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987. in Baltimore, MD Year.
Key words: environmental aspects, Arco Anchorage oil spill, Washington

Mandel, F.S., J.A. Engman, W.R. Whiting, and J.F. Nicol. Novel Compositions and Method for Control and Clean- up of Hazardous Organic Spills. Patent No. US 4770715, c 9/13/88, f 5/2/86 (Appl 859121) (4 pp; 4 claims)1988.
Key words: pollution control, activated charcoal, adsorbent, charcoal, control, fluidized system, oil spill, powder, solid adsorbent, sorbent, (p) USA, acrylic acid homopolymer, adsorption, alumina, blanketing, carbon, cement, composition, compound, compressed gas, contamination, ecology, element (chemical), environment, evaporation loss, fire hazard

Mansfield, D. P. 1992. Proposed offshore safety cases a comparison with onshore cimah (Control of industrial major accident hazards) safety cases. Inst Chem Eng Major Hazards Onshore & Offshore Symp, Manchester, England. Pp. 39-48.
Key words: Oil Spills, Risk Analysis, Contingency Planning

Manson, J. 1988. Oil, mud and moonlight. Water & Waste Treatment, 31(12):19-20.
Key words: Abstract, Adsorbent, Boom, Oil Waste, Petroleum, Pollution Control, Skimmer

Mansur, Lamya, Alan Williams, Keith D. Bartle, and Mark W. Raynor. 1989. Characterization of the initial weathering of petroleum hydrocarbons by FTIR spectroscopy and supercritical fluid chromatography. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: weathering, petroleum, hydrocarbon, FTIR, spectroscopy, chromatography.

Manuell, R. W. 1979. Oil spill prevention and control in Australia. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil spill, prevention, control, Australia.

Manzano, R., and A. Chaviel. September 29, 1992. Floating

barriers for containing oil spills. 30(p).
Key Words: Oil retention booms design, oil pollution containment, oil spills, performance, water pollution control, pollution control, pollution control equipment.

Mar Log. 1992. World's Largest Tractor Tug Serves LOOP. October 1992. Mar Log. 97(9):59(2).
Key Words: Engineering, marine, oil spill prevention, ships, propulsion systems, ship speed, oil tankers.

Maraven, SA. Floating barriers for containing oil spills, having barrier with containment curtain of woven nylon double-coated with PVC, and polyurethane floats. Patent No. EP 91302655_910325.
Key words: Aluminum, Ballast, Boom, Oil Waste

March, Frank A. 1971. Dynamic Keel oil containment systems. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.,
Key words: Dynamic Keel, oil, containment.

March, Frank A. and Robert L. Beach. 1973. High seas oil recovery system. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: seas, oil, recovery.

Marchard, G., G. Bergot, M. Melguen, and G. Peigne. 1987. French know-how in the prevention and fight against accidental oil spills. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: French, prevention, fight, oil spills.

Marcus, Capt. E. 1977. A Bad day at Bunker Point. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: Bunker Point.

Maresca, Jr., J.W., J.W. Starr, R.D. Roach, and J.S. Farlow. 1989. Evaluation of the accuracy of volumetric leak detection methods for underground storage tanks containing gasoline. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: evaluation, leak, detection, underground, tanks.

Marine Pollution Bulletin. 1991. New double boom from 3M. Marine Pollution Bulletin. 22(12):624-25.
Key words: Health, Environment, Pollution Control, Boom, Oil Waste, Equipment

Marine Engineers Review. 1992. Spilling the beans on (oil) clean-up solutions (for tankers). Marine Engineers Review, pp.14 15
Key words: environment, transport & storage, health, legal considerations, safety, pollution control, accident, boom

Marinello, S.A., and K.W. Fucik. 1992. A Performance Comparison of Selected Commercially Available Sorbents. Colorado Sch Mines.

In: Proceedings of the 24TH Annu Spe Et Al Offshore Technol Conf (Houston, 5/4-7/92) proc v 1, pp 489-495, 1992 (otc-6868; 2 refs).

Marks, W., G.R. Geiss, and J. Hirschman. 1971. Theoretical and experimental evaluation of oil spill control devices. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: evaluation, oil spill, control.

Marley, N.A., J.S. Gaffney, P. Bennett, and D.R. Janecky. 1989. Spectroscopic evidence for organic diacid complexation with dissolved silica in aqueous systems : PT.1 : Oxalic acid. Organic Geochem. 14(5):525-528.
Key words: Water Pollution, groundwater, Oil Spill

Marrin, D.L. 1989. Detection of non-volatile hydrocarbons using a modified approach to soil-gas surveying. National Water Well Association, Dublin, OH (US). 698(p):87-95.
Key Words: Ground water contamination, oil spills detection, soils contamination, carbon dioxide ecological concentration, fuel oils hydrocarbons, land pollution, leaks, methane, soil chemistry, spatial distribution, water pollution, alkanes, carbon compounds, carbon oxides, chalcogenides, fossil fuels, hydrogen compounds, liquid fuels, nonmetals, organic compounds, other organic compounds, oxygen compounds, petroleum products.

Marsh, Lt. Gordon D., Lawrence A. Schultz, and Frank W. DeBord. 1979. Cold regions spill response. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: spill, response.

Marshall, M.J., S.C. Snedaker, and C.D. Getter. 1990. The Sensitivity of South Florida Environments To Oil Spills and Dispersants. US MMS OCS Report No. MMS 90-0019 (Synthesis of Available Biological, Geological, Chemical, Socioeconomic, and Cultural Resource Information for the South Florida Area) 559-607 (May 1990) Petroleum Abstracts ABSTR. NO. 502,231 31(18).
Key words: Abstract, Accident, Additive, Animla, Biology, Contingency Plan, Crude Oil, Economic Factor, Pollution Control

Marshall, T.R. 1988. Biodegradation of petroleum wastes in soil: The microbial ecosystem and optimization of a treatment process. PHD Thesis: Southern California Univ.
Keywords: biodegradation, oil spill, bacteria, environmental impact, monitoring, oil waste, soil pollution

Martin, F. D., R. E. Bretz, R. S. Bowman and T. L. Kieft. 1992. The Hobbs Oil and Water Experimental Facility of the Waste-Management Education and Research Consortium. In: Proceedings of PETRO-SAFE '92: 3rd Annual Environmental and Safety Conference for the Oil, Gas, and Petrochemical Industries, Jan. 27 29, Houston, TX. PenWell Conferences and Exhibitions Co.: Houston, TX, pp. 909 931.
Key words: Oil Spills, Groundwater, Waste Processing, Water Pollution

The Hobbs Oil and Water Experimental (HOWE) Facility came on-line as a research component of the Waste-Management Education and Research Consortium (WERC) when funding for the Consortium became official in late February 1990. As a support facility for WERC, which was established to expand the ability of this nation to manage hazardous, radioactive, and solid wastes through a multidisciplinary approach, HOWE can tap into the expertise that resides at three major New Mexico universities, on Native American community college, and two national laboratories. The intention of the HOWE is to provide education, as well as research and development programs, that reflect concerns of the petroleum industry in the United States. Personnel work to solve environmental problems and assess the impact to the industry of regulatory actions pertaining to those problems. Leadership for the program is provided from the New Mexico Institute of Mining and Technology at Socorro, NM, by Technical Leaders F. D. Martin, Director of the Petroleum Recovery Research Center, and Dr. R. E. Bretz of the petroleum engineering faculty. The HOWE site is administered by Mike Demarco, Director of the Petroleum Technology Program at the New Mexico Junior College in Hobbs, NM. Currently, the HOWE laboratory is being provided with state-of-the-art equipment to support research pertaining to groundwater pollution transport processes, slurry-phase bioremediation of oilfield production pit sludges, and treatment of produced brines or contaminated waters. This paper introduces the HOWE and discusses the research programs relevant to the petroleum industry that are presently underway or planned. Future collaborative efforts with industry that are presently underway or planned. Future collaborative efforts with industry groups are being encouraged.

Martin, B.W., and G. Rose. September 3, 1992. Oil spill spells caution for collector sewer construction. Tunnels & Tunnelling, North American Special Issue 14-15 (1991) Aqualine Abstracts (ISSN 0748-2531) ABSTR. NO. 92-0873 V8 N.5 (3/3/92). 8(5):14-15. Key Words: Abstract, air, business operation, compression, construction, contingency plan, economic factor, engineering, gasket, ground water, grout, hydrocarbon, liner, mechanical property, oil waste, physical property, pollutuion control, pollution source, sewage, soil (earth), soil pollutant, urban, waste material, water pollutant.

Martinsen, R.J., and E.J. Bock. 1993. Optical measurements of ripples using a scanning laser slope gauge. Part 1. Instrumentation and Preliminary Results. Report No. WHOI-CONTRIB-8701, 15 pp.
Key words: Cape Hatteras, Gulf Stream, Oil Spills, Ocean Currents, Remote Sensing
We describe the design, implementation, and deployment of a laser slope gauge developed at the Woods Hole Oceanographic Institution for the purpose of studying the propagation characteristics of capillary ripples, and how currents and natural slicks on the ocean surface modify ripple spectra. The laser slope gauge constitutes a nondisruptive optical technique for determining the slope spectrum for a range of waves with wavelengths between 2 mm and 20 cm using both spatial and temporal information. Operation of the sensor and data acquisition system is discussed and a

sample data record collected in the Gulf Stream off Cape Hatteras, NC is interpreted and analyzed.

Marum, J.P., W.R. Quanstrom, and R.G. Will. 1977. Technical support of spill control operations. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: support, spill, control.

Marwaha, V. Treatment of E.O.R. waste sludges using AOSTRA (Alberta Ol Sands Technology & Research Authority) Tacuik processor. In: Proceedings of the 3rd Zulia Univ Et Al Enhanced Oil Recovery Int Symp (MaracaibO, Venez, 2/19 22/89).
Key words: recovery, disposal, oil

Maryasin, I., E. Sandbank, and G. Shelef. 1989. Structure of Expanded Graphite and Its Use in the Removal of Oil from Water Technion Res Dev Found Ltd. Patent No. Europe 435766, p 7/3/91, f 12/24/90, pr Isr 12/25/89 (Appl 92872) (c01b-031/00; b01j-020/00; c02f-001/28; c09k-003/32; b01d-017/022; c11b-003/10) (also assigned to I. Maryasin, G. Shelef and E. Sandbank; 4 pp; 9 claims)

Maslowski, J.A. 1988. Legislation, prices step up pluggings. Northeast Oil World. 8(2):12,15-17.
Key words: Disposal, Groundwater, Oil Spill, Regulatory Agency, Soil Pollution, Water Pollution, Well Plug

Massachusetts Inst Tech. Phase-transition gel responding to environmental stimulus_useful e.g. as sensor, to form actuators, transducers, memories, controlled release systems and selective pumps. Patent No. US 558733_900726.
Key words: Physical Separation, Pollution Control, Solidification
Massachusetts has recently enacted new environmental regulations, the Massachusetts Contingency Plan (M.C.P.), which require regulatory review and approval before implementation of any remedial activity. The decision has recently been made that excavation and replacement of a leaky tank constitutes remedial action under the M.C.P. This paper discusses ramifications of this decision. This paper will present a regulatory Catch-22 created by the decision of the Massachusetts Department of Environmental Protection (MDEP) to classify underground storage tank removal as a remedial action, and will discuss some of the implications of that decision. Catch-22 refers to a situation where conflicting requirements of different regulations do not allow logical resolution of the problem the regulations are intended to solve. This decision created conflict with a number of other regulations, significantly delayed tank replacement, and made construction scheduling virtually impossible. It also served to postpone the environmental benefits of tank replacement at contaminated sites. Eventually, logic and necessity prevailed and solutions to the impasse were reached. The solutions, while practical, are ad hoc and require some creative interpretation of the regulations. In the author's opinion, a far better solution would have been to reconsider the classification of tank removal as a remedial action.

Mastracchio, R.L. 1992. Exxon Valdez oil spill cleanup (slide) presentation. In: Proceedings of the CONCAWE - DGMK Remediation of Oil Spills Scientific Seminar, May 18 21 1992, Hamburg, Germany, N.5.3, pp. 193-205.
Key words: Alaska, Bulk Carrier, Crude Oil, Oil Waste

Materials Performance. 1991. Tiny organisms help (to) clean Prince William Sound, (Alaska). Materials Performance 30(8):64-65.
Key words: Accident, Alaska, Biochemical Reactions, Biodegradation, Bioremediation, Crude Oil, Environmental Protection Agency

Mathavan, G.N. 1993. Treatment of oily waters using peat. PhD Thesis, 1990; Diss Abstr Int, Sect B 53(10):5345-B.
Key words: Water Treating, Contamination, Environmental Pollution, Oil Spill, Pollution Control

Matsumoto, Ken. 1989. Estimation method for oil spill cleanup capability of refineries and terminals. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil spill, cleanup, refineries, terminals.

Matsumoto, Ken. 1991. A Guide to response evaluation for oil spill combat in Japan. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: guide, response, oil spill, Japan.

Matsumoto, K. 1989. Japan Oil Spill Cooperative of the Petroleum Association of. Estimation method for oil cleanup capability of refineries and terminals. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf. (San Antonio 2/13-16/89) API Publ. N.4479 221-224.
Key words: absorbent, absorption process, additive, API, association, dispersant, efficiency, emulsifier, equation, gelation, industrial plant, mathematics, meeting paper, oil refinery.

Matthews, Lt. Cdr. Kent W. 1979. The Global Hope is aground: an incident at Salem Sound. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: Global Hope, aground, Salem Sound.

Matthews, Jr., John F. 1971. California contingency plan for oil and other hazardous materials spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: California, contingency, oil, hazardous materials, spills.

Mattson, James S. and Allen van Emmerik. 1983. The Law and practice of assessing damages to natural resources. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio,

TX.
Key words: law, damages, resources.

Mattson, Chester P. 1977. Hackensack estuary oil spill: cutting oil-soaked marsh grass as an innovative damage control technique. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: Hackensack, estuary, oil spill, oil-soaked, marsh, control.

Maurer, Jack R. 1992. Practical Aspects and Performance of Heat Exchanger Components and Materials. In: Proceedings of the 1992 International Joint Power Generation Conference, October 18 22 1992, Atlanta, GA, 119 pp.
Key words: Heat Exchangers, Power Plants, Cleaning Technology
This conference contains 15 papers. The subject matter is primarily concerned with the environmental effects of service conditions on heat exchanger tubes due to fouling, water conditions, high temperature transients and oil spills. Corrosion and fouling treatment programs are evaluated. Cleaning technologies, performance tests, analysis of steam cycle effects, and maintenance data are applied to the evaluation of various designs of heat exchangers.

Maurer, Lt. A.T., A.T. Edgerton, and D.C. Meeks. 1977. U.S. Coast Guard airborne oil surveillance system status report. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: U.S., Coast Guard, oil, surveillance.

Maurer, Lt. A., and A.T. Edgerton. 1975. Flight evaluation of U.S. Coast Guard airborne oil surveillance system. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: evaluation, U.S., Coast Guard, oil, surveillance.

Mauro, G. 1990. Oil-hungry bacteria pass the test. World Oil. 211(2):9.
Key words: Bacteria, Biochemical Reaction, Biodegradation, Boom, Bulk, Crude Oil, Pollution Control

May, H.D., W.A. Price, A.W. Boyle, C.K. Blake. 1992. The activities and requirements of anaerobic PCB dechlorinating organisms in the presence and absence of river sediment. In: Proceedings of emerging technologies for hazardous waste management. 701-704,755.
Polychlorinated biphenyls (PCBs) in the environment have long been a public concern due their pervasive nature, recalcitrance to degradation, potential ability to bioaccumulate in animal tissue, and potential carcinogenicity in humans and wildlife. Substantial reductive dechlorination of PCBs in river sediment has been observed in situ and in the laboratory, however many aspects of this reductive dechlorination are unclear. Several of the authors' investigations with anaerobic enrichments of Hudson River sediments (H7) have addressed some of these issues. One series of experiments examined the lag in dechlorination that is observed with fresh H7 enrichments or in transfers from active

cultures. In this paper, the authors observe that PCB dechlorination occurred 3 to 4 weeks after the introduction of PCBs regardless of the duration of the pre-incubation period without PCBs present (Table 1). A related experiment was performed with an enrichment (C-146) that can dechlorinate 2, 3, 6-chlorobiphenyl (CB) rapidly when supplemented nutrients and 2, 3, 6-CB daily. When C-146 was maintained under identical conditions, except without PCBs, the dechlorinating activity lagged for 4-9 days after PCB addition even though these cultures were methanogenic.
Key words: animals, biological, effects, biphenyl, biodegradation, environmentals impacts.

Mayer, Jules F. 1975. Planning for minimum oil-spill risk: Estero Bay deepwater terminal and pipeline. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: planning, oil-spill, Estero Bay, deepwater, terminal, pipeline.

Maynard, Nancy G., Conrad D. Gebelein, and Adam Zsolnay. 1977. The Effects of pelagic hydrocarbons on the rocky intertidal flora and fauna of Bermuda. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: pelagic, hydrocarbons, intertidal, flora, fauna, Bermuda.

Mazzotta, M.J., J.J. Opaluch, and T.A. Grigalunas. 1993. Restoration and natural resource damage assessment. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: restoration, natural resource, assessment.

Mc Minn, LTJG T.J. and LTJG Paul Golden. 1973. Behavioral characteristics and cleanup techniques of north slope crude oil in an Arctic winter environment. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: characteristics, cleanup, north slope, oil, Arctic.

McAuliffe, C.D. November 1987. Measuring hydrocarbons in water. Chem. Eng. Prog. (United States). 83(11):40-45.
Key Words: Ground water ecological concentration, ground water quantitative chemical analysis, hydrocarbons environmental transport, hydrocarbons monitoring, surface waters ecological concentration, surface waters quantitative chemical analysis, aquatic organisms, environmental exposure pathway, oil spills, toxicity, water chemistry, water pollution, chemical analysis, hydrogen compounds, mass transfer, organic compounds, oxygen compunds.

McAuliffe, Clayton D. 1989. The Weathering of volatile hydrocarbons from crude oil slicks on water. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: weathering, volatile, hydrocarbons, oil slicks, water.

McAuliffe, Clayton D. 1987. Organism exposure to volatile/soluble hydrocarbons from crude oil spills: a field and laboratory comparison. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.

McAuliffe, Clayton D. 1981. The 1979 Southern California Dispersant Treated Research Oil Spills. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: California, dispersant, research, oil spills.

McAuliffe, C.D. 1975. Chevron main pass block 41 oil spill: chemical and biological investigations. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: Chevron, oil, spill, chemical, biological.

McCabe, C. 1989. The worst U.S. crude (oil) spill challenges the oil industry. Ocean Ind. 24(6):24-26,28-29.
Key words: Accidnet, Additive, Alaska, Beach, Boom, Crude Oil, Pollution Control Equipment

McCarthy, M., B.J. Denahan, and J.R. Herbert. 1989. Technologies for the remote detection of hydrocarbons in the subsurface. In: Proceedings of the API et al Oil Spill (Prev, Behav, Contr, Cleanup) 20th Anniv Conf, February 13 16 1989, San Antonio, pp. 13-17.
Key words: Remote Sensing, Oil Spill, Contamination, Pipeline Leak, Pollution Control

McCarthy, M.W., and J. McGrath. 1993. The contribution of air cushioned vehicles in oil spill response. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 127-133.
Key words: Cleaning, Oil Spill, Pollution Control, Cleanup, Contamination

McCarthy, Leo T. and J.R. Gould. 1983. EPA-API standard reference oil program. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX. Key words: EPA-API, standard, oil.

McCarthy, Leo T. 1977. Considerations for field use of dispersants. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: dispersants.

McCarty, Perry L. 1987. Bioengineering Issues Related to In-situ Remediation of Contaminated Soils and Groundwater. In: Proceedings of the NSF/et al (Plenum) Reducing Risks from Environmental Chemicals Through Biotechnology, July 19 23,1987, Seattle, WA. pp. 143 62.
Keywords: in-situ, biodegradation, groundwater, water pollution, soil contamination, bacteria, waste site remediation

A few issues of importance to in-situ biotransformation of hazardous chemicals are addressed. These issues include a discussion of relevant biotransformation processes, reaction kinetics, and reaction stoichiometry. For some contaminants that can be readily used as primary energy sources for bacteria with or without the presence of oxygen, bacterial removal is relatively simple and occurs naturally. The major challenge to both engineers and scientists lies in the decomposition of hazardous chemicals that appear to be transformed by the process of co-metabolism.

McCauley, Cynthia A. and Richard C. Harrel. 1981. Effects of oil spill cleanup techniques on a salt marsh. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: oil spill, cleanup, marsh.

McCleary, G.D., I.D. MacFarlane, and S.L. Pattison. 1988. Three phase liquid recovery and treatment at a former coal gasification site. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, pp. 443-455.
Key words: Oil Spill, Soil Pollution, Water Pollution, Groundwater

McClelland, Jr., Lt. Cdr. Joseph J. 1979. Marine environmental protection in the Soviet Union. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: marine, environemental, protection, Soviet Union.

McClellen, Kristen L., Netty Buras, and Roger C. Bales. 1989. Biodegradation of trichloroethylene by bacteria indigenous to a contaminated site. J Env Science & Health-Env Science & Engineering. A24(6):561-570.
Key words: Biodegradation, Microorganism, Bacteria, Hydrocarbons, Degradation, Groundwater
The ability of bacteria indigenous to a trichloroethylene (TCE) contaminated site to degrade TCE was investigated by exposing the microorganisms to 0.56 and 6.7 mg/L TCE under aerobic, oligotrophic conditions. The bacteria were able to degrade 47% and 33% of the TCE, respectively, for the two concentrations studied, while increasing their numbers by two orders of magnitude. Control bacteria demonstrated no ability to degrade TCE. In addition, chemical analysis showed that no dehalogenation isomers of TCE were formed in the biodegradation process.

McClure, N.C., J.C. Fry, and A.J. Weightman. 1991. Genetic engineering for wastewater treatment. J Inst Water Environ Manag. 5(6):608-616.
Key words: Wastewater, Hydrocarbons, Biodegradation, Bacteria, Degradation
Genetic engineering is useful in treatment of wastewater, especially for the biodegradation of organic pollutants, particularly chlorinated aromatic compounds. The performance of bacteria constructed to degrade 3-chlorobenzoate was studied in an activated-sludge system microcosm. The activity and survival

of the bacteria in the sludge was monitored, as was the BOD of both influent and effluent, suspended solids parameters, and index of sludge volume. Although the bacteria survived for more than two months in the sludge, an initial decline in population was demonstrated, and 3-chlorobenzoate introduced into the system after day 32 remained undegraded. Degradation was improved by addition of a bacteria stain that had been enriched with the chlorinated aromatic, combined with another strain of bacteria that was genetically engineered to degrade the compound. The value of microcosm systems to test genetically engineered bacteria for biodegradation is discussed.

McColl, W.D., M.F. Fingas, R.A.E. McKibbon, and S.M. Till. CCRS (Canada Centre for Remote Sensing) remote sensing of the Beaufort Sea dispersant trials 1986. In: Proceedings of the tenth Arctic and Marine Oil Spill Program Technical Seminar, June 9 1987, Edmonton, Canada, pp. 291-306.
Key words: Beaufort Sea, Oil Spills, Remote Sensing, Oil Pollution Containment
The Canada Centre for Remote Sensing with the Environmental Emergencies Technology Division, Environment Canada, participated in a co-operative project to provide remote sensing measurements of the Beaufort Sea Dispersant Trials in August 1986. The aircraft configuration for the Beaufort Trials was the basic Falcon electro-optical system. This system provided the capability to satisfy both operational and research objectives. Operationally the task required temporal mapping of the distribution and relative thickness of the oil at the multiple test site to document the effects of the various dispersant applications. Research objectives included the utilization of dual infrared detectors at 5 and 10 micrometers to provide additional oil thickness information and the test of the MSS spectrometer for imaging the dispersed oil in the water column. The on-location analysis of the real-time video cassette recording of the UV/IR data verified success in documenting each test slick and the relative effectiveness of the dispersant applications for the trial
date. Subsequent analysis of multispectral image data recorded on the high density tape has provided position and area information of each test slick with time for the complete trial period. 1 ref., 9 figs., 2 tabs.

McCracken, W.E., T.J. Charlton, and F.J. Freestone. 1979. Oil pollution prevention, control and countermeasure practices at small petroleum facilities. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil, pollution, prevention, control, countermeasure, petroleum, facilities.

McCracken, W.E. and F.J. Freestone. 1977. Hydrodynamics of a diversionary boom. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: hydrodynamics, boom.

McCready, R.G.L. Proceedings of the fifth annual general meeting

of Biominet. Canada Centre for Mineral and Energy Technology, Ottawa, ON. 1989. 119-127.
Landfarming has been used for disposal of oily wastes and spilled oil in the oil industry for some time. In this process, the oil is plowed into the soil and a natural population of bacteria in the soil degrades the oil products under the influence of nitrogen and phosphorus fertilizers. Landfarming is limited by a relatively low biodegradation rate and the narrow range of oil components readily degraded. Methods are required to address these limitations. The oil absorbent peat product, Oclansorb, has been found to increase normal rates of oil degradation in both laboratory and landfarm studies. These studies first demonstrated that Oclansorb increased oil degradation over background levels in the presence of nutrients of nitrogen and phosphorus. Lab studies involving further additions of commercial oil-degrading preparations demonstrated increased oil degradation; in one instance and no effect above Oclansorb treatment in another.Concern that commercial preparations may not persist in the environment and may have to be tailored to specific sites makes inclusion of such agents in commercial products questionable.
Key words: oil spills, biodegradation, waste oils, bench-scale experiments, chemical reactions, decomposition, oils, organic compounds, other organic compounds, testing.

McDermott, H.J. 1993. Selecting protective gloves for oil spill response and cleanup. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill, response, cleanup.

McDonagh, M., A. Payne, and D. Tookey. 1992. Remote sensing of chemicals at Sea. In: Proceedings of the Environ Canada Chemical Spills 9th Technical Semin, June 8 9 1992, Edmonton, AB, pp. 321 337.
Key words: Remote Sensing, Infrared, Remote Sensing
The ability of infrared, UV, and side-looking airborne radar currently in use on UK aircraft to detect chemicals as well as oil spilled at sea was studied. Results of pilot-scale and sea trials with styrene, cyclohexane, toluene, nonyl acetate, methanol, and paraffin are reported. The best imagery was provided by infrared instruments, with slicks typically appearing in sharp contrast to the sea surface. UV imagery and visual observation might supplement detection by infrared sensing.

McDonald, B.L., M.N. Miller. Proceedings: 1991 fuel oil utilization workshop, Electric Power Research Inst., Palo Alto, CA (United States) Carnot, Tustin, CA (United States); The topics addressed at the Workshop were combustion and emission of coke particles formed from residual fuel oil and wall-fired electric utility boilers, the size distribution of particulate matter from combustion of low-sulfur residual fuel oils in a utility boiler, the results of an R D evaluation of low NO{sub x} oil/gas burners, an update on residual fuel oil market conditions since the Gulf War, fluid-dynamic modifications in a utility boiler combustion system, fuel oil vapor and odor control, the new Coking Index method for characterizing fuel oil, an update on

Orimulsion{trademark} testing, a summary of the EPRI hazardous air pollutants conference, and an update on implementation of the *Clean* Air Act Amendments of 1990. Two group discussion sessions, open only to to electric utility representatives, were again held in 1991. These two sessions provided utility workshop attendees with an opportunity to address *oil* *spills* and the *Clean* Air Act Amendments of 1990.

McFarland, W. E. 1992. Factors affecting hydrocarbon removal by air stripping. In: Proceedings of the National Research and Development Conference on the Control of Hazardous Materials, Feb. 4 6, San Francisco, CA. Hazardous Materials Control Resources Institute: Greenbelt, MD, pp 42 48.
Key words: Decontamination, Oil Spills, Water Pollution, Hydrocarbons
This paper includes an overview of the theory of air stripping design considerations and the factors affecting stripper performance. Effects of temperature, contaminant characteristics, stripping tower geometry, and air/water ratios on removal performance are discussed. The discussion includes treatment of groundwater contaminated with petroleum hydrocarbons and chlorinated solvents such as TCE and PCE. Control of VOC emissions from air strippers has become a major concern in recent years, due to more stringent restriction on air quality in many areas. This paper includes an overview of available technology to control air emissions (including activated carbon adsorption, catalytic oxidation, and steam stripping) and the effects of air emission control on overall efficiency of the treatment process. The paper includes an overview of the relative performance of various packing materials for air strippers and explains the relative advantages and disadvantages of comparative packing materials. Field conditions affecting selection of packing materials are also discussed. Practical guidelines for the design of air stripping systems are presented, as well as actual case studies of full-scale air stripping projects.

McFarland, Wayne E., and John V. Heintz. 1991. Secondary containment options for petroleum facilities. Ground Water Management. 8:3-11.
Key Words: Pollution, oil spills, preventive measures, storage tanks ,secondary containment, oil storage, liners, controls, permeability.

McFarland, M.J., X.J. Qiu, W.A. Aprill, and R.C. Sims. 1990. Biological composting of petroleum waste organics using the white rot fungus phanerochaete chrysosporium. In: Proceedings of the 2nd Inst Gas Technol Gas, Oil, Coal, & Environ Biotechnol Int Symp, December 11 13, 1989, New Orleans, LA. pp. 37 57.
Keywords: bioremediation, biodegradation, oil waste, soil remediation, soil pollution

McFarland, B., J. Murphy, and D. Simecek-Beatty. 1993. Conventions for reporting and displaying overflight observations. In: Proceedings of the 13. international conference on the prevention, behavior, control and cleanup of oil spills, March 29 April 1 1993, Tampa, FL, 789-790.
Key words: Oil Spills, Petroleum

During the critical initial phases of an oil spill response, as observations and reports come in from different agencies and companies, descriptions and representations can vary widely. These apparently conflicting reports can cause unnecessary confusion, wasting valuable time and resources. As the number of [open quotes]experts[close quotes] and the amount of [open quotes]necessary[close quotes] information multiply, the potential for information overload also increases. Important information that needs to be presented can be lost in the flood of information that is available. For many years the National Oceanic and Atmospheric Administration (NOAA), in support of the US Coast Guard, has coordinated scientific input concerning the tracking and prediction of the transport of oil spilled in the marine environment. This role frequently involves recording visual or remote sensing observations from multiple platforms and observers, and displaying the information in a clear format, which needs to be rapidly available and unambiguous. Simple graphic products help identify conflicting views of information and allow responders to quickly build a [open quotes]graphic consensus[close quotes] of the situation. To this end the authors have developed in-house guidelines for presentation of crucial response information. Because correctly designed graphics can clearly and rapidly transmit large amounts of information, these guidelines focus on the graphic presentation of information. Some of these same conventions and criteria are being applied in evaluating and developing information acquisition and display tools. This poster presentation includes examples of the hardware and software used by Genwest and NOAA for the rapid display of response information.

McFarlane, Craig and Robert Watson. 1977. The Detection and mapping of oil on a marshy area by a remote luminescent sensor. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: detection, mapping, oil, marshy, luminescent, sensor.

McGinnis, G.D. 1987. Potential for migration of hazardous wood-treating chemicals during land-treatment operations. Final technical report. Mississippi State Univ., Mississippi Forest Products Utilization Lab, Jackson, MS. Report No. PB-88-116785/XAB, 137 pp.
Key words: groundwater, water pollution, biodegradation, soils, hydrocarbons, monitoring
This project is an extension of the project undertaken jointly by the Environmental Protection Agency, Southern Pressure Treaters Association, and Mississippi Forest Products Laboratory. The overall objective of the study is to determine the amount and type of toxic chemicals that migrate into the ground water during active land-treatment operations. The hazardous waste at each site has been characterized chemically using a variety of parameters. Determination of the rates of microbiological degradation is complete. Studies on migration patterns are still in progress. The principal findings are that all the sites had bacteria that could degrade polycyclic aromatic hydrocarbons and pentachlorophenol. The relative rates varied for each constituent and depended on the soil type.

McGrattan, K.B., A.D. Putorti, W.H. Twilley, and D.D. Evans. 1993. Smoke Plume Trajectory from In situ Burning of Crude Oil in Alaska. National Inst. of Standards and Technology (BFRL), Gaithersburg, MD. Fire Safety Engineering Div. Report No. NISTIR-5273, 72 pp.
Key words: Oil Spills, Crude Oil, Combustion, Smoke, Dispersing, Fire Tests, Plumes
Experimentation, analysis, and modeling have been performed to predict the downwind dispersion of smoke resulting from in situ burning of oil spills. North Slope and Cook Inlet crude oils are burned on water in a 1.2 meter diameter pan. Burning rates and smoke aerosol size distributions are also measured, and found similar to previous work with different crude oils. Derivation of scaling factors for predicting the burning rates and smoke yields are large scale fires are guided by previous experiments with Louisiana crude oil. Scaled burning rates and smoke yields are supplied as input parameters for the LES (Large Eddy Simulation) model, version 2.0, of windblown smoke transport over flat terrain. For weather conditions appropriate for the Cook Inlet and North Slope areas, model results are presented which predict downwind dispersion and ground level concentrations of the fire generated particulate matter.

McIntyre, David. 1983. Underground oil spill investigation and cleanup. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: underground, oil spill, cleanup.

McKay, Terry R. and Jerry Galt. 1983. Computer prediction and mapping of oil spills in Australia. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: computer, prediction, mapping, oil spills, Australia.

McKenzie, B., and N. Ingram. 1993. Mutual aid in oil spill response: The Alaskan North Slope model. In: Proceedings of the API - EPA - USCG 1993 International Oil Spill Prevention, Preparedness,
Response Conference, March 29 April 1 1993, Tampa FL, API Publication N.4580 19-22.
Key words: environment, transport & storage, health & environment, land pollution

McKinley, Lt. Audrey A. 1991. Fate of oil and debris recovered from spill cleanup operations. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: oil, debris, spill, cleanup.

McLain, D.R. 1991. Progress in gathering and managing in-situ marine data. In: Proceedings of the Mar Technol Soc et al conf (MTS 91), November 10 14 1991, New Orleans, LA, 2:1049-1054.
Key words: Environmental Data, Oil Spill

McLeod, W.H.H. 1991. The role of the marine pollution control unit in contingency planning for, and in the conduct of, offshore

pollution operations. IBC Tech Serv LTD Offshore Ind & The Environ Conf, September 30 November 1 1991, London, England, Proc 1991 (14 pp.
Key words: Pollution Control, Contingency Planning, Oil Spill, Contamination

McMahon, Anderson C., and R. P. Labelle. 1990. Estimated occurrence rates for analysis of accidental oil spills on the U.S. outer continental shelf. Oil Chem Pollut 6(1):21 35.
Key words: Oil Spill, Continental Shelf

McMahon, P.J.T. 1989. The impact of marinas on water quality. Water Science & Technology. 21(2):39-43.
Key words: Bacteria, Degradation, Petroleum, Hydrocarbon, Water Pollution
Analyses of water, sediment and biological samples showed no evidence of dissolved oxygen depletion or nutrient enrichment of the water column and no nutrient enrichment, organic pollution, toxic pollution or bacterial degradation of the sediments. Analyses of organotin compounds from antifouling residues were inconclusive due to problems in interpreting the results and comparing them with overseas results. The major impact was found to be the build-up of heavy metals (Pb, Cu, Zn, Hg) and petroleum hydrocarbons. The accumulated levels of these, however, were similar to those in other areas affected by human activity and were not indicative of significant water pollution. Guidelines for marina construction were developed based on the results of this study and a literature review. -from Author.

McManus, Kevin R. 1987. Conversion of a U.S. Coast Guard skimming barrier into a single-vessel skimming system. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: U.S., Coast Guard, skimming, barrier, single-vessel.

McMillan, William W. 1975. Stream preservation training. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: preservation.

McNally, Joseph T., Craig R. Robertson, and Ned E. Wehler. 1985. Containment and removal of fuel oil from groundwater beneath a densely populated housing development. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: containment, removal, oil, groundwater.

McNeil, C.S.L. 1975. On-line computer systems for environmental emergency management. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: computer, environmental, management.

McWhorter, D.B. 1987. Retardation of flow in oil shale residues affected by in-situ hydration. In: Proceedings of the Commonwealth Kentucky et al east oil shale symp (Lexington, Ky, 11/18 20/87).

Key words: waste disposal, disposal, oil, petroleum

Meade, Norman F. and Robert C. Anderson. 1979. Problems and perspectives in measuring the social costs of oil pollution. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: measuring, costs, oil, pollution.

Meade, Norman F., Thomas F. LaPointe, and Robert C. Anderson. 1983. Multivariate analysis of worldwide tanker casualties. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: analysis, tanker.

Mearns, A.J., P. Roques, C.B. Henry Jr. 1993. Measuring efficacy of Bioremediation of oil spills: monitoring, observations, and lessons from the APEX oil spill experience. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 335-343.
Key words: Bioremediation, Biodegradation, Oil Spill, Remediation, Chemical Analysis, Petroleum

Mechrez, E., A. Kessler, H. Rubin, C. Veret. 1987. Optical visualization of oil spill penetration into the capillary zone of groundwater aquifers. Hemisphere Publishing, New York, NY. 827-832.
Key Words: Flow visualizatin optical systems, oil spills flow visualization, oil spills fluid flow, oil spills migration length, oil spills photography, aquifers, capillary flow, contamination, ground water, information, intrusion, mathematical models, porosity, porous materials, research programs, simulation, dimensions, hydrogen compounds, oxygen compounds.

Meck, John P. and Robert E. Lutz. 1977. Recovering for marine life damage: legal aspects of allocating social costs and protecting public interests. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: recovering, marine, damage, legal, costs.

Medbury, S.J. 1988. Filter for the Sorption of a Petroleum Product from a Liquid. Patent No. US 4759847, c 7/26/88, f 11/26/84, pr US 12/5/83 7 pp.
Key words: Oil water separator, adsorbent, control, filter, oil skimming, oil spill, oil water separation, physical separation, pollution control, separation equipment, solid adsorbent, sorbent, (p) USA, adhesion, adhesive, adsorption, belt, business operation, byproduct, chart, construction material, contamination, conveyor belt, decontaminating, ecology, engineering drawing, environment, manufacturing, mounting, natural resin, oil waste, polyester, polymer, product, purifying, salvaging, sorption, synthetic resin, waste material, waste oil recovery, water pollution, ecology & pollution

Meeks, Dudley G. 1981. A View on the laboratory testing and assessment of oil spill dispersant efficiency. In: Proceedings of

the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA. American Petroleum In:stitute: Washington, D.C.
Key words: testing, assessment, oil spill, dispersant.

Meidt, CWO Richard M. 1991. Public perceptions in spill response. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: public, spill, response.

Meidt, CWO Richard M. 1987. On-scene coordinators can effectively inform the public through the news media. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: inform, public, media.

Meier, K. Tidal pumping plant., esp for coastal oil spill collection , or as barrier, has floating barrier and guide members for light liquids, including specifically shaped pump housing with mixt. inlet in upper front face, 2-part extendable mixt. run-up ramp etc. Patent No. DE 4112639_910418.
Key words: Boom, Coastal Area, Oil-Water Emulsion, Pipeline, Pollution Control

Meier, K. Dam to collect and skim oil spillages etc. on water, consists of steel boxes connected together which sink to half their depth to prevent oil escaping. Patent No. DE 3916026_890517.
Key words: Accumulating, Boom, Crude Oil, Oil Waste, Pollution Control, Skimmer

Meijs, F.H., L.J. Schmit Jongbloed, and H.J. Tadema. 1969. New Methods For Combating Oil Slicks. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: oil slicks.

Meikle, K.M., H. Whittaker, and F. Laperriere. 1985. An experimental high pressure waterjet barrier. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: barrier.

Meikle, K.M. 1983. An effective low-cost fireproof boom. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: fireproof boom.

Meikle, K.M. 1981. An oil slick igniter for remote areas. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: oil slick.

Meikle, K.M. 1989. The Arctic and Marine Oil Spill Program-AMOP. In: Proceedings of the US Dep Interior Minerals Manage Serv Alaska Arctic Offshore Oil Spill Response Technol Workshop,

November 29 December 1 1988, Anchorage, Alaska, (NIST SPEC Publication No. 762), pp. 117-131.
Key words: Oil Spill, Contamination, Oil Skimming, Pollution Control, Remote Sensing

Meikle, K. M. December 1988. The Arctic and Marine Oilspill Program: AMOP. Spill Technology Newsletter. 13(4):67(8).
Key Words: Arctic waters, oil spill cleanup, Canada, oil spills-platform, oil spills-tanker, oil spill analysis, coastal waters, marine pollution equipment, polltant fate, oil booms, oil skimmers, dispersants.

Meikrantz, D.H. 1989. Development of high throughput annular centrifugal contactors for rapid oil-water separations. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX. American Petroleum Institute: Washington, D.C. pp. 571.
Key words: centrifugal, oil-water, separations.

Melguen, M. and J.F. Levy. 1987. Pollution fighting: training in France. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: pollution, training, France.

Melville, L. and P. Hamm. 1977. Preventing oil spills in the West Coast forest industry. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA. American Petroleum Institute: Washington, D.C. pp. 57 60.
Key words: preventing, oil spills, forest.

Mendelsohn, D.L. 1991. A mesoscale meteorological model hindcast of the Exxon Valdez oil spill. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: meteorlogical, Exxon Valdez, oil spill.

Mendelssohn, I.A., M.W. Hester, and J.M. Hill. 1993. Assessing the recovery of coastal wetlands from oil spills. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 141-145.
Key words: Wetland, Estuary, Louisiana, Oil Spill, Cleaning, Environmental Impact

Mensing, Arthur E. and Richard Stoeffer. 1971. Investigation of the use of vortex flow to separate oil from an oil-water mixture. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: flow, separate, oil, oil-water.

Menta, N. A. and R. R. Dupont. 1992. Bioventing treatability studies for the remediation of fuel contaminated soils. In: Proceedings of Special Symposium on Emerging Technologies for Hazardous Waste Management, Sept. 21 23, Atlanta, GA. American Chemical Society: Washington DC, pp. 495 498.

Key words: Oil Spills, Remedial Action, Water Pollution, In-Situ Biodegradation
Approximately two million underground storage tank (UST) systems are located at nearly 700,000 facilities nationwide. The U.S. Environmental Protection Agency (USEPA) indicated that approximately 25 percent of existing UST systems fail tightness testing and may be leaking. Potential environmental problems arise when a spill of organic solvent or petroleum products contained within these tanks occurs. Many naturally occurring microorganisms in soil ecosystems have the capability to degrade hydrocarbons. However, in many cases the natural microbial degradation processes are too slow, often due to the lack of oxygen or nutrients, to prevent hydrocarbon contaminants from moving to groundwater. Thus the need for an accelerated, engineered, in-situ biodegradation process becomes apparent. Pump-and-treat technology is often employed to treat contaminated groundwater, but it has been found that this technique leaves a substantial fuel residue in the capillary fringe or vados zone which continue to contaminate the groundwater. Bioventing is an emerging technology that can minimize the need for off-gas treatment and is effective in removing low vapor pressure compounds. This method utilizes naturally occurring microorganisms in the soil to mineralize residual contaminants. In this method, required amounts of oxygen, nutrients, and moisture are supplied to the bacteria to enhance the rate of biodegradation of soil contaminants using the gas phase as the primary transport medium for oxygen transfer. The objectives of this paper are to develop bascale treatability methods to determine the optimum moisture contents and nutrient levels for the design of field scale bioventing systems and to verify if labscale treatability studies are useful to evaluate the potential success of field bioventing remedial technology, by comparing results obtained from both field and laboratory experiments.

Merlin, F. 1991. Toward a French approval procedure for the use of dispersants in inland waters. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: French, use, dispersants, waters.

Merlin, Francois, Christian Bocard, and Gilles Castaing. 1989. Optimization of dispersant application, especially by ship. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: dispersant, ship.

Mertzl, Douglas K. and James S. Mattson. 1985. Legal contingency planning for oil spills. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: legal, contingency, oil spill.

Mesyats, S.P., L.A. Kirillova, and J.A. Sentyabreva. 1992. Elaboration of complex methods for reduction of oil pollution of surficial waters. Csm Quart rev v 92, no 3, pp 15-17, 1992.
Key words: pollution control, absorbent, clay mineral,

contamination, control, environmental pollution, Eurasia, Europe, heat treatment, heating, KolaPeninsula, mineral, Russian Republic Europe, silicate mineral, sorbent, USSR (Europe), vermiculite, water pollution, absorption, Arctic ocean, Barents Sea, business operation, chart, cleaning, diagram, field testing, manufacturing, oil spill, oil waste, recycling, seas and oceans, sorption, surface water, testing, volume, waste material, water, ecology & pollution

Mew, Jr., H.E., A.H. Rooney-Char, and Capt. J.D. Webb. 1983. Organizational obstacles to decision-making during oil spills. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: obstacles, oil spills.

Meyer, David S. 1987. French spot and the U.S. landsat jockey for position in the race for a multimillion-dollar remote sensing market. Commercial Space. 2(4):62.

Meyer, D. S. 1987. French Spot and the U.S. Landsat jockey for position in the race for a multimillion-dollar remote sensing market. Commercial Space 2(4):62.
Key words: Landsat TM
Landsat 5 thematic mapper image of New York Harbor, produced by combining data from three bands in the visible and near-infrared ranges of the electromagnetic spectrum, provides more information about vegetation, shown in shades of red, than the Spot image. Overall detail, at only 30-meter resolution, is lower than that provided by Spot. Shades of gray and white are assigned to illustrate buildings and roads. Spectral wavelenghts measured by satellite reveal conditions on the Earth's surface. Spot 1 provides a smaller range of this remote sensing data in bands of 0.5 0.89 microns. The data can be applied specifically to such areas as farming, forestry, engineering projects, and mineral exploration. Spot 10-meter-resolution panchromatic data image shows runaways of Denver Stapleton International Airport left-center, and farmland indicate different crops and surface conditions. Circular areas are irrigation plots.

Meyers, Robert J. and Michael R. Bennett. 1983. Marine industry group (MIRG). In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: marine, industry, MIRG.

Meyers, Robert J. 1981. Response to the Esso Bayway oil spill. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: Esso Bayway, oil spill.

Meyers, R.J., J.L. Payne, and C.B. Strong. 1987. Oil spill training: the need continues. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil spill training.

Michael, A.D., C.R. Van Raalte, and L.S. Brown. 1975. Long-term effects of an oil spill at West Falmouth, Massachusetts. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil spill, West Falmouth, Massachusetts.

Michaelis, W., H.H. Richnow, A. Jenisch, T. Schulze, and B. Mycke. 1990. Structural inferences from organic geochemical coal studies. In: Ittekkot, V, S. Kempe, W. Michaelis and A. Spitzy (eds.), Facets of modern biogeochemistry. Springer-Verlag, Berlin, Germany, pp.388-401.
Key words: Bacteria, Degradation, Germany, Hydrocarbons

Michaud, J. M., A. H. Parsons, S. R. Ripple and D. J. Paustenbach. 1990. Human health risks associated with contaminated sites: critical factors in the exposure assessment. In: Proceedings of the Annual West Coast Conference on Hydrocarbon Contaminated Soils and Groundwater, Feb. 1990, Newport Beach, CA. Lewis Publishers: Chelsea, MI, pp. 283 292.
Key words: Groundwater, Oil Spills, Remedial Action, Land Pollution
This paper reports that the widespread use of petroleum in the United States has created the potenial for contamination of soil and groundwater. The environmental, health, and economic implications of soil contamination have become a topic of interest to many in the past several years. The application of risk assessment to evaluations of petroleum-contaminated sites will help prioritize sites, focus resources, and develop cost-effective remediation strategies. Risk assessment is an important tool for evaluating the potential hazards of human exposure to industrial chemicals, such as petroleum hydrocarbons, in air, water, and soil. Health risk assessments have become so widely adopted in the United States that their conclusions are now major factors in many environmental decisions. The risk assessment process has helped the American public to better understand the magnitude of risks posed by naturally-occurring and man-made products and consequently has helped to reduce unwarranted concern over trivial hazards.

Michel, Jacqueline. 1989. Natural resource damage assessment of the Amazon Venture. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: natural resource, damage, assessment.

Michel, Jacqueline and Miles O. Hayes. 1993. Persistence and weathering of Exxon Valdez oil in the intertidal zone: 3.5 years later. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: weathering, Exxon Valdez, oil, intertidal.

Michel, J., M.O. Hayes, R.S. Keenan, J.R. Jensen, S. Narumalani. 1993. Oil in nearshore subtidal sediments of Saudi Arabia from the Gulf War spill. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 383-388.

Key words: Oil Waste Fate, Arabian Sea, Crude Oil, Oil Spill, Contamination, Pollution Control, Remote Sensing

Michel, J. 1989. Trends in natural removal of the Exxon Valdez oil spill in Prince William Sound from September 1989 to May 1990. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: removal, Exxon Valdez, oil spill, Prince William.

Michel., Victor H., walter J. Owens, and Jacqueline Sexton. 1987. A Comparison of soil-gas sampling methods used at two harbor sites. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: soil-gas, sampling.

Mickey, V. 1985. Water disposal rules pose new problems. Western Oil World (1985): 42
Key words: oil, disposal, petroleum

Mickey, V. 1985. Water handling both simple, complex. Southwest Oil World (1985): 34
Key words: recovery, oil, disposal

Midkiff, H.E. Oil Spill recovery, using floating chamber which receives oil-water mixt. and returns purified water to stream. Patent No. US 91095_870831.
Key words: Aggregate, Ballast, Boom, Control Equipment, Oil Waste, Pollution Control

Mielke, J.E. 1990. Oil in the ocean: The short- and long-term impacts of a spill. Congr. Res. Serv. Rep. No. 90356 SPR, 36 pp., Petroleum Abstracts ABSTR. NO. 521,148 32(11).
Key words: Biochemical Reaction, Biodegradation, Crude Oil, Environemtal Impact, Pollution Control

Miget, R.J., C.H. Oppenheimer, H.I. Kator, and P.A. LaRock. 1969. Microbial degradation of normal paraffin hydrocarbons in crude oil. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: microbial, degradation, hydrocarbons, oil.

Mignone, E.J., and C. Yapijakis. 1991. Emergency in situ detoxification of gasoline contaminated soil through bioremediation. In: Proceedings of the Pennwell Conf & Exhibit co Petro-Safe 91 Conf, Feb. 6-8, 1991, Houston, TX, pp.841-865.
Key words: Biodegradation, Soil Pollution, Bacteria, Environmental Impact, Groundwater, Oil Spill

Mikesell, Mark D., Ronald H. Olsen, and Jerome J. Kukor. 1991. Stratification of anoxic BTEX-degrading bacteria at three petroleum-contaminated sites. Battelle In Situ Bioreclamation Symp, San Diego, CA, 351-362.
Key words: Biodegradation, Microorganism, Hydrocarbons, Water Pollutants
Bioremediation of soils contaminated by benzene, toluene,

ethylbenzene, and xylenes (BTEX), is frequently limited by electron acceptor availability. This consideration is examined, along with the importance of the stratification of contaminants and microorganisms within aquifers, for three BTEX-contaminated sites. It was possible to isolate bacteria that, under anoxic and denitrifying conditions, could utilize BTEX. Degradation of BTEX was correlated with the presence of such bacteria. Aerobic BTEX degraders occurred evenly in the sampled profiles, but anoxic BTEX-utilizing bacteria were stratified in zones within the hydrocarbon plume at each site.

Miklaucic, Cdr. E.A. and J. Saseen. 1989. The Ashland oil spill, Floreffe, PA: case history and response evaluation. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: Ashland, oil spill, Floreffe, PA, response.

Mikolaj, Paul G. and Edward J. Curran. 1971. A hot water fluidization process for cleaning oil-contaminated beach sand. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, DC.
Key words: fluidization, cleaning, oil contaminated, beach.

Milde, G., M. Nerger, and R. Mergler. 1988. Biological degradation of volatile chlorinated hydrocarbons in groundwater. Water and Science Technology. 20(3):67-73.
Key words: Soils, Groundwater, Pollution, Microorganisms, Bacteria, Biodegradation, Germany

Miles, D. Howard, Mary Jane Coign, and Lewis R. Brown. 1977. A liquid chromatographic flourescence technique for estimating crude oil in water, sediment, and biological material. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: chromatographic, oil, water, sediment, biological material.

Miles, D. Howard, Mary Jane Coign, and Lewis R. Brown. 1975. The Estimation of the amount of empire mix crude oil in mullet, shrimp, and oysters by liquid chromatography. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil, mullet, shrimp, oysters, chromatography.

Milgram, Jerome H. 1973. Physical requirements of oil pollution control barriers. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: requirements, oil, pollution, control, barriers.

Milgram, Jerome H. and Richard A. Griffiths. 1977. Combined skimeer-barrier high seas oil recovery system. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: skimmer-barrier, seas, oil, recovery.

Mille, G., M. Mulyono, T. El Jammal, J.-C. Bertrand. 1988.

Effects of oxygen on hydrocarbon degradation studies in vitro in surficial sediments. Estuarine, Coastal & Shelf Science. 27(3):283-295.
Key words: Hydrocarbons, Bacteria, Biodegradation, Coastal, Water Pollution
Hydrocarbon degradation occurred markedly in sediments where the dissolved oxygen concentration in the overlying seawater was 8 ppm and the redox potential was around + 150 mV. The degradation was slower (2 to 3 times less) when the dissolved oxygen concentration (2-3 ppm) and the redox potential (+30 mV) decreased. -from Authors.

Mille, G., M. Almallah, M. Bianchi, F. Van Wambeke, and J.C. Bertrand. 1991. Effect of salinity on petroleum biodegradation. Fresenius' journal of analytical chemistry. 339(10):788-791.
Key words: Biodegradation, Bacteria, Microorganism, Marine Environment, Pollution Control
The biodegradation of Ashtart crude oil by a mixed bacterial community (EH1) isolated from a marine sediment was investigated in varying concentration of sodium chloride (0 to 2 mol/l). Each fraction of Ashtart crude oil was biodegraded after a 30 day incubation period for a NaCl concentration equivalent to the one of seawater (0.4 mol/l). Saturates were more readily degraded than aromatics. The amount of oil degraded increased initially with increasing salt concentrations to a maximum level for 0.4 mol/l NaCl concentration.

Miller, J.W. 1981. Oil spill cleanup assessment for the Columbia River basin. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.

Key words: oil spill, cleanup, Columbia, River.

Miller, Jr., Eugene R. 1973. Development and prediminary design of a sorbent oil recovery system. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: development, design, sorbent, oil, recovery.

Miller, C.D., S.R. Signorini, L.E. Borgman, D.W. Denbo, and C.E. Dorman. 1991. Initial statistical characterization of the variability of coastal winds and currents. executive summary. Minerals Management Service, Camarillo, CA. Pacific OCS Region. Report No. OCS/MMS-91/0024, 39 pp.
Key words: Meteorology, Computerized Simulation, Offshore Oil Drilling
The purpose of the present study originates with the goal of the U.S. Department of the Interior, Minerals Management Service (MMS) to improve the methodology for evaluating risks associated with spilled oil in the marine environment. To achieve an improvement in risk assessment, the means by which the trajectories of hypothetical oil spills are predicted must be improved. In this regard, the spatial and temporal coverage of observations of currents and winds, alone or in conjunction with numerical models, must be adequate to describe the appropriate wind and current flow patterns. The present study addresses two aspects in the application of statistical techniques to the

problem of improving our understanding of current and wind patterns off the U.S. west coast: (1) the characterization of the temporal and spatial variability observable in wind and current records and (2) the identification of ways to statistically supplement these records and eventually incorporate this variability in the initial and boundary conditions of numerical models.

Miller, Robert T. 1988. Hydrogeology and preliminary regional flow modeling at the Bemidji, Minnesota, research site. Open-File Report (United States Geological Survey. 1978). C11-C16.
Key Words: Minnesota, hydrogeology, ground water, Beltrami County, Minnesota, USGS, Midwest, United States, northwestern Minnesota, Bemidji Minnesota, oil spills, pollution, aquifers, crude oil, movement, regional patterns.

Miller, S.S. 1990. In a faraway state...(Alaska). Environmental Science & Technology. 24(9):1286-89.
Key words: Accident, Additive, Alaska, Beach, Biochemical, Biodegradation, Bird, Boom, Crude Oil, Economic Factor, Pollution Control, Skimmer

Miller, R.N. C.M. Vogel, R.E. Hinchee, R.R. Dupont, and D.C. Downey. 1990. A field scale investigation of enhanced petroleum hydrocarbon biodegradation in the vadose zone at tyndall afb, Florida. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection, & Restoration Conf, October 31 November 2, 1990, Houston, TX. Ground Water Manage No 4:39 351.
Keywords: soil remediation, biodegradation, remediation, Florida, in-situ, inground tank, leak, soil pollution, water pollution

Miller, James A. 1987. Beach agitation for crude oil removal from intertidal beach sediments. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: beach, oil, removal, intertidal, beach, sediments.

Miller, John W. 1973. A Multiparameter oil pollution source identification system. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil pollution, identification.

Miller, James A. 1989. Physical and chemical recovery of intertidal and shallow subtidal sediments impacted by the Arco Anchorage oil spill, Ediz Hook, Washington. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: physical, chemical, recovery, intertidal, subtidal, sediments, Arco, Anchorage, oil spill, Washington.

Miller G.P., R.J. Portier, D.G. Hoover,and D.D. Friday. 1990. Biodegradation of chlorinated hydrocarbons in an immobilized bed reactor. Environmental progress. 9(3): 161-164.
A 75 liter immobilized microbe biological reactor with a bed retention time of 20.5 hours was used in a continuous flow mode

to remediate contaminated groundwater containing ethylene dichloride (EDC), tetrachloroethylene, and trichloroethylene, with EDC being the predominant contaminant. The reactor was initially seeded with
Xanthobacter autotrophicus. In addition to Xanthobacter autotrophicus, four indigenous *bacterial* species from the groundwater had successfully acclimated to the reactor bed.
Key words: biodegradation, chlorocarbon, ethylene(trichloro), ethylene(tetrachloro), bioreactor, fixed bed reactor, entrapped microorganism, continuous flow method, water pollution, ground water, Xanthobacter autotrophicus.

Milligan, J.D., and D. Durnford. 1990. Petroleum thickness in ground water - a laboratory study. Final report, May 87-Mar 89. 50(p).
Key Words: Ground water-water pollution, petroleum products monitoring, water wells monitoring, de-aquifers, correlations, equations, functions, jet engine fuels, laboratories, land pollution, oil spills, premeability, physical properties, soil mechanics, thickness, dimensions, hydrogen compounds mechanics, oxygen compounds.

Mills, Aaron L., and Susan E. Randall. 1991. Abundance and distribution of microbial guilds in subsurface plume of gasoline contamination at Galloway Township, New Jersey. Water-Resources Investigations. 263-267.
Key Words: New Jersey, pollution, ground water, environmental geology, oil spills, biodegradation, USGS, Eastern U.S., United States, southeastern New Jersey, Atlantic County New Jersey, Galloway New Jersey, volatile organic compounds, Atlantic Coastal Plain, North America, microorganisms, bacteria, plumes, anaerobic environment, hydrochemistry.

Minchew, C. Douglas, Lewis R. Brown, Cornell M. Ladner. 1979. The Occurrence of white eye syndrome in shrimp(Penaeus aztecus). In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: shrimp.

Minerals Management Service.1988. Alaska update: January 1987 August 1988: outer continental shelf oil & gas activities. In: U.S. Dep Interior MMS OCS Inform Rep No MMS 88-0073 1988 (1 Microfiche with 50 Pp; 6 Refs).
Key words: Alaska, Beaufort Sea, oil, disposal

Minnesota Mining Mfg Co. Redeployable multilayer high temp. oil containment boom, using knitted wire mesh, refractory fabric and cellular flotation core, can be used in situ burning of spilled oil. Patent No. US 103268_871001.
Key words: Alloy steel, Aluminum, Aluminum Oxide, Boron, Chlorohydrocarbon, Crude Oil, Galvanizing, Halohydrocarbon, Pollution Control, Silicon

Minnesota Mining & MFG co. Ceramic foam body buoyant boom member to contain offshore oil spills, has hard-shell crust and closed-cell interior. Patent No. US 707836_910530.
Key words: Carbon, Cellular, Containment, Cooling Rate, Oil Waste

Minnesota Mining Mfg Co. High temperature oil containment boom allowing site burning comprises polymer coated nylon fabric over two layers of fire retardant fabics mounted on flotation core. Patent No. US 899737_860825.
Key words: Accidental Fire, Alloy Stell, Boom, Chlorohydrocarbon, Glass Fiber, In-situ, Pollution Control, Waste Disposal

Minugh, E.M. 1983. A case history: cleanup of a subsurface leak of refined product. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: cleanup, subsurface leak.

Mitchell, N. 1985. An estuarine oil spill incident in the United Kingdom. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: estuarine, oil spill, United Kingdom.

Mitchell, K.G., D.W. Bates Jr., and E.L. Schrader. 1992. First Response Remediation of Marine Oil Spills : pt.2 : Characteristics and Experimental Results for Polypropylene and Cellulosic Sorbent Materials. 41st Annu GSA Southeast Sect Et Al Mtg (Winston-Salem, NC, 3/18-20/92) pap no 8591; abstr with programs (gsa) v 24, no 2, p 54, March 1992 (issn 00167592; abstract only) (ao).
Key words: oil spill, barrier, contamination, environmental pollution, floating barrier, pollution control equipment, remediation, water pollution, ecology & pollution

Mitchell, M.E. 1980. Waste oil disposal at the Department of Energy facilities at Oak Ridge, Tennessee.
In: Proceedings of the 1980 UCC-ND and GAT waste management seminar. in Portsmouth, OH, U.S.A. Year.
Key words: oil, disposal, waste oil
The disposal of waste oil generated at the USDOE facilities in Oak Ridge has become a significant problem in recent years. The presence of radioactivity and other contaminants in some oils prohibits the use of commercial disposal and oil reclamation firms, and, thus, often necessitates on-site disposal. Recent and proposed federal regulations have and will continue to control all waste oil disposal operations, including those of the Department of Energy. In order to ensure adequate and acceptable disposal of waste oils, a special committee of UCC-ND personnel located in Oak Ridge was established in December 1978 and asked to make appropriate recommendations for both near-term and long-range operations. Included in this paper is a brief description of the efforts of the committee, the associated efforts of development and engineering personnel, and conclusions and recommendations pertaining to UCC-ND waste oil disposal.

Moir, M.E., and D.C. Yetman. 1993. The Detection of oil under ice by pulsed ultraviolet Fluorescence. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, Tampa, FL, pp. 521-523.
Key words: Oil Spill, Crude Oil, Petroleum, Contamination, Remote

Sensing

Moir, M.E., S. Charbonneau, and J.B.A. Mitchell. 1993. Soot reduction chemicals for in-situ burning. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 761-763.

Moldan, A., L.F. Jackson. 1987. Oil spill contingency planning in South Africa. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil spill contingency, Africa.

Moles, A.D., S.D. Rice, M.S. Okihiro. 1993. Herring parasite and tissue alterations following the Exxon Valdez oil spill. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: herring, Exxon Valdez, oil spill.

Moller, T.H., H.D. Parker, J.A. Nichols. 1987. Comparative costs of oil spill cleanup techniques. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: costs, oil spill, cleanup.

Moller, T.H., B. Dicks, and C.N. Goodman. 1989. Fisheries and mariculture affected by oil spills. In: Proceedings of the 1989 API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 389-94.
Key words: Animal, Coastal Area, Crude Oil, Economic Factor, Legal Consideration, Environmental Protection Agency, Water Pollution

Mommessin, P.R., J.C. Raia. 1975. Chemical and physical characterization of tar samples from the marine environment. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: chemical, tar, marine, environment.

Monahan, Thomas P., Alan W. Maki. 1991. The Exxon Valdez 1989 Wildlife Rescue and Rehabilitation Program. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: Exxon Valdez, wildlife, rehabilitation.

Mondello, F.J. 1989. Cloning and expression in Escherichia coli of Pseudomonas strain LB400 genes encoding polychlorinated biphenyl degradation. J. Bacteriol.(United States). 171:3:1725-1732.
Pseudomonas strain LB400 is able to degrade an unusually wide variety of polychlorinated biphenyls (PCBs). A genomic library of LB400 was constructed by using the broad-host-range cosmid pMMB34 and introduced into Escherichia coli. Approximately 1,600 recombinant clones were tested, and 5 that expressed 2,3-dihydroxybiphenyl dioxygenase activity were found. This enzyme is encoded by the bphC gene of the 2,3-dioxygenase pathway

for PCB-biphenyl metabolism. Two recombinant plasmids encoding the ability to transform PCBs to chlorobenzoic acids were identified, and one of these, pGEM410, was chosen for further study. The PCB-degrading genes (bphA, -B, -C, and -D) were localized by subcloning experiments to a 12.4-kilobase region of pGEM410. The ability of recombinant strains to degrade PCBs was compared with that of the wild type. In resting-cell assays, PCB degradation by E. coli strain FM4560 (containing a pGEM410 derivative) approached that of LB400 and was significantly greater than degradation by the original recombinant strain. High levels of PCB metabolism by FM4560 did not depend on the growth of the organism on biphenyl, as it did for PCB metabolism by LB400. When cells were grown with succinate as the carbon source, PCB degradation by FM4560 was markedly superior to that by LB400.
Key words: chlorinated aromatic hydrocarbons, biodegradatio, gene regulation, clone cells, cell constituents, halogenated, oxygenases, genes, biological pathways, bacteria, escherichia.

Monenco Consultants Ltd., Calgary (Alberta). Used oil management in Canada: Existing practices and alternatives. In Report no. CCME-TS/WM-TRE007E
Canadian Council of Ministers of the Environment. 1. 1989.
Key words: Canada, transport, waste oils, environment
The used oil generated in Canada each year is the largest single source of liquid organic hazardous wastes in the country. This report covers handling and transport, reprocessing and re-refining, used oil end uses, and used oil disposal. It also presents a socio-economic analysis.

Monk, D. 1989. Caring for the environment worldwide. Pet. Rev. 43(508):248-50.
Key words: Biochemical reaction, Biodegradtion, Biomedical Technique, Crude Oil, Economic Factor, Environmental Protection, Legal Consideration, Thermal Pollution

Monk, D.C., and D. Cormack. 1992. The management of acute risks. Oil spill contingency planning and response. Cairns, W.J. in: North Sea oil and the environment. (Elsevier Applied Science). pp. 619-642.
Key words: Contingency Planning, Oil Spill Response, Risk Assessment
Following a brief introduction the chapter is divided into the following sections: the potential for damage; remote sensing in prevention and detection; the response to oil spills; contingency planning in practice; and Sullom Voe case study. The key elements in implementing a strategy for oil spill clean-up and the associated roles of industry and the authorities are discussed.

Montello, T.M. 1993. Persistence of Gulf War oil versus intertidal morphology and sediments: one year later. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: Gulf War, oil, morphology, sediments.

Monticello, D.J., and J.J. Kilbane. 1991. Practical considerations in biodesulfurization of petroleum. In: Proceedings of the 3RD Inst Gas Technol (Chicago) Gas, Oil, Coal,

& Environ Biotechnol Int Symp, December 3 5, 1990, New Orleans. pp. 455 466.
Keyword: bacteria, biodegradation, Environment Protect Agency, environmental impact, government, legal

Montoro, Cdr. Donald P. 1989. Photographic review of the shell oil spill, Martinez, California. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: shell, oil spill, California.

Moore, Lt. Cdr. M., Lt. R.B. Gaines, I.M. Lissauer. 1989. Coast Guard computerized spill response system. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: Coast Guard, computerized spill response.

Moorfield, J.L. 1990. Environmental impact of chemicals used offshore. In: Proceedings of the Norwegian Soc Chartered Eng Oil Field Chem Conf, March 19 21, 1990, Geilo, Norway. Pap Pt 2, 5pp.
Keywords: biodegradation, environmental impact, offshore

Morchin, William C., and Stephen L. Johnston. 1991. Modern airborne early warning radars. Microwave Journal. 34:30 42.

Moreau, Jerry P. 1993. Cotton nonwovens as oil spill cleanup sorbents. Text. Res. J. 63(4):211-18.
Key words: Petroleum, Oil Spills

Moreira, A. 1990. Airborne real-time SAR processing activities at DLR. In: Proceedings of the tenth EARSeL symposium: new European systems, sensors and applications, Toulouse, 1990. pp 170-177.
Key words: SAR Processing, Real Time Monitoring
The real-time SAR processing activities began in 1987 with a concept for an on-board Quick-Look SAR processor. The development was instigated by the need for a real-time monitoring facility, especially for applications such as the detection of oil spills at sea. For azimuth and range compression, the real-time Quick-Look processor carries out a modified unfocused correlation approach, that produces a good image contrast and a point target response with strong suppression of the side lobes. The achieved resolution is about 10 X 25m in azimuth and range, while 3 X 3m with 8 looks are obtained by off-line high precision processing. As the low resolution Quick-Look image contains a reduced amount of data, the image can be stored on a conventional video recorder. A new high resolution real-time processor is currently under development which works with a new time-domain subaperture approach (SUPER-M approach) and with a new improved Multi-Look technique (IML-technique). -from Author.

Morgan, C., H.S. Solomon, A. Barrios, A. Valenti. 1989. Implications of regulatory consideration of tank replacement as a remedial action: Economic loss, remedial delay, and conflict with UST regulations. National Water Well Association, Dublin, OH (US). 698(p):1-10.
Key Words: Gasoline underground storage, oil spills pollution regulations, oil spills remedial action, pollution regulations

economic impact, underground storage pollution regulations, gasoline service stations, land pollution, land pollution, abatement, Massachusetts, petroleum, resource recovery acts, water pollution abatement, commercial sector, containers, energy sources, Federal Region I, fossil fuels, liquid fuesl, marketers, North America, petroleum products, pollution abatement, retailers, USA.

Morgan, B. 1989. Risk analysis approach in assessing the benefits of subsea valves. In: Proceedings of the Subsea Eng News Subsea Emergency Shutdown Syst Seminar, June 1, London, England.
Key words: Oil Spill, Pipeline, Risk Analysis

Morin, Paul R., and Elizabeth G. Woodhouse. 1989. Asphalt batching; an alternative to landfill disposal of petroleum hydrocarbon contaminated soil. Natl. Water Well. Assoc., Dublin, OH, United States. 505-518.
Key Words: New Jersey, engineering geology, waste disposal, asphalt batching, asphalt, bitumens, organic materials, PCBs, chlorinated hydrocarbons, case studies, landfills, bioreclamation, seepage, oil spills, hydrocarbons, ground water, hazardous waste, berms, Eastern U.S., United States.

Morris, P.R. 1985. Recovery of viscous emulsions from a firm sandy beach. In: Proceedings of the 1985 Oil Spill Conference (prerention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: recovery, emulsions, beach.

Morris, J.T. 1990. Pollution control. Patent No. GB 2229936A, 9p.
Key words: oil spills, water pollution control, equipment, wetting agents
Oil spillages on water are removed by plastics mesh which is preferentially wetted by the oil, which is subsequently removed by shaking or squeezing. Pieces or bundles of mesh may be dropped into the water and agitated or the mesh is in the form of an endless rope which is dragged through the water or a boom which surrounds the oil slick. Mesh of the sort used for reinforcing concrete, whose resilience tends to close the openings, is preferred. Mesh may be polypropylene and coated with wetting agent. (author).

Morris, P.J., J.F. Quensen III, J.M. Tiedje, and S.A. Boyd. 1992. Reductive debromination of the commercial polybrominated biphenyl mixture firemaster BP6 by anaerobic microorganisms from sediments. Applied and Environmental Microbiology (United States). 58:10:3249-3256.
Anaerobic microorganisms eluted from three sediments, one contaminated with polybrominated biphenyls (PBBs) and two contaminated with polychlorinated biphenyls, were compared for their ability to debrominate the commercial PBB mixture Firemaster. These microorganisms were incubated with reduced anaerobic mineral medium and noncontaminated sediment amended with Firemaster. Firemaster averages six bromines per biphenyl molecule; four of the bromines are substituted in the meta or para position. The inocula from all three sources were able to debrominate the meta and para positions. Microorganisms from the

Pine River (St. Louis, Mich.) contaminated with Firemaster, the Hudson River (Hudson Falls, N.Y.) contaminated with Aroclor 1242, and Silver Lake (Pittsfield, Mass.) contaminated with Aroclor 1260 removed 32, 12, and 3% of the meta plus para bromines, respectively, after 32 weeks of incubation. This suggests that previous environmental exposure to PBBs enhances the debromination capability of the sediment microbial community through selection for different strains of microorganisms. The Pine River inoculum removed an average of 1.25 bromines per biphenyl molecule during a 32-week incubation period, resulting in a mixture potentially more accessible to aerobic degradation processes. No ortho bromine removal was observed. However, when Firemaster was incubated with Hudson River microorganisms that had been repeatedly transferred on a pyruvate medium amended with Aroclor 1242, 17% of the meta and para bromines were removed after 16 weeks of incubation and additional debromination products, including 2-bromobiphenyl and biphenyl, were detected.
Key words: bromine compounds, biodegradation, removal, microorganisms, bromine, anaerobic digestion, polychlorinated, aerobic.

Morris, Byron F., James N. Butler. 1973. Petroleum Residues in the Sargasso Sea and on Bermuda Beaches. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: petroleum, residues, Sargasso Sea, Bermuda, beaches.

Morris, P.R., D. Tookey, T. Walsh. 1983. The Warren Spring Laboratory beach material washing plant for shoreline cleanup. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: Warren Spring, beach, washing, shoreline cleanup.

Morrison, Cdr. C.D. 1979. Between a dam and a hard spot. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.

Morrow, S.R. 1991. Priming methods for vacuum extraction wells. Patent No. US 5076360911231, 9p.
Key words: Soil Remediation, Soil Pollution, Groundwater, Oil Spill, Vadose Water

Mortenson., Steven F., Gordon A. Railsback, and Jack R. Robilliard. 1987. Strategy for monitoring the short-term distribution of dispersed oils. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: monitoring, short-term, distribution, dispersed, oils.

Moscovchenko, M.V., H.V. Stabnikova. 1992. Application of biosurfactants to bioremediation of contaminated soil. Soil Decontamination Using Biological Processes. (1992): 6 9 December.
Key words: hydrocarbons, soil, decontamination, biodegradation, bacteria, degradation

Moskat, G. W. 1984. California used oil recycling program. In:

California State Solid Waste Management Board, Sacramento. 5p. 1984.
Key words: hazardous wastes, regulations, California, recycling, oil wastes
Used oil in California is classified as a hazardous waste material subject to the regulatory overview of many agencies. Because of its classification as such, used oil is regulated by the State Department of Health Services (DOHS), and subject to manifesting and vehicle registration requirements; the Air Resources Board (ARB), who regulates emission levels and hydrocarbon emissions from processing plants and fuel oil burners; the Regional Water Quality Control Boards who monitor oil disposal operations; the California Highway Patrol, who performs vehicle inspections of the hauling industry; and the State Solid Waste Management Board (SWMB), who regulates used oil recycling activities in the state. This report will focus upon the latter area of used oil recycling, and the program California has developed to effectively monitor the disposition of over 50.6 million gallons of used oil collected and recycled each year in the state. In addition, the author will discuss the efforts the state has made to promote the concept of oil recycling through public awareness and marketing activities.

Mossteller, T.L. 1975. Preparation of an oil spill prevention training program. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil spill, prevention.

Moya, J.L., and R.U. Acton. 1989. The use of a thermal probe to determine the effective thermal conductivity of packaging contents. The 9th international symposium on the packaging and transportation of radioactive materials. Proceedings: Volume 3. 1553-1562.
Contact-handled transuranic (CH-TRU) waste materials are nonradioactive items contaminated with alpha-emitting transuranium radionuclides. The most common transuranium radionuclides in the waste are plutonium and associated daughter products. These contaminants are usually in the form of oxides and are embedded, trapped, or otherwise attached to a variety of inert host or parent materials. Due to the high efficiencies of the recovery process, the actual contaminants are normally small in size and the contaminants remaining in the waste are usually well attached to their host. The TRU waste is typically sealed in plastic bags which, in turn, are placed within cans or other containers and are subsequently placed in 55-gallon steel drums with polyethylene liners. These procedures prepare the waste for transport and storage and reduce the possibility of contaminant release. Department of Transportation Regulation require that there will be no mixture of gases and vapors in the package which could, through any credible spontaneous increase of heat or pressure or through an explosion, significantly reduce the effectiveness of the packaging. Since many CH-TRU wastes produce gases, the designers of radioactive transport containers must consider the consequences of gas generation to ensure the safe operation of transport containers. During transport, gases are primarily generated in CH-TRU waste through three mechanisms:

radiolysis, bacteriological decay, and thermal degradation. Radiolysis of organic materials, such as cellulosics, plastic, and oil, generates hydrogen, carbon dioxide, and carbon monoxide and depletes oxygen. Bacteriological decay of organic materials produces carbon dioxide or methane.
Key words: plutonium, containers, methane, radioactive waste management, transuranium, alkanes, elements, environmental transport, actinides, metals, national organizations, organic compounds, transuranium.

Mu-Zhen, Lu. 1989. Oil spill prevention and treatment in offshore oil industry of China. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil spill, prevention, offshore, treatment, China, oil.

Mucha, H., W. Troesch, and F. Lingens. 1988. Conversion of propionate to acetate and methane by syntrophic consortia. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 27:5/6:581-586.
The anaerobic degradation of propionate to acetate and methane by a defined sulfidogenic syntrophic co-culture consisting of Syntrophobacter wolinii and Desulfovibrio G11, and a new thermophilic, methanogenic consortium T13 was studied. Tracer experiments using (/sup 14/C) propionate produced evidence for the generally accepted biochemical pathway involving methylmalonyl-CoA as an intermediate in the degradation of propionate. The degradation of (1-/sup 14/C) propionate led exclusively to the formation of /sup 14/CO/sub 2/ by S. woliniiD. G11 and to the formation of /sup 14/CH/sub 4/ by the methanogenic consortium T13. (orig.EF).
Key words: methane, biosynthesis, culture media, methanogenic bacteria, organic wastes, digestion, decomposition, waste managment, organic compounds, processing, synthesis, digestion, bioconversion, bacteria, alkanes.

Mueller, M.B. Absorption of oils, esp. clean-up oil spills, using absorbent oleophilic biodegradable sponge material comprised of fat-free, foamable natural prods. Patent No. US 387825_890801.
Key words: Adsorption Process, Animal, Aromatic Hydrocarbon, Biochemical reaction, Biodegradation, Foam, Pollution Control

Mueller, J.G., P.J. Chapman, P.H. Pritchard. 1989. Action of a fluoranthene-utilizing bacterial community on polycyclic aromatic hydrocarbon components of creosote. Applied and Environmental Microbiology (USA). 55:12:0099-2240.
Cultures enriched by serial transfer through a mineral salts medium containing fluoranthene were used to establish a stable, seven-member bacterial community from a sandy soil highly contaminated with coal tar creosote. This community exhibited an ability to utilize fluoranthene as the sole carbon source for growth, as demonstrated by increases in protein concentration and changes in absorption spectra when grown on fluoranthene in liquid culture. Biotransformation of other polycyclic aromatic hydrocarbons (PAHs) was verified by demonstrating their disappearance from an artificial PAH mixture by capillary gas

chromatography. When grown on fluoranthene as the sole carbon source and subsequently exposed to fluoranthene plus 16 additional PAHs typical of those found in creosote, this community transformed all PAHs present in this defined mixture. After 3 days of incubation, 13 of the original 17 PAH components were degraded to levels below the limit of detection (10 ng/liter). Continued incubation resulted in extensive degradation of the remaining four compounds. The ability of this community to utilize a high-molecular-weight PAH as the sole carbon source, in conjunction with its ability to transform a diverse array of PAHs, suggests that it may be of value in the bioremediation of environments contaminated with PAHs, such as those impacted by creosote.
Key words; bacteria, metabolism, polycyclic aromatic, hydrocarbons, soils.

Mueller, M.B., and K.J. Marean. 1989. Process for Separating and/or Recovering Hydrocarbon Oils from Water Using Biodegradable Absorbent Sponges. Patent No. US 5039414, c 8/13/91, f 8/1/89 (Appl 387825) (c02f-001/28) (7 pp; 15 claims) See related patent abstract # 513200
Key words: synthetic sponge, absorbent, contamination, environmental pollution, oil spill, oil water separation, physical separation, pollution control equipment, sorbent, water pollution, (p) USA, absorption, adsorption, adsorption capacity, aerobic bacteria, agar agar, bacteria, bacteriology, biodegradation, biology, business operation, chemical process, collagen, collecting agent, combustion, composition, compound, construction material

Mueller, James G., Peter J. Chapman, Beat O. Blattmann, and P. Hap Pritchard. Isolation and characterization of a fluoranthene-utilizing strain of pseudomonas paucimobilis. Applied & Env Microbiology. 56(4):1079-1087.
Key words: Hydrocarbons, Biodegradation, Soil Pollution
A strain of Pseudomonas paucimobilis, EPA505, using fluoranthene as the sole source of carbon and energy for growth, was purified from a creosote waste site bacterial community capable of degrading PAHs. Utilization of fluoranthene was demonstrated by an increase in bacterial biomass, a decrease in aqueous fluoranthene concentration, and transient formation of transformation products in liquid cultures where fluoranthene was supplied as the sole carbon source. Resting cells of EPA505 showed activity toward anthraquinone, benzo(b)fluorene, biphenyl, chrysene, and pyrene, as well as six other PAHs. Organic compounds not previously reported to serve as growth substrates can be used by axenic cultures of microorganisms. Such organisms may possess novel degradative systems that are active toward other compounds whose biological degradation has been limited because of inherent structural considerations or low aqueous solubility.

Mueller, J.G., P.J. Chapman, P.H. Pritchard. 1989. Creosote-contaminated sites: Their potential for bioremediation. Environmental Science and Technology. 23(10):1197-1201.
Key words: Biodegradation, Monitoring
Bioremediation of creosote-contaminated materials is reviewed

here by characterizing coal-tar creosote, identifying techniques for assessing the biodegradation.

Mueller, J.G., P.J. Chapman, B.O. Blattmann, and P.H. Pritchard, P.H. 1990. Utilization of fluoranthene by Pseudomonas paucimobilis strain EPA505. Akin, C., Smith, J., 1990. Gas, oil, coal, and environmental biotechnology II. 2. international IGT symposium on gas, oil, coal, and environmental biotechnology. 243-253. 594.
Pseudomonas paucimobilis strain EPA505 was previously purified from a 7-membered bacterial community originally isolated from a creosote-contaminaated siol for its ability to degrade polycyclic aromatic hydrocarbon (PAH) components of creosote. The unique ability of this organism to utilize fluoranthene as sole source of carbon and energy for growth in pure culture was demonstrated by increase in bacterial biomass, changes in UV-absorption, decrease in aqueous fluoranthene concentration, and the production of metabolites when fluoranthene was supplied as sole carbon source in liquid culture. Compounds accumulating in fluoranthene culture medium during growth of EPA505 have been distinguished by HPLC and UV-absorption properties. Based on precedents established for bacterial degradation of similar compounds, speculative pathways aare proposed to illustrate the novel biochemistry employed by strain EPA505 in the utilization of fluoranthene. Whereas utilization of fluoranthene appears to involve previously undefined variations on established oxygenation and ring cleavage processes, these findings suggest the potential of this and other organisms for accelerating the biotransformation of other environmental pollutants currently considered recalcitrant to microbiological attack. Hence, strain EPA505 and other organisms similarly isolated for their ability to degrade fluoranthene and related compounds may prove useful to remediation efforts employing biological processes.
Key words: biodegradation, creosote, pseudomonas, absorption, spectroscopy.

Mueller, Allan J., Carlos H. Mendoza. 1983. The Port Bolivar, Texas oil spill: a case history of oiled bird survival. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: Port Bolivar, Texas, oil spill, bird.

Muller-Karger, F.E. 1992. Remote sensing of marine pollution: a challenge for the 1990s. Mar Pollut Bull. 25(1-4):54-60.
Key words: Water Pollution, Oil Spill, Remote Sensing

Muncrief, P.M. Oil Absorbent Layered Fabric Sheet. Patent No. US 5156743, c 10/20/92, f 3/21/91 (e02b-015/04) (7 pp; 2 claims)
Key words: solid adsorbent, absorbent adsorbent, contamination, environmental pollution, fabric, oil spill, sheet, sorbent, water pollution, (p) USA, absorption, additive, adhesion, adhesive, adsorption, adsorption capacity, business operation, cellulose, chart, construction material, control, design, engineering, engineering drawing, environment, fiber, layer, lipophilic, manufacturing, melting point, multiple, natural resin, ocean environment,

oil waste, orientation, particle size, physical property, pollution control, pollution control equipment, porosity, process design, salvaging, sorption, surface property, thickness, transition temperature, waste material, waste oil recovery, water resistance, wettability, ecology & pollution

Munnings, Edgar R., and Charles E. Sorensen. 1990. Maximizing physical site conditions to biochemically enhance the degradation of perched ground water and soil contaminated with DOP, DAP and number 6 fuel oil. Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:845-861.
Key Words: Ground water, reclamation, soils, pollution, natural resources, oil spills, degradation, biodegradation, case studies, dioctylphthalate, diallylphthalate.

Munzer, S.R. 1975. Automobile and the regulation of its impact on the environment. In: Water pollution problems related to the automobile: crankcase oil disposal., 457 468. Norman, OK: University of Oklahoma Press, 1975.
Key words: crankcase oil, disposal, legal
Crankcase oil presents a problem because its disposal after ordinary use may damage the environment. All oils generally have adverse effects on natural bodies of water they coat the surface and thereby prevent oxygen from reaching the water and sunlight from penetrating to the plants below. This retards photosynthesis and hence decreases the dissolved oxygen content of the water which is indispensable for fish and plant life. Crankcase oil occasions further problems because of the additives (chiefly detergents and metals) found in motor oil and because it acquires lead and other gasoline additives when used in automotive engines. A discussion is given of: (1) the crankcase oil problem; (2) methods of disposal and their economic and environmental impact; and (3) the legal regulation of crankcase oil disposal.

Murarka, I.P., S. Cordle. 1990. Field and laboratory evaluation of the use of nitrate to remove BTX from a fuel spill. In: Proceedings of the Environmental research conference on groundwater quality and waste disposal, Washington, DC (USA).29(1-17):17.
Key Words: Benzene biodegradation, benzene environmental transport, ground water pollution, toluene biodegradatoin, tolune environmental transport, xylenes biodegration, xylenes environmental transport, bench-scale experiments dentrification, gas spills, gasoline, leaks, Michigan, nitrates, oil spills, storage facilities, underground facilities, alkylated aromatics, chemical reactions, decomposition, Federal Region V, hydrogen compounds, liquid fuels, mass transfer, nitrogen compounds, North America, organic compounds, oxygen compounds, petroleum products USA.

Murday, Maylo, and Erich R. Gundlach. 1989. Oil spill contingency planning in Mauritius. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil spill contingency, Mauritius.

Murday., Jerry, N. Nwankwo, Maylo Jacqueline Michel. 1987. Environmental Baseline Studies for Oil Pollution Control in Nigeria. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987. in Baltimore, MD Year.
Key words: environmental, oil, pollution, control, Nigeria

Murdy, W.H., C.E. Beck. 1989. Delineation and characterization of solvent contamination within unconfined sandy aquifer near Augusta, Georgia. The proceedings of the third national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods, National Water Well Association outdoor action conference. 1161(p):1053-1066.
Key Words: Ground water contamination, solvents environmental transport, waste oil refineries environmental effects, waste oils environmental transport, aquifers, cretaceous period, ecological concentration, flow rate, fluid flow, Georgia, hydrology, monitoring, water chemistry, water pollution, chemistry Federal Region IV, geologic ages, hydrogen compounds, industrial plants, mass transfer, mesozoic era, North America, organic compounds, other organic compounds, oxygen compounds, USA, waste processing plants.

Murphy, J.A., D.D.H. Dale, Lt. Cdr. D.J. Sigrist. 1985. A Transportable spill information management system, a case study. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: transportable, spill management.

Murphy, M.P., and R.J. Stier. Oil Recovery Mop. Spec Weld Fabricat NY Inc. Patent No. US 5084171, c 1/28/92, f 1/17/91 (Appl 642472) (e02b-015/04)5pp.
Key words: pollution control equipmnt, adsorbent, collecting agent, contamination, environmental pollution, hand tool, oil spill, solid adsorbent, sorbent, water pollution, (p) USA, absorption, adsorption, buoyancy, business operation, chart, clamp, connector, construction material, control, control equipment, coupling (mechanical), decontaminating, ecology, engineering drawing, environment, fabric, fastener, fiber, fitting, float, floating, lake, lipophilic, manual override, marine ecology, ocean, ocean environment, oil waste, physical property, plastic, pollution control, polymer, propene homopolymer, salvaging, sorption, Spec Weld Fabricat NY Inc., stream, surface property, synthetic resin, thread (mechanical), waste material, waste oil recovery, wettability, ecology & pollution

Murphy, T.A., L.T. McCarthy. 1969. Evaluation of the effectiveness of oil-dispersing chemicals. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: evaluation, oil-dispersing, chemicals.

Murphy., Lt. David, J. Kruth, Edward Overton. 1987. Protecting an Island's Drinking Water and Desalinization Plant. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987. in Baltimore, MD.

Key words: island, water, desalinization

Murray, S.P., and E.H. Owens. 1988. The role of oceanic fronts in oil spill dipsersion and for oil spill response planning in the coastal zone. In: Proceedings of the eleventh Arctic and marine oil spill program technical seminar, June 7 1988, Ottawa, Ontario.
Key words: coastal waters, oil spills, emergency plans, water currents
Over the past decade coastal and marine oil spill response plans have become more sophisticated by the inclusion of data on many aspects of the physical process environment. One physical element that, to date, has been missing from trajectory modeling and response plans is the role of oceanic and nearshore fronts. This paper considers some of the applications of this knowledge to coastal response planning. Fronts are particularly common in coastal waters where they are associated with the outflow of rivers, upwelling at capes and headlands, and larger scale wind-induced upwelling. The complex velocity field and the density differences associated with such fronts tends to make them very efficient traps or natural booms for spilled oil, which can prevent the oil from moving in a direction that would otherwise take place due to driving forces such as near-surface winds. Examples of frontal influences on notable oil spills are presented. Another example, the behavior of a water plume in Eclipse Sound, Baffin Island, showed how ice floes in the plume were driven against a headwind and did not escape from the plume. This serves as an analogy for an oil spill situation, showing how the fronts which defined the plume would have constrained any oil spill which could have occurred. It is concluded that oil spill response plans should factor in data on fronts, where available, to take advantage of natural oceanographic processes in the coastal zone. Spill trajectory analysis should also include knowledge on fronts in their projections. 8 refs., 4 figs.

Murrell, Thomas L., Joseph R. Levine, James B. Regg, and Edward J. Tennyson. 1987. Oil-spill-response measures for offshore oil and gas operations. US Minerals Management Service Report 87-0062.
Key words: Oil Spill Cleanup, Marine Pollution Equipment, Emergency Planning, Controlled Burning
Oil spill response capabilities are examined for arctic and subarctic outer continental shelf (OCS) areas. The responsibility to protect the marine environment from oil pollution is established by the OCS Lands Act of 1978. U.S. Minerals Management Service judges the adequacy of leasees' spill response preparedness and requires operators to provide training and oil spill response exercises. Various spill response measures identified for use offshore Alaska are emphasized. These involve efforts in eight major categories: detection, containment, recovery, in situ burning, chemical application, shoreline cleanup, wildlife protection and rehabilitation, and disposal. Equipment and procedures highlighted are oil booms, skimmer systems, chemical dispersants, shoreline cleanup via direct suction or in situ burning, and disposal via incinerators, dispersion, or in situ burning.

Murti, D.G.K., H.R. Al-Nuaimi. 1991. Renovate produced-water-treating facilities to handle increased water cuts. In: Proceedings of the 66th Annu Spe Tech Conf (Dallas, 10/6 9/91) Proc (Production Operations & Engineering)
Key words: disposal, tank, oil

Murti, D.G.K., A.H. Al Maskati, and L.K. Sood. 1987. Improved disposal water treatment of Bahrain oil fields. In: Proceedings of the 5th Spe Middle East Oil Show (Manama, Bahrain, 3/7 10/87).
Key words: monitoring, disposal, oil

Murty, T.S., M.L. Khandekar. 1973. Simulation of movement of oil slicks in the strait of Georgia using simple atmosphere and ocean dynamics. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: simulation, oil slicks, Georgia, ocean.

Musil, P. 1992. Degradation of kerosene and other hydrocarbons. Soil Decontamination Using Biological Processes. 6 9 December 1992. Paper given at Int. Symp. Soil Decontamination using Biological Processes, Karlesruhe, D, 6 9.12.92.
Key words: bacteria, degradation, hydrocarbon
Isolated microorganisms are used for groundwater bioremediation in a bioreactor. The effect of aeration, temperature, pH, N and P concentration on bacterial growth is studied. Kerosene degradation depends on the ratio of Bacillus, Acinetobacter and Klebsiella, rates vary from 40 to 55%. Immobilized bacteria are used with groundwater to decrease kerosene to 0.05 mg/l within 3 months, process efficiency is 93 to 99%.

Mut, S.C. 1971. Role of the oil spill cooperative in the oil producing industry. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: oil spill, cooperative, industry.

Mycke, B., F. Narjes, and W. Michaelis. 1987. Bacteriohopanetetrol from chemical degradation of an oil shale kerogen. Nature (London). 326(6109):179-181.
Key words: Organic Materials, Hydrocarbons, Bacteriohopanetetrol, Bacteria, Biodegradation

Myers, Julian M., Kimberly A. Minkel, and Brian S. Schepart. 1991. In-situ bioaugmentation of gasoline contaminated soil. Ground Water Managment. 8:443-456.
Key Words: Massachusetts, pollution, ground water, soils, environmental geology, oil spills, in situ, bioaugmentation, hydrocarbons, organic materials, water table, underground storage, Springfield Massachusetts, Hampden County Massachusetts, New England, Eastern U.S., United States, vapor extraction, water treatment, bioremediation, volatile organic compounds, laboratory studies.

Nadeau, Royal J., Eugene T. Bergquist. 1977. Effects of the March 18, 1973 oil spill near Cabo Rojo, Puerto Rico on tropical marine communities. In: Proceedings of the 1977 Oil Spill Conference

(prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: effects, oil spill, Puerto Rico.

Nadeau, Royal J., Thomas H. Roush. 1973. A salt marsh microcosm: an experimental unit for marine pollution studies. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: marsh microcosm, marine, pollution.

Nadeau, R., R. Singhvi, J. Ryabik, Y.H. Lin, and J. Syslo. 1993. Monitoring for Bioremediation efficacy: the marrow marsh experience. In: Proceedings of the 13th Bien API et al oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 477-485.
Key words: Bioremediation, Galveston Bay, Oil Spill, Biodegradation, Contamination

Nadeau, Paul F. 1977. Debris handling system for Navy harbor oil spill cleanup operations. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: Navy, harbor, oil, cleanup.

Naesgaard, B. A. 1988. Environmental impact of pipelines on offshore environments. In: Proceedings of the Pipes Pipelines Int & Aberdeen Univ Pipelines & The Environ Conf, March 8 10, Bournemouth, England.
Key words: Oil Spill, Underwater Pipeline

Nagata, Shinichi, and Goro Kondo. 1977. Photo-oxidation of crude oils. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: photo-oxidation, oils.

Nakhia, G. F. 1989. Treatment of inhibitory wastewaters using expanded-bed anaerobic GAC reactors. University of Illinois: Urbana, IL, 187 p. Dissertation.
Key words: Biodegradation, Monitoring, Transport
The expanded-bed anaerobic GAC reactor, operating with GAC replacement, was demonstrated to effectively treat wastewaters which contain toxic chemicals that resist biodegradation and inhibit the utilization of the biodegradable constituents of the wastewater. The objectives of the study were to investigate the effect of the GAC replacement rate on the process performance, evaluate the impact of the organic loading and hydrolic retention time (HRT) on the treatment efficiency, and to develop a predictive model for the process. A synthetic wastewater consisting of acetate, phenol and o-cresol, as model compounds of pollutants that exhibit different types of behavior in the anaerobic reactor with respect to biodegradability, adsorbability on GAC and inhibition, was used for the purposes of this study. GAC replacement rates of 25, 37.5, 50, 75, 100, and 150 g/d were employed in this study. The anaerobic GAC reactors were operated in a wide range of GAC mean residence times investigated in this study. Adsorption and biodegradation complemented each other as

removal mechanism in this reactor with a dominance of biodegradation at high residence times and appreciable contributions from adsorption at low GAC residence times. A technique to measure the shear loss coefficients of the microbial populations present in the systems was developed. the shear loss coefficients for the acetate and phenol utilizing organisms were found to differ appreciably. The findings of the study demonstrated the importance of biomass shear loss as a phenomenon that can impact the performance of the anaerobic GAC reactor significantly, particularly at low GAC mean residence times.

Nakib, N.A. 1987. The kuwait national contingency plan in action. In: Proceedings of the 10th bien api et al oil spill (prev, behav, contr, cleanup) conf (baltimore, 4/6-9/87) proc pp 157-160.
Key words: administration, asia, buildings, business Operation , emergency, industrial plant, kuwait, management planning, strategy, water supply,water treating plant.

Nardella, J.A., and G.H. Stokes. 1989. New technology in oil content monitors. Nav. Eng. J. 101(2):48-55.
Key words: Oil Spills, Pollution Control Equipment, Petroleum, Real Time Assessment
International antipollution requirements have been legislated to regulate the oil content of bilge effluent from ships. In response to these standards, the U.S. Navy is currently in the process of installing pollution equipment on all vessels. The equipment will consist of an oil-water separator in the bilge discharge line, followed by an oil content monitor which makes the final decision on whether or not the water is clean enough to be pumped overboard. The monitor is required to make a real-time measurement of oil concentration in the range 15 +- 5 to 100 +- 20 ppm for flow rates up to 50 gal/min. and possibly in the presence of interfering contaminants, such as rust. This paper presents the results of the current effort to develop a monitor which satisfies all of these requirements and is sufficiently rugged for fleet deployment. The monitor under development employs two fiber optic systems and a small microprocessor. The first optical system measures the concentration of particles in the flow as a function of their sizes, using small angle forward scattering. The second determines what percentage of the particles in the flow are oil, using large angle scattering. The microprocessor takes the data from the two optical systems and calculates the oil concentration in the flow. Since the particle size is measured by the monitor, no sample preparation is required and the monitor may be placed directly in the discharge line where it responds to changes in oil content in less than one second. In addition, this *monitor* can notify the operator of impending oil-water separator failure associated with passing large oil particles.

Narumalani, Sunil, John R. Jensen, Oliver Weatherbee, Maylo Murday, and Walter J. Sexton. 1992. Coastal sensitivity mapping for oil spills in the United Arab Emirates using landsat thematic mapper imagery and GIS technology. Am Soc Photogrammetry Remote Sensing/et al 1992 Annu Convention, Albuquerque, NM. 1:314 328.
Key words: Oil Spill Analysis, Geographic Information Systems,

Satellite Applications, Remote Sensing
Effective cleanup of oil spills requires access to information, including the environmental sensitivity of the impact area. The Environmental Sensitivity Index (ESI) ranks the relative sensitivities of geomorphic coastal environments in terms of oil/sediment interactions. ESI combines remote sensing and geographic information systems. The ESI concept is applied to Abu Dhabi, one of the United Arab Emirates subjected to crude oil spills from terrorism during the 1991 Persian Gulf War. The ESI data-base system includes planimetric base maps, a shoreline sensitivity index, identification of oil sensitive wildlife, and a listing of access protection features. The digital data base also contains an oil spill trajectory model.

Nash, J.H. 1991. Boom response operators developed from OHMSETT boom test data. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA. American Petroleum Institute: Washington, D.C.pp. 727.
Key words: boom, response, OHMSETT.

Nash, James H., M.G. Johnson. 1981. Coherent, plunging water jets for oil spill control. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: water, oil spill, control.

Nash, J., W. Cooper, V. Nee, and H. Nigim. 1992. Oil Spill Recovery Technology energy technology and the environment. Proc. 2nd World congress, Reading, 1992. Volume 5, A.A.M. Sayigh , pp 2993- 2997.
Current deficiencies in oil spill cleanup processes have resulted in research and development of new cleanup technologies at the University of Notre Dame. Emphasis on reducing, reusing and recycling equipment and waste at a cleanup site has prompted advances in oil recovery technology as well as improvement in sorbent materials. (Authors)
Key words: oil spills , cleaning, removal, research and development, Notre Dam University

Nash, J.H., R.W. Hillger, and R.F. Weston. 1988. Preliminary results of the verification of offshore oil spill containment boom performance evaluation protocol. In: Proceedings of the eleventh Arctic and marine oil spill program technical seminar, June 7 1988, Vancouver, Canada, 267-276.
Key words: oil retention booms, evaluation, oil spills, pollution control equipment.
An effort is underway to systematize the testing of oil spill booms. Using the knowledge gained over the past years a ''Test Protocol for the Evaluation of Oil-Spill Containment Barriers'' is being established. The required testing is designed as two separate phases. The first phase is a series of tests to be conducted in a test tank, to document the oil holding abilities of the barrier. The second phase designates open-water testing, to measure the wave conformance capabilities of the barrier. Open water tests do not use oil although the tests reported here do involve oil being spilled incidental to the tests. This paper is about the reaction of a boom to water surface wave motion and

the resulting deterioration of oil holding ability; and specifically, about testing an oil boom at OHMSETT Facility and in the open ocean off Newfoundland. The Boom Test Protocol element involving boom response amplitude operator and wave conformance was verified for the sea conditions encountered during the sea trials. Although the Protocol does not call for the spilling of oil at sea, this ''spill of opportunity'' was used to verify the tank testing of first loss tow speed. This aspect was not verified, due primarily to the maneuvering difficulties created by the sea conditions that caused boats to respond but not the boom. 8 refs., 7 figs., 1 tab.

Nash, J.H. 1991. The Alyeska tactical oil spill model. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: Alyeska, oil spill.

National Technical Information Service. 1990. Oil spill removal: Dispersants, absorbants, booms, and skimmers. March 1978-May 1989 Report for March 1978-May 1989. Report No. PB-90-856766/XAB.
Key words: oil spills, environmental impacts, oil spills, water pollution control, skimmers, surfactants, tanker ships
This bibliography contains citations concerning the techniques available for the removal of oil following major spills. Chemical dispersants, gelling agents, foam plastics, *booms*, skimmers, and burning are discussed. Specific oil spills are considered and the environmental impacts of oil spills are noted. (This updated bibliography contains 173 citations, 12 of which are new entries to the previous edition.)

National Technical Information Service. 1989. Oil-spill removal techniques and equipment. January 1973-September 1989 (Citations from Fluidex data base). Report for January 1973-September 1989. Report No. PB-89-871974/XAB, 42p.
Key words: Aquatic organisms, environmental impacts, oil spills, oil pollution containment, skimmers, waste disposal
This bibliography contains citations concerning equipment and techniques for the control, dispersion, cleanup, and disposal of oil spills. Topics include chemical dispersants, booms, and mechanical skimmers. Harbors, estuaries, shorelines and the resulting impact on water birds and marine life are emphasized. (This updated bibliography contains 171 citations, 20 of which are new entries to the previous edition.)

National Technical Information Service. 1989. Oil-spill removal techniques and equipment. January 1976-October 1989 (Citations from the NTIS data base). Report for January 1976-October 1989. Report No. PB-90-851635/XAB, 146p.
Key words: oil pollution containment, bibliographies, oil spills, water pollution control
This bibliography contains citations concerning methods and equipment used for the containment and removal of oil as a result of oil-spill mishaps. Dispersants, separators, skimmers and absorbants are discussed. Related studies regarding film spreading and dispersion are presented. Studies pertaining to shipboard ballast and bilgewater cleaning are excluded. (This updated bibliography contains 276 citations, 86 of which are new

entries to the previous edition.)

National Technical Information Service, Springfield, VA. Waste oil reclamation. 1964 August, 1982 (Citations from the NTIS Data Base). (1982):

National Technical Information Service. 1989. Oil-water separation. February 1971-September 1989 (Citations from the US Patent data base). Report for February 1971-September 1989. Patent No. PB-90-850520/XAB, 92p.
Key words: oils, separation, equipment, water separation, waste water
This bibliography contains citations of selected patents concerning oil water separation methods and equipment. Selected patents include gravity separators, centrifugal filters, coalescers, emulsion separation, vortex separators, vibration separation, and siphons. Patent designs for content monitor/control systems, crude oil/water and fuel oil/water separators, and polymeric materials for removing oil from water are presented. Patents concerning booms and skimmers for oil-spill recovery are excluded and examined in a separate bibliography. (This updated bibliography contains 197 citations, 23 of which are new entries to the previous edition.)

National Pollutant Discharge Elimination System Permit Application
Regulations for Storm Water Discharges. Friday, November 16, 1990. Rules and Regulations. 55(222).

National Technical Information Service. 1990. Oil spill handling: foreign patent technology. November 1979-December 1989 (A Bibliography from the Energy Data Base). 101pp.
Key words: Bibliographies, Technological Intelligence, Patents, Crude Oil, Pollution, Inventions
This bibliography contains citations of selected foreign patents concerning the handling, containment, cleanup, and recovery of oil spills and oil spill contamination. Cleanup vehicles, separation equipment, absorbants, blowout prevention, detection equipment, aerating equipment, biodegradation of oil spills, soil decontamination, solidification, and modifying additives are examined. United States patents and general references regarding oil spill pollution are discussed in related published bibliographies. (Contains 222 citations fully indexed and including a title list.)

National Technical Information Service, Springfield, VA. 1991. Oil spill removal techniques and equipment. January 1980-October 1991
(Citations from the NTIS Database). 32pp.
Key words: Bibliographies, Oil Pollution, Booms, Skimmers, Water Pollution
The bibliography contains citations concerning methods and equipment used for the containment and removal of oil as a result of oil spill mishaps. Dispersants, separators, skimmers and absorbents are discussed. Related studies regarding film spreading and dispersion are presented. (Contains 107 citations with title list and subject index).

National Oil and Hazardous Substances Pollution Contingency Plan. Thursday, February 8, 1990. Rules and Regulations. 55(46):3644-1.

National Technical Information Service, Springfield, VA. Waste Oil Reclamation. 1964 June, 1981 (Citations from the NTIS Data Base) Rept. for 1964 Jun 81. (1981):

National Science Foundation. 1978. Limitations of rock mechanics in energy-resource recovery and development. In: National Science Foundation, Washington, D.C. (USA). Panel on Rock Mechanics Problems that Limit Energy Resource Recovery and Development. 78. 1978.
Key words: disposal, oil, rock mechanics, geothermal, in-situ
Rock-mechanics problems which limit energy-resource recovery and development are assessed. The most serious limitations were found in the fields of geothermal exploration, mining and in-situ recovery, nuclear-waste disposal, oil and gas recovery, underground storage, and under-ocean tunneling. Recommendations include research to determine and predict porosity, permeability, and fluid flow in-situ; research to develop better methods for determining and obtaining shallow and deep in-situ stresses; research to improve the ability to map fracture patterns, particularly major fractures and faults, at depth; research to improve the understanding of rock-fragmentation processes for increasing the effectiveness of drilling and excavation systems; research to increase understanding of the relation of laboratory-measured quantities to in-situ conditions; and research to provide the thermophysical and thermomechanical properties of rock, ncluding fractured rock. (JRD)

Nauman, Scott A. 1991. Shoreline cleanup: equipment and operations. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: shoreline, cleanup.

Nauman, S.A. 1990. Shoreline cleanup techniques: Exxon Valdez operations. In: Proceedings of the Thirteenth Arctic and Marine Oil Program technical seminar, June 6 8 1990, Edmonton, AB, pp.431-438.
Key words: Alaska, oil spills, removal, oil pollution containment, skimmers, cleaning, equipment
The extreme diversity of the shoreline areas in Prince William Sound impacted by the Exxon Valdez oil spill necessitated a variety of treatment techniques. Innovation produced equipment that was versatile and effective in the environments encountered. The tools developed represented an integration of techniques rather than a single concept. A review is presented of some of the key shoreline treatment equipment used during the spill cleanup in the summer of 1989. The cold water landing craft vessel (LCV) varied from 40 to 75 ft in length and was fitted with a deluge system made up of pumps, hoses, and manifolds. This system was used to flush large volumes of ambient temperature seawater down the beach. Over 60 LCVs were ultimately deployed and formed the backbone of the treatment program. To increase the volume of water moved to the shoreline, the maxi-barge was

developed. These were about 50 ft wide and up to 180 ft long and had a hot-water flushing capability. The next generation focused on providing more hot water to the beach to improve cleaning efficiency. The omni-barge was similar in size to the maxi but made of flexifloat components and had an articulating boom with spray head. A hot water LCV was also developed and proved very effective in near-shore areas. An array of containment equipment was used to contain the oil washed from the shore by the various vessels described. Skimmers were used to collect the waterborne oil. 4 figs.

Navale, V. 1992. A study of chemical transformation of glycerol ether lipids to hydrocarbons by flash and hydrous pyrolysis. Journal of analytical and applied pyrolysis. 23(2):121-133.
Key words: Hydrocarbon, degradation, Bacteria

Navy News & Undersea Technology. 1993. Sandia teams with Coast Guard. Navy News & Undersea Technology. 10(28).

Nawaz, M., J.D. Richardson, K.D. Chapatwala, and J.H. Wolfram. 1989. Degradation of acetonitrile by pseudomonas aeruginosa. In: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, West Lafayette, IN, pp.251-256.
Key words: Biodegradation, Industrial Wastes, Monitoring, Soils, Waste Water, Water Pollution
Nitrile compounds and their derivatives are used in increasing amounts in a number of industrial operations as chemical solvents, extractants, and recrystallizing agents. Consequently, there is also a concomitant increase in the dissemination of these chemicals into the environment via the industrial wastewater streams. Increasing accumulation of such compounds in the ecosystem may cause deleterious effects, as most of them are highly toxic and tend to destabilize the ecological balance, by inhibiting beneficial microbial growth. Currently, a number of these compounds are listed as priority pollutants by the Environmental Protection Agency. Biodegradation, the microbial transformation of organic compounds, has been recognized as an effective process for the removal of toxic chemicals from the environment. Microbial ecosystems exposed to cyanide in the soil especially in sewage plants treating industrial waste water have been studied. However, only a few reports have appeared, on pure cultures utilizing cyanide as sole carbon substrate. A majority of these microorganisms were strictly autotrophic actinomycetes and just a few microbial strains such as Arthobacter Brevibacterium and Rhodococcus sp were shown to hydrolyze nitrile compounds into amides. Little is known about microorganisms utilizing acetonitrile, a methyl cyanide of increasing industrial use and having potential of becoming a major pollutant, as a substrate. The authors present study was undertaken to isolate and characterize various bacteria that were able to use acetonitrile, as the sole carbon source and to define the optimal conditions for growth of such organisms. This report describes one such isolate.

Neal, R.W., R.A. Bianchi, E.E. Johansen. 1975. The Design and demonstrations of a remotely-controlled high seas oil recovery system. In: Proceedings of the 1975 Conference on Prevention and

Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: design, remotely-controlled, seas, oil, recovery.

Nebeker, E.B., S.E. Rodriguez, P.G. Mikolaj. 1973. Free vortex recovery of floating oil. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: recovery, floating oil.

Nee, V.W., D.E. Fritz, J. Nash, and R.C. Stevens. 1993. Improved oil spill recovery using polypropylene fabric. In: Proceedings of the Environment Canada 16th Arctic and Marine Oil Spill Technical Seminar, June 7 9 1993, Calgary, AB, 1:497 509.
Key words: environment, transport & storage, water pollution control

Neel, J. 1993. The States/BC oil spill task force: an international model for formulating and influencing public policy. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: States/BC, oil spill, influencing public policy.

Neff, Jerry M., Mary Sue Sharp, and Wayne L. McCulloch. 1981. Impact of the Esso Bayway oil spill on salt marsh Macrofauna In Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981. 413 418. Atlanta, GA: Washington, D.C.: American Petroleum Institute. 1981.
Keywords: Esso Bayway, oil spill, marsh, Macrofauna.

Neff, Jerry M., Jack W. Anderson. 1975. Accumulation, release, and distribution of Benzo [a] Pyrene-C14 in the Clam Rangia cuneata. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: accumulation, Benzo [a] Pyrene-C14, clam.

Neff, J. M., L. P. Marum, and J. S. Warner. 1983. Composition and fate of clean ballast water discharged from crude oil tankers. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. pp. 435 442. San Antonio, TX: Washington, D.C.: American Petroleum Institute.
Keywords: ballast, water, oil, tankers.

Neidhardt, Dietmar.1985. Rig-site system allows water reuse, cuts cleanup costs. Oil and Gas Journal (1985): 83
Key words: disposal, oil, recycling
A new well-site treatment system extends the use of solids control equipment to help solve the common drilling problems of water supply and/or wastewater disposal. Proven on a much-publicized French discovery well, the new closed-loop system combines water treatment (chemical/physical) with more conventional solids handling (mechanical) to continuously create clean water. The results include: (1) re-use of water for rig cleaning, mud, and even cement makeup with no need to eject liquid to the environment, (2) greatly reduced water-input requirements, and (3) division of the conventional wastewater pit

into an active treatment operations pit and an overflow reserve pit for emergency storage.

Nelson, W.G., and B. McKensie. 1993. Effect of water spray on the combustion of crude oil on a water surface. In: Proceedings of the SPE 1993 Western Regional Meeting, May 26 28 1993, Anchorage, Alaska, pp. 65-69.
Key words: Crude Oil, Diaster Control, Louisiana, Pollution Control

Nelson, M.J., S.O. Montgomery, P.H. Pritchard. 1988. Trichloroethylene metabolism by microorganisms that degrade aromatic compounds. Pseudomonas putida. Appl. Environ. Microbiol.(United States). 54:2:604-606.
Trichloroethylene (TCE) was metabolized by the natural microflora of three different environmental water samples when stimulated by the addition of either toluene or phenol. Two different strains of Pseudomonas putida that degrade toluene by a pathway containing a toluene dioxygenase also metabolized TCE. A mutant of one of these strains lacking an active toluene dioxygenase could not degrade TCE, but spontaneous revertants for toluene degradation also regained TCE-degradative ability. The results implicate toluene dioxygenase in TCE metabolism.
Key words; chlorinated aliphatic hydrocarbons, biodegradation, pseudomonas, chemical reactions, water pollution, toluene biodegradation, biological pathways, oxygenases, alkylated aromatics, enzymes, bacteria.

Nelson, N., S. Baker, S.P. Levine, L. Young, J. O'Connor, R.D. Hill, A. Sarofim, D.G. Wilson, L.B. Lave and A.C. Upton. 1987. Toxic chemicals, health and the environment. Cleanup of contaminated sites. John Hopkins University Press: Baltimore, MD, pp. 205-279.
Key words: Biodegradation, Disposal, Soil Pollution
The problem of cleanup of toxic waste dumps is discussed. It begins with the question of whether cleanup is warranted and then addresses the problems and difficulties of cleanup. The authors address a wide range of topics: protection of workers at the toxic waste site; biological degradation of the chemicals; various disposal methods; and recycling. Each discussion is based on an extensive body of technological knowledge.

Nelson, Y.M. 1993. Vinyl chloride biodegradation with methanotrophic attached films. Journal of Environmental Engineering (New York) (United States). 119:5:890-907.
Methanotrophic degradation of vinyl chloride (VC) is investigated using a laboratory-scale methanotrophic attached-film expanded-bed bioreactor. This study provides a basis for applying a microbial cometabolizing reaction to practical treatment of toxic chlorinated compounds. The MAFEB reactor was operated at 20 C with influent VC concentrations ranging from 1,800 to 9,600 [mu]g/L and bed hydraulic retention times ranging from 3.7 to 7.6h. VC effluent concentrations during steady continuous operation ranged from 3 to 140 [mu]g/L, with most values less than 26 [mu]g/L, resulting in removal efficiencies of 96.3% to 99.8%. The maximum continuous-flow VC degradation rate observed at 20 C was 2.5 mg VC per gram volatile

solids (VS) per day [2.5 mg VC/(g VS d)] or 30 mg VC per liter expanded bed per day 30 mg VC/L[sub eb] d, under substrate-limited conditions. During semibatch runs at 35C, vinyl chloride degradation rates up to 60 mg VC/(g VS d) or 1 g/(L[sub eb]d) were observed. Degradation rates increased with temperature between 20 C and 35 C approximately doubling every 10 C. Dissolved methane concentrations above 0.5 mg/L inhibited VC degradation, with no VC degradation observed with 8 mg/L dissolved methane. The methane consumed during VC degradation was about 40 g CH[sub 4]/g VC. Toxic effects were observed after prolonged exposure of the methanotrophic culture to high concentrations of VC.
Key words: methanotrophic, bacteria, growth, vinyl, chloride, biodegradation, bioreactors.

Nelson, L.R., W. Zalewski, I. Rubinstein. 1992. In-situ recovery and produced water recycle an environmental and economic success story. In: Proceedings of the AOSTRA-Can Heavy Oil Ass Fueling the Future Conf (Calgary, Can, 6/10 12/92).
Key words: recovery, sand oil

Nelson, William G. and Alan A. Allen. 1981. Oil migration and modification processes in solid sea ice. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981. 191 198. Atlanta, GA: Washington, D.C.: American Petroleum Institute. 1981.
Keywords: oil, migration.

Nerac, Inc. 1993. Ocean pollution detection: Petroleum. (Latest citations from Oceanic Abstracts database). Published Search. NERAC, Inc., Tolland, CT. Report No. PB-93-863744/XAB, 10pp.
Key words: Coastal Waters, Monitoring, Oil Spills, Bibliographies, Remote Sensing, Biological Accumulations, Hydrocarbons, Petroleum
The bibliography contains citations concerning the detection and monitoring of oil pollution in the ocean. The citations examine identification and mapping of oil spills, the monitoring of ocean dumping, and detection of pollution resulting from off-shore drilling for petroleum. Techniques discussed include satellite sensing, infrared imagery, UV fluorescence, thermal mapping, microwave radiometry, gas chromatography and mass spectrometry. Methodology for monitoring the persistence of petroleum hydrocarbons in marine sediments, their bioconcentration in marine organisms, and their effects on marine ecosystems is also discussed. (Contains a minimum of 179 citations and includes a subject term index and title list.).

NERAC, Inc. 1993. Remote sensing applied to environmental pollution detection and management. (Latest citations from the NTIS database). Published Search. NERAC, Inc., Tolland, CT. Report No. PB-93-877264/XAB, 10 pp.
Key words: Water Pollution, Bibliographies, Remote Sensing, Estuaries, Oil Spills
The bibliography contains citations concerning the utilization of remote sensing techniques and equipment to study air and water pollution. Topics include the use of aerial photographs, radar, and spaceborne photography to study oil spills, ocean dumping

sites, plume dispersions, and pollution problems in estuaries. Data interpretation and processing techniques are also discussed. (Contains 250 citations and includes a subject term index and title list.).

NERAC, Inc. 1993. Marine biodegradation: Chemical pollutants. (Latest citations from Oceanic abstracts). Published Search. 10 pp.
The bibliography contains citations concerning the biological degradation of marine pollutants. The citations explore the microbial breakdown of petroleum, herbicides, pesticides, polychlorinated biphenyls and other hazardous materials. The chemical details of biotransformation, and the development of microorganisms capable of degrading pollutants are presented. (Contains a minimum of 222 citations and includes a subject term index and title list.)
Key words: biodegradation, bibliographies, abstracts, bacteria, marine disposal.

NERAC, Inc. Oil spill removal: Dispersants, absorbents, booms, and skimmers. (Latest citations from the Life Sciences Collection database). Published Search NERAC, Inc., Tolland, CT (United States) Jun 1993 pg ([10] p). Updated with each order. Supersedes PB--92-853589 ERA (Energy Research Abstracts), ETD (Energy Technology Data Exchange), INS (US Atomindex input).
The bibliography contains citations concerning the techniques available for the removal of oil following major spills. Chemical dispersants, gelling agents, foam plastics, booms, skimmers, and burning are discussed. Specific oil spills are considered, and the environmental impacts of oil spills are noted. (Contains a minimum of 77 citations and includes a subject term index and title list.)
Key words: oil spills

NERAC, Inc. 1993. Oil water separation. (Latest citations from the U.S. Patent Database). National Technical Information Service, Springfield, VA. 250 citations.
Key words: Bibliographies, Patents, Filters, Industrial Waste Treatment
The bibliography contains citations of selected patents concerning oil water separation methods and equipment. Patents concerning gravity separators, centrifugal filters, coalescers, emulsion separation, vortex separators, vibration separation, and siphons are included. Patent designs for content monitor/control systems; crude oil/water and fuel oil/water separators; and polymeric materials for removing oil from water are presented. Patents concerning booms and skimmers for oil spill recovery are examined in a separate bibliography. (Contains 250 citations and includes a subject term index and title list.).

NERAC, Inc. 1993. Oil spill handling: foreign patent technology. (Latest citations from the Energy Data Base). National Technical Information Service, Springfield, VA. 147 citations minimum.
Key words: Bibliogrpahies, Technological Intelligence, Patents, Crude Oil, Pollution
The bibliography contains citations of selected foreign patents concerning the handling, containment, cleanup, and recovery of

oil spills and oil spill contamination. The citations review cleanup vehicles, absorbants, blowout prevention, biodegradation of oil spills, soil decontamination, solidification, and modifying additives. Patents are included for separation, detection, and aerating equipment. United States patents and general references regarding oil spill pollution are discussed in related bibliographies. (Contains a minimum of 147 citations and includes a subject term index and title list.).

NERAC, Inc. 1993. Remote sensing of ocean pollution. (Latest citations from the Aerospace database). Published Search. NERAC, Inc., Tolland, CT. Report No. PB-93-887172/XAB, 10 pp.
Key words: Oil Spills, Bibliographies, Water Pollution
The bibliography contains citations concerning the use of remote sensing to investigate ocean pollution, including oil pollution and ocean dumping. Remote sensing techniques include laser fluorescence, radar scattering, aerial and spaceborne photography, microwave imagery, thermal mapping, and infrared scanning.
Applications include identification and mapping of oil slicks, identification of coastal outflow plumes, the monitoring of ocean dumping, the monitoring of biological blooms associated with nitrogenous pollution, and sewage dumping. Instrumentation, photointerpretation, and image enhancement applied to pollution monitoring are included. Remote sensing applied to air pollution detection is discussed in a separate bibliography. (Contains 250 citations and includes a subject term index and title list.)

NERAC, Inc. 1993. Oil pollution sampling, detection, and analysis. (Latest citations from the NTIS database). Published Search. NERAC, Inc., Tolland, CT. Report No. PB-93-874295/XAB, 10pp.
Key words: Oil Spill, Bibliography, Chemical Analysis, Pollution Control, Remote Sensing
The bibliography contains citations concerning the monitoring and analysis of pollution resulting from oil production and transport operations. Citations discuss pollution monitoring methods and devices, tracing and analytical techniques, remote sensing, and oil-laden sediment sampling. Marine pollution assessment and control, offshore oil industry discharges, pollution effects on wildlife, and international cooperation on pollution control are also examined. (Contains 250 citations and includes a subject term index and title list.)

NERAC, Inc. 1993. Oil Spill Recovery: Oil Booms and Skimmers. (Latest citations from the U.S. Patent Database).
NERAC, Inc., Tolland, CT.
Key words: Bibliographies, Patents, Oil Pollution, Skimmers, Booms, Recovery
The bibliography contains citations of selected patents concerning booms, skimmers and skimming techniques used for oil spill recovery. Patents covering oil absorbent materials, dispersants, floating booms, methods and equipment for oil spill containment and collection, marine barriers, cryogenic beach cleaners, microbial materials, and ultrasonic oil removal are included. Citations concerning oil/water separation for non-oil spill recovery applications are examined in a separate

bibliography. (Contains a minimum of 159 citations and includes a subject term index and title list.)

NERAC, Inc. 1993. Oil spill removal techniques and equipment. (Latest citations from the NTIS Bibliographic Database). National Technical Information Service, Springfield, VA. 250 citations.
Key words: Bibliographies, Oil Pollution, Skimmers
The bibliography contains citations concerning methods and equipment used for the containment and removal of oil as a result of oil spill mishaps. Dispersants, separators, skimmers and absorbants are discussed. Related studies regarding film spreading and dispersion are presented. Studies pertaining to shipboard ballast and bilgewater cleaning are excluded. (Contains 250 citations and includes a subject term index and title list.).

NERAC. 1993. Remote sensing applied to environmental pollution detection and management. (Latest citations from the NTIS Bibliographic Database). National Technical Information Service, Springfield, VA. 250 citations.
Key words: Bibliographies, Remote Sensing, Environmental Surveys, Air Pollution, Water Pollution, Oil Pollution
The bibliography contains citations concerning the utilization of remote sensing techniques and equipment to study air and water pollution. Topics include the use of aerial photographs, radar, and spaceborne photography to study oil spills, ocean dumping sites, plume dispersions, and pollution problems in estuaries. Data interpretation and processing techniques are also discussed. (Contains 250 citations and includes a subject term index and title list.)

Neralla, V.R., and S. Venkatesh. 1989. Real-time application of an oil spill movement prediction system. Natural Hazards. 2(1):31-44.
Key words: Oil Spill Movement, Simulation Model, Pollution
Examines the prediction of the motion of experimental oil slicks. The experiments were conducted during September 1983 offshore near Halifax on the east coast of Canada. The objectives of the experiments were to determine the suitability of oil spill dispersants as countermeasures and the testing and verification of oil spill trajectory models and systems. The spill trajectories and oil weathering information obtained from the system during the experiments demonstrated the relative ease with which the system could handle the required input and provide timely forecasts. The accuracy of these forecast trajectories was confirmed by observations, and their utility was demonstrated by their application in the operational decision-making process. -from Authors.

Neufeld, R. D. and L. W. Casson. 1991. Proceedings of the Twenty-third Mid-Atlantic Industrial Waste Conference. Technomic Publishing Co., Inc.: Lancaster, PA, 405 p.
Key words: Oil Spills, Remedial Action, Industrial Wastes, Groundwater
This book contains the proceedings of the 23rd Mid-Atlantic Industrial Waste Conference on Hazardous and Industrial Wastes. Topics covered include: waste refuse and minimization; waste

transport in the environment; treatment and bioremediation; and air quality issues.

Neuman, Lawrence D. 1979. The protection and development of the marine environment and coastal areas of the Kuwait conference region: the program of the United Nations system. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979. 287 292. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1979.
Keywords: marine, environement, coastal, Kuwait.

Neuman, R.S., B.N. Diel, and Y. Halpern. 1992. Soil washing: An effective remedial alternative for organic and inorganic contaminated soil. In: American Chemical Society (ACS) special symposium on emerging technologies in hazardous waste management, Spetember 21 23 1992, Atlanta, GA, p. 363.
Key words: Land Pollution, Remedial Action, Pollution Control, Petroleum Industry, Oil Spills
Disposal of soils or sludges contaminated with organic and inorganic compounds is a major problem for environmental remedial activities, hazardous waste generators, and the disposal industry. This paper reports that many of these wastes can be effectively treated utilizing soil washing technology. CWM has been developing soil washing technology over the past few years, with extensive work being conducted on the bench scale. These studies have demonstrated consistently high removal efficiencies (95-99%) for a wide variety of PCB and petroleum hydrocarbon contaminated waste. Recently, a comprehensive study examining the removal of both organic and inorganic contraminants from two different types of surrogate soil matrices was completed. In addition to establishing the range of contaminants that can be removed from soil, a method for surfactant/water separation was evaluated. For example, using a thermal phase separation method, approximately 90% of the surfactant could be recovered from the water.

New Technology Week. 1990. Budget bill means big bucks for S&T An Overview Of Federal Technology Programs. New Technology Week. 4(43).

New Pig Corp. 1989. Experimental technology for oil spill containment and recovery (OSCAR). Chem. Eng. 96(5):17.
Key words: Alaska, Boom, Crude Oil, Pollution Control Equipment, Skimming, Supertanker

Newcomer, K., and S. Richter. 1991. Floating layer recovery apparatus. Patent No. US 4998585910312, 10 p.
Key words: Groundwater, Oil Spill, Leak, Pollution Control, Water Pollution

Newell, Maura and Carol Collinson-Kahl. Natural resource damage assessments: linking injury to restoration. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993. 846 847. Tampa, Florida: Washington, D.C.: American Petroleum Institute. 1993.
Keywords: natural resource, damage assessments.

Newell, C.J., J.A. Connor, D.K. Wilson. 1990. Pilot test for evaluating the effectiveness of enhanced in-situ biodegradation for soil remediation. National Water Well Association, Dublin, OH (US). 664(p):369-383.
Key Words: hydrocarbons biodegradation, hydrocarbons environmental transport, soils land pollution abatement, biochemical reaction kinetics, cleaning, computerized simulation, hydraulic conductivity, hydrology, injection wells, land pollution, oil spills, removal, site characterization, volatile matter, chemical reactions, decomposition, kinetics, mass transfer, organic compounds, pollution abatement, reaction kinetics.

Ney, U., S.M. Schoberth, and H. Sahm. 1989. Anaerobic degradation of sulfite evaporator condensate from pulp industries by defined bacterial mixed cultures. 7. DECHEMA annual meeting on biotechnology and 58. meeting of the European Biotechnology Federations, and joint meeting of Society for Industry Microbiology (SIM). 772-775.
Treating crude SEC from paper industry (COD: 36600 mg O{sub 2}/l, acetate: 425 mM, methanol: 75 mM and furfural: 28 mM) the defined culture reached space loading rates of 47,6 g COD/lxd at 17,9 h HRT and 84% COD reduction. These values were comparable with the enrichment culture which reached a space loading rate of 55 g COD/lxd at a HRT of 16 h and a COD reduction of 82,1%. Thus it could be demonstrated that by setting up a defined mixed culture SEC could be degraded at rates and efficiency comparable to those of the enrichment culture. This defined culture can be used as starter culture for anaerobic degradation of SEC.
Key words: paper industry, waste water, chemical oxygen demand, gas yields, methane, organic compounds, hydrocarbons, alkanes, chemical reactions, liquid wastes, organic compounds.

Niaki, Shahzad and John Broscious. 1985. Review and evaluation of leak detection methods for underground storage tanks. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 651. Los Angeles, CA: Washington, D.C.: American Petroleum Institute.
Keywords: leak detection, underground, tanks.

Nichols, J. A. and H. D. Parker. 1985. Dispersants: comparison of laboratory tests and field trials with practical experience at spills. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup),February 25 28, 1985. 421 428. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1985. .
Keywords: dispersants, spills.

Nichols, A.B. 1988. Oil accident ignites response debate. J. - Water Pollut. Control Fed. 60(4):467-472.
Key words: Oil Spills, Environemtnal Effects, Pollution Regulations
This article describes the environmental effects of the oil spill that occurred at Ashland Oil Company's Floreffe river terminal 25 miles south of Pittsburgh, Pennsylvania. Besides serious drinking water shortages, the contamination caused massive fish and water flow mortality. A task force was established by the EPA to study

the regulations governing contingency planning and response under the Clean Water Act. In addition, the task force reviewed the implementation and enforcement aspects of oil spill regulations. Several bills were introduced in Congress that would regulate above
ground storage tanks and revitalize oil spill legislation.

Nichols, A. B. 1990. In-situ groundwater treatment method holds high promise. Water Technology. 2(11):13.
Key words: Biodegradation, California, Groundwater, Water Pollution
A multi-disciplinary team of scientists at the Lawrence Livermore National Laboratory (LLNL) in California is developing a new subsurface method to clean up groundwater. The approach will use natural microbes to degrade hazardous chemicals like trichloroethylene (TCE), into harmless compounds such as water, carbon dioxide, and natural salts. The project started in 1989 with funding of $ 1.5 million, including 250,000 from the Department of Energy.

Nichols, J. A. and T. H. Moller. International cooperation in oil spill response. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991. 61 64. San Diego, CA: Washington, D.C.: American Petroleum Institute. 1991.
Keywords: international, oil spill, response.

Nichols, J.A. 1992. Surveillance and remote sensing: ITOPF participation. In: Proceedings of the first international oil spill R&D forum, June 1 4 1992, McLean, VA, p. 51.
Key words: Oil Spills, Monitoring, Remote Sensing, Pollution Control
Although the Federation does not sponsor or undertake surveillance and remote sensing research and development projects, it is a potential user of remote sensing equipment when responding to oil spills. Indeed, the Federation has already made use of suitably equipped aircraft on a number of occasions in Europe. Several countries in north west Europe, viz. France, Germany, Netherlands, Norway, Sweden and the U.K., operate aircraft fitted with broadly similar systems comprising side-looking airborne radar (SLAR), infra-red line scanners (IRLS) and ultra-violet line scanners (UVLS). These aircraft are used routinely for the detection of operational discharges of oil from ships in violation of the International Convention on the Prevention of Pollution from Ships 73/78 (MARPOL 73/78).

Nichols, J. A. and H. D. Parker.1989. Effects of oil pollution on industrial water intakes. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. 473 478. San Antonio, TX: Washington, D.C.: American Petroleum Institute. 1989.
Keywords: oil pollution, industrial, water.

Nielson-Cerquone, Christopher, Karl J. Anania, and Mary L. Scruggs. 1989. Innovative approaches to hydrocarbon and animal fat contamination assessment and cleanup. Natl. Water Well. Assoc., Dublin, OH, United States. 413-426.

Key Words: Ground water, California, surveys, environmental geology, waste disposal, oil spills, Oakland California, in situ, hazardous waste, soils, water wells, monitoring, evaluation, biodegradation, aquifers, Pacific Coast, Western U.S., United States.

Nielson, R., M. Vorum. 1992. Using resource recovery technology for waste cleanup. In: Proceedings of the AOSTRA-Can Heavy Oil Ass Fueling the Future Conf (Calgary, Can, 6/10 12/92)
Key words: recovery, oil, disposal, sand oil

Nieman, L. D., W. G. Cline, and C. R. Woodford. Design of a refinery dock to prevent oil spills. In :Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973. 53 60. Washington, D.C.: Washington, D.C.: American Petroleum Institute. 1973.
Keywords: refinery, dock, prevent, oil spills.

Nilsen, Jan. 1985. Fiber-optical measurements of mechanically and chemically dispersed oil in water. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 67 80. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1985.
Keywords: fiber-optical, measurements, mechanically, chemically, dispersed, oil, water.

Nippon, K.K. Easily recoverable oil adsorbing material prepn. by pressing and moulding heat expanded graphite and treating with binder.
Key words: absorption, accident, adsorbent, adsorption, process, binder, conservation, density, economic, factor, efficiency, energy conservation, float, graphite, heat, heating, liquid, oil waste, physical property, pollution control, recovery, solvent, sorbent, sorption, use, waste, heat, water, treating.

NIPPON SHOKUBAI CO LTD. Mfg. swellable oil absorptive agent used in recovery of marine spillage oil, food waste oil disposal, oil sealant etc. by suspension polymerisation in aq. medium using oil-soluble initiator.
Key words: Addition, polymerization, additive, adhesion, adsorbent, adsorption, agitator, benzene ring, branched chain, carboxamide, composition, concentration, copolymer, dispersant, food, hydrocarbon, hydrophobic, monoolefinic, monomer, oil.

Nishino, S.F., J.C. Spain, L.A. Belcher, C.D. Litchfield. 1992. Chlorobenzene degradation by bacteria isolated from contaminated groundwater. Applied and Environmental Microbiology (United States). 58:5:1719-1726.
Bacterial isolates were obtained from groundwater and soils contaminated with chlorobenzene (CB). The isolates were tested to determine whether the natural community could remove the groundwater contaminants. These isolates were identified and characterized as to their ability to grow on CB and related aromatic compounds. The complete consortium could mineralize approximately 54% of the CB within 7 days, with no accumulation of 3-chlorocatechol. Metabolic pathways were evaluated for several isolates. One phenotype was characterized by the ability

to degrade CB by the modified ortho pathway. One strain also degraded p-dichlorobenzene by using the same pathway. Isolates exhibiting a second phenotype degraded p-cresol, benzene, and phenol by the classical ortho pathway and accumulated 3-chlorocatechol when grown in the presence of CB. Strains of the third phenotype grew on complex media in the presence of CB but did not transform any of the aromatic compounds tested. The results suggest that the indigenous microbial community at the contaminated site would be able to degrade CB if provided with the appropriate conditions.

Noble, Capt. John M. Crisis management during and oil spill response. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991. 35 38. San Diego, CA: Washington, D.C.: American Petroleum Institute. 1991.
Keywords: management, oil spill, research.

Noble, P.G. 1990. Safe transport of oil at sea. In: Proceedings of the API 1990 Alternative Tank Vessel Design Forum, June 5 1990, Washington, DC, N.10, 33 pp.Boom, Bulk Carrier, Crude Oil, Economic Factor, Emergency Response, Pollution Control Equipment

Noble, John M. 1989. Salvage techniques: case histories of specific spills. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. 137 142. San Antonio, TX: Washington, D.C.: American Petroleum Institute. 1989.
Keywords: salvage, spills.

Nobles, C., Marinello, S.A. 1992. Misconceptions and resistance in accepting novel oil spill remediation technologies. PETRO-SAFE '92: 3rd annual environmental and safety conference for the oil, gas and petrochemical industries. 751-757.
Spills, oil in particular, seem to be occurring more often. This is despite all the legislative and regulatory efforts taken to stem the tide in response to public outcry for prevention and better remedial solutions. Since spills continue to happen and continue to be grossly mishandled technically and publicly and it continues to be extremely costly to get very little done, it is an obvious conclusion that the old ways, materials, and technologies don't work. Newer technologies do exist that are oleophilic and hydrophobic and can isolate *hydrocarbon* contaminants from the impacted ecosystem and inhibit overall spread. They can minimize the volumetric expansion of the released contaminant/waste by inhibiting emulsification and mousse formation thereby reducing treatment or remediation volume and further restricting expanded involvement. They can enhance natural biodegradation of hydrocarbon spills. The authors of this paper have been involved in the development and introduction to the spill response community' of two pollution control products that achieve these results. Known commercially as Sansorb and SeaSweep, both materials employ capillary action technologies to internally absorb hydrocarbon liquids, such as crude oil, thereby isolating the contaminant and preventing its continued spread and involvement with a vulnerable environment. Both products absorb oil and repel water, while providing substrate and nutrients to

facilitate contaminant degradation by natural bacteria. This paper analyzes these products along with industry's reluctance to change.
Key words: oil spills, biodegradation, pollution, assessment,, land pollution, chemical reaction, equipment.

Noerager, J.A., and R.H. Goodman. 1991. Oil tracking, containment, and recovery during the Exxon Valdez response. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 193-203.
Key words: Oil Spill, Containment, Removal, Contingency Planning, Environmental Pollution, Petroleum, Remote Sensing

Nolan, J.T. 1988. Used oil: Disposal options, management practices and potential liability. Rockville, MD: Government Institutes Inc.
Keywords: oil, disposal, petroleum, environment, legal, management, government.
Of more than everyday concern, are the enormous risks of liability and litigation that are generated when used oil is not disposed of properly. This book can help businesses of all sizes minimize the risks, regardless of the quantity of used oil they generate, by providing guidance on how to manage used oils so that it enters the used oil management system properly and is recycled in accordance with EPA regulations. The authors provide coverage of the precautions generators should take, and the recommended used oil management practice; the federal law and policies; the necessary steps to assure regulatory compliance (including underground storage tank requirements); the disposal options of recycling and re-refining; how and why you should investigate your recycler; what your contact with your recycler must cover, your potential liability under Superfund and the crucial insurance coverage issues and much more.

Nolan, John P., and Susan J. Blood. 1991. Development of the international convention on oil pollution preparedness and response. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.

Noonan, D.C., and J.T. Curtis. 1990. Groundwater remediation and petroleum. Lewis Publishers, Chelsea, MI (USA). 250(p).
Key Words: Ground water-water pollution control, oil spills environmental transport, petroleum underground storage, ecological concentration, economics, gasoline, leaks, pollution control equipment, pollution regulations, underground facilities, fossil fuels, hydrogen compounds, liquid fuels, mass transfer, oxygen compounds, petroleum products, pollution control.

Nordin, J.S. 1987. Characterization and treatment of by-product waters from selected oil shale retorting tests: topical report. In: U.S. Dep Energy Rep No DOE/MC/11076-2638 Dec 1987, 1987.
Key words: oil recovery, oil, disposal, in-situ

Nordvik, A.B., F.R. Engelhardt, and P.S. Daling. 1992. (A survey of the) problems in the interpretation of spill response

technology studies. In: Proceedings of the Environment Canada 15th Arctic and Marine Oil Spill Technical Seminar, June 10 12 1992, Edmonton, Alberta, pp. 211-17.
Key words: Additive, Dispersion, Oil Waste, Pollution Control Equipment

Norman, Michael E., Sunil Kapoor, Allan G. Smalley, Jr., and Bruce M. Daniel. 1992. Wastewater planning helps meet anticipated changes in regulations. (Refinery Wastewater, part 3) The Oil and Gas Journal. 90:63 67.
Key words: oil, petroleum, refineries, waste management

Norman, J.M. 1989. Oil and water separator having plural nested tanks. Patent No. US 4844819890704, 6p.
Key words: Oil Spill, Pollution Control, Storage Facility, Tank, Groundwater

Norris, R.O., W.H. Lockwood, Jr. 1971. The Use of a gravity type oil separator for tanker operations. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: oil separator, tanker.

Norrisand, Lt. Cdr. William H., Lt. Hugh Johnston, Jr. 1977. Problems and perspectives in the recovery of oil pollution removal costs. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: recovery, oil pollution, removal.

Norton, Reese W., and D.W. Lerch. 1975. An oil recovery system for the San Francisco Bay area. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil recovery, San Francisco Bay.

Norway State Pollution Control Authority. 1990. Norwegians conduct oil spill cleanup tests. Oil & Gas Journal. 88(31):28,30.
Key words: Accident, Blowout, Boom, Crude Oil, Pollution Control, Skimmer, Spill

Norwegian State Pollution Control Authority. 1990. Oil spill clean up in Norway. Marine Pollution Bulletin. 21(2):55.
Key words: Additive, Biodegradability, Boom, Oil Waste, Equipment, Pollution Control

Norwegians conduct oil spill cleanup tests. July 30, 1990. Oil & Gas Journal. 88(31):28,30.
Key Words: Oil spills, clean-up, North Sea, pollution.

Norwest Soil Research Ltd. 1988. Oil spill cleanup and site reclamation. Edition 2. Norwest Soil Research Ltd., Edmonton, Alberta (Canada). Report No. NSR-1988|CE-01219, 38 pp.
Key words: Land Reclamation, Oil Pollution Containment, Oil Spills
This field guide has been prepared as a technical aid for the on-site coordinator in the event of an oil spill. The procedures

described in the booklet represent an up-to-date guide in a rapidly developing field of knowledge which takes into consideration not only evaluation but the application of various techniques for attaining a satisfactory and early reclamation program at a spill site. In addition to outlining some of the options available, the manual emphasizes the importance of each stage relative to the other stages and in this way assists in the development of a framework from which a safe and effective program can be carried out. It must be kept in mind that there is no normal or typical oil spill as such, and therefore it is not possible to establish a step-by-step set of instructions on what to do when a spill occurs. The editors have attempted to condense the information into easily read general suggestions. Specific topics covered include: spill documentation, initial containment and cleanup methods and their comparative advantages/disadvantages, damage assessment and reclamation planning, soil reclamation methods, revegetation, and monitoring and assessment. Included are appendices on soil sampling and analysis, recommended fertilizers, and a list of plant species tolerant to oil. 1 ref., 9 figs.

Norwood, V.M. October, 1990. Literature review of waste treatment technologies which may be applicable to wastes generated at fertilizer/agrichemical dealer sites. National Fertilizer and Environmental Research Center, Muscle Shoals, AL.36(p).
Key Words: Fertilizer industry, fertilizers, fuel oils, ground water, pesticides, soils, data compilation, land pollution, marketers, oxidation, physical radiation effects, remedial action, ultraviolet radiation, waste processing, water pollution.

Norwood, V. M. and M. E. Randolf. 1990. A literature review of biological treatment and bioremediation technologies which may be applicable at fertilizer/agrichemical dealer sites. Tennessee Valley Authority, Knoxville, TN. Report No. TVA Bull Y 215, 37 pp.
Key words: Biodegradation, Fuel Oils, Groundwater, Monitoring, Transport, Soil Pollution, Water Pollution
Pesticide and fertilizer products, as well as petroleum fuels and oils, are handled by several thousand fertilizer/agrichemical dealers in the United States. Incidental spillage of these products, as well as improper disposal or recycling of equipment and container rinsewaters, can result in contamination of soil, surface, and groundwaters with hazardous chemicals. Past accidental spills and previously acceptable disposal and management practices are another source of contamination. As dealers continue their efforts to contain. collect, and recycle their wastes and spills, there will be an increasing need for safe, efficient, and cost-effective waste treatment and site remediation technologies to address this issue of pesticide and fertilizer product contamination of soil and water media at dealer sites. The National Fertilizer Environmental Research Center (NFERC) has initiated an effort to modify, research, develop, demonstrate, introduce, and market waste treatment and site remediation technologies for dealers. Biological treatment technologies include the trickling filter and activated sludge processes. Bioremediation technologies for contaminated soil at dealer sites include land application, soil mounds, and

composting. Commercial firms offer several other remediation technologies including in-situ bioremediation and slurry-phase biodegradation. Site characterization factors required prior to implementing bioremediation technologies are discussed in this report. Finally, a case history concerning the bioremediation of pesticide-contaminated soil and groundwater is summarized, and conclusions drawn from this information are presented.

Noto, Lt. j.g. Aldo. and Sandra K. and Thearin R. Wendel. Novotny. 1989. The national response center. A comparison of regulations related to the oil SPCC program. In Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989.
Keywords: national response center.

Novotny, Sandra K., Thearin R. Wendel. 1989. A Comparison of regulations related to the oil SPCC program. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: regulations, oil, SPCC.

Nowicki, V.K., Ivey, G.A. 1991. Bioremediation processes: Hydrocarbons. Haztech Canada Halifax '91: 1st annual Atlantic onshore and offshore environmental conference. 262-275, 277.
Bioremediation, involving the use of microorganisms to destroy organic compounds, is well accepted as a viable and economic means of remediating hydrocarbon-contaminated soils and water. The mechanisms of bacterial degradation of hydrocarbons are described and the factors that affect a successful bioremediation program are discussed. These factors not only include the microbiological characteristics of the organism used, but also the presence of oxygen, the establishment and maintainance of contact between the organism and the contaminant, the presence of a stable and accessible nutrient system, and ground temperature. At a contaminated site, microorganisms in place may already be adapted to degrade the hydrocarbon, but means are available to add cultured and adapted microorganisms to the affected area. Application of microorganisms is done normally through infiltration galleries laid horizontally beneath the ground surface, as well as through vertical infiltration points. Throughout the treatment period, maintenance of the in-ground system is essential; this is most easily achieved through the use of a conventional pump-and-treat system. Limitations related to in-situ bioremediation relate to the ability of the microorganism to contact the contaminant, toxic effects of the contaminants, adverse pH effects, adverse salinity conditions, possible adverse effects of intermediates or byproducts, inadequate maintenance of biodegradation conditions, and biological effects. 29 refs.
Key words: hydrocarbons, biodegradation, land pollution, technology assessment, organic compounds.

Nuefeld, R.D., and S.F. Pedersen. 1991. Microbial dehalogenation of a hexachlorinated PCB at low redox potential. Final report. 109.
In three studies using a single PCB congener, 2,2',4,4',5,5'-hexachlorobiphenyl degradation was observed at soil concentrations between 1000 and 1500 mg HCB/KG soil, but not

in a fourth study conducted at 100 mg HCB/KG soil. Degradation did not occur in controls poisoned by 0.1% mercuric chloride; however, it was enhanced by the addition of a nutrient solution at approximate ratios of 100TOC:2N:1P. The degradation was observed in both soil and sand matrices. A study of different reducing agents revealed mixed effects on the degradation process; addition of equal parts of 1-cystine hydrochloride and sodium dithionite appeared to enhance degradation, while the use of 2 parts of sodium dithionite alone had little effect. Inoculating the HCB contaminated soil with an inoculum of chlorobenzoate dechlorinating bacteria from the University of Michigan resulted in degradation of the HCB.
Key words: chlorinated aromatic hydrocarbons, biodegradation, decontamination.

Nunuparov, Sergei N., Oleg N. Khalimonov. 1983. On some activities in preventing sea pollution performed in the merchant marine of the U.S.S.R. In: Proceedings of the 1983 Oil Spill Conference (prevention,
behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: preventing sea pollution, merchant marine, U.S.S.R.

Nuzzi, Robert. 1973. Effects of water-soluble extracts of oil on phytoplankton. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: water-soluble, oil, phytoplankton.

Nwankwo, J.N., J. Michel, and M. Murday. 1987. Environmental baseline studies for oil pollution control in nigeria. In: Proceedings of the 10th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Conf, April 6-9, 1987, Baltimore, MD, pp. 517-519.
Key words: Africa, Environmental Impact, Monitoring, Pollution Control, Groundwater, Oil Spill, Soil Pollution

Nyan, C.V., and G.S. Solovev. 1991. Experimental criterion for determining toxicity and biodegradability of wastewater components. Soviet Journal of Water Chemistry & Technology, 13(6):113 115.
Key words: biodegradation, microorganism, waste disposal, waste water, water pollutant

Nyart, J.D., H.N. Psaraftis, W.S. Laird. 1981. The Legal environ-

ment component of an oil spill cleanup model. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: legal, environment, oil spill, cleanup.

Nyer, Evan K. July 10-12, 1989. Biological methods petroleum hydrocarbons cleanup. Environ Eng Proc 1989 Spec Conf. Publ by ASCE, New York, NY, USA. 366-375.
Key Words: Water pollution, oil spills, environmental protection, hydrocarbons removal, wastewater biological treatment, soil pollution, bioreactors.

Nyer, E.K., G. Campbell, R.T. Ackart. 1989. Biological methods for petroleum hydrocarbons remediation. The proceedings of the third national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods. National Water Well Association outdoor action conference. 1161(p):507-520.
Key Words: Bioreactors uses, gas spills biodegradation, ground water contamination, oil spills biodegradation, California, feasibility studies, field tests, gasoline, land pollution abatement, Virginia, water pollution abatement, chemical reactions, decomposition, energy sources, Federal Region III, Federal Region IX, fossil fuels, hydrogen compounds, liquid fuels, North America, oxygen compounds, petroleum products, pollution abatement, USA.

O'Brien, Lt. Cdr. James L. 1981. National Strike Force Response, IXTOC I Blowout, Bay of Campeche. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: response, IXTOC I Blowout, Bay of Campeche.

O'Brien, James L., John J. Gallagher. 1993. The Mother of all oil spills and the Dawhat Ad Dafi. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spills, Dawhat Ad Dafi.

O'Brien, Lt. Cdr. J.L., DCC D.A. Jago. 1983. Logistics: an underdeveloped link for offshore incidents. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: logistics, offshore incidents.

O'Connor, M.J., A.M. Wofford, R.M. Richardson. 1981. Contamination of groundwater by hydrocarbons from a refinery: a case history. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: contamination, groundwater, hydrocarbons, refinery.

O'Connor, M.J., Agar, J.G. 1988. Drawdown/recovery wells and vapour extraction techniques. Two active methods for remediating hydrocarbon contamination in refineries. Refinery groundwater conference/workshop. Info-Tech, Calgary, Alberta (Canada). 22(p).
Key Words: Ground water water pollution control, petroleum refineries environmental impacts, extraction, installation, oil spills, performance, hydrogen compounds, industrial plants, oxygen compounds, pollution control, separation processes.

O'Dell, Catherine Hobbs. 1988. A laboratory investigation of the relationship between groundwater velocity and mass transfer from a simulated aromatic hydrocarbon spill at the water table interface. Masters Thesis. Univ. of Minnesota, Minneapolis, MN, United States. 65.
Key Words: Ground water, pollution, oil spills, mass transfer, simulation, laboratory studies, benzene, aromatic hydrocarbons, hydrocarbons, organic materials, toluene, m-xylene, xylene, solubility, oil-water interface.

O'Donovan, Patrick. 1991. Claims for oil pollution damage: arbitration and alternative dispute resolution. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: oil pollution, damage, arbitration.

O'Donovan, P. 1988. The remote sensing of oil slicks - the law and remote sensing evidence. In: Proceedings of the INST Petrol London Remote Sensing of Oil Slicks Conf, May 17 18 1988, London, England, Pap; Quart J Tech Pap (INST Petrol), pp. 43-62.
Key words: Oil Spill, Economic Factor, Legal Consideration, Remote Sensing

O'flanagan, B., P. Carter, Jr., D. Errede, and S. Ugargol. 1990. Health risk assessment as a viable option to aquifer remediation: a case study in Michigan. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection, & Restoration Conf, October 31 November 2, 1990, Houston, TX. Ground Water Manage No 4:593 612.
Keywords: water pollution, biodegradation, Environment Protect Agency, map, remediation

O'Neill, Joseph, Raymond Sosnowski. 1983. Oil spill model for Port and Harbor Contingency planning. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil spill, model, Port, Harbor, contingency planning.

Oakes, T.W. 1980. Waste oil management at the Oak Ridge National Laboratory. In Proceedings of the 1980 UCC-ND and GAT waste management seminar. in Portsmouth, OH, U.S.A. Year.
Key words: oil, disposal, oil spill, prevention, waste oil
It is the policy of the Oak Ridge National Laboratory (ORNL) to require that oily substances be handled and disposed of in a manner that protects the environment and personnel from harm. Federal regulations prohibit the discharge of oil into navigable waters, with stiff penalties possible to violators. A strict waste oil management program has been developed and implemented because of the potential for oil problems resulting from the large and varied uses of oil at the Laboratory. Also, past records of improper discharges of oil have mandated immediate corrective actions. In order to resolve the problems of waste oil at the Laboratory, the ORNL Waste Oil Investigation Committee was formed on March 14, 1979. The work of the committee included a survey of every building and area of the Laboratory to locate the presence of oil and the pathways of oil discharges to the environment. The committee also provided a basis for the development of oil spill procedures and waste oil disposal. The Department of Environmental Management (DEM) of the Industrial Safety and Applied Health Physics Division at ORNL has the responsibility of developing environmental protection procedures for the handling and disposal of oil. It approves storage and collection facilities, disposal methods, and disposal sites for oil-containing wastes. The DEM has developed and implemented an ORNL Environmental Protection Procedure for oils and an oil spill prevention and countermeasure plan. In order to familiarize ORNL personnel with the problems and procedures of waste oil, the DEM

has held seminars on the subject. This report reviews the findings of the Waste Oil Investigation Committee and the actions of the laboratory management and the DEM in dealing with the waste oil problem at ORNL.

Oakley, D.J., and M.H. Hodder. 1990. Environmental protection an incentive for new developments in drilling fluid design. In: Proceedings of the 4TH Annu IBC Tech Serv LTD Offshore Drilling Technol Conf, November 11 28 28, 1990, Aberdeen, Scotland, 21 pp. Keywords: biodegradation, drilling waste disposal, environmental impact, legal consideration, North Sea, offshore drilling, soil pollution, water pollution

Oberbremer, A., Mueller-Hurtig, R. 1989. Aerobic stepwise hydrocarbon, degradation and formation of biosurfactants by an original soil population in a stirred reactor. Applied microbiology and biotechnology. 31(5-6): 582-586.
This paper deals with the characterization of hydrocarbon degradation in a stirred reactor containing an in situ soil population. In particular, adaptation to, extent of and order of degradation were studied since differing orders of degradation of the various hydrocarbon fractions, such as aromatics and saturates, are given in the literature. One reason may be that these fractions cannot be quantitatively separated. This overlap has been shown using a model oil.
Key words: biodegradation, aerobiosis, biphasic system, surfactant, production, biomass, model study, mixed tank reactor, substrate, soils, hydrocarbon, bacteria, fungi.

Oberbremer, A., R. Mueller-Hurtig, F. Wagner. 1990. Effect of the addition of microbial surfactants on hydrocarbon degradation in a soil population in a stirred reactor. European Journal of Applied Microbiology and Biotechnology. (1990): 32
Key words: bacteria, soil, degradation, hydrocarbon
The effect of additional microbial surfactants on the length of adaption and on the extent and velocity of hydrocarbon degradation was investigated in a soil population. The anionic glycolipids were added in excess and cultivations were carried out in a stirred bioreactor under oxygen saturation. The biosurfactants were found to facilitate degradation of all hydrocarbon components. All glycolipids shortened the two observed adaption phases for two degradation phases (from about 35 h to 17-23 h and from 21 h to 0-8 h, respectively). The addition of biosurfactants resulted in an ncrease of the elimination efficiency from 81% to 93-99% and an increase of the degradation capacity from 16.3 to a range of 23.8-39.0 g hydrocarbonkg soil dry weight per day. For fermentations with sophorose lipids performed under oxygen saturation, the second adaption phase was terminated after 57 h, in contrast to 75 h for oxygen-limited conditions. The hydrocarbon degradation capacity of the soil under non limiting conditions could be doubled by the addition of sophorose lipids as biosurfactants. The addition of glycolipids produced increased biomass during oil degradation. All biosurfactants exept cellobiose lipids were degraded within the second degradation phase.

Oberg, P.O. 1988. Method of Producing Contaminant Restraining

Booms and the Like. 6(pp).
Key Words: Floating barrier, compartment, float, plastic, pollution control, polymer, reinforced plastic, welding, USA, bracing, buoyancy, business operation, chart, construction material, containment, contamination, deformation, engineering drawing, expansible, fabric, manufacturing, oil spill, physical property, reinforcing agent, water pollution.

Oberholtzer, George R., James T. Acuff. 1979. Targeting spill prevention and control training to the responsible individual. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: spill, prevention, control.

Obertson, I. 1991. Operational examples of in-situ burning: lessons from the burning of two recent diesel spills on the B.C. coast. In: Proceedings of the 14th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 12 14 1991, Vancouver, Canada, pp. 411-419.
Key words: Fire, Cleaning, Oil Spill, Contingency Planning, Economic Factor, Legal Consideration

Ocean Ind. 1991. Fertilizer accelerates oil cleanup process. Ocean Ind (1991b): 26.
Key words: bacteria, bioremediation, oil spill, biodegradation, oil, disposal

OCS, U.S. Dep. Interior MMS. 12th Annual United States Department of the Interior MMS Gulf of Mexico Information Transfer Meeting (New Orleans, 11/5 7/91) Proceedings.
Key words: environment, water pollution, control, government, Gulf of Mexico, Louisiana, management, Mississippi River, oil spill, Texas

Octavio, K. H. 1986. Decision support framework for oil spill response. Dissertation Abstracts International: Section B Science & Engineering 48(1):
Key words: Oil Spills, Water Pollution, Contingency Planning, Computer Programming

Oda, A. 1969. Laboratory evaluation of chemical oil dispersants. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: evaluation, chemical, oil, dispersants.

Odencrantz, J.E., A.J. Valocchi, B.E. Rittmann. 1990. Modeling two-dimensional solute transport with different biodegradation kinetics. Proceedings of petroleum hydrocarbons and organic chemicals in ground water: Prevention, detection, and restoration. 664(p): 355-368.
Key Words: Ground water flow models, ground water-water pollution, hydrocarbons biodegradation, hydrocarbons environmental transport, de-aquifers, bacteria, biochemical reaction kinetics, cleaning, mathematical models, oil spills, water pollution abatement, chemical reactions, decomposition, hydrogen compounds, kinetics, mass transfer, microorganisms, organic compounds, oxygen compounds, pollution abatement,

reaction kinetics.

Odham, G. 1971. Cleaning and rehabilitation of oiled seabirds. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: cleaning, rehabilitation, seabirds.

Odu, C.T. 1991. Strategies for baseline/environmental impact studirs in Nigeria: a case study of the Isampou manifold spill. In: Proceedings of the 1st SPE et al Health, Safety & Environ in Oil & Gas Explor & Prod Int Conf, November 11 14 1991, The Hague, Netherlands, 2:271-280.
Key words: Nigeria, Oil Spill, Hydrocarbon Compound, Pollution Control, Remote Sensing

Oelkers, E. H. 1991. Calculation of diffusion coefficients for aqueous organic species at temperatures from 0 to 350C. Geochimica et Cosmochimica Acta 55(12):3515 3529.
Key words: Oil Spills, Groundwater
Evaluation of hydrocarbon transport through the pore spaces of saturated rock in the subsurface as a function of time and distance requires accurate values of diffusion coefficient for aqueous organic species. Analysis of aqueous tracer diffusion coefficients (D(sup 0)) for normal alkanes, alcohols, amides, carboxylic acids, alkylbenzenes, and alkylnaphthalenes reported in the literature indicates that diffusional activation energies decrease with increasing temperature, reaching a constant limiting value of (approximately) 3,300 cal mos (sup(minus)1) at temperatures (approx gt) 100C. This observation is consistent with the modified Arrhenius expression reported by Oelkers and Helgeson (1988). The Kirkwood-Riseman equation is used to predict D (sup 0) values as a function of the polymer chain length of hydrocarbons. Regression of experimental D (sup 0) data with a combined expression of the Kirkwood-Riseman and modified Arrhenius equations yields parameters which permit calculation of tracer diffusion coefficients for over 50 aqueous organic species at temperatures from 0 to 350C and P(sub SAT). (P(sub SAT) refers to pressures corresponding to the liquid-vapor equilibrium curve for H(sub 2)0 at temperatures greater than 100C and 1 bar at lower temperatures. Resulting values of D(sup 0) permit evaluation of the extent of diffusional mass transfer in both contaminated near-surface environments and in the porewater adjoining oil field reservoirs. The computed tracer diffusion coefficients, which are qualitatively similar to D(sup 0) values previously calculated for aqueous ions, increase substantially with increasing temperature from 0 to 350C.

Oestgaard, K. and A. Jensen. 1985. Acute phytotoxicity of oil-based drilling muds. Oil Petrochem. Pollut.2(4):281 291.
Key words: Oil Spills, Diatoms, Diesel Fuels, Aquatic Ecosystems
Cultures of the marine diatom Skeletonema costatum (Grev.) Cleve exposed to sea water extracts of various oil- and water-based muds and cuttings showed reduced photosynthetic capacity within a few minutes; mortality was generally low on the first day. Growth rate was the most sensitive indicator of toxicity, falling to zero even for cultures which appeared normal and physiologically intact. Exposure to aqueous solutions of 100-1000 ppm of

diesel-based muds reduced growth rate significantly, while water-based muds exerted a similar effect only at 100,000 ppm. Various alternative (low aromatic) oil-based muds gave intermediate effects, not only dependent on the base oil, but also on the mud composition and on changes occurring during drilling. The toxicity of the muds and the derived cuttings was clearly correlated, even in 9 months old sediment layers of cuttings. 34 references, 3 figures, 2 tables.

Offhsore. 1991. Research Efforts Advance Oil Spill Response Effectiveness. Offshore v 51, no 1, pp 36,40, Jan 1991.
Key words: oil spill, containment, detection, inspecting, oil spreading, response, testing, visual inspection, accident, additive, administration, biodegradation, business operation, chemical process, cleaning, combustion, contamination, control, demulsifier,demulsifying, design, detector, dispersant, dispersing, efficiency, emergency, engineering, environmental pollution, fluid property, flushing, gel, gelation, gelling agent, identification

Offshore. 1990. Analysis technique enhances oil spill response optimization. Offshore. 50(9):34-35,37-38.
Key words: Abstract, Accidental Fire, Boom, Economic Factor, Oil Waste, Polllution Control, Skimmer

Offshore. 1991. Research efforts advance oil spill response effectiveness. Offshore, 51(1):36,40.

Offshore. 1993. World's longest boom ready for swift spill combat. 1993. Offshore. 53(7):71.
Key Words: Oil spills, booms-floating, containment.

Offshore. 1993. SPILLSIM sights set on global market. Offshore. 53(7):72.
Key Words: Oil spills, computer simulation.

Oil Chem pollut. oil and the seagrass ecosystem of the red sea, oil chem pollut v 5, no 1, pp 21-45, 1989.
Key words: contamination, ecology, environment, environmental impact, flora, marine ecology, red sea, seas and oceans, vegetation, water pollution

Oil water separation. (Latest citations from the US Patent database). Published Search. January 1993. ERA (Energy Research Abstracts). 10(p).
Key Words: Separation processes bibliographies, chemical spills, commercial sector, compiled data, emulsions, filters, industrial wastes, patents, petroleum, skimmers, waste water, colloids, data, dispersions, document types, energy sources, fossil fuels, hydrogen compounds, information, liquid wastes, numerical data, oxygen compounds, pollution control equipment.

Oil and Gas Journal. 1992. Felt efficiently absorbs oil in drum skimming operations. Oil and Gas Journal. 90(3):46-47.
Key words: oil spills, skimmers, performance testing, efficiency, pollution control
The rate of oil recovery in drum-skimming operations is dependent

on the rate of cycling of the skimmer, the velocity of the recovery vessel on which the cycling drum is installed, and the absorbent material used. This paper reports that these conclusions were reached after analyzing results from a series of drum-skimming test performed at Al-Azhar University in Cairo. The velocity of the skimming vessel is important because there is a critical velocity, above which an hydraulic jump will form in the oil along an arc ahead of the skimming vessel. This causes oil to escape around the end of the booms, which are used to concentrate the oil as the vessel moves through the water. The rate of cycling of the drum is significant because, if it is too great, water is picked up by the absorbing element and the oil-removal efficiency is reduced.

Oil & Gas J. 1992. Felt Efficiently Absorbs Oil in Drum Skimming Operation. Oil & Gas J., 90(3), pp 46-47.
Tests on oil removal from water surfaces using a drum skimmer are reported. Factors determining the rate of oil recovery, including the type of absorbent material used, were identified. Polyurethane foam and felt were both tested. No significant difference was found in respect of absorbing power, but foam withstood the pressure of the squeezing rollers better. Overall, foam was the more efficient absorber for oil recovery. (D.W.T.)
Key words: skimmers, drums, oil spills, absorption, felt

Oil Map International. 1987. Portugal (Port orders oil spill cleanup vessel. Mar. Pollut. Bull. 18(1):8.
Key words: Accident, Additive, Boom, Pollution Control, Equipment, Storage, Waste Material

Oil spill clean-up. April 1993. Science in Parliament (United Kingdom). 50(2):24-27.
Key Words: Oil spills cleaning, combustion, environmental policy, oil pollution containment, oil retention booms, rotating disk removal systems, skimmers, sorbent recovery systems, surfactants, technology assessment, United Kingdom, Weir Oil Recovery Systems, chemical reactions, developed countries, Europe, government policies, oxidation, pollution, pollution control equipment, thermochemical processes.

Oil & Gas Journal. 1993. Oil spill burn test slated off E(ast) Canada. Oil & Gas Journal 91(30):28,30.
Key words: air pollution control, environment, transport & storage

Oil & Gas Journal. 1990. State solons accent environmental issues. Oil & Gas Journal. 88(27):32,34.
Key words: Alaska, Barge, Beach, Boom, Business Operations, Crude Oil, Oil Waste, Petroleum, Pollution Control, Spill

Oil and Gas Journal (USA). 14 Jan 1991. Advanced filter system part of oily groundwater cleanup. 89(2):59-60.
Key Words: Filters, ground water, filtration, petroleum recovery, water filtration,design, oil spills, petroleum refineries, pollution control equipment, water pollution control, energy sources, fossil fuels, hydrogen compounds, industrial plants, oxygen compounds, pollution control, separation

processes.

Oil Pollution Prevention; Non-Transportation-Related Onshore Facilities. Wednesday, February 17, 1993. Environmental Protection Agency (EPA). 58(030).

Oil Spill Burn Test Slated Off E. Canada. July 26, 1993. Oil Gas Journal. 91(30):28(2).
Key Words: Controlled burning, oil spill, cleanup, Newfoundland, marine pollution research, air pollution indicators, marine pollution indicators, oil booms, particulates, hydrocarbons-air, hydrocarbons-water.

Oil Spill Intelligence Report. EPA Proposes Long-Awaited Changes to US National Contingency Plan. Oil Spill Intelligence Report. 16:43.

Oil Spill Intelligence Report. MEPA asks Saudi Government for additional funds for Persian Gulf Beach cleanup. Oil Spill Intelligence Report. 14:33.

Oil-spill removal techniques and equipment. January 1980-October 1991 (Citations from the NTIS Data-Base). Rept. for Jan 80-Oct 91. 32.
The bibliography contains citations concerning methods and equipment used for the containment and removal of oil as a result of oil spill mishaps. Dispersants, separators, skimmers and absorbents are discussed. Related studies regarding film spreading and dispersion are presented. (Contains 107 citations with title list and subject index).
Key words: oil spills, bibliographies, oil spills, cleaning, adsorption, adsorbents, flotation, material, recovery, petroleum products, separtation equipment, skimmers, surfactantas, water pollution.

Oil spill removal techniques and equipment. (Latest citations from
Oceanic Abstracts database). Published Search. October 1993. Review Article. 10(p).
Key Words: Oil spills-bibliographies, oil spills-remedial action, animals, aquatic ecosystems, biodegration, birds, environmental impacts, estuaries, harbors, oil retention booms, optimal control, skimmers, surfactants, waste disposal, water pollution control, animals, chemical reactions, decomposition, document types, ecosystems, pollution control equipment, surface waters, vertebrates, waste management.

Oil & Gas Journal. 1993. Tanker spills Norwegian crude oil off Shetlands. Oil & Gas Journal. 91(2):26-27.
Key words: Accident, Animal, Beach, Bulk Carrier, Economic Factor, Environmental Impact, Pollution Control

Oil-spill recovery: oil booms and skimmers. January 1971-Octobe 1988 (Citations from the US Patent data base). Report for January 1971-October 1988. 56.
This bibliography contains citations of selected patents concerning booms, skimmers, and skimming techniques for oil spill

recovery. Selected patents include oil absorbent materials, dispersants, floating booms, methods and equipment for oil-spill containment and collection, marine barriers, cryogenic beach cleaners, microbial materials, and ultrasonic oil removal. Citations concerning oil-water separation for non-oil spill recovery applications are excluded and examined in a separate bibliography. (Contains 127 citations fully indexed and including a title list.).
Key words: oil pollution containment, bibliographies, oil spills, water pollution control, absorption, materials recovery, patents, progress report, skimmers, containment, control, document types, equipment, management, waste processing.

Okamoto, K., H. Masuko, S. Ochiai, S. Uratsuka, and K. Nakamura. 1993. Artificial oil pollution detection and wave observation in the sea adjacent to Japan by ERS-1 SAR. In: Esa, Proceedings of 1ST ERS-1 Symposium on Space at the Service of Our Environment, Volume 2 pp. 817-821.
Key words: ESA Satellite, Radar Imagery, Remote Sensing, Synthetic Aperture Radar, Oil Pollution
On 10 and 13 Nov. 1991, an experiment to detect artificial oil pollution and ocean waves was performed using the C band Synthetic Aperture Radar (SAR) of ERS-1. An artificial oil slick was made by spilling oleyl alcohol from a small vessel in the Pacific ocean about 100 km off the coast of Omaezaki, Shizuoka prefecture (Japan). Sea truth data were gathered from a research vessel and from another small vessel. Synchronous observation by X band, VV polarization airborne real aperture Side Looking Airborne Radar (SLAR) was made together with the observation by SAR. In the 10 Nov. 1991 SAR image, the artificial oil spill, which appeared to be dark because of capillary wave action, was clear. The decrement of the scattering cross section was about 2.5 dB at the maximum.

Okolo, N. 1991. Oil spill preparedness in Kenya. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: oil spill, preparedness, Kenya.

Okpokwasili, Gideon C., Charles C. Somerville, Margery Sullivan, D. Jay Grimes, and Rita R. Colwell. 1986. Plasmid mediated degradation of hydrocarbons in estuarine bacteria. Oil and Chemical Pollution. 3(2):117.
Key words: Biochemistry, Degradation, Bacteria, Water Pollution

Oldenhuis R., J.Y. Oedzes, J.J. Van Der Waarde, D.B. Janssen. 1991. Kinetic of chlorinated hydrocarbon degradation by methylosinus trichosporium OB3b and toxicity of trichloroethylene. Applied and environmental microbiology. 57(1): 7-14.
The kinetics of the degradation of trichloroethylene (TCE) and seven other chlorinated aliphatic hydrocarbons by methylosinus trichosporium OB3b were studied. All experiments were performed with cells grown under copper stress and thus expressing soluble methane monooxygenase. Compounds that were readily degraded included chloroform, trans-1,2-dichloroethylene, and TCE, with V SUB m SUB a SUB x values of 550, 330, and 290 nmol min SUP - SUP

1 mg of cells SUP-SUP 1 ,respectively. 1,1-Dichloroethylene was a very poor substrate. TCE was found to be toxic for the cells, and this phenomenon was studied in detail.
Key words: methylosinus, trichosporium, biodegradation, chlorocarbon, kinetic, parameter, kinetics, ethylene(trichloro), toxicity, inactivation, activated carbon, microorganism culture, radiolabelling, pollutant, bacteria.

Oldenhuis, R. Vink, R.L.J.M., Janssen, D.B., Witholt B. 1989. Degradation of chlorinated aliphatic hydrocarbons by Methylosinus trichosporium OB3b expressing soluble methane monooxygenase. Applied and environmental Microbiology. 55(11): 2819-2826.
Degradation of trichloroethylene (TCE) by the methanotrophic bacterium Methylosinus trichosporium OB3b was studied by using cells grown in continuous culture. M. trichosporium OB3b cells degraded TCE only when grown under copper limitation and when the soluble methane monooxygenase was derepressed. The two perchlorinated compounds tested, carbon tetrachloride and tetrachloroethylene, were not converted.
Key words: biodegradation, hydrocarbon, enzymatic activity, bacteria, industrial waste, gene expression, enzyme, methylosinus trichosporium, methane monooxygenase.

Oldenhuis, R., L. Kuijk, A. Lammers, D.B. Janssen, B. Witholt. 1989. Degradation of chlorinated and non-chlorinated aromatic solvents in soil suspensions by pure bacterial cultures. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 30:2:211-217.
Several strains that utilize aromatic solvents were isolated and tested for their ability to degrade chlorinated and non-chlorinated aromatic hydrocarbons. The effect of inoculation with pure bacterial cultures on the degradation of benzene, toluene, o-, m- and p-xylene, chlorobenzene, o-dichlorobenzene and 1,3,5-trichlorobenzene in soil slurries was studied. The compounds for which organisms were added were rapidly degraded. Without inoculation, however, degradation of benzene, toluene, m- and p-xylene and o-dichlorobenzene were only slightly degraded. The results showed that degradation was due to growth of the inoculated cells using the aromatic compounds as sources of carbon and energy. Addition of activated sludge did not stimulate degradation. The degradation rate of aromatic solvents by the added bacteria in soil slurries was similar or higher than that observed in liquid cultures of the same organisms.
Key words: aromatics, biodegradation, pseudomonas, cell cultures, diagrams, gas chromatography, inoculation, halogenated aromatic hydrocarbons.

Olender, William K. 1983. Statistical failure mode analysis of submarine pipeline accidents. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: analysis, submarine, pipeline.

Olhoeft, Gary R. 1991. Quantitative statistical description of subsurface heterogeneities with ground penetrating radar at Bemidji, Minnesota. Water-Resources Investigations. 650-653.
Key Words: Minnesota, pollution, ground water, geophysical

surveys, electromagnetic surveys, oil spills, plumes, USGS, Midwest, United States, North-Central Minnesota, Bemidji Minnesota, Beltrami County, Minnesota, aquifers, ground penetrating radar, radar methods, statistical analysis, heterogeneity.

Olsen, Lt. Cdr. Peter C., Cdr. Wayne R. Hamilton. 1991. Estimating the work required to clean up after the Exxon Valdez. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: estimating, cleanup, Exxon Valdez.

Olsen, R.H., J.J. Kukor, M.D. Mikesell. 1992. Occurrence, genetic organization and regulation of alkyl-substituted benzene degradation by a denitrifying bacterium Pseudomonas pickettii PKO1. Soil Decontamination Using Biological Processes. (1992): 6 9 December. Paper given at Int. Symp. Soil Decontamination Using Biological Processes, Karlsruhe, D, 6 9.12.92.
Key words: hydrocarbon, decontamination, biodegradation
P. pickettii PKO1 genes related with BTEX metabolism are cloned for plasmid pRO1957. There are 3 regulons for the conversion of benzene to phenol, phenol to catechol, and catechol degradation to substrates for the tricarboxylic acid cycle metabolism. Toluene metabolism under hypoxic conditions shows higher transformations with P. pickettii PKO1 in the presence of nitrate.

Olsen, R.L. and R. Chappell. 1988. Organic geochemistry related to subsurface contaminant transport. In: Proceedings of Superfund '88: 9th National Conference and Exhibition on Hazardous Waste, November 28-30, 1988, Washington, D.C., pp. 393 394.
Key words: Biodegradation, Groundwater, Laws, Pollution, Monitoring, Soils,Transport
The rate of migration and the concentration of hazardous chemicals in groundwater is a major factor in determining potential extent of migration, in performing risk assessment and in designing remedial actions. To assess the rate of migration and concentration of chemicals in groundwater requires a thorough understanding of the geochemical behavior of the hazardous chemicals in soil-water systems. Organic chemicals can undergo a variety of reactions in the subsurface including hydrolysis, oxidation/reduction, volatilization, adsorption, and biodegradation. The importance of each of these processes in effecting the fate and transport of chemicals depends upon the site conditions and the specific chemical compounds of concern. Generally, adsorption and biodegradation are the major reactions effecting chemical transport in groundwater. Adsorption can be evaluated and predicted using eight general methods. Several of these methods require only minimal site data that can be easily obtained. As many of the methods as possible should be used depending on the data available and the purposes of the prediction. For example, laboratory studies may be necessary when a quantitative prediction of desorption is needed to design a treatment plant in terms of concentration and design life. In all cases, the prediction should be compared to actual site data. Methods to predict biodegradation are not only currently well developed. Qualitative evaluations can be made; however,

laboratory and field studies are necessary to make definitive evaluations. Currently a variety of chemical (solute) transport models are available to predict organic chemical transport in groundwater aquifers. Typically, these models include adsorption (By including a distribution coefficient) and degradation (by including a first order decay constant).

Olson, David G., Gordon P. Wright. 1973. An optimal prevention and detection model for pollution patrol. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, DC.
Key words: prevention, detection, pollution.

Oltmanns, R.H., W. Reineke, H.G. Rast. 1988. Degradation of 1,4-dichlorobenzene by enriched and constructed bacteria. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 28:6:609-616.
Three strains, RHO1, R3 and B1, tentatively identified as a Pseudomonas sp., an Alcaligenes sp. and a Pseudomonas sp. which were able to use 1,4-dichlorobenzene as the sole carbon and energy source were isolated from water of the Rhine river and from the sewage plant at Leverkusen-Buerrig. A hybrid strain, WR1313, which uses chlorobenzene as the growth substrate, was obtained by mating the benzene-growing Pseudomonas putida strain F1 with strain B13, a Pseudomonas sp. degrading chlorocatechols. Further selection of this strain for growth on 1,4-dichlorobenzene allowed the isolation of strain WR 1323. During growth on 1,4-dichlorobenzene the strains released stoichiometric amounts of chloride. The affinity of the organisms to 1,4-dichlorobenzene was measured with strain R3 showing a K/sub s/ value of 1.2 mg/l. Respiration data and enzyme activities in cell extracts as well as the isolation of 3,6-dichlorocatechol from the culture fluid are consistent with the degradation of 1,4-dichlorobenzene via 3,6-dichlorocatechol, 2,5-dichloro-cis,cis-muconate, 2-chloro-4-carboxymethylenebut-2-en-4-olide.
Key words: chlorinated aromatic hydrocarbons, aerobic conditions, biological pathways, continuous culture, environmental effects, enzyme activity, metabolism, oxidation, pseudomonas, aromatics, organic compounds, microorganims.

Omar, S.H., U. Buedecker, H.J. Rehm. 1990. Degradation of oily sludge from a flotation unit by free and immobilized microorganisms. Applied Microbiology and Biotechnology (Germany, F.R.). 34:2:259-263.
The degradation rate of hydrocarbons in oily sludge obtained from a flotation unit by free and immobilized cells in shaking flasks and in a stirred tank reactor was investigated. For the biodegradation of 3.3% hydrocarbons free cells and cells immobilized on granular clay were used. Free cells needed 7-8 weeks to use 30% of the 3.3% hydrocarbons, whereas with immobilized cells the same results was obtained after 3-4 weeks only. In shaken flasks with high hydrocarbon concentrations (8%), immobilized Candida parapsilosis degraded 90% of the hydrocarbons in the oily sludge within 3 weeks, while free cells degraded only 27.5% in the same period. In degradation experiments with a bioreactor, free and immobilized cells of the isolate ISO-OS BUe

20 showed better results compared to cultures in shaken flasks due to better aeration and mixing. Free cells degraded 50% of the 5% hydrocarbon-containing oily sludge in 7 weeks, whereas immobilized cells gave the same result after only 4 weeks.
Key words: hydrocarbons, biodegradation, sludges, gasoline service stations, immobilized cells, microorganisms.

Omene, G.E., E.C. Odogwu, T.E. Allen. 1987. First african oil spill cooperative clean nigeria associates (CNA). In: Proceedings of the API - EPA - U.S. Coast Guard oil spill prev. behavior control cleanup conf., April 6 9 1987, Baltimore, MD, API PUBL. N.4452, pp. 151-56.
Key words: Adsorbent, Africa, Boom, Economic Factor, Oil Waste, Pollution Control, Skimmer, Oil Spill

Omori, T., T. Kimura, T. Kodama. 1987. Bacterial cometabolic degradation of chlorinated paraffins. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 25:6:553-557.
Cometabolic dechlorination of chlorinated paraffins was demonstrated in the presence of n-hexadecane by bacterial strains (HK-3, HK-6, HK-8, and HK-10) isolated from soil samples. Eleven per cent of chlorine of chlorinated paraffin-150 (CP-150) was released by strain HK-3. The mixed culture of strain HK-3, catalyzing the dechlorination of terminal chlorine of chloroalkane, and strain H15-4, capable of releasing the chlorine from 2-chlorinated fatty acids, dechlorinated CP-150 up to 13%. The mixed culture of the four strains (HK-3, HK-6, HK-8, and HK-10) performed the dechlorination of CP-150 by cometabolism in a jar fermentor pH at 7.0. The amount of chloride released from the chlorinated paraffins tested was in the range of 15-57%. The activated sludge acclimatized to n-hexadecane for 60 days showed a little dechlorination activity to CP-150.
Key words: chlorinated aliphatic hydrocarbons, biodegradation, activated sludge process, bacteria, biochemical reaction kinetics, bioreactors, culture media, hexadecane, pH value, pseudomonas, alkanes.

Ondrus, M.G., T.R. Steinheimer. 1990. High-performance liquid chromatographic determination of azaarenes and their metabolites in groundwater affected by creosote wood preservatives. Journal of Chromatographic Science (USA). 28:6:0021-9665.
Polynuclear azaheterocyclic compounds (azaarenes) are nitrogen-containing analogs of polycyclic aromatic hydrocarbons (PAHs). The nitrogen atom in the ring system causes these compounds to be slightly polar and considerably more water soluble than related PAHs. A method using a solid-surface sorption technique to extract and concentrate azaarenes and their principle metabolites present in groundwater that contains creosote waste is described. Analytic isolation and concentration is accomplished by solid-phase extraction on n-octadecyl cartridges followed by instrumental determination involving high-performance liquid chromatography. Separations and detection are achieved using flexible-walled, wide-bore columns with ultraviolet and fluorescence photometric detectors connected in series. Fluorescence detection alone is insufficient because the fluorescence response produced by two-ring azaarenes is limited. Short wavelength (229 nm) absorbance detection provides improved

sensitivity for these compounds and peak rationing for more definitive identification. In this study, oxygen-containing metabolites of quinoline, isoquinoline, and acridine are detected in groundwater from hazardous waste sites in Pensacola, Florida and St. Louis Park, Minnesota. Concentrations ranging from mg/L to ng/L are measured. The dependence of measured octanol-water partition coefficients on pH is discussed in the context of the isolation chemistry. As a direct bacterial degradation product of acridine with a relatively long environmental persistence, 9-acridinone may serve as a biogenic marker signaling creosote contamination of groundwater.
Key words: liquid column chromatography, contamination, water pollution, ecological concentration, fluorescence.

Onstad, L.A., John J. Gallagher. 1989. Imdemnification of oil spill cooperatives during third party spills. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: imdemnification, oil spill.

Onstad, Skip, Thomas McCloskey. 1989. Clean seas' response to the sinking of the Pac Baroness. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: response, sinking, Pac Baroness.

Onstad, S. and S.A. Poulter. A Children's Oil Spill Preparedness Education Program. Marine Spill Response Cor, Fugro McClelland West Inc. In: Proceedings of the 7 tH Amer Soc Civil Eng et al coastal & ocean manage symp (coastal zone 91) (Long Beach, Calif, 7/8-12/91) proc v 4, pp 3525-3529, 1991.
Key words: oil spill, academic, administration, business operation, California, education, employee relations, environment, environmental impact, North America, public relations, training program, United States, Western US additive, adsorbent, barrier, book, cause, cleaning, coast, contamination, disp ersant, ecology, environmental pollution, floating barrier, laboratory equipment, manual, marine ecology, ocean environment, procedure, recording, response, risk, skimming tank, sorbent, storage facility, tank, videotape recording, visual aid, water pollution, ecology & pollution

Onstad, Capt. Lindon A. 1983. Offshore oil spill equipment evolution in Southern California: a systems approach?. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.

Opaluch, James J., Thomas A. Grigalunas. 1989. OCS-related oil spill impacts on natural resources: an economic risk analysis. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: OCS, oil spill, natural resources.

OPEC Bull. 1992. Averting an oil slick disaster in the gulf. OPEC Bull (1991): 22

Key words: oil slick, oil spill, disposal, oil

Oppenheimer, C.H., W. Gunkel, G. Gassmann. 1977. Micro-organisms and hydrocarbons in the North Sea during July August, 1975. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: microorganisms, hydrocarbons, North Sea.

Oradovsky, S.G. 1987. On the procedures for separation of petroleum hydrocarbons in contaminated seawater samples into suspended, dissolved and dispersed forms, Alkane-naphthenic and aromatic fractions. In: Proceedings of the Seminar on oil pollution questions, November 19 20 1986, Norrkoeping (Sweden), 161-162.
Key words: Hydrocarbons, Petroleum, Extraction
Methodological recommendations for the separation of petroleum hydrocarbons in seawater to suspended and dissolved/dispersed forms, alkane-naphthenic and aromatic fractions have been worked out by the State Oceanographic Institute (Moscow, USSR). The methodology of separation to migration forms is based on stage precipitation of suspended matter from samples of seawater on filters with pore diameters 1.5; 1.0; 0.4 {mu}. Suspended petroleum hydrocarbons are extracted using cold percolation, and from filtrate - by extraction. The obtained percolate and extract can be prepared for separation of petroleum hydrocarbons in chemical fractions, or analysed without separation to fractions using common integral methods (for example IR-spectrophotometry). The method of *separation* to chemical fractions is based on eluation of these fractions from percolate or extract in glass pipette packed with aluminium oxide - silica (10:2) composed sorbent with eluates - penthan and ether. This method makes it possible to separate samples of oil spills to fractions and helps to identificate sources of oil pollution. The analysis of separated fractions can be performed using such common methods as gas chromatography for alkanes and naphthenics, spectrofluorometry and liquid chromatography for aromatics.

Orazio, Carl Edmond. 1992. Persistence and transport of organochlorine contaminants in soils. Doctoral, University of Missouri.
Key Words: Chlorinated hydrocarbons, ground water, movement, oil spills, organochlorine, PCBs, pollutants, soils.

Orem, W.H., P.G. Hatcher. 1987. Solid-state /sup 13/C NMR studies of dissolved organic matter in pore waters from different depositional environments. Org. Geochem.(United Kingdom). 11:2:73-82.
Dissolved organic matter (DOM) in pore waters from sediments of a number of different depositional environments (marine and estuarine sediments, freshwater and marine peats) was isolated by ultrafiltration using membranes with a nominal molecular weight cutoff of 500. This <500 molecular weight DOM represents 70-98% of the total DOM in these pore waters. The gross chemical structure of this material using both solid-state /sup 13/C nuclear magnetic resonance spectroscopy and elemental analysis was determined. The results show that the DOM in these pore waters appears to exist as two major types: one type dominated by

carbohydrates and paraffinic structures and the second dominated by paraffinic and aromatic structures. The authors suggest that the dominance of one or the other structural type of DOM in the pore water depends on the relative oxidizing/reducing nature of the sediments as well as the source of the detrital organic matter. Under dominantly anaerobic conditions carbohydrates in the sediments are degraded by bacteria and accumulate in the pore water as DOM. However, little or no degradation of lignin occurs under these conditions. In contrast, sediments thought to be predominantly aerobic in character have DOM with diminished carbohydrate and enhanced aromatic character. The aromatic structures in the DOM from these sediments are thought to arise from the degradation of lignin. The large amounts of paraffinic structures in both types of DOM may be due to the degradation of unidentified paraffinic materials in algal or bacterial remains. 35 refs.
Key words: interstitial water, chemical analysis, anaerobic conditions, aromatics, carbohydrates, molecular weight, redox reactions, bacteria, alkanes, biodegradation, carbon 13, nuclear magnetic resonance, peat, solutes.

Oren, A. 1990. Anaerobic degradation of organic compounds in hypersaline environments. Wise, D.L. 1990. Possibilities and limitations. Bioprocessing and biotreatment of coal. 155-176:744.
The author has been studying the microbiology of anaerobic sediments of the Dead Sea as a model by isolating and characterizing the bacteria present and determining the processes performed by them. In this chapter the author presents some of the results of reviews knowledge of the nature of bacteria able to grow in anaerobic hypersaline environments, and on their ecology.
Key words: organic wastes, anaerobic digestion, seas, sediments, bioconversion, salinity.

Oren, Aharon, Peter Gurevich, Malkit Azachi, and Yigal Henis. 1992. Microbial degradation of pollutants at high salt concentrations. Biodegradation. 3(2-3):387-396.
Key words: Biodegradation, Microorganism, Water Pollution, Hydrocarbons, Bacteria
The treatment of chemically contaminated high-salinity lakes, using microorganisms is discussed. The presently available information on the biodegradation of pollutants at high salt concentrations, under both aerobic and anaerobic conditions, and the *bacteria* involved in these processes are reviewed. Results are presented from laboratory experiments designed to investigate the biodegradation of formaldehyde at high salt concentrations by halotolerant eubacteria, and the transformation of nitroaromatic compounds by anaerobic halophilic eubacteria. In the formaldehyde experiments, a rod-shaped Gram-negative, motile eubacterium called MA-C was found to grow well at sodium chloride concentrations in the range 0-20%, and possibly higher. In the nitroaromatics evaluations, Haloanaerobium praevalens and Sporohalobacter marismortui, isolated from the Great Salt Lake and the Dead Sea, respectively, were shown to reduce p-nitrophenol to p-aminophenol in the presence of 13-14% NaCl.

Ormond, Tom. 1990. Satisfying high-volume needs at low cost:

silicon pressure sensors. EDN 35(May 24):79.
Key words: Sensors

Ornstein, R.L. 1991. Rational redesign of biodegradative enzymes for enhanced bioremediation: overview and status report for Cytochrome P450. Battelle Memorial Inst Report No. PNL SA 18691 (DE91008225) Feb 1991, 25 pp.
Keywords: biodegradation, bioremediation, environmental impact, waste oil

Osman, F.P. 1988. Ashland Oil Spill: A state of environmental perspective. Journal of the New England Water Works Association. 102(4):222-229.
Key words: Diesel Fuels, Environmental Effects, Oil Spills, Water Pollution Containment, Petroleum
The Ashland Oil Spill, while certainly not the largest in history, may have been the most severe in terms of its potential impact on water supplies. This paper presents a case history of the spill from initial notification to the long-term environmental clean-up activities and underscores the need for additional regulation of above-ground storage tanks. On January 2, 1988, a tank containing 3.9 million gallons of diesel fuel collapsed and discharged three quarters of a million gallons into the Monongahela River in Floreffe, PA. The spill resulted in severe short-term environmental damage, the closing of a major inland port, and threatened the drinking water supplies of 500,000 people in Pennsylvania. The PA Dept. of Environmental Resources (DER) staff worked closely with local authorities to first contain the diesel fuel on site and then to provide additional warnings to downstream users as more information about the size of the spill became available. With the deployment of 20,000 feet of a river-wide containment boom, eleven vacuum trucks, three cranes, and over 150 people, about 30% of the product which entered the river through a 24-inch pipe was collected. One week after the spill, all PA water plants were back on line and treating water, albeit with modified processes. The Ashland tank failure led to numerous reviews of the response to the incident, the causes and effects of the incident, and the regulatory requirements for above-ground tank storage.

Ostebo, R., L. Tronstad, and T. Fikse. 1991. Risk analysis of drilling and well operations. In: Proceedings of the SPE/IADC Drilling Conf, March 11 14, Amsterdam, The Netherlands. Pp. 481 492.
Key words: Oil Spill, Drilling, Risk Analysis, Norway

Ostendorf, D.W., and D.H. Kampbell. 1991. Biodegradation of hydrocarbon vapors in the unsaturated zone. Water Resources Res. 27(4):453 462.
Keywords: bacteria, biodegradation, bioremediation, Michigan, monitoring, soil pollution

Ostrander, Ronald O., Stanton J. Kleinert. 1973. Drain oil disposal in Wisconsin. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil disposal, Wisconsin.

Ott, Gary L. 1987. Comparison of federal guidelines for natural resource damage assessment of a major oil spill, Island Park, New York. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: federal guidelines, natural resources, assessment, oil spill.

Ott, G.L., J. Lindstedt-Siva, A.H. Walker. 1993. Evolving spill management systems under OPA 90 could reduce response effective-

ness. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: spill management, OPA, response.

Ouderkirk, D., R. Walter, S. Novotny. 1991. Emergency response notification system: an indicator of oil release trends. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: response, notification, oil, release.

Overton, Edward B. 1981. Petroleum residue source identification following a fire and oil spill. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: petroleum.

Overton, E.B., J.R. Patel, J.L. Laseter. 1979. Chemical characterization of mousse and selected environmental samples from the Amoco Cadiz oil spill. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: chemical, environmental samples, Amoco Cadiz, oil spill.

Owen, Wadsworth, and William Leaf. 1971. Oil spill prevention and detection using an instrumented submersible. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: oil spill prevention, detection, submersible.

Owens, Edward H. 1983. Shoreline experiments and the persistence of oil on Arctic Beaches. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: shoreline, oil, Arctic, beaches.

Owens, Edward H. 1987. The Fate of stranded oil four years after an experimental spill on a sheltered gravel beach. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: stranded oil, spill, beach.

Owens, E.H. 1993. An inland oil spill response manual to minimize adverse environmental impacts. In: Proceedings of the 1993 Oil

Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill, environmental.

Owens, Edward H. 1985. Factors affecting the persistence of stranded oil on low energy costs. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: factors, oil, energy costs.

Owens, E.H., C.R. Foget, H.H. Roberts, S.P. Murray. 1985. Containment strategies for marine oil spills in nearshore waters. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: containment, marine, oil spills, waters.

Owens, E.H., P.D. Reimer. 1991. Aerial videotape shoreline surveys for oil spill reconnaissance, documentation, and mapping. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: videotape, shoreline, oil spill.

Owens, Edward H., Gordon A. Robilliard. 1981. Spill impacts and shoreline cleanup operations on Arctic and sub-Arctic Coasts. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: spill, shoreline, cleanup, Arctic.

Owens, E.H. 1991. Shoreline conditions following the Exxon Valdez spill as of fall 1990. In: Proceedings of the 14th Annu. Arctic & Mar. Oilspill Program Tech. Seminar (1991) Pap. (June 1991), 49 pp., Petroleum Abstracts, ABSTR. NO. 522,005, 32(13).
Key words: Abstract, Alaska, Animal, Biochemical Reaction, Biodegradation, Bioremediation, Crude Oil, Pollution Control

Owens, E.H., J.R. Gould, and J. Lindstedt-Siva. 1993. Field studies to determine the ecological effects of cleanup methods on oiled shorelines. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 401-406.
Key words: Cleaning, Coast, Oil Spill, Bibliography, Contamination, Economic Factor, Pollution Control

Owens, E.H., P.D. Reimer, and G.A. Sergy. 1991. Arabian gulf oil spill: shoreline surveys and cleanup guidelines for Bahrain and Qatar. In: Proceedings of the 14th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 12 14 1991, Vancouver, Canada, pp. 655-663.
Key words: Oil Spill, Indian Ocean, Contingency Planning, Crude Oil, Economic Factor, Pollution Control Equipment, Remote Sensing

Owens, E.H. 1991. Shoreline evaluation methods developed during the nestucca response in British Columbia. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, SanDiego, CA, pp. 177 179.
Key words: Oil Spill, Oil Waste, Data Processing, Legal Consideration, Regulation

Owens, E.H., J.R. Harper, W. Robson, and P.D. Boehm. 1987. Fate and persistence of crude oil stranded on a sheltered beach.40(1):109-123.
Key Words: Coastal regions oil spills, oil spills cleaning, oil spills field tests, petroleum biodegradation, petroleum weathering, arctic regions, distribution, oil pollution containment, pavements, seidments, chemical reactions, containment, decomposition, energy sources, fossil fuels, polar regions, testing.

Owens, Edward H. 1977. Contingency planning for the impact of oil spills in different coastal environments of Canada. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 10, 1977. pp.115 124. New Orleans, LA: Washington, D.C.: American Petroleum Institute.
Keywords: contingency planning, impact, oil spills, coastal, Canada.

Owens, Victor H., Walter J. Sexton, and Jacqueline Michel. 1987. A Comparison of soil-gas sampling methods used at two harbor sites. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., 605 - 610. Baltimore, MD.: Washington, DC: American Petroleum Institute.
Keywords - Soil, Sampling, Harbor.

Oxenham, J. P. 1973. Development of a polyurethane foam marine oil recovery system. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973. 277 290. Washington, D.C.: Washington, D.C.: American Petroleum Institute. 1973.
Keywords: polyurethane, marine, oil, recovery.

Oxenham, J.P. 1971. A Study of the performance characteristics of the ole/philic Belt Oil scrubber. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: oil spill.

Oxley, R.A. 1991. An Absorbent Pad. Patent No. Austral 607113, C 3/21/91, F 9/8/89 Australian offic J. Pat V 5, no 4, p 797.
Key words: pollution control equipment, absorbent, business operation, control, oil spill, pollution control, retention, salvaging, sorbent, waste oil recovery, (p) Australia, absorber, absorption, chart, cleaning, collecting agent, containment, crude oil, design, diagram, engineering, oil spreading, oil waste, particle, petroleum, removal, separation equipment, sorption, waste material, ecology & pollution

Ozkaynak, H., B. L. Murphy, and J. J. Watson. 1979. A comparative risk assessment technique for tanker oil spills. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979. in Los Angeles, CA Year.
Keywords: risk assessment, tanker, oil spills.

Paddock, Arnold. 1987. A major inland spill case history viewed as a candidate for dispersant use. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987. 621. Baltimore, MD: Washington, D.C.: American Petroleum Institute. 1987.
Keywords: inland, spill, dispersant.

Paddock, Arnold. 1989. Field experience with dispersants for oil spills on land. ASTM Spec. Tech. Publ. 1018:73-7.
Key words: soil pollution, dispersants, cleanup, dispersing agents, oil spill cleanup, land, petroleum, oil spills.

Page, David S. 1983. Long-term fate of dispersed and undispersed crude oil in two nearshore test spills. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 March 3, 1983. 465 472. San Antonio, TX: Washington, D.C.: American Petroleum Institute. 1983.
Keywords: dispersed, oil, spills.

Page, David S. 1985. Compositional changes in dispersed crude oil in the water column during a nearshore test spill. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 521 530. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1985. a.
Keywords: oil, spill, nearshore.

Page, D.S. 1985. Mangrove leaf tissue sodium and potassium ion concentrations as sublethal indicators of oil stress in mangrove trees. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 391 394. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1985. b.
Keywords: mangrove, sodium, potassium, concentrations.

Page, David S. 1979. Hydrocarbon distribution and weathering characteristics at a tropical oil spill site. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 22, 1979. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1979.
Keywords: hydrocarbon, tropical, oil spill.

Page, David S. 1989. Long-term weathering of Amoco Cadiz oil in soft intertidal sediments. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. 401 406. San Antonio, TX: Washington, D.C.: American Petroleum Institute. 1989.
Keywords: weathering, Amoco Cadiz, oil, intertidal, sediments.

Pahan, K., S. Ray, R. Gachhui, J. Chaudhuri, and A. Mandal. 1991. Volatilization of mercury compounds and utilization of various aromatic compounds by a broad-spectrum mercury resistant Bacillus pasteurii strain. Bulletin of Environmental Contamination and Toxicology. 46:4:591-598.
Aquatic ecosystems may receive aromatic compounds through various routes. These compounds can cause cancerous diseases in aquatic

animals and enhance mutagenicity of the sediments. The persistence of aromatic compounds deposited in sediments is affected by microbial degradation. Plasmid-determined mercuric and organomercurial resistance in microorganisms has also been studied by several workers. Utilization of various aromatic compounds as sole sources of carbon by an Hg-resistant bacterial strain has not been reported. The author isolated broad-spectrum Hg-resistant Bacillus pasteurii strain DR{sub 2} which could volatilize different mercury compounds and utilize various aromatic compounds as sole sources of carbon. This strain preferentially utilized benzene in a medium containing both glucose and benzene. To their knowledge, until recently there has been no report on preferential utilization of other compounds, particularly an aromatic compound to glucose in a mixture.
Key words: bacillus, sensitivity, mercury compounds, glucose, metabolism.

Painter, Louis J. and Donald R. Haley. 1985. Approaches to oil spill risk sssessment for maritime vessel operations. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup),February 25 28, 1985. 603 606. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1985.
Keywords: oil spill, risk assessment, maritime, vessel.

Palumbo, A.V., W. Eng, P.A. Boerman, G.W. Strandberg, T.L. Donaldson, and S.E. Herbes. 1991. On-site bioreclamation. Stoneham, MA. Butterworth Publisher. 77-91:527.
This paper reports that groundwater contaminated with organic compounds, especially solvents such as benzene, trichloroethylene (TCE), perchloroethane (PCE), carbon tetrachloride, and chlorinated ethanes, is a problem at many U.S. Department of Energy (DOE) facilities, including the Oak Ridge National Laboratory (ORNL). These sites are on the National Priority List and fall under the jurisdiction of both the Comprehensive Environmental Response, Compensation, and Liability Act and DOE/Environmental Protection Agency Interagency Agreements. Regulations require consideration of alternatives for remediation of these sites. A demonstration project was initiated in the spring of 1990 that will permit evaluation of two cometabolic approaches to remediation of groundwater and may lead to remediation alternatives that prove both more effective and less costly than traditional methods.
Key words: chlorinated aromatic hydrocarbons.

Palumbo, A.V., G.W. Strandberg, and W. Eng. 1990. The effects of groundwater chemistry on co-metabolism of chlorinated solvents by methanotrophic bacteria. Oak Ridge National Lab., TN (USA). 26.
Degradation of chlorinated alkenes such as trichloroethylene (TCE) by methanotrophic bacteria is a promising technology for the remediation of contaminated groundwater. Ultimately, the success of this approach may be dependent on the influence of groundwater chemistry on degradation rates and extent. TCE can rapidly be reduced to low levels in laboratory cultures growing on defined media. However, if major changes in groundwater chemistry are necessary to achieve substantial TCE degradation, field application of processes (i.e., above ground and in situ

treatment) may be limited by cost or logistic problems. For example, the presence of competitive inhibitors may limit the extent of TCE degradation. The goal of our research is to quantify the potential effects of groundwater chemistry on the biodegradation of TCE by methanotrophs and to define concentrations of methane that need to be added to the system to produce maximum rates of TCE degradation. This includes evaluation of major nutritional requirements (e.g., PO{sub 4}) in addition to the focus on competitive inhibition. 20 refs., 6 figs.
Key words: ground water, geochemistry, pollutants, biodegradation, methane, solvents.

Palumbo, A.V., and W. Eng. 1990. Methanol suppression of trichloroethylene degradation by M. trichosporium. Twelfth symposium on biotechnology for fuels and chemicals: Program and abstracts. Scheitlin, F.M. Oak Ridge National Lab., TN (United States). 114.
Biodegradation by methylotrophs has been considered a potential method for in situ remediation, but delivery of sufficient methane could be a problem. Since methanol could be delivered more readily into soil, the authors examined TCE degradation under methane (0.89 M), methanol (1.187 mM), and combined methane (0.89 mM) methanol (1.187 mM) stimulated treatments using M. trichosporium and mixed cultures JS and DT. Degradation of TCE was determined by the summation of radiolabeled CO{sub 2}, water-soluble intermediates, and biomass transformed from {sup 14}C TCE. M. trichosporium degraded 0.36 {plus minus} 2.08% (mean {plus minus} std dev) of the initial TCe (0.3 mg/l) with methanol stimulation, compared to 9.07 {plus minus} 1.04% with methane stimulation. JS and DT cultures degraded 4.34 {plus minus} 0.11% on methanol compared to 24.3 {plus minus} 1.38% and 34.3 {plus minus} 3.0% on methane, respectively. If methanol was added to methane-stimualted cultures, TCE degradation was reduced to 1.08 {plus minus} 1.74% for M. trichosporium, and 5.08 {plus minus} 0.56% for JS culture. Methanol retarded the rates of methane and oxygen utilization as well. However, methanol-stimulated cultures grew to a greater extent than methane-stimulated cultures with 14 mg/l TCE. Previous workers have shown that methanol suppresses methane monooxygenase, and they suggest this may explain the reduced amount of TCE degraded.
Key words: bacteria, biochemical reaction, biodegradation, fluid injection, carbon dioxide.

Paluszkiewicz, Theresa and Charles F. Marshall. 1989. Comparison of techniques for forcing an oil spill trajectory model. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. 547 554. San Antonio, TX: Washington, D.C.: American Petroleum Institute. 1989.
Keywords: oil spill, trajectory.

Pancirov, R. J. and R. A. Brown. 1975. Analytic methods for polynuclear aromatic hydrocarbons in crude oils, heating oils, and marine tissues. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975. 103 114. San Francisco, CA: Washington, D.C.: American Petroleum

Institute.
Keywords: polynuclear, hydrocarbons, oils, marine, tissues.

Panday, S.M. October 1990. (Modeling of) soil and groundwater contamination by petroleum products in frozen soils. Dissertation Abstracts International: Section B Science & Engineering. 51(4):1966-B.
Key Words: Abstract, accident, aerobic microorganism, Alaska, Arctic Area, biochemical reaction, biodegradation, cargo, chemical reaction, composition, diffusion, District 5, ground water, immobilization, insoluble, low temperature, mass transfer, mathematical model, multiphase, nonisothermal condition, North America, oil and gas fields, oil waste, operation condition, petroleum fraction, phase change, physical property, pollution control, pollution source, risk assessment, soil (earth), soil pollutant, soil pollution, solidification, solubility, thermodynamic property, trunk pipeline, USA, waste material water insoluble, water solubility.

Paris, Franklin A., and Jerry W. Roberson. 1992. Compositions for oil and hazardous spill cleanup. Patent No. WO 9200804_A1, 13 pp.
Key words: Leather, Oil Spill and Hazardous Waste Cleanup

Park, P. Kilho, Jane A. Elrod, and Dana R. Kester. 1991. Applications of satellite remote sensing to marine pollution studies. Chem. Ecol. 5(1-2):57-73.
Key words: Water Pollution, Remote Sensing, Oil Spills, Petroleum

Park III, William C. 1985. Response to the MOBILOIL spill incident. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 335 340. Los Angeles, CA: Washington, D.C.: American Petroleum Institute. 1985.
Keywords: response, MOBILOIL, spill.

Park, P. K., J. A. Elrod and D. R. Kester. 1989. Satellites as tools to study marine pollution. In: Proceedings of the Eighth International Ocean Disposal Symposium, Oct. 9 13, Dubrovnik, Yugoslavia. Florida Institute of Technology: Melbourne, FL. 21(2):16 17.
Key words: Oil Spills, Remote Sensing, Alaska, Landsat TM, Exxon Valdez
In the field of marine pollution studies, the anomalous radiances of dumped acid wastes have been tracked by aircraft sensors, Land Remote-Sensing Satellite (Landsat), and Coastal Zone Color Scanner (CZCS). Although more work is needed, oil spill trajectory studies can be enhanced by satellite data. The recent Exxon Valdez oil spill of 24 March 1989 in and around the Prince William Sound, Alaska, was imaged by the NOAA-11 polar orbiting radiometer. The location of 1.5-2.0 degree C cooler radiant sea-surface temperature coincides with the leading edge of the spill. Also, the Interactive Image Analysis System (IIAS) of Alaska SAR Facility has demonstrated that a highly enlarged Landsat Thematic Mapper (TM) image, 3 x 3 km, can be used to ascertain oil spill coverage.

Parker H.W., C.E. Heitz, and P.T. Nash. 1993. Biodegradable

adsorbents for aquatic oil spills. Adsorbent capabilities and biodegradation rates. In: Proceedings of the Environment Canada 16th Arctic and Marine Oil Spill Technical Seminar (Calgary 6/7-9/93) Proceedings V1 367-75 (1993).
Key words: adsorbent, adsorption process, aerobic microorganism, anaerobic microorganism, bacteria, biochemical reaction, biodegradability, biodegradation, biological activity, business operation, commercial, composition, cotton, crude oil, density, diesel fuel, district, growth, homopolymer, hydrocarbon, marketing, meeting, motion, motor fuel, natural fiber, North America.

Parker, Grant D. 1989. The role of Indian tribes in natural resources damages recovery. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 16, 1989. San Antonio, TX.,297 302. Washington, D.C.: American Petroleum Institute.1989.
Keywords: natural resources, damages, recovery.

Parker, Jill. 1991. U.S. fish and wildlife service response activities following the Exxon Valdez oil spill. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 7, 1991. 243 246. San Diego, CA: Washington, D.C.: American Petroleum Institute.
Keywords: U.S. fish and wildlife service, response, Exxon Valdez, oil spill.

Parker, John and Xiaoge Xiong. 1991. The accelerating market for auto sensor devices: sales soar, but bringing advanced technology to the auto industry still takes time, with no guarantee of quick payoffs to suppliers. Electronic Business 17(May 6):64
Key words: Sensors, Auto Industry

Parker, J.C. and R.J. Lenhard. 1990. Vertical integration of three-phase flow equations for analysis of light hydrocarbon plume movement. Transp Porous Media. 5(2):187-206.
Key words: Oil Spreading, Crude Oil, Flow Model, Groundwater, Oil Spill, Water Pollution

Parker, J. C., A.K. Katyal, J.L. Zhu, S. Mishra. 1990. Estimation of spill volume from monitoring well networks. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:1233-1243.
Key Words: Pollution, oil spills, methods, monitoring, volume, soils, ground water, errors, environmental geology, data processing.

Parker, J. C., A.K. Katyal, J.L. Zhu, V.J. Kremesec, and E.L. Hockman. 1991. Ground Water Management. 5:291-305.
Key Words: Pollution, ground water, reclamation, oil spills, natural resources, recovery, mathematical models.

Parkinson, G., A. Shanley, and D. Jensen. 1991. Cleaning up Saddam's slick. Chemical Engineering. 98(4):44S,44U.
Key words: Absorbent, Boom, Business Operations, Economic Factor, Oil Waste, Pollution Control Equipment

Parra-Pardi, Gustavo, Emery A. Sutton, and Nelson E. Rincon. 1985. Effects of petroleum on algal blooms in Lake Maracaibo. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. 373 378. Los Angeles, CA: Washington, D.C.: American Petroleum Institute.
Keywords: petroleum, algal blooms, Lake Maracaibo.

Parson, John W. 1981. Coastal ecosystem studies and their application to oil spill response. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 5, 1981. 311 318. Atlanta, GA: Washington, D.C.: American Petroleum Institute. 1981.
Keywords: coastal, ecosystem, oil spill, response.

Parsons, J.R., D.T. Sijm, and M.C. Storms. 1988. Biodegradation of chlorinated aromatic chemicals in continuous cultures. Organic micropollutants in the aquatic environment. In: Proceedings of the 5. European symposium on organic micropollutants in the aquatic environment. pp. 206-214.
Chemostat cultures of microorganisms offer a number of advantages for the study of the biodegradation of xenobiotic chemicals compared to the more commonly used batch systems. Chemostat cultures enable the influence of environmental conditions and adaptation on biodegradation to be studied, as well as simplifying kinetic studies. The cometabolic degradation of chlorobiphenyls by a Pseudomonas strain in batch and chemostat cultures was compared. In batch cultures, there was ready degradation of mono- and dichlorobiphenyls, but not of tetracylorobiphenyls. In contrast, tetrachlorobiphenyls were degraded in chemostat cultures exposed continuously to the compounds by means of a generator column. degradation was apparently enhanced by the more favorable conditions in chemostat cultures, and not by adaptation of the bacteria. First order biodegradation rate constants for the tetrachlorobiphenyls were calculated from the steady-state concentrations in the cultures and the exposure concentrations. The rate constant for 2,2{prime},3,3{prime}-tetrachlorobiphenyl was much higher than those for the 2,2{prime}5,5{prime}-and 2,2{prime},6,6{prime}-isomers, suggesting that steric hindrance of 2,3-dioxygenation controls their degradation rates. 9 refs., 3 figs., 3 tabs.
Key words: chlorinated aromatic hydrocarbons, biphenyl, continuous culture, pseudomonas, steady-state, hydrocarbons, decompostition, halogenated aromatic hydrocarbons, microorganisms.

Passos, J.A.L., N.M.S. Neves, and M.Q. Ferreira. 1991. Handling and processing of hazardous solid wastes from petrochemical industries Cetrel's experience. In: Proceedings of the International Association on Water Pollution Research and Control (IAWPRC) International Seminar on Industrial Residuals Management, November 7 9, 1990, Salvador, Brazil, pp. 93 101.
Key words: biodegradation, industry, brazil

Pastorok, Robert A. and Jeanette A. Thomas. 1985. Considerations for treatment and rehabilitation of oiled sea otters. In: Proceedings of the 1985 Oil Spill Conference(Prevention,

Behavior, Control, Cleanup), February 25 28, 1985. 646. Los Angeles, CA: Washington, D.C.: American Petroleum Institute.
Keywords: treatment, rehabilitation, oiled, sea otters.

Patchell, W.S., and J.M. Wilson. 1991. Safety and environmental considerations for hydrocarbon remedial systems. In: Proceedings of the Nat Water Well Ass & API Petrol Hydrocarbons & Org Chem in Ground Water: Prev, Detection, & Restoration Conf, November 20 22 1991, Houston, TX, pp. 127-141.
Key words: Soil Remediation, Oil Spill, Pollution Control, Contingency Planning, Remote Sensing

Paterson, B., G. Comfort, and M. Punt. 1992. Development of a waterjet barrier for oil spill containment. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar. 818(p):439-455.
Key Words: Oil spills-oil pollution containment, design, field tests, performance, pollution control equipment, sprays, pollution control, testing.

Paterson, Candy. 1976. A new system for soluble oil disposal to prevent pollution. Ind Lubr Tribol (Jan-Feb 1976): 28
Key words: petroleum refining, water pollution, control, emulsion, pollution control, used oil, disposal

Patterson, K.H., Redlinger, J.F. March 1992. Hopper dredges applied to the Alaska oil spill, March 1989. Management of Bottom Sediments Containing Toxic Substances. In: Proceedings of the US/Japan Experts Meeting (14th) Held in Yokohama, Japan on 27 February-1 March 1990,' AD-A250 148. 131-144.
Key Words: Alaska oil spills, petroleum material recovery, accidents, decontamination, dredging, North America, oil pollution containment, remedial action, US Corps of Engineers, water pollution control, cleaning, developed countries, energy sources, fossil fuels, National Organizations, North America, pollution control, US DOD, US Organizations, USA, waste management, waste processing.

Patterson, S., and R. Dawson. 1991. A Park Service barrier island GIS: assessment and forecast of impacts from dredging and oil transport. In: Resource Technology 90. Proc. second international symposium on advanced technology in natural resources management, Washington, DC, 1990, Ed. G. J. Buhyoff. ASPRS, pp. 376-386
Key words: Oil Spills, Barrier Island, Remote Sensing, Geograhic Information System
The coastal US and it's associated barrier islands have been subjected to large-scale dredging and oil spill impacts. Accurate and quantifiable assessment of the impacts to coastal and barrier islands has been inadequate. The Southeast Regional Office of the National Park Service and the Department of Environmental Sciences, Univ. of Virginia are developing a coastal and barrier island remote sensing, monitoring and GIS program. The power of the GIS will be it's incorporation with analytical forecast and impact models. These models will be employed in two main areas: shoreline erosion and sand transport; and oil spill response and contingency planning. The future of effective impact forecasting, in dynamic areas like barrier islands, resides in the use of

predictive GIS models that have been tested against historical suites of monitoring data and scientific research.

Patterson, Samuel, and Richard Dawson. 1991. Barrier islands GIS modelling. Technical Papers - 1991 ACSM-ASPRS Annual Convention, Baltimore, MD, 3:312-317.
Key words: Information Systems, Remote Sensing, Oil Spills
National park service (NPS) coastal barrier islands have experienced significant problems associated with dredging projects and oil spills. Quantification and prediction of these impacts, from man-induced problems, has suffered from the lack of an accessible, comprehensive body of information. A GIS-based analytical model for oil spills and dredge impacts is being produced for the southeastern barrier islands. The Southeast Regional Office (SERO) of the National Park Service is developing a state-of-the-art coastal barrier island remote sensing, monitoring and GIS program. Remote sensing of the southeast barrier islands is being performed by NASA's high altitude mission branch using the ER-2 aircraft loaded with three high resolution cameras (3 m. to .5 m resolution) and the Daedalus Thematic Mapper Scanner. The barrier island GIS will be used to generate analytical forecast and impact models. Models will be employed for two main areas: shoreline erosion and sand transport (park inlets, dredge and remedial impacts); and oil spills (response protocol, MIRG oil spill model, dispersion, contingency planning and impact prediction). The future of effective impact forecasting, particularly in dynamic areas like barrier islands, resides in the use of predictive GIS models that have been tested against historical suites of monitoring data. (Author abstract) 8 Refs.

Paul Proctor. 1992. Japan Plans New Generation Of Remote Sensing Satellites. Aviation Week & Space Technology. 137(2):66.

Paules, M.S. II, J.F. Mednick, D.E. Callahan. 1990. Installation of large diameter recovery wells utilizing triple-wall percussion hammer drilling. In: Proceedings of petroleum hydrocarbons and organic chemicals in ground water: Prevention, detection, and restoration.664(p):491-505.
Key Words: Ground water monitoring, gournd water-water pollution, percussive drills efficiency, percussive drills uses, water wells design, water wells well completion, water wells well drilling, de-alluvial deposits, cleaning Colorado, oil spills, petroleum refineries, water pollution abatement , well casings, drilling equipment, energy sources, federal region VIII, fossil fuels, geologic deposits, hydrogen compounds, industrial plants, north america, oxygen compounds, pollution abatement, USA.

Paulsen, Gordon W. 1971. The oil pollution problem from the viewpoint of marine insurance. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, 1971. 43 48. Washington, D.C.: Washington, D.C.: American Petroleum Institute.
Keywords: oil, pollution, marine.

Paulson, A.S., A. D. Schumaker, and W. A. Wallace. 1975. A risk-analytic approach to control of large volume oil spills. In:

Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, 1975. 301 306. San Francisco, CA: Washington, D.C.: American Petroleum Institute.
Keywords: risk-analysis, control, oil spills.

Pauwels, Stanislas J. and James R. Clark. 1993. Overview of international oil spill dispersant toxicity testing requirements. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 April 1, 1993. pp.803 804. Tampa, Florida: Washington, D.C.: American Petroleum Institute.
Keywords: international, oil spill, dispersant, toxicity.

Pavia, Robert and Cdr. Lindon A. Onstad. 1985. Plans for integrating dispersant use in California. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords: Dispersant, California.

Pavia, Robert, D. L. Payton, J. A. Galt. , J. L. Payne, M. A. Krone, and D. V. Morris. 1985. Scientific response to the Blue Magpie spill. Texas A&M oil spill training activities: a sixth year perspective. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 28, 1985. Washington, D.C.: American Petroleum Institute. 1985.
Keywords: response, Blue Magpie. Conference Proceedings.

Pavia, Robert and D. L. Payton. 1983. An approach to observing oil at sea. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., 345 - 348. San Antonio, TX.: Washington, DC: American Petroleum Institute. , 1983. .
Keywords: Oil, Sea.

Pawlowicz, G.and C. C. Carter. 1990. Impacts of volatile organic compounds on groundwater, health hazards, public awareness, solutions. In: Proceedings of the First USA/USSR Joint Conference on Environmental Hydrology and Hydrogeologyh, June 18 21, Leningrad, USSR. Kendall/Hunt Publishing Co., Dubuque, IA, pp. 250 259.
Key words: Florida, Groundwater, Oil Spills
There are many potential sources of groundwater contamination gasoline and related products are one of them. To deal with a problem of this magnitude, the 1986 Legislature initiated the State Underground Petroleum Environmental Response Act program. Implementation of this program has aided in the detection and elimination of human exposure to drinking water contaminated by volatile organic compounds from leaking underground storage systems. When violations of the maximum containment levels were in question, corrective actions such as connection to a non-contaminated public water supply or installation of petroleum removal filter systems have been necessary in many cases for consumer protection. A monitoring program for polluted aquifers, based on existing wells, has also been established to detect any adverse changes in potable groundwater quality for public protection. This paper discusses

the volatile organic groundwater contamination of both public and private water supplies in Duval County, Florida, with emphasis on health risks, the impact on the communities involved, and solutions.

Payne, James R. 1985. Estimating dispersant effectiveness under low temperature, low salinity conditions. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25- 28, 1985., p.638. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords: Dispersants, Temperature, Salinity.

Payne, J.R. 1991. EXXON VALDEZ oil weathering fate and behavior: model predictions and field observations. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., pp. 641- 654. San Diego, CA.: Washington, DC: American Petroleum Institute., 1991.
Keywords: EXXON VALDEZ, Oil, Weathering, Prediction, Observation.

Payne, James R. 1983. Multivariate analysis of petroleum hydrocarbon weathering in the subarctic marine environment. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983.,pp. 423- 434. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords: Petroleum, Hydrocarbon, Weathering, Subarctic, Marine.

Payne, J.R., J.R. Clayton, Jr., C.R. Phillips, J. Robinson, D. Kennedy, J. Talbot, G. Petrae, J. Michel, and T. Ballou. 1991. Dispersant trials using the PAC Baroness, a spill of opportunity. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 427-433.
Key words: Dispersant, Oil Spill, Contamination, Pollution Control, Remote Sensing

Payne, J. R. 1993. Spill of opportunity testing of dispersant effectiveness at the MEGA BORG oil spill. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29- April 1, 1993., Tampa, Florida.: Washington, DC: American Petroleum Institute. pp. 791 - 793.
Keywords: Spill of opportunity, Dispersant, MEGA BORG, Oil Spill.

Payne, Jerry F., Robert Maloney, and Anver Rahimtula. 1979. Are petroleum hydrocarbons an important source of mutagens in the marine environment?. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19- 22, 1979., pp.533 - 536. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords: Petroleum, Hydrocarbons, Mutagens, Marine.

Payne, J. Larry and R. E. Lewis. 1979. Training techniques: Texas A & M university's oil spill control course. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., pp. 205 - 208. Los Angeles, CA. : Washington, DC: American Petroleum Institute.

Keywords: Training, Texas A&M, Oil Spill, Control.

Payne, J. Larry. 1977 . Oil spill control training: Texas A&M university's approach. . In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8- 10, 1977., pp. 129 - 134, New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords: Oil Spill, Control, Texas A&M.

Peabody, C. H. and R. H. Goodman. 1983. Innovative training: computer assisted learning. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28- March 3, 1983., pp. 243- 248. San Antonio, TX. : Washington, DC: American Petroleum Institute. , 1983. .
Keywords: Training, Computer Assisted Learning.

Peacock, M.J. 1993. Acoustic leak detection system. Patent No. US 5231866930803.
Key words: Leak Detector, Storage Facility, Crude Oil, Oil Spill, Petroleum

Pearce, R. B. 1977. What constitutes good telecommunications systems for an oil spill cleanup. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8- 10, 1977., pp.69-78. New Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords: Telecommunications.

Pearson, R.D., and G.B.R. Feilden. 1991. Oil slick skimmer. Patent No. GB 2239819A, 73p.
Key words: skimmers, oil spills, pollution control, equipment
This invention relates to apparatus for recovering oil spills at sea, in estuaries or in inland waterways. The emphasis is on a high speed of response to an emergency. A self-propelled, remote-controlled boat carries means for skimming oil from the surface and feeding it into a dracone. The whole assembly is small enough to be dropped from an aircraft. The dracone may have lower outlets so that it can discharge water separating therein, of the boat may include a settling tank from which water is recycled to nozzles 35 ahead of the boat and oil pumped to the dracone. In the example given, the boat is a catamaran, and arcuate slots in the underside of the floats pick up the floating oil. Other constructions use a single-hulled boat with various booms and pick-up devices, which can be flexible and/or inflatable.(author).

Peck, H.D., Jr., and L.G. Ljungdahl. 1988. The microbiology and physiology of anaerobic fermentations of cellulose: Progress report, May 1987--October 1988. Georgia University. 23.
The long term goals of this research project are to define (1) the mechanism(s) of the activation of molecular hydrogen in terms of the nickel-sulfur, nickel-selenium and non-heme iron redox centers and (2) to understand the physiological role of hydrogenases in the metabolism of the sulfate reducing bacteria and other anaerobic bacteria. Toward these goals, the presence of three different hydrogenases, termed the (Fe) hydrogenase, the (NiS) hydrogenase and the (NiSe) hydrogenase, have been

demonstrated in the sulfate reducing bacteria (18) gram qualities of the hydrogenases prepared, molecular biological studies initiated (5,13) and a bioenergetic mechanism demonstrated which requires two or more hydrogenases (3). The goals of our study were to obtain properties of extreme thermophilic anaerobes involved in the degradation of cellulosic material to understand better the process of biomass conversion and its possible industrial studying organisms which grow naturally together with cellulose degraders and those which can be grown in cocultures with cellulolytic and hemicellulolytic bacteria to obtain special fermentation products. It also includes the study of the ability of a group of extreme thermophiles to grow over an extended temperature span of 40/degree/c or more and to examine a forwarded theory on the nature of temperature tolerant thermophiles. 43 refs., 3 figs.
Key words: biomass, fermentation, biosynthesis, ethanol fuels, amino acid sequence, molecular biology, temperature dependence, hybridization, alcohol fuels, alkanes, progress report, liquid fuels, document types, hydrogenases, chemical reactions.

Peigne, G., D. Fauvre, and N. Chowings. 1993. Full-scale tests of a gravity-type separator. In: Proceedings of the 13th Bien API et al oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 561-565.
Key words: Oil Water Separator, Oil Spill, Pollution Control, Crude Oil, Petroleum

Peigne, Georges and Maurice CEssou.. 1989. Improving the pumping of viscous oil by the use of demulsifiers or by annular water injection.. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13-16, 1989., pp. 175-180. San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords: Oil, Demulsifiers.

Pelger, J.W. 1991. Microbial enhanced oil recovery treatments and wellbore stimulation using microorganisms to control paraffin, emulsion, corrosion, and scale formation. In: Proceedings of the U.S. DOE Microbial Enhancement of Oil Recovery Int Conf, May 27 June 1, 1990, Norman, OK. Elsevier Develop Petrol Sci Ser No. 31:451 466.
Keywords: bacteria, biodegradation, cost control, disposal, legal consideration, map, Michigan, monitoring, Texas, oil recovery, Oklahoma

Premuzic, E.T., M.S. Lin, and S.K. Kang. 1991. Progress in geothermal waste treatment biotechnology. In: Proceedings of the Annu Geotherm Resources Counc Mtg, October 6 9, 1991, Sparks, NV. 15:149 154.
Keywords: bacteria, biodegradation, bioremediation, equipment cost, waste disposal

Pellegrino, Carl R. 1993. OPA 1990 takes us back to the 1970s. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., 843. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords: OPA 1990.

Pelletier, E. 1988. Oil spill in the St. Lawrence Estuary: a preliminary approach to a risk estimation model. El-Sabh, M.I., and T.S. Murty. Natural and man-made hazards. Proc. symposium, Rimouski, Quebec. pp 575 588.
The risk index attempts to describe the short-term behavior of an oil spill and evaluate the nature and the significance of its effects on the ecosystem. The risk level, defined as the chance of damage to the ecosystem integrity, is given by the rate of the risk index variation as a function of the elapsed time after the accidental spill. According to this approach, the risk level is high when the spreading of the oil slick is fast and the shoreline is close to the spill site, but the level is minimum for a spill occurring far from sensitive beaches under dead calm conditions.-from Author.

Pelletier, E., C. Brochu, and J. H. Vandermeulen. 1987. Long term oil weathering under sea ice in experimental mesoscale simulator. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6- 9, 1987., p. 627. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords: Oil, Weathering, Ice, Mesoscale.

Pelletier, Emilien and Charles Brochu. . Study of oil in water dispersion using a dynamic turbidimeter. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989. , 347 - 352. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords: Oil in water, Dispersion, Turbidmeter.

Pelon, W., and J.A. Mayo. 1987. Growth of mixed microbial populations in ground water containing highly chlorinated organic wastes. Bull. Environ. Contam. Toxicol.(United States). 38(4):661 666.
Key words: microorganisms, hydrocarbons, groundwater, biodegradation, Louisiana
In Louisiana, there are about 300 chemical waste dump sites. Some have been abandoned, while others are still active. Most of the wastes deposited by the petro-chemical industries, are often highly chlorinated and considered not to be readily biodegradable. The contamination of ground water by hazardous organic chemical deposited at these locations has become a matter of concern, because of the risk of drinking water sources becoming polluted. There have been many reports presented regarding the microbial biodegradation of oil pollutants and other recalcitrant compounds by communities of microorganisms. Based upon such findings, the authors suspected that natural mechanisms that would detoxify hazardous organic wastes, would exist at waste sites. They report the isolation of microbial populations that would grow in organic-saturated ground water, with no added carbon sources.

Pennwell Conferences and Exhibitions Company. 1989. Petro-safe '89. In: Proceedings of the PETRO-SAFE '89: international exhibition and conference for environmental and safety concerns of the energy industries, October 3 5 1989, Houston, TX, 811 pp.

Key words: Environmental Safety Standards, Industrial Accidents, Oil Spills, Environmental Impacts, Petroleum, Waste Management
The papers presented in this book include: Clean Air Act reauthorization, Presentation of the Ashland Oil spill story, and Use of less environmentally toxic drilling muds.

Peratrovich Notting. Floating containment boom to contain pollutants, composed of floatation unit, ballast, continuous curtain of at least one sheet of flexible geosynthetic fabric and at least two tow cords. Patent No. US 472568_900114.
Key words: Ballast, Boom, Containment, Oil waste, Pollution Control, Waste Material

Perchthaler, H., J. Haintz. 1983. Dewatering of oil sludge. Oil Gas Europe Mag. (1983): 9
Key words: sludge, disposal, oil, recovery

Percy, Roger James. 1993. Canadian national sensitivity mapping program. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29- April 1, 1993., p. 890. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords: Canadian, Mapping.

Peretti, S.W., and S.M. Thomas. 1991. Nitro-Aromatic biodegradation pathway analysis and augmentation via genetic engineering. In: Proceedings of the 201ST ACS National Meeting of the American Chemical Society, April 14 19, 1991, Atlanta, GA.
Key words: escherichia-coli, bacteria, environmental pollutant, water pollution, soil pollution, biodegradation

Perry, W.J., P.E. Williamson, and C.J. Simpson. 1991. NOAA (National Oceanic and Atmospheric Administration) satellite data in natural oil slick detection, Otway basin, Southern Australia. Bmr J Australian Geol Geophys, 12(1):25-33.
Key words: Aerial Survey, Contamination, Environmental Pollution, Hydrocarbon Seep, Remote Sensing

Pesta, T.J., and A. Cassley. 1992. Leak detection - a regulatory perspective. In: Proceedings of the 11th ASME et al Offshore Mech & Arctic eng Int Conf, June 7 12 1992, Calgary, Can, 5(B):493-500.
Key words: Pipeline Leak, Economic Factor, Pollution Control, Oil Spill, Petroleum

Peters, R.W. 1988. Effect of inorganic cations on biological fixed-film systems. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 137-158.
Key words: Biodegradation, Bioreactors, Microorganisms, Monitoring, Wastewater
The effects and inhibitions associated with heavy metals (Ag, Cr, Cu, Pb, and Zn) on the performance of fixed-film biological processes such as trickling filters, anaerobic filters, and rotating biological contacters, are addressed. High concentrations of heavy metals are toxic microorganisms. With proper acclimation, the biological system can be used to remove a

certain amount of the metal(s) without being adversely affected. The removal of cations, particularly heavy metals, is primarily due to sorption of both soluble and fine particulate by the biofilm. The anaerobic filter is quite efficient for removal of heavy metals and retention of the metals in the biofilm. Due to the relatively recent development of fixed film processes, much less attention has been paid on these processes (as compared to suspended growth systems) particularly in terms of heavy metal inhibition.

Petersen, F. S., F.K. Hiebert. 1992. Biodegradation of crude oil tank bottom sludge. In: arco pipe line co^alpha environmental inc. Api et al petrol hydrocarbons & org chem in ground water prev. Detection, & restoration conf November 4, Houston, TX. Key words: biodegradation, bioremediation, contamination, environmental pollution, metabolic behavior, remediation, sludge, soil (earth), soil pollution, tank bottoms, waste material, weathered oil

Peterson, D., J. Clark, L. Twitty, R. Woods, G. Biddinger. 1993. Predictive fish toxicity modeling: short pulse exposure. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29- April 1, 1993., pp. 867-869.Tampa, Florida. : Washington, DC: American Petroleum Institute.
Keywords: Fish, Toxicity, Exposure.

Petroleum Abstracts. 1991. Research efforts advance oil spill response effectivess. Offshore. 51(1):36-40.
Key words: Biochemical Reaction, Biodegradation, Containment, In-situ, Pollution Control

Petroleum Abstracts. 1990. Valdez oil spill technology: 1989 operations. Petroleum Abstracts. NO. 522,972 V32 N.15.
Key words: Health, Environment, Pollution Control, Beach, Boom, Crude Oil, Equipment

Pettersson, L.H., O.M. Johannessen, and O. Frette. 1990. Norwegian remote sensing spectrometry for mapping and monitoring of algal blooms and pollution - NORSMAP-89. In: Proceedings of the Ocean sciences meeting, February 12 16 1990, New Orleans, LA, pp. 135-136.
Key words: Oil Spills, Pollution Control, Remote Sensing
During the late spring of 1988 an extensive bloom of the toxic algae Chrysocromulina polylepis occurred in the Skagerrak region influencing most life in the upper 30 meter of the ocean. The algal front was advected northward with the Norwegian Coastal Current along the coast of southern Norway, where it became a severe threat to the Norwegian seafarming industry. An ad-hoc expert team was established to monitor and forecast the movement of the algae front. Remote sensing of sea surface temperature from the operational US NOAA satellites monitored the movement of the algal front, consistent with a warm ocean front. The lack of any optical remote sensing instrumentation was recognized as a major de-efficiency during this algal bloom. To prepare for similar events in the future Nansen Remote Sensing Center initiated a three week pilot study in the Oslofjord and Skagerrak

region, during May 1989. The Canadian Compact Airborne Spectrographic Imager (CASI) was installed in the surveillance aircraft. Extensive in situ campaigns was also carried out by the Norwegian Institute for Water Research and Institute of Marine Research. A ship-borne non-imaging spectrometer was operated from the vessels participating in the field campaign. As a contribution from a joint campaign (EISAC '89) between the Joint Research Centre (JRC) of the European Community and the European Space Agency (ESA) both the Canadian Fluorescence Line Imager (FLI) and the US 64-channel GER scanner was operated simultaneously at the NORSMAP 89 test site. Regions of different biological and physical conditions were covered during the pilot study and preliminary analysis are obtained from oil slicks, suspended matter from river, as well as minor algal bloom. The joint analysis of the data collected during the NORSMAP 89 campaign and conclussions will be presented, as well as suggestions for future utilization of airborne spectroscopy systems for operational monitoring of algal bloom and water pollution.

Pettigrew, C.A., Jr. 1989. Microbial ecology of bacterially mediated PCB biodegradation. Tennessee Univ., Knoxville, TN (USA). 215.
The roles of plasmid mediated and consortia mediated polychlorinated biphenyl (PCB) biodegradation by bacterial populations isolated from PCB contaminated freshwater sediments were investigated. PCB degrading bacteria were isolated by DNA:DNA colony hybridization, batch enrichments, and chemostat enrichment. Analysis of substrate removal and metabolite production were done using chlorinated biphenyl spray plates, reverse phase high pressure liquid chromatography, Cl{sup {minus}} detection, and {sup 14}C-labeled substrate mineralization methods. A bacterial consortium, designated LPS10, involved in a concerted metabolic attack on chlorinated biphenyls, was shown to mineralize 4-chlorobiphenyl (4CB) and 4,4{prime}-dichlorobiphenyl (4,4{prime} CB). The LPS10 consortium was isolated by both batch and chemostat enrichment using 4CB and biphenyl (BP) as sole carbon source and was found to have tree bacterial isolates that predominated; these included: Pseudomonas, testosteroni LPS10A which mediated the breakdown of 4CB and 4,4{prime} CB to the putative meta-cleavage product and subsequently to 4-chlorobenzoic acid (4CBA), an isolate tentatively identified as an Arthrobacter sp. LPS10B which mediated 4CBA degradation, and Pseudomonas putida by A LPS10C whose role in the consortium has not been determined.
Key words: polycyclic aromatic hydrocarbons, contamination, sediments, carbon 14 compounds, fresh water, liquid, biodegradation, bacteria, pseudomonas, tracer techniques, chemical reactions.

Pettigrew, C.A., B.E. Haigler, J.C. Spain. 1991. Simultaneous biodegradation of chlorobenzene and toluene by a Pseudomonas strain. Applied and Environmental Microbiology (USA). 57:1:0099-2240.
Pseudomonas sp. strain JS6 grows on a wide range of chloro- and methylaromatic substrates. The simultaneous degradation of these compounds is prevented in most previously studied isolates

because the catabolic pathways are incompatible. The purpose of this study was to determine whether strain JS6 could degrade mixtures of chloro- and methyl-substituted aromatic compounds. Strain JS6 was maintained in a chemostat on a minimal medium with toluene or chlorobenzene as the sole carbon source, supplied via a syringe pump. Strain JS6 contained an active catechol 2,3-dioxygenase when grown in the presence of chloroaromatic compounds; however, in cell extracts, this enzyme was strongly inhibited by 3-chlorocatechol. When cells grown to steady state on toluene were exposed to 50% toluene-50% chlorobenzene, 3-chlorocatechol and 3-methylcatechol accumulated in the medium and the cell density decreased. After 3 h, the enzyme activities of the modified ortho ring fission pathway were induced, the metabolites disappeared, and the cell density returned to previous levels. In cell extracts, 3-methylcatechol was degraded by both catechol 1,2- and catechol 2,3-dioxygenase. Strain JS62, a catechol 2,3-dioxygenase mutant of JS6, grew on toluene, and ring cleavage of 3-methylcatechol was catalyzed by catechol 1,2-dioxygenase. The transient metabolite 2-methyllactone was identified in chlorobenzene-grown JS6 cultures exposed to toluene. These results indicate that strain JS6 can degrade mixtures of chloro- and methylaromatic compounds by means of a modified ortho ring fission pathway.
Key words: chlorinated aromatic hydrocarbons, biodegradation, cell cultures, decomposition.

Pettigrew, C.A., A. Breen, C. Corcoran, G.S. Sayler. 1990. Chlorinated biphenyl mineralization by individual populations and consortia of freshwater bacteria. Applied and Environmental Microbiology (USA). 56:7:0099-2240:2036-2045.
Comparative studies were performed to investigate the contribution of microbial consortia, individual microbial populations, and specific plasmids to chlorinated biphenyl biodegradation among microbial communities from a polychlorinated biphenyl-contaminated freshwater environment. A bacterial consortium, designated LPS10, was shown to mineralize 4-chlorobiphenyl (4CB) and dehalogenate 4,4'-dichlorobiphenyl. The LPS10 consortium involved three isolates: Pseudomonas testosteroni (LPS10A), which mediated the breakdown of 4CB and 4,4'-dichlorobiphenyl to 4-chlorobenzoic acid; an isolate tentatively identified as an Arthrobacter sp. (LPS10B), which mediated 4-chlorobenzoic acid degradation; and Pseudomonas putida bv. A (LPS10C), whose role in the consortium has not been determined. None of these isolates contained detectable plasmids or sequences homologous to the 4CB-degradative plasmid pSS50. A freshwater isolate, designated LBS1C1, was found to harbor a 41-megadalton plasmid that was related to the 35-megadalton plasmid pSS50, and this isolate was shown to mineralize 4CB. In chemostat enrichments with biphenyl and 4CB as primary carbon sources, the LPS10 consortium was found to outcomplete bacterial populations harboring plasmids homologous to pSS50. These results demonstrate that an understanding of the biodegradative capacity of individual bacterial populations as well as interacting populations of bacteria must be considered in order to gain a better understanding of polychlorinated biphenyl biodegradation in the environment.
Key words: chlorinated aromatic hydrocarbons, water pollution,

cell constituents, bacteria.

Peurala, M. 1987. The Method of Defence Against Oil Damages and Container for Applying of Method. pct gaz v 1987, no 24, p 4175.
Key words: container, absorbent, aerial transportation, containment, control, oil spill, pollution control, sorbent, transportation, (p) world, absorption, aircraft, aperture, casings, chart, chemical, contamination, damage, diagram, filling, flushing, organic matter, output, peat, Pipetek Oy, site preparation, soil pollution, sorption, water pollution, ecology & pollution

Pfannkuch, Hans-Olaf, Susan M. Nourse, and Marc F. Hult. 1988. Mass transfer at the alkane-water interface in laboratory columns of porous media. Open-File Report (United States Geological Survey. 1988). C29-C32.
Key Words: Organic materials, hydrocarbons, alkanes, Beltrami County Minnesota, USGS, Minnesota, Midwest, United States, northwestern Minnesota, Bemidji Minnesota, oil spills, pollution, ground water, aquifers, crude oil, mass transfer, aliphatic hydrocarbons, porous materials, experimental studies, solubility.

Phelps, T.J., J.J. Niedzielski, R.M. Schram, S.E. Herbes, and D.C. White. 1990. Biodegradation of trichloroethylene in continuous-recycle expanded-bed bioreactors. Applied and Environmental Microbiology (USA). 56:6:1702-1709.
Experimental bioreactors operated as recirculated closed systems were inoculated with bacterial cultures that utilized methane, propane, and tryptone-yeast extract as aerobic carbon and energy sources and degraded trichloroethylene (TCE). Up to 95% removal of TCE was observed after 5 days of incubation. Uninoculated bioreactors inhibited with 0.5% Formalin and 0.2% sodium azide retained greater than 95% of their TCE after 20 days. Each bioreactor consisted of an expanded-bed column through which the liquid phase was recirculated and a gas recharge column which allowed direct headspace sampling. Pulses of TCE (20 mg/liter) were added to bioreactors, and gas chromatography was used to monitor TCE, propane, methane, and carbon dioxide. Pulsed feeding of methane and propane with air resulted in 1 mol of TCE degraded per 55 mol of substrate utilized. Perturbation studies revealed the pH shifts from 7.2 to 7.5 decreased TCE degradation by 85%. The bioreactors recovered to baseline activities within 1 day after the pH returned to neutrality.
Key words: bioreactors, performance, chlorinated, carbon dioxide, methane, propane, chemical reaction, halogenated, bacteria, biodegradation.

Phelps, T.J. 1990. Bioremediation potential of toxics by manipulation of deep terrestrial subsurface ecosystems. Gas, oil, coal, and environmental biotechnology II. Akin, C., Smith, J. 1990. 2. international IGT symposium on gas, oil, coal, and environmental biotechnology. 594.
Mixed physiological types of bacteria in consortia recovered from subsurface contaminated sediments degrade mixed organic wastes containing carbon-rich (benzene, xylene, toluene) and halogenated hydrocarbon substrates (chlorobenzene, trichloroethylene, dichloroethylenes, vinyl chloride) in column bioreactors when

provided with oxygen and methane and/or propane substrates. In expanded bed bioreactors degradation proceeds to 99% completion for several organic and chlorocarbon contaminants (60% for tetrachloroethylene) to carbon dioxide on repeated cycles in 21 days with little loss of volatiles in the control bioreactor except for a 70% loss of vinyl chloride in the control. Biodegradation is most efficient when the microbial consortia is maintained in a suboptimal nutritional state which can be monitored by ratios of endogenous storage lipid (poly beta-hydroxy alkanoic acid, PHA) to total phospholipid ester-linked fatty acids (PLFA). Under the best conditions the efficiency of biodegradation was 50-65 moles substrate (propane or propane + methane)/mole of TEC degraded. The microbial communities showed a rich diversity of microbes based on PLFA biomarkers. The effects of adding methane and/or propane in inducing specific subsets of the microbial community can readily be detected in the PLFA biomarker. Despite the presence of carbon rich substrates (benzene, toluene, xylene) in the mixed wastes, no evidence of plugging of interstitial spaces by exopolysaccharide was detected.
Key words: chlorinated aliphatic hydrocarbons, biodegradation, aerobic digestion.

Phillips, N. M. 1993. Process waste assessment machine and fabrication shop. Sandia national Labs,, Livermore, CA. Report No. SAND 93 8225, 15 pp.
Key words: Biodegradation, Environment, Monitoring, Transport, Wastes
This Process Waste Assessment was conducted to evaluate hazardous wastes generated in the Machine and Fabrication Shop at Sandia National Laboratories, Bonding 913, Room 119. Spent machine coolant is the major hazardous chemical waste generated in this facility. The volume of spent coolant generated is approximately 150 gallons/month. It is sent off-site to a recycler, but a reclaiming system for on-site use is being investigated. The Shop's line management considers hazardous waste minimization very important. A number of steps have already been taken to minimize wastes, including replacement of a hazardous solvent with biodegradable, non-caustic solution and filtration unit; waste segregation; restriction of beryllium-copper alloy machining; and reduction of lead usage.

Piccone, R.P. 1992. Improved tank gauging for safe product movements. In: Proceedings of the Pennwell Conf & Exhibit Co Petro- Safe 92 Conf, January 27 29 1992, Houston, TX, 3:711-719.
Key words: Computer Control, Remote Sensing, Pollution Control, Hydrostatic Pressure, Oil Spill

Pickard, C., Foght, J.M., Pickard, M.A., Westlake, D.W.S. 1993. Oil field and freshwater isolates of Shewanella putrefaciens have lipopolysaccharide polyacrylamide gel profiles characteristic of marine bacteria. Canadian Journal of Microbiology (Canada). 39:7:715-717.
The lipopolysaccharide structure of oil field and freshwater isolates of bacteria that reduce ferric iron, recently classified as strains of Shewanella putrefaciens, was analyzed using polyacrylamide gel electrophoresis and

lipopolysaccharide-specific silver-staining procedure. The results demonstrate that all the oil field and freshwater isolates examined exhibited the more hydrophobic R-type lipopolysaccharide, which has been found to be characteristic of Gram-negative marine bacteria. This hydrophobic lipopolysaccharide would confer an advantage on bacteria involved in hydrocarbon degradation by assisting their association with the surface of oil droplets. 15 refs., 1 fig.
Key words: bacteria, lipopolysaccharides, biodegradation, petroleum.

Pieken, W.A., J.W. Kozarich. 1990. Lactonization of cis,cis-3-halomuconates: Influence of pH and halo substitutent on the regiochemistry. Journal of Organic Chemistry (United States). 55:10:0022-3263.
The (2E,4Z)-3-fluoro-2,4-hexadienedioate (1a; cis,cis-3-fluoromuconate) and its chloro 1b and bromo 1c analogues, which are important metabolites in the microbial degradation of halogenated aromatic pollutants, lactonize under acidic conditions. Two modes of lactonization can occur involving either carboxylat4e group. The authors show here that the lactonization and stereomutation of 1a-c are dependent not only on the pH but also on the halo substituent. The major product from reaction of 1a-c at pH 1-6, (2,5-dihydro-5-oxofuranylidene)acetic acid (2), arose from attack of the C-6 carboxylate on the halide-bearing carbon and subsequent expulsion of the halide. The rate of formation of 2 was maximal at pH 3-4 and approached zero at pH 0 and 7. At pH 3.2 and below, reaction of 1b and 1c, but not 1a, produced the (2E,4E)-3-halo-2,4-hexadienedioates as additional products. At pH 0 the major product fromr eaction of 1a, 2,5-dihydro-2-fluoro-5-oxofuranacetic acid (4a), was due to lactonization via the C-6 carboxylate. The 3-chloro- and -bromomuconates (1b,c), in contrast, lactonized at pH 0 via attack of the C-1 carboxylate on the unsubstituted C-4 to the 2,5-dihydro-3-halo-5-oxofuranacetic acids. The mechanism of the observed pH and substitutent-dependent changes in regiochemistry of lactonization is discussed.
Key words: halogenated aromatic hydrocarbons, chemical preparation, biodegradation, dicarboxylic.

Pimentell, Emily M. 1985. Oil spill cleanup and habitat restoration: little Panoche Creek, California. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25- 28, 1985., pp. 331- 334. Los Angeles, CA. : Washington, DC: American Petroleum Institute. , 1985. .
Keywords: Oil Spill, Cleanup, Restoration, California.

Pinckard, J.A., and P.E. Gill. 1992. Process for bioremediation of soils. Patent No. US 5100455920331, 6 pp.
Keywords: biodegradation, bioremediation, oil spill, pipeline leak, soil pollution

Pintler, L.R. 1991. Maximum tech, minimum time. Response and cleanup of the Fidalgo Bay oil spill. Waste Business West (Canada).vo 2:2 Apr 1991 pg 24-26 ETD (Energy Technology Data Exchange)

CANM (Canada (sent to DOE from)) Canada.
A booster pump failure on a pipeline at Texaco's Anacortes refinery spilled more than 17,000 gallons of oil into Fidalgo Bay. A description is given of the spill control measures taken under Texaco's Spil Prevention and Control Countermeasures and facility contingency plans. The spill was addressed quickly, and containment booms were used to cordon off the spill. Vacuum trucks, rope mop machines and disk skimmers were used to collect the thickest concentrations of oil, and the oil and water collected was separated at the refinery's wastewater treatment centre. Nonwoven polypropylene sorbent pads, sweeps, booms and oil snares were used to clean up thinner concentrations of oil. Essential steps for a smooth spill response include the following: a comprehensive spill prevention and control countermeasures plan, training and regular drills and testing; immediate notification of appropriate regulatory agencies and company emergency response personnel; and the use of professional oil spill management contractors to assist in spill cleanup. 2 figs.
Key words: oil spills--emergency plans, oil spills--water pollution control, skimmers, Washington, control, developed countries, equipment, federal region X, North America, pollution control, pollution control equipment

Piotrowski, D.A., Yost, K.W. 1990. Intercept trench technology for remediating waste oil contaminated soil and groundwater. A case study. Proceedings of the 44th industrial waste conference annual Purdue industrial waste conference. 951(p):65-74.
Key Words: Oil spills pollution control, petroleum residues underground storage, ground water, land pollution control, land reclamation, removal, soils, water pollution control, energy sources, fossil fuels, hydrogen compounds, oxygen compounds, petroleum fractions, pollution control.

Piper, E., and Exxon Valdez. 1991. Alaska officials have approved the use of fertilizers to boost microbial breakdown of oil from the Exxon Valdez oil spill. Environmental Science & Technology 25(6):996.
Key words: biodegradation, legal, microorganism, oil waste, soil pollutant, oil spill, water pollutant

Pirages, S.W. 1988. Hazardous waste management: Biological treatment. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 25-35.
Key words: Biodegradation, Industrial Wastes, Monitoring, Wastewater, Waste Management
The commercial waste service industry recognizes the potential application of biological treatment for industrial hazardous wastes. Facilities employing this technique currently exist in Canada and the US. Greater application and commercial development is possible, particularly if certain operational costs/performance criteria are met. These include: complete destruction of hazardous constituents; the ability to concentrate target constituents for further treatment or for resource recovery; application of the technology to a diverse range of hazardous constituents found in mixtures, rather than in single

constituent waste streams; and consistency among treatment beaches to reduce the need for expensive monitoring of the residue, and of the ability to be competitive financially with other treatment technologies that are currently available. Advocates of biological technology should be concerned about and watchful of the developing Environmental Protection Agency policy on Resource Conservation and Recovery Act treatment standards. Depending on the direction of this policy, commercial development of biological treatment technology could be affected adversely. It will be necessary for experts in this area to work with the Agency in identifying the needed data and in validating real world applications of these data. If the Congressional mandate to treat all hazardous wastes includes the broadest possible range of management options, it will be to the benefit of all. However, a concerted effort is required to assure that policies that optimize treatment opportunities leave the door open for new research and development.

Pirbazari, M., K.S. Shing, B.N. Badriyha, and S.T. Chung. Oxidation, Biodegradation, and SCFE Studies for Treatment of Hazardous Leachate. In: Proceedings of the ASCE/et al Env Engineering Natl Conf,July 13 15, 1988, Vancouver, Canada. pp. 216 223.
Keywords: waste disposal, biodegradation
Several potential treatment alternatives were investigated for the treatment of a hazardous landfill leachate. Chemical oxidation, biodegradation, and super-critical fluid extraction (SCFE) were tested individually and in combination. Biological treatment was the most effective option for reducing TOC; the process was not markedly enhanced by preoxidation. SCFE was not very effective in decontaminating this particular leachate. However, it might be an attractive alternative for leachates with recalcitrant constituents.

Pistiner, A., Rubin, H. (CAMERI - Coastal and Marine Engineering Research Inst., Haifa (IL). Faculty of Civil Engineering), Shapiro, M. (Technion-Israel Inst. of Technology, Haifa (IL). Faculty of
Mechanical Engineering). 1989. Analysis of fuel pollutant migration in water flow through porous media. International Journal of Multiphase Flow (UK). 15(2):135-154.
Key Words: Fuels migration, ground water pollution, porous materials two-phase flow, coalescence, contamination, mathematical models, oil spills, fluid flow, hydrogen compounds, oxygen compounds.

Pistruzak, W. M. Dome petroleum's oil spill resaerch and development program for the Arctic. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 173 - 182. Atlanta, GA.: Washington, DC: American Petroleum Institute. , 1981. .
Keywords - Dome Petroleum, Oil Spill, Research, Arctic.

Pizarro, F., and Cabo Pilar. 1989. The Cabo Pilar grounding and oil spill. In: Proceedings of the 1989 API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 61-64.

Key words: Animal, Coastal Area, Crude Oil, Economic Factor, Pollution Control

Plambeck, M. Biological purificn. of contaminated soil, by breaking it up with explosives and spraying a nutrient for the growth of bacteria. Patent No. DE 3811856_880408.
Key words: Bacteria, Biochemical Reaction, Biodegradation, Economic Factor, Pollution Control

Plante, K. J. Florida's pollutant discharge natural resource damage assessment compensation schedule: a rational approach to the recovery of natural resource damages. In Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., 717- 720. Tampa, Florida.Washington, DC: American Petroleum Institute.
Keywords: Florida, Discharge, Natural Resource, Damage Assessment.

Pledge, Tom. 1991. War Within a War. Aramco World. 42(3):35(5).
Key Words: Oil spill cleanup, Persian Gulf, Arabian Amer Oil Co., Saudi Arabia, oil booms, marine pollution equipment, dispersants, Iraq, Kuwait, warfare, oil skimmers, desalination.

Pluymers, D., and H. Nash. March 1990. Guidance Manual for Petroleum-Related LUST Cleanups in Illinois, Spring 1990. Interim rept. 194pp.
Key Words: Petroleum, underground storage, water pollution, Illinois, ground wate, manuals, regulaions, storage tanks, leakage, containment, reporting, hazards, surface waters, cost analysis.

Podolsky, R. 1993. Quantification of habitats in Prince William Sound from Landsat thematic mapper satellite imagery. In: Proceedings of the Alaska Univ, Fairbanks, et al Exxon Valdez Oil Spill Symo, February 2 5 1993, Anchorage, Alaska, ABSTR P. 147.
Key words: Alaska, Oil Spill, Prince William Sound

Pogorzelski, Stanislaw J. 1989. Statistics of underwater acoustic signals scattered by the rough water surface covered with a layer of oil substances. Oceanologia. 27:45 60.
Key words: Oil Spill Detection, Remote Sensing
A technique based on the statistical analysis of an acoustic signal scattered on the surface of seawater was examined as a method for detecting oil pollution. Statistical distributions of amplitude of an acoustic signal scattered at a rough water surface covered with various layers of oil substances were studied under laboratory conditions. Statistical parameters describing the distributions are presented in the form of two-dimensional dependences on velocity of an air stream in the measuring tunnel and thickness of the oil film. The relationship between the values of statistical parameters and molecular weight of a fraction was empirically estimated for a range of air stream velocities.

Pogorzelski, Stanislaw J. 1989. Detection of oil-derivative contamination of water surfaces by statistical analysis of scattered acoustical signals. Acoustical Society of America J.

85(6):2383 2387.
Key words: Oil Spill Detection, Remote Sensing
An acoustic, high-frequency, surface-scattering system was demonstrated as effective in detecting changes of an undulated water surface caused by the presence of an oil layer. The detection system consisted of a directional transducer of a narrow transmitting characteristic. Statistical parameters of the distribution of the amplitude of the acoustical signal scattered by the water surface were determined as functions of the speed of the air stream and the thickness of the oil layer. Values of the obtained parameters differ from those expected for scattering on the surface of clean water.

Poile, C.A. 1990. Cleaning up oil spills. Probe Post. 12(3 4):13-15.
Key words: oil spills, oil pollution containment, pollution control, equipment, water pollution
Tackling an oil spill is a question of options, not solutions. This paper discusses collection and cleaning methods available in the event of a spill. One option is the use of dispersants to break up oil into small droplets. These oil droplets sink down below the water's surface and stick to minute particles. The disadvantage is that the mixture of oil and dispersant is more toxic than oil or dispersant on their own, and the organism below the spill gets a greater dose of pollution. Other options include the use of booms, slicklickers, skimmers and absorbent pads to physically remove the oil before it reaches the shore. Once the oil has come ashore, there are three basic types of cleaning strategies that may be used to remove stranded oil. Physical cleaning methods include the use of mechanical equipment such as bulldozers, shovels and loaders, as well as the use of hand tools such as shovels, scrapers, mops, and the use of high-pressure water streams (sometimes using heated water). Chemical methods make use of a variety of solvents designed to lift or remove stranded oil from surface materials on the shore. Since solvents often only partially remove oil from shore materials, chemical cleaning is often combined with physical cleaning techniques. Biological cleaning methods artificially stimulate the degradation of oil by the application of organisms (usually bacteria) to stranded oil. This technique is not widely used because it will only work in certain climatic zones and on certain types of shore environments. In some cases, the best option may be to take no action, because the physical and ecological damage from cleaning efforts can be more severe and persistent than that which would have occurred had there been no cleanup effort. 3 figs.

Poley, Johannes. 1979. Ph. Selective oil spill combat planning for offshore exploration and production operations in the North Sea. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19- 22, 1979., 641- 648. . Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords: Oil Spill, Offshore, Production, North Sea.

Poley, Johannes. 1981. Ph. Tailored oilspill contingency planning for offshore blowouts: a tale of lessons learned. In: Proceedings of the 1981 Oil Spill Conference(Prevention,

Behavior, Control, Cleanup), March 2- 5, 1981., pp. 563- 570. Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - Oilspill, Contingency Planning, Offshore, Blowouts.

Polissi A., G. Bestetti, G. Bertoni, E. Galli, and G. Deho. 1990. Genetic analysis of chromosomal operons involved in degradation of aromatic hydrocarbons in Pseudomonas putida TMB. Journal of Bacteriology. 172(11): 6355-6362.
The catabolic pathway for the degradation of aromatic hydrocarbons encoded by Pseudomonas putida TMB differs from the TOL plasmid-encoded pathway as far as regulation of the upper pathway is concerned. We found, by analyzing Tn5-induced mutants and by Southern blot hybridization with appropriate probes derived from the TOL plasmid pWW0, that the catabolic genes of strain TMB were located on the bacterial chromosome and not on the 84-kb plasmid harbored by this strain.
Key words: pseudomonas putida, catabolism, hydrocarbon, aromatic compound, gene, operon, chromosome, localization, mutation, microorganism culture, southern blotting.

Pollard, S.J., S.E. Hrudey, B.J. Fuhr, R.F. Alex, L.R. Holloway, and F. Tosto. 1992. Hydrocarbon wastes at petroleum- and creosote-contaminated sites: rapid characterization of component classes by thin-layer chromotography with flame ionization detection. Environ Sci Technol. 26(12):2528-2534.
Keywords: biodegradation, disposal, environmental pollution, oil waste, remediation, soil pollution, water pollution, weathering

Pope, Pamela, Al Allen, and William G. Nelson. 1985. Assessment of three surface collecting agents during temperature and Arctic conditions. In Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25-28, 1985. , pp. 199- 202. . Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords: Assessment, Collecting.

Porter, K.S. 1991. Fiscal Year 1990 Program Report: New York State Water Resources Institute. New York State Water Resources Research Inst., Ithaca. 29(p).
Key Words: Research projects, water resources, New York, water pollution, environmental transport, ground water, water quality management, sediments, toxicity, aquatic animals, hazardous materials.

Pothuluri, J.V., J.P. Freeman, F.E. Evans, and C.E. Cerniglia. 1993. Biotransformation of fluorene by the fungus Cunninghamella elegans. Applied and environmental microbiology. 59(6):1977-1980.
Key words: Biodegradation, Microorganism, Hydrocarbon, Bacteria
The metabolism of fluorene, a tricyclic aromatic hydrocarbon, by Cunninghamella elegans ATCC 36112 was investigated. Approximately 69% of the (9- SUP 1 SUP 4 4C) flkuorene added to cultures was metabolized within 120 h. The major ethyl acetate-soluble metabolites were 9-fluorenone (62%), 9-fluorenol, and 2-hydroxy-9-fluorenone (together, 7.0%). Similarly to bacteria, C. elegans oxidized fluorene at the C-9 position of the five-member ring to form an alcohol and the corresponding ketone. In addition, C. elegans produced the novel metabolite

2-hydroxy-9-fluorenone.

Potter, S. G., S. L. Ross, and L. C. Oddy. 1987. The Development of a Canadian oil spill training program. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6- 9, 1987., pp. 577- 582. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Canadian, Oil Spill, Training.

Powell, T.G. 1987. Depositional controls on source rock character and crude oil composition. In: Proceedings of the twelfth world petroleum congress. 31-42.
The initial composition of organic matter in source rocks and their derived oils is related to the nature primary source materials, the extent of their bacterial modification during deposition and the lithology of the source rock. For the various depositional environments in which organic matter accumulates, it is possible to predict the range of kerogen types, oil compositions and biological marker compounds that might be expected. In clastic marine environments Type II kerogens yield paraffinic-naphthenic oils, but as the clastic content diminishes, the sulphur content of the kerogen increases, the threshold of oil generation shifts to lower maturation levels and the oil becomes progressively more asphaltic. In non-marine environments, the oil potential of Type III kerogen depends on the nature of the land flora and the enrichment of oil prone components during bacterial degradation. The latter is favoured under lacustrine conditions where the terrestrial source material may be supplemented by algal and bacterial biomass. High wax oils are formed in such environments. These differences lead to a hydrocarbon generation model based on the depositional conditions of the source rock. Differences in maturation threshold are attributed to difference in activation energy and must be taken into account in the application of geochemical modelling in petroleum exploration.
Key words: petroleum, maturation, kerogen, organic matter, chemical composition, materials, fossil fuels, mineral resources, source rocks, bituminous materials, organic matter, exploration.

Powell, Robert M. 1990. Total organic carbon determinations in natural and contaminated aquifer materials; relevance and measurement. In: Proceedings of the Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:1245-1258.
Key Words: Chemical analysis, pollution, ground water, reclamation, methocs, instruments, oil spills, analysis, characterization, organic carbon, organic materials, aquifers, measurement, soils, geochemistry, carbon, saturated zone, unsaturated zone, volatiles, biodegradation, environmental geology.

Powers, J.K. 1988. Determination of bedrock topography beneath a tank farm using gravity techniques.National Water Well Association, Dublin, OH (US). 597(p):171-180.
Key Words: Gravity surveys uses, ground water contamination, ground water fluid flow, petroleum terminal facilities, terminal facilities water pollution, alluvial deposits, basement rock,

mapping, monitoring, oil spills, petroleum industry, topography, water pollution monitors, water wells, energy sources, fossil fuels, geologic deposits, geophysical surveys, hydrogen compounds, measuring instruments, oxygen compounds.

Prasad, D.Y., and Thomas W. Joyce. 1993. Sequential treatment of E1 stage kraft bleach plant effluent. Bioresour Technol. 44(2):141-147.
Key words: Biodegradation, Hydrocarbons, Bacteria
Two process trains for the destruction of chlorinated organics in kraft bleach plant effluents were evaluated. One treatment scheme employed a rotating biological contactor on which a white rot fungus was immobilized, followed by an anaerobic digester. The second configuration used an aerated lagoon, followed by an anaerobic digester. The fungal/anaerobic digester route was more effective than the lagoon/digester train. The fungus metabolized the chlorinated organics and degraded the chlorolignins, rendering them more amenable to further degradation by bacteria in the digester.

Pratt, D. B. 1987. Fire protection at berths handling bulk flammable liquids and gases. In: Proceedings of the BHRA et al. Fire Eng in Petrochem & Offshore Appl Int Conf, June 23 24, Stratford-Upon-Avon, England. Pp. 35 38.
Key words: Oil Spill, Fire Protection

Premack, Joel and George A. Brown. 1973. Prediction of oil slick motions in Narragansett Bay. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13-15, 1973., pp. 531- 540. Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords: Prediction, Oil Slick, Narragansett Bay.

Premdas, P. D. and B. Kendrick. 1991. The effect of some commercial pesticide carrier formulations on the germination of Pseudoaegerita matsushimae propagules. Canadian Journal of Botany 69(1): 119 122.
Key words: Pesticide, Phytotoxicity, Water Pollution, Surfactant, Oil Spills
Propagules of P. matsushimae, an aero-aquatic hyphomycetous fungus commonly occurring on the surface of woodland ponds, were shown to germinate readily on moist surfaces. Oil emulsions or emulsifiable oil concentrates containing surfactants were up to 30% more toxic than mineral oils which did not contain such additives. The surfactant itself (Tween 80) did not significantly inhibit germination. Our initial studies indicated that aromatic carriers such as xylene or turpentine are highly toxic to P. matsushimae propagules, whereas aliphatic carriers such as kerosene produce no significant reduction of germination.

Preslo, Lynne, Roy F., Michael Miller, Wendell Suyama, and Paul Kostecki. 1988. Remedial technologies for petroleum-laden soils and ground water. In: TAPPI Env Conf, April 18-20, 1988, Charleston, SC, pp. 213-219.
Key words: Groundwater, Oil Spills, Biodegradation, Microorganism, In-situ
Possible remedial technologies available for cleaning up soil and

groundwater containing petroleum products from an underground storage tank leak or other discharges, leaks, and spills are surveyed. Thirteen options, categorized as in situ and non-in situ treatments, have been evaluated. Selection of the most viable option will depend on the site-specific conditions involved. Relative costs and efficiencies are covered for volatilization, biodegradation, vitrification, passive remediation, land treatment, thermal treatment, chemical extraction, and other technologies.

Preston, E.B. 1993. Remote sensing GIS technologies support sea ice motion monitoring. GIS World. 6(1):36-39.
Key words: Oil Exploration, Fishing Industry, Arctic Ocean
Battelle's Ice Data and Forecasting System (IDFS) uses near-real-time satellite data, along with ancillary wind and ocean current data, to produce forecasts of impending ice conditions. ERS-1 SAR imagery will be used to generate high-resolution ice forecasts, which will be ground truthed by scientists working with Battelle's IDFS team. Knowledge gained from the validation efforts will be used to update the ice prediction model as necessary. IDFS's modular nature also lends itself to other applications, such as oil spill monitoring and forecasting. -from Author.

Preus, Paul. 1969. Good salvage operations: key to preventing oil pollution. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969., pp.253 - 256. New York, NY.: Washington, DC: American Petroleum Institute.
Keywords - Salvage, Oil, Pollution.

Prihandoko, T., and Sudradjad A.I. 1992. Environmental control and safety achievement in Arun Natural Gas Co (PT). In: Proceedings of the International Gas Union - International Institute of Refrigeration 10th LNG International Conference (Kuala Lumpur 5/25-28/92) Proceedings N.Spare 2 (1992) 14pp.
Key words: absorbent, absorption, process, accident, activated charcoal, adsorbent, adsorption process, API, association, ate, butane, C3, C4, carbon, carbon dioxide, carbon oxide, charcoal, composition, compounds, concentration, demetallization, diethanolamine, economic factor, effluent, element, full scale, gas, gas treating.

Prince, M., and Y. Sambasivam. 1993. Bioremediation of petroleum wastes from the refining of lubricant oils. Environmental Progress (United States). 12:1:0278-4491.
The results of an initial feasibility study on the bioremediation of sludge are presented. The sludge used in the study was taken from a site containing waste produced during the refining of lubricant oils to which sulfuric acid had been added. The effectiveness of bioremediation was examined using shake flask experiments with indigenous and other bacteria sources and nutrient supplementation. The initial results show limited effectiveness of biological treatment at conditions employing indigenous bacteria and low (2%) sludge concentrations in Bushnell-Haas media. In addition, the indigenous bacteria were seen to degrade the polycyclic aromatic hydrocarbons naphthalene, penanthrene and pyrene which are present at some locations at the

site. No apparent degradation of material was seen using conditions of high
(30%) sludge concentrations in Bushnell-Haas medium under a variety of conditions. In addition, nutrients were rapidly depleted at these sludge concentrations, with the exception of sulfates which were produced when high sludge concentrations were used. 23 refs., 8 figs., 3 tabs.
Key words: petroleum, refineries, pollution, abatement, waste processing.

Prince William Sound. 1991. Prince William Sound threatens Aleutian Shores. Marine Pollution Bulletin. 22(7):320.
Key words: Accidental Fire, Animal, Boom, Combustion, Economic Factor, Pollution Control Equipment

Pritchard, P.H., E.J. O'Neill, and C.M. Spain. 1987. Physical and biological parameters that determine the fate of p-chlorophenol in laboratory test systems. Appl. Environ. Microbiol.(United States). 53:8:1833-1838.
Shake-flask and microcosm studies were conducted to determine the fate of para-chlorophenol (p-CP) in water and sediment systems and the role of sediment and nonsediment surfaces in the biodegradation process. Biodegradation of p-CP in estuarine water samples in shake flasks was slow over incubation periods of 300 h. The addition of detrital sediment resulted in immediate and rapid degradation evidence by the production of /sup 14/CO/sub 2/ from (/sup 14/C)p-CP. The addition of sterile sediment, glass beads, or sand resulted in approximately four to six times more CO/sub 2/ evolution than observed in the water alone. Densities of p-CP-degrading bacteria associated with the detrital sedim.
Key words: compounds, carbon oxides, chalcogen, chemical reaction, decomposition, halogenated, compounds, surface wastes, chlorine compounds, organic halogen compounds, oxygen compounds, pollution, surface waters.

Pritchard, P.H. 1990.Bioremediation of oil contaminated beach material in Prince William Sound, Alaska. American Chemical Society, Division of Environmental Chemistry, Preprints (USA). 30:1:0093-3066.
The Office of Research and Development within the Environmental Protection Agency has been evaluating bioremediation to help clean up beaches in Alaska's Prince William Sound following the March 24, 1989 Exxon Valdez oil spill. Bioremediation techniques have been used elsewhere to accelerate the natural biological degradation of environmental contaminants. The purpose of EPA's project was to determine the best bioremediation approach for the oil contaminated shoreline of Prince William Sound. The major portion of the EPA study, therefore, has been a field demonstration to determine if nutrient (fertilizer) addition to contaminated beaches will effectively stimulate hydrocarbon breakdown by indigenous bacteria. Concurrently, a monitoring program has been instituted to check for any possible adverse environmental effects from nutrient addition. Techniques of applying nutrient mixtures to the beaches have been investigated.
Key words: oil spills, biodegradation, data analysis, measuring methods, pollutants, proceedings.

Pritchard, Ken and Betsy Peabody. 1989 . Washington oiled bird rescue: a model for a statewide system. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., 584. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Washington, Bird.

Pritchard, P.H. 1988. Fate of Pollutants (Journal Version). Pub. in Jnl. of the Water Pollution Control Federation, 60(6):983 994.
Key words: pollution, hydrocarbons, water pollution
Published literature on the environmental fate of pollutants published during 1987 are reviewed. Short excerpts are presented from each reference covering such areas as photolysis, biodegradation, hydrolysis, sorption, and volatility for pollutants including pesticides, hydrocarbons, heavy metals, polynuclear hydrocarbons, and other toxic organic chemicals.

Pritchard, P.H., and C.F. Costa. 1991. EPA'S Alaska oil spill bioremediation project. Environ Sci Technol. 25(3):372-379.
Key words: Bioremediation, Alaska, Bacteria, Biodegradation, Oil Spill, Prince William Sound, Groundwater, Soil Pollution, Water Pollution

Pritchard, P.H. 1993. Measures of bioremediation effectiveness in the field. In: Proceedings of the Symposium on Bioremediation and Bioprocessing presented at the 205th National Meeting of the American Chemical Society, Denver, CO. Preprints Division of Petroleum Chemistry, American Chemical Society, 38(2):238.
Key words: biodegradation, monitoring, oil spills, microbiology, bioremediation, Exxon Valdez
The application of bioremediation to the cleanup of hazardous waste chemicals requires that the role of biodegradation be clearly delineated. Definitive determinations of biodegradation and consequently measures of bioremediation effectiveness, are relatively straight forward at the level of the laboratory and pilot scale studies. At this level, appropriate controls and mass balance approaches can be incorporated into the experimental design. In field application, however, measuring effectiveness is a more complicated undertaking; often the cleanup of a contaminated site is erroneously attributed to biodegradation processes because proper effective control measures were not performed. The potential errors can greatly slow technology development and thus considerable research is needed to perfect and refine measures of bioremediation effectiveness. Special assessments of biodegradation are required that use sophisticated chemical analyses and biological monitoring techniques. Examples will be discussed using the field experiences in oil and creosote bioremediation that have been supported by the Bioremediation Research Program in the EPA. In the bioremediation of oil-contaminated beach material from the Exxon Valdez oil spill in Prince William Sound, Alaska, measures of decay rates to convince critics that chemical washing effects from certain fertilizers were not occurring. Substantial field analyses are required, as they will be in many other types of bioremediation applications. Supplemental measurements of oil mineralization rates, nutrient uptake rates, microbial biomass, and stable isotopes further substantiated the role of biodegradation. New

developed and incorporated into future assessments of effectiveness in bioremediation procedures. In addition, protocols for evaluating the usefulness of biodegradation processes for bioremediation under study conditions that mimic the field must also take into account appropriate measures of effectiveness. (Author abstract).

Proctor, P. 1992. Japan plans new generation of remote sensing satellites. Aviation Week & Space Technology 137(2):66.
Key words: Synthetic Aperture Radar, Remote Sensing, Japan
Stereographic image of Mt. Akagi area, in the center of Japan's main island of Honshu, is based on computer terrain modeling data and images from JERS-1 satellite sensors. Photograph JERS-1 synthetic aperture radar details Japan's Shimokita Peninsula, at the northern tip of Japan's main Honshu island. Individual piers and a 62-ft.-wide ship are shown.

Prosen, B. J., W. M. Korreck and J. M. Armstrong. 1991. Remedial technology for contaminated natural gas dehydrator sites. In: Proceedings of Petro-Safe '91: 2nd International Environmental and Safety Conference and Exhibition for the Oil, Gas, and Petrochemical Industriesm, Feb. 6 8, Houston, TX. Pp. 983 996.
Key words: Remedial Action, Water Pollution, Biodegradation
Groundwater ess of discharging condensate to the ground was stopped. Many oil and gas well sites had become impacted from the process during this time. Although condensate is no longer discharged to the ground, soil and water contamination still remains at many of these sites. In the last few years, the Michigan Department of Natural Resources has targeted over 90 well sites for assessment of contamination associated with gas dehydration. The results of many of these assessments indicate that soil and groundwater have been impacted, and the State of Michigan has mandated cleanup of these sites. Remedial technologies which have been used to contain and/or clean up the sites include excavation and product removal, soil venting, purge and treat, and enhanced biodegradation. This paper is a discussion of the technology, implementation, and results from each of these methods.

Psaraftis, Harilaos and J. D. Nyhart. . Strategic planning for large and small oil spills in New England. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., 645. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Planning, Oil Spill, New England.

Pullen, R.M. 1992. Some effects of clay particles on the microbial degradation of naphthalene. University of Tennessee, Dissertation, :180p. (1992) Dissertation Abstracts International: Section B Science & Engineering (ISSN 0419-4217) V53 N.11 5873-B-5874-B (May 1993) (Order from University Microfilms International as No. DA9306676).
Key words: abstract, adsorption, analytical method, biodegradation, boundary layer, diffusion, fluid flow, naphthalene, composition, clay content, inhibition, inorganic solvent, luminescence.

Putnam, W. H. 1977. A workshop for defining the role of local governments in oil spill response. In Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., 125 - 128. New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Governments, Oil Spill, Response.

Putnam, W. H. 1971. Causes of oil spills from ships in port. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 - 17, 1971., 199 - 204. Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spills, Ships, Port.

Putukian, John, and Robert R. Hiltabrand. National contingency plan product schedule data base. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 824. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - National Contingency Plan, Data Base.

Quina, Christopher L. 1987. Containment and cleanup of a major oil well blowout in Texas. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., 39 - 42. Baltimore, MD.: Washington, DC: American Petroleum Institute.
Keywords - Cleanup, Oil, Blowout, Texas.

Quinquis, J. J. 1985. Cleaning rocks and coastal structures. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp. 637. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Cleaning, Rocks, Coastal.

Rabus, R., and Widdel, F. 1993. Complete oxidation of toluene under strictly anoxic conditions by a new sulfate-reducing bacterium. Applied and Environmental Microbiology (United States). 59:5:0099-2240.
Anaerobic degradation of aromatic hydrocarbons has long been questioned. However, studies with anaerobic enrichment cultures have demonstrated that aromatic *hydrocarbons* were degraded without O[sub 2] and that oxygen in phenolic compounds formed as intermediates was derived from H[sub 2]O. This paper reports the isolation of a pure culture of a novel marine sulfate-reducing bacterium that anaerobically degrades an aromatic *hydrocarbon*, toluene. The consumption of hypothetical intermediates was studied to determine possible starting reactions of toluene *degradation* by the new isolate. 36 refs., 7 figs., 1 tab.
Key words: anaerobic, biodegradation, biological pathways, toluene.

Raddell, C.F., and G.M. Gibbons. 1991. Environmental management of pipeline releases. In: Proceedings of the API pipeline conf, April 23 24 1991, Dallas, TX, pp. 471 513.
Key words: Pipeline Leak, Environmental Pollution, Pollution Control, Bioremediation, Economic Factor, Petroleum, Natural Gas

Radecki, Edward A., Charlton Matson, and Michael R. Brenoel. 1987. Enhanced natural degradation of a shallow hydrocarbon contaminated aquifer. Haztech Intl (Pudvan) Conf, St Louis. pp. 331-341.
Key words: Hydrocarbons, Groundwater, Biodegradation, Microorganism,

Bacteria, Michigan
The success of a groundwater bioreclamation project in Michigan is summarized. The site is characterized by a shallow unconfined aquifer with a considerable dissolved hydrocarbon plume covering over 1.5 acres. In early 1985, monitoring wells were installed and a recovery system was implemented to rehabilitate the gasoline-tainted water resource. Hydrogeological and other studies indicated the utility of in situ bioreclamation. A well-established population of aerobic, hydrocarbon-utilizing bacteria was stimulated by pre-aerating infiltration water and by direct well sparging. The degradation of the hydrocarbons by the resultant biomass has resulted in a reduction in excess of 100 gal of gasoline in 12 weeks of operation.

Raible, R.L., and J.L. Loggains. 1989. Oil Spill Cleanup Compositions. Patent No. US 4925343, 16 pp.
Key words: absorbent, cellulose, collecting agent, oil spill, oil water separation, physical separation, sorbent, wood, (p) USA, biodegradation, byproduct, cleaning, composition, contamination, control, data, decontaminating, disposal, environment, fiber, lake, lipophilic, metabo lic behavior, mixture, multicomponent mixture, natural resin, ocean, ocean environment, oil waste, organic, physical property, pollution control, polymer, polysaccharide, product, sea, soil (earth), soil pollution, surface property, table (data), terrestrial environment, waste disposal, waste material, water pollution, wettability, ecology & pollution

Rainwater, Ken, Mary P. Mayfield, Caryl Heintz-Wyatt, and Billy Claborn. 1989. Laboratory studies of the effects of cyclic vertical water table movement on in situ biodegradation of diesel fuel. Natl. Water Well. Assoc., Dublin, OH, United States. 673-685.
Key Words: Ground water, pollution, geochemistry, effects, in situ, water table, transport, laboratory studies, biodegradation, bacteria, unsaturated zone, soils, oil spills, microorganisms, creosols, phenols, organic materials, aquifers, permeability, anaerobic environment, environment, distribution, surveys, underground storage, processes.

Raj, P. K. 1993. A graphics-based oil spill tracking and coastal impact model for contingency planning. In: Proceedings of the International Oil Spill Conference: Prevention, Preparedness, Response. Biennial International Conference on the Prevention, Behavior, Control and Cleanup of Oil Spills, Tampa, FL, March 29 April 1. American Petroleum Institute: Washington, DC, pp. 817 819.
Key words: Oil Spills, Trajectories, Remedial Action, Computerized Simulation The US Coast Guard's (USCG) Marine Safety Office (MSO) in each port has the responsibility to perform detailed contingency planning to respond to oil and hazardous material releases in water. Contingency planning involves consideration of a vast amount of diverse data, such as traffic (shipping) volumes, historical spills, and locations of ecologically sensitive areas. Spill simulation models are generally used to identify potential danger areas to the public or the environment. Noting that a desk-top computer is a very effective tool in planning and management, the USCG initiated an effort in the late 1980s to develop a software system, called the Spill Response Information System (SRIS), to provide ports the ability to perform contingency planning using graphic displays of port areas, spill simulation models, and several port-specific databases. One of the simulation models included in the SRIS is the oil spill trajectory model. The principal purpose of this

model is to evaluate potential oil impact areas under a variety of assumptions about spill locations, spill quantities, tidal phases, weather, and seasons. Such a simulation model will provide a basis for optimally locating response personnel and equipment. This paper describes the features of this module.

Raj, Phani P. K. and Richard A. Griffiths. 1979. The Survival of oil slicks on the ocean as a function of sea state limit. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., pp. 719 - 724. . Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil Slicks, Ocean.

Raloff, Janet. 1993. Cotton, Fleece, and Beads: Sopping Up Oil with Unconventional Sponges. Sci News. V143, n21, p332(2).
Research is under way to develop fly ash and poor-quality cotton and fleece as oilspill-eating materials. Titanium dioxide-treated microscopic glass bubbles have been shown to bind hydrocarbons and decompose them into carbon dioxide and water. In theory, these beads could eliminate their weight in oil each hour. When sufficient quantities become available, field tests will be undertaken, using the beads to clean up hydrocarbons in industrial waste ponds. Ingestion of the beads by birds and other animals may have toxic consequences, but this remains to be evaluated. A separate research efforts involves theuse of waste cotton fibers as sorbents for spilled hydrocarbons. The fibers meet or exceed the absorbency of materials currently marketed to sop up spilled oil, but unlike the synthetic materials, the wooland cotton fibers are biodegradable. The oil could then be separated from the fibers, treated, and reused. Full text available from Congressional Information Service. 2 photo(s)
Key words: oil spill cleanup, hydrocarbons-water, cotton, flyash, titanium dioxide, adsorption, water pollution control, separation processes, technology planning, biodegradation-microorganism, decomposition, water pollution research

Ramamurthy, V. D. 1991. Effects of oil pollution on bio ecology and fisheries on certain enclosed coastal regions of Arabian Sea. Marine Pollution Bulletin. 23:239-245.
Key words: Oil, Arabian Sea, Degradation, Fish
The enclosed regions of inlets were heavily exposed to the crude oil pollution by tankers. The degradation of oil involved both bacterial utilisation and partial dissolution. The low boiling saturated hydrocarbon fractions of crude oil caused mortality in a wide variety of fish and shrimp fry. The hydrocarbon content of Indian seafood ranges from 0.6-3.0mg/kg wet wt. -from Author.

Ramaswami, A., S. Ghoshal and R. G. Luthy. 1992. Dissolution and biodegradation of PAH compounds from coaltar at residual saturation in porous media. In: Proceedings of Special Symposium on Emerging Technologies for Hazardous Waste Management, Sept. 21 23, Atlanta, GA. American Cancer Society (ACS): Washington DC, pp. 463 466.
Key words: Oil Spills, Decontamination, Remedial Action, Water Pollution
Soil and groundwater contamination by organic-phase compounds is a widespread phenomenon which may result from the production and processing of industrial solvents, liquid petroleum products, coal gas, etc. This paper reports on the organic-phase compounds that enter the sub-surface from such sources which are often sparingly soluble in water and exist as

separate Non-Aqueous Phase Liquids (NAPLs). Many NAPLs such as gasoline and coaltar are multi-component and are composed of a broad range of organic compounds. Groundwater contamination by NAPLs occurs in different modes, and depends on the physical characteristics of the NAPL and the porous medium. On a macroscopic scale, blobs or ganglia of NAPL may be held immobile in the aquifer matrix, partially saturating the pore spaces between soil particles, while on a microscopic scale the NAPL may be imbibed within the micropores of soil particles and aggregates. The presence of NAPLs at residual saturation in the soil and subsurface media may represent a continuous long-term source of organic contamination to groundwater.

Ramos, J.L., and K.N. Timmis. 1987. Experimental evolution of catabolic pathways of bacteria. Microbiol. Sci. 4(8):228 237.
Key words: soil, catabolism, bacteria, biodegradation
Experimental evolution of catabolic pathways offers considerable potential for accelerating the evolution of bacteria able to degrade toxic industrial chemicals, and this may be useful for combatting environmental pollution. The principal strategies that have been successfully followed to evolve useful catabolic routes for aromatic compounds in soil bacteria are analysed.

Ramshaw, C. 1987. A discussion covers the opportunities for exploiting centrifugal fields. Chem. Eng. 437:17-21.
Key words: Crude Oil, Economic Factor, Pollution Control

Rand, R.S., M.B. Satterwhite, D.A. Davis, and J.E. Anderson. 1992. Methods of monitoring the Persian Gulf oil spill using digital and hardcopy multiband data. Technical report, January-July 1991. Report No. AD-A-257301/2/XAB, 47 pp.
Key words: Oil Spill Monitoring
A quick response demonstration was performed during the Persian Gulf War that showed a capability to monitor the path of oil dumped into the bay near Kuwait City using commercial satellite imagery. Both manual and semi-automated methods of image analysis were performed on AVHRR and Landsat TM imagery. Estimates of the oil area coverage were obtained using conventional classification methods. A hardcopy generation and reproduction capability was also demonstrated.

Rangel, E.J., and J.D. Lindsay. 1990. Aboveground tank regulations spread. Amer Oil Gas Reporter, 33(5):58,60,111.
Key words: Aboveground Storage Facility, Economic Factor, Oil Spill, Contingency Planning, Petroleum, Remote Sensing

Rappaport, Allen, Louis H. Zincone, Jr., and Peter Fricke. 1981. The media and oil spills: does the press cause damage perceptions? In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 704 - 714. Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - Oil Spills, Press, Damage.

Rasche, M.E., M.R. Hyman, and D.J. Arp. 1991. Factors limiting aliphatic chlorocarbon degradation by Nitrosomonas europaea: Cometabolic inactivation of ammonia monooxygenase and substrate specificity. Applied and Environmental Microbiology (United States). 57:10:2986-2994.
The soil nitrifying bacterium Nitrosomonas europaea is capable of degrading trichloroethylene (TCE) and other halogenated hydrocarbons. TCE

cometabolism by N. europaea resulted in an irreversible loss of TCE biodegradative capacity, ammonia-oxidizing activity, and ammonia-dependent O{sub 2} uptake by the cells. Inactivation was not observed in the presence of allylthiourea, a specific inhibitor of enzyme ammonia monooxygenase, or under anaerobic conditions, indicating that the TCE-mediated inactivation required ammonia monooxygenase activity. When N. europaea cells were incubated with ({sup 14}C)TCE under conditions which allowed turnover of ammonia monooxygenase, a number of cellular proteins were covalently labeled with {sup 14}C. Treatment of cells with allylthiourea or acetylene prior to incubation with ({sup 14}C)TCE prevented incorporation of {sup 14}C into proteins. The ammonia-oxidizing activity of cells inactivated in the presence of TCE could be recovered through a process requiring de novo protein synthesis. In addition to TCE, a series of chlorinated methanes, ethanes, and other ethylenes were screened as substrates for ammonia monooxygenase and for their ability to inactivate the ammonia-oxidizin system of N. europaea. The chlorocarbons would be divided into three classes depending on their biodegradability and inactivating potential: (1) compounds which were not biodegradable by N. europaea and which had no toxic effect on the cells (2) compounds which were cooxidized by N. europaea and had little or no toxic effect on the cells; and (3) compounds which were cooxidized and produced a turnover-dependent inactivation of ammonia oxidation by N. europaea.
Key words: chlorinated aliphatic hydrocarbons, toxicity, ammonia.

Rasche, Madeline E., Michael R. Hyman, Daniel J. Arp. 1990. Biodegradation of halogenated hydrocarbon fumigants by nitrifying bacteria. Applied & Env Microbiology. 56(8):2568-2571.
Key words: Biodegradation, Microorganism, Bacteria, Degradation
The ability of three nitrifying bacteria to degrade the halocarbon fumigants methyl bromide, 1,2-dichloropropane, and 1,2-dibromo-3-chloropropane was evaluated. The soil nitrifiers Nitrosomonas europaea and Nitrosolobus multiformis degraded all three fumigants. Nitrosococcus oceanus, a marine nitrifier, degraded only methyl bromide. Inhibition of biodegradation by allylthiourea and acetylene, specific inhibitors of ammonia monooxygenase, indicates that ammonia monooxygenase is the enzyme catalyzing fumigant degradation.

Ravikumar, Joseph X. 1990. In-situ enhancement of biodegradation of hazardous chemicals by chemical oxidation. In: Proceedings of the 1990 Specialty Conference, July 8 11, Arlington, VA, pp. 913 914.
Key words: biodegradation, soils, microorganisms
This study examines the efficacy of enhancing biodegradation of recalcitrant chemicals in the soil through the application of a chemical oxidant. The objectives of this study are (i) to demonstrate the feasibility, and (ii) to determine the optimum conditions for the enhancement of microbial degradation through partial oxidation by hydrogen perioxide in the presence of iron salts and nutrients. Pentachlorophenol and trichloroethylene have been examined as model compounds. (Edited author abstract).

Ravikumar, J. X. and M. D. Gurol. 1990. In-situ chemical oxidation of hazardous compounds in soil. In: Hazardous and Industrial Wastes. Proceedings of the 22nd Mid-Atlantic industrial waste Conference, July 24 27, 1990, Philadelphia, PA, pp. 57 64.
Key words: Disposal, Groundwater, In-Situ, Soils, Waste Management
Inadequate or improper disposal of hazardous chemicals has resulted in considerable contamination of soil and groundwater. Considerable concern

persists over the contamination of the vadose zone, the region of primary impact of a spill, for fear of contamination of the underlying aquifer due to infiltration. Although adsorption onto soil surfaces or retention in the pores can temporarily mitigate the immediate danger of contamination of the groundwater, it is desirable to remediate the soil before the contaminants can migrate and contaminate any aquifer. Biological treatment can transform some of these compounds to innocuous end products. Many compounds, however, persist either due to the low rate of biodegradation or recalcitrance. This paper examines the efficacy of chemical oxidation for the treatment of biorefractory chemicals in soil. Hydrogen peroxide was utilized as the chemical oxidant in this study. Pentachlorophenol (PCP) has been examined as a model compound in soil-packed columns in the author's laboratory. Preliminary results of the author's study indicate that application of hydrogen peroxide helped to achieve significant removal of PCP from soil.

Rawson, S.A., J.C. Walton, R.G. Baca.1989. Modeling potential migration of petroleum hydrocarbons from a mixed-waste disposal site in the vadose zone. National Water Well Association, Dublin, OH (US). 698(p):357-371.
Key Words: Ground water flow models, oil spills land pollution abatement, oil spills water pollution abatement, chlorinated alicyclic hydrocarbons, computerized aliphatic hydrocarbons, chlorinated aromatic hydrocarbons, computerized simulation, environmental transport, Idaho National Engineering Laboratory, monitoring, petroleum remedial action, waste disposal, water pollution monitors, energy sources, fossil fuels, halogenated alicyclic hydrocarbons, halogenated aliphatic hydrocarbons, halogenated aromatic hyrdrocarbons, hydrogen compounds, management, mass transfer, mathematical models, measuring instruments, national organizations, organic chlorine compounds, organic compounds, organic halogen componds, pollition abatement, simulation US DOE, US ERDA, US Organizations, waste management.

Reddy, K.J., V.R. Hasfurther, J.I. Drever. 1991. Effects of a CO2 pressure process on the solubilities of major and trace elements in oil shale solid wastes. Environ Sci Technol (1991): 25.
Key words: disposal, oil, recovery

Reed, Mark, Eric Anderson, Katherine Jayko, Eoin Howlett, Tatsu Isaji, and Malcom Spaulding. 1992. ASAP: a State of the Art Oil Spill Model for Worldwide Application. In: Proceedings of the Environ Canada Proc 15th Arctic & Marine Oil Spill Program Tech Semin, June 10 12 1992, Edmonton, AB, 143 146.
Key words: Oil Spill Analysis, Mathematical Models, Emergency Planning, Oil Spill Cleanup, Computer Applications
A consortium of major oil companies, US and Canadian government agencies, the Canada Petroleum Assoc, and other organizations has developed a state-of-the-art oil spill model system called ASAP for contingency response and spill planning. ASAP predicts and simulates marine spill trajectories anywhere in the world and develops several response scenarios for users to evaluate. The model will be completed in 1993 and will be able to run on personal and lap-top computers. Capabilities, the graphical interface, the spill fate model, and trajectory forecasting are summarized. A hypothetical user session is outlined.

Reed, T.B., and W.L. Mobeck. 1991. Adsorbent may make clean sweep of oil spills. Chemical Engineering Progress. 87(5):12-13.

Key words: Adsorbent, Adsorption Process, Biodegradation, Crude Oil, Pollution Control, Spill

Reed, M., C. Turner, A. Odulo, and T. Isaji. 1990. Field test of satellite-positioned drifters for oil spill simulation and tracking. In: Proceedings of the 13th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 6 8 1990, Edmonton, Canada, pp. 329-360.
Key words: Tracking System, Remote Sensing, Contamination, Environmental Pollution

Reed, Thomas B., and William L. Mobeck. 1992. Floating materials from wood for absorbing oil or hydrocarbons.
Patent No. US 5110785_A, 7 pp.
Key words: Petroleum Products, Oil Spills, Absorbents

Reed, W. E. 1977. Petroleum and anthropogenic influence on the composition of sediments from the southern California bight. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977.,pp. 183 - 188. New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Petroleum, Anthropogenci, Sediments, California, Bight.

Reed, Mark, Deborah French, and R. I. Narragansett. 1991. A Natural Resource Damage Assessment Model and Geographical Information System for the Great Lakes. Environ Canada Chemical Spills 8th Technical Semin, June 10 11, Vancouver, BC, p. 1
Key words: Oil Spills, Great Lakes, Environmental Impact Assessment
A coupled geographical information system (GIS) is the basis for a model of the physical transport, biological consequences, and economic effects of an oil or chemical spill. The model, which accommodates various biological habitats, hydrological regimes, and wind-driven hydrodynamics common to lakes and shorelines, has been applied to the Great Lakes and associated rivers, but is applicable to any freshwater or marine environment. For use on a microcomputer, the model will be incorporated into the US federal regulatory framework.

Reed, M., and E. Gundlach. 1989. Coastal interaction processes in the minerals management service coastal zone oil spill model. In: Proceedings of the API et al Oil Spill (Prev, Behav, Contr, Cleanup) 20th Anniv Conf, Feb 13-16, 1989, San Antonio, TX, pp. 539-545.
Key words: Oil Spill, Model, Computer, Grpundwater, Soil Pollution, Water Pollution

Reed, M., K. Jayko, A. Bowles, E. Anderson, and S. Leatherwood. 1987. Computer simulation of the probability that endangered whales will interact with oil spills. Hubbs Marine Research Inst., San Diego, CA.^Minerals Management Service, Anchorage, AK. Alaska Outer Continental Shelf Office. Report No. ASA-84-35, 303 pp.
Key words: Animal Migrations, Whales, Mathematical Models, Oil Pollution
A numerical model system was developed to assess quantitatively the probability that endangered bowhead and gray whales will encounter spilled oil in Alaskan waters. Bowhead and gray whale migration and diving-surfacing models, and an oil spill trajectory model comprise the system. The migration models were developed from conceptual considerations, then calibrated with and tested against observations. The movement of a whale point is governed by a random walk algorithm which stochastically follows a migratory pathway. The oil spill model, developed

under a series of other contracts, accounts for transport and spreading behavior in open water and in the presence of sea ice. Historical wind records and heavy, normal, or light ice cover data sets are selected at random to provide stochastic oil spill scenarios for whale-oil interaction simulations.

Reed, M., C. Turner, A. Odulo, and T. Isaji. 1991. Field test of satellite tracked buoys to simulate oil drift. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 619-628.
Key words: Oil Spreading, Oil Spill, Crude Oil, Remote Sensing

Reed, Mark, Malcolm L. Spaulding, and Saul B. Saila. 1983. Assessing the impacts of oil spills on Georges Bank fisheries. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., 579. . San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Impacts, Oil Spills, Georges Bank, Fisheries.

Reed, M., C. Turner, and J. Price. 1993. Implications of observations of intentional oil spills. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993. , 617 - 622. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Observations.

Reed, Mark and Erich Gundlach. 1989 . Coastal interaction processes in the minerals management service coastal zone oil spill model. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., 539 - 546. . San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Coastal Interaction, Minerals, Management, Oil Spill.

Reetz, Gordon. 1988. California sea otter: Impact assessment and mitigation. In: Proceedings of the Oceans '88: Proceedings - a Partnership of Marine Interests, October 31 November 2 1988, Baltimore, MD, p. 966 971.
Key words: Water Pollution, Oil Spills, Ecosystems, Petroleum Industry
Oil-containment-equipment effectiveness and some of its limitations in the California sea otter range are examined. Oil-spill occurrence probability is cited and the types of equipment available within 24 h to points within the California sea otter range are examined. Using data compiled in a US Minerals Management Service study, the percent of time this equipment could be deployed and effectively used under sea and weather conditions typical to the sea otter range is estimated. 18 Refs.

Reeve, A. 1990. Setting the scene for sensing technology. Control and Instrumentation 22(Dec):40. Key words: Sensors

Refae, R.I. 1992. Factors influencing the biodegradation of volatile chlorinated hydrocarbons and aromatic compounds in soil at the Eppelheim site. Soil Decontamination Using Biological Processes.
(1992): 6 9 December 1992.
Key words: bacteria, hydrocarbon, degradation
Studies in the Eppelheim dump consider physico-chemical and nutrient conditions, effects of pH, temperature and co-substrates on anaerobic chloroethylene conversion, and microorganisms for reductive dehalogenation. The autochthonous microflora proved rather inactive.

Sucrose is required as co-substrate. CHC degradation activity is attributed predominantly to methanogenic bacteria. Paper given at Int. Symp. Soil Decontamination using Biological Processes.

Reidy, P.J., W.J. Lyman, D.C. Noonan. 1990. Assessing UST corrective-action technologies: Early screening of clean-up technologies for the saturated zone. Report for June 1988-February 1990. Camp Dresser and McKee, Inc., Boston, MA (USA). 135(p).
Key Words: Ground water contamination, petroleum products environmental transport, soils contamination, environmental impacts, land pollution, manuals, oil spills, remedial action, site surveys, water pollution, document types, hydrogen compounds, mass transfer, oxygen compounds.

Reimer, Ernest M. 1981. Anticipated oil dispersion rates in pack ice. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 199 - 202. . Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - Oil Dispersion.

Reimer, E.M., J.R. Rossiter. 1987. Measurement of oil thickness on water from aircraft: pt.1: active microwave spectroscopy (and) pt.2 : electromagnetic thermoelastic emission. Can Environ Stud Res Funds Report No. 078, 89 pp.
Key words: Oil Spill, Crude Oil, Petroleum, Experimental Data, Offshore Equipment, Remote Sensing

Reindl, Wilhelm, and Williams, Doil. 1993. Manufacture of oleophilic scrap rubber particles for sorption of spilled oil. Patent No. US 5180704_A, 13 pp.
Key words: Tires, Scrap, Crude Oil

Reis, J.C. 1992. Meeting the environmental challenge : a univeristy approach. Texas Univ, Austin, TX. SPE Unsolicited PAP NO SPE-24410, 18p.
Key words: Pollution Control, Groundwater, Oil Spill, Soil Pollution, Water Pollution

Reiter, Lt. G. A. 1981. Cold weather response, f/v RYUYO MARU NO. 2, St. Paul, Pribilof Islands, Alaska. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 227 - 232.

Reuter, R., and T. Hengstermann. 1988. Untersuchungen zur flugzeuggetragenen Laser-Fernerkundung fuer die Vermessung von Oelverschmutzungen der Deutschen Bucht. Abschlussbericht. (Studies on airborne remote laser sensing for the purpose of oil spill detection in the German Bight. Final report). In: Ministerium fuer Wissenschaft und Kunst des Landes Niedersachsen, Hannover (Germany, F.R.), 17 pp.
Key words: Remote Sensing, Oil Spills
The optical spectroscopy of organic substances can also be applied from airplanes since efficient pulsed lasers have been developed. The method of remote sensing by laser derived therefrom allows a specific detection of naturally occurring as well as artificially introduced organic substances in the sea on the basis of the characteristic fluorescence of these substances. A special advantage is that this detection can be carried out both in daylight and in the darkness as it is not the sunlight that serves as a signal source, but laser irradiation. The investigations in the framework of the documented project have shown that, compared to

measuring instruments applied in monitoring airplanes already today, the laser fluorosensor can above all be used for the analysis of controlled discharges of mineral oil as they occur due to marine transport or offshore production. Moreover various factors which are relevant for hydrography and marine biology and important for future monitoring programs can be determined by means of this method from an airplane. (orig./RHM). (TIB: AC 1000(34,54).) (Copyright (c) 1990 by FIZ. Citation no. 90:080606.)

Reuter, R. 1991. Laser-fluoro-sensor (Laser Fluorosensor). In: Mbb Euromar-Seastars: A Definition Study on Modular Multisensor Instrumentation for Airborne Remote Sensing of the Sea 25 p. Key words: Laser Induced Fluorescence, Oil Spill, Remote Sensing, Water Pollution It is shown that the laser fluorosensor allows a measurement of the volume of films on the sea surface and a classification of the substance type, so that parameters which are relevant for the evaluation of ecological conditions can be obtained. Particular emphasis is put on the capability for two-dimensional mapping of the sea surface, to allow an optical probing on small geometrical scales. The XeCl laser which is used for the analysis of oil spills is described. A dye laser enables an efficient excitation of chlorophyll fluorescence. The main system parameters are summarized.

Revill, A.T., M.R. Carr, and S.J. Rowland. 1992. Use of oxidative degradation followed by capillary gas chromatography-mass spectrometry and multi-dimensional scaling analysis to fingerprint unresolved complex mixtures of hydrocarbons. Plymouth Devon, United Kingdom. Journal of chromatography. 589(1-2): 281-286. Key words: hydrocarbon, multicomponent mixture, chemical composition, analysis method, organic geochemistry, petroleum source rock, pollution, sediments, biodegradation, bacteria, weathering, pollution source, gas chromatography, mass spectrometry, oxidative degradation, data processing, sampling distribution, statistical analysis. I

Rewick, R.T. 1981. An Evaluation of oil spill dispersant testing requirements. In: Proceedings of the 1981 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 5 - 10. Atlanta, GA. : Washington, DC: American Petroleum Institute. Keywords - Oil Spill, Dispersant.

Reynders, M.P., P. Stegmann, R.W. Hiley, R.E. Penfold, and J.F. Pedley. 1988. Biological monitoring and control strategy for large diesel fuel storage facilities. In: Proceedings of the Third international conference on stability and handling of liquid fuels. Conference proceedings. 137-150. Large diesel fuel storage containers are subject to microbiological related problems, i.e. biofouling biocorrosion and degradation of the fuel. Micro-organisms are able to use diesel fuel as carbon and energy source. Four fungi and nineteen bacteria species were isolated from contaminated diesel fuel and blocked filters, all proved to be primary users of diesel fuel. Two bacteria species specifically were found to be the most common cause of microbial induced filter blockages due to their ability to form spores and to inhibit the growth of other hydrocarbon utilizing micro-organisms. It was shown that one of these was capable of excreting a gummy substance which was able to rapidly block fuel filters. Factors which contribute to the development of a biological treatment strategy are the presence of water with readily available nutrients and carbon source within the tank, cost of treatment

and operational considerations. The use of a water soluble biocide treatment program in these storage facilities has proved successful and has prevented the establishment of a food chain which can cause the blockage of fuel filters, the corrosion of containers, pipelines and meters and the degradation of the fuel.
Key words: diesel fuels, biodegradation, antimicrobial agents, bacteria, corrosion, monitoring, tanks, petroleum, microorganisms, anti-infective agents, chemical reactions.

Reynolds, R.L., M.B. Goldhaber, M.L. Tuttle. 1991. Sulfidization and magnetization above hydrocarbon reservoirs. AAPG Bulletin (American Association of Petroleum Geologists). 75:3:0149-1423.
Geochemical and rock magnetic studies of strata over Cement oil field (Anadarko basin, Oklahoma), Simpson oil field (North Slope basin, Alaska), and the Edwards deep gas trend, south Texas coastal plain, document changes in original magnetizations caused by postdepositional iron sulfide minerals that are, or may be, related to hydrocarbon seepage. At Cement, ferrimagnetic pyrrhotite (Fe{sub 7}S{sub 8}) formed with pyrite and marcasite in Permian red beds. The Fe-S minerals contain isotopically heavy, abiogenic sulfur derived from thermal degradation of petroleum and (or) isotopically light sulfur derived from sulfate-reducing bacteria fed by leaking hydrocarbons. At Simpson, ferrimagnetic greigite (Fe{sub 3}S{sub 4}) dominates magnetizations in Upper Cretaceous nonmarine beds that contain biodegraded oil. Sulfur isotopic data are consistent with, but do not prove, a genetic link between the greigite ({delta}{sup 34}S {gt} +20 per mil) and seepage. In middle Tertiary sandstones of southeast Texas, pyrite and marcasite formed when abiogenic H{sub 2}S migrated upward from deep reservoirs, or when H{sub 2}S was produced at shallow depths by bacteria that utilized organic material dissolved in migrating water from depth. The sulfide minerals replaced detrital magnetite to result in a systematic decrease in magnetic susceptibility toward faults that connect deep petroleum reservoirs to shallow sandstone. The authors results show that abiologic and biologic mechanisms can generate magnetic sulfide minerals in some sulfidic zones of hydrocarbon seepage. The magnetizations in such zones are diminished most commonly by replacement of detrital magnetic minerals with nonmagnetic sulfide minerals or are unchanged if such detrital minerals were originally absent. Key words: Alaska, petroleum deposits, natural.

Reynolds, James J. 1977. Oil spill liability and compensation (superfund). In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., pp. 15 - 20. New Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Liability, Compensation, Superfund.

Rhein, R. 1991. Bioremediation gets a qualified o.k. (for oil spill cleanup) Chemical Engineering. 98(7):44D,44G.
Key words: Additive, Beach, Biochemical Reaction, Biodegradation, Pollution Control

Rheinheimer, G., K. Gocke, H.G. Hoppe, K. Lochte, L.A. Meyer-Reil. 1991. Distribution and activity of microorganisms in the sea. <Original Series/Collective> Kieler Meeresforschungen. 8:46-54.
In 1988 and 1989 data about the distribution and activity of petroleum hydrocarbon degrading bacteria in the North Sea and Baltic Sea were

collected. Crude oil degrading bacteria and the number of bacteria which especially decrade naphthalene were quantified using a modified dilution (MPN) method. Crude oil degrading bacteria were present in all of about 100 water samples, with as many 10{sup 3} ml{sup -1} in sum. Naphthalene degrading bacteria were present in at least tenfold fewer numbers which corresponded with petroleum hydrocarbon (PHC) concentrations (ultraviolet fluorescence spectroscopy method, UVF) in more highly polluted areas. There is obviously a greater connection between this bacteria group and PHC pollution determined by UVF than between the more nonspecific group of crude oil degrading bacteria and UVF-determined PHC pollution.
Data from the North Sea show an extremely high abundance of hydrocarbon degrading bacteria, even in winter, while in the southern Baltic Sea low numbers of bacteria were found and a slower crude oil degradation was observed.
Key words: Naphthalene, biodegradation, aquatic ecosystems, bacteria, spatial destribution.

Ricci, Roy J. and Anne M. Kelley. 1977. Monitoring oil content in shipboard waste water discharges by use of a multi-phased dye transfer process. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., 161 - 164. New Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords - Monitoring, Oil, Shipboard, Waste Water, Discharges.

Rice, Stanley D., D. Adams Moles, and Jeffrey W. Short. 1975. The Effect of Prudhoe Bay crude oil on survival and growth of eggs, alevins, and fry of pink salmon(Oncorhynchus gorbusha). In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., 502 - 508. . San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Prudhoe Bay, Oil, Survival, Salmon.

Rice, D.D. 1991. Geologic settings and controls of shallow gas, Rocky Mountain area. AAPG Bulletin (American Association of Petroleum Geologists) (United States). 75:6:1138.
Shallow gas is generated by the degradation of organic matter by anaerobic bacteria and is referred to as microbial or bacterial gas. Bacterial gas can be generated and can accumulate in significant quantities and is an important resource in the Rocky Mountain area. Factors controlling bacterial gas generation after sediment burial are anoxic conditions, low sulfate content, low temperatures, abundant organic matter, sufficient pore space, and rapid sediment deposition. Bacterial gas is distinguished by its chemical and isotopic composition; the hydrocarbon fraction generally contains more than 98% methane, and {delta}{sup 13}C{sub 1} values are generally lighter than {minus}55 {per thousand}. In the Rocky Mountain area, bacterial gas accumulations occur in three main geologic settings: clastic shelves, carbonate shelves, and coal swamps. In the clastic shelf setting, bacterial gas occurs in thick (200 ft) sequences of sandstone, siltstone, and shale. The siltsone and sandstone occur as thin (a few inches thick), discontinuous lenses and laminae that serve as low-permeability reservoirs because of their small grain size. The enclosing shales are organic rich (average 2% total organic carbon (TOC)), contain type 3 kerogen, and serve as the source of and seal for the bacterial gas. The carbonate shelf setting is analogous to the clastic shelf with rythmically bedded couplets (a few inches thick) of low-permeability chalk (reservoir) and shale (source and seal). These

shales are also organic rich (average 3.2% TOC) but contain type 2 kerogen. In the swamp setting, thick (as much as 200 ft), humic (type 3 kerogen) coal beds serve as both the source of and reservoir for the bacterial gas. The gas is trapped by the low porosity and permeability of coal and gas adsorption enhanced by hydrostatic pressure. Key words: federal region VIII, natural gas deposits, reservoir rock.

Rice, D.D. 1993. Controls of coalbed gas composition. In: Proceedings of the international coalbed methane symposium. Volume 2, 17-21 May 1993. Coalbed gases are quite variable in composition. In addition to methane, they can contain significant amounts of heavier hydrocarbon gases (C[sub 2+]>20 percent) and carbon dioxide (>99 percent). Coalbed gases are also variable in their isotopic composition; methane [delta] [sup 13]C values range from -80[per thousand] to [minus]16.8[per thousand] and carbon dioxide [delta][sup 13]C values range from [minus]26.6[per thousand] to +18.6[per thousand]. The primary controls of hydrocarbon gas composition are coal rank and composition, and depth/temperature. Biogenic gas is generated by the degradation of organic matter at shallow depths and low temperatures in coals of any rank and is mainly methane. Thermogenic coalbed gas results from devolatilization of coal at ranks of high volatile bituminous and higher. These gases can be wet at intermediate ranks (high to medium-volatile bituminous) and are dry at higher ranks. Methane [delta][sup 13]C become more positive with increasing rank. In addition, at intermediate ranks, hydrogen-rich coals generate wetter gases than do oxygen-rich coals. Shallow coalbed gas is relatively dry with isotopically light methane as compared to gas from deeper coal, regardless of rank. This trend results from the original gases being altered by relatively recent microbial activity (aerobic oxidation of heavier hydrocarbons and/or anaerobic generation of biogenic methane). This alteration occurs at depths less than 1 km and is controlled by the physical characteristics of the coal beds, burial history, and groundwater flow. Carbon dioxide generated during devolatilization is commonly not preserved in present-day coalbed gases because it is highly reactive and soluble in water. Significant amounts of present-day carbon dioxide can be the result of several processes not related to coalification, such as recent bacterial activity, thermal destruction of carbonates, and migration from magma chambers or the upper mantle. Key words: coal seams, gas analysis, natural gas, chemical composition.

Richards, D.J. and W.K. Shieh. 1988. Anoxic/oxic activated sludge treatment of cyanogens and ammonia in the presence of phenols. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 573-583. Key words: Biodegradation, Bioreactors, Monitoring, Wastewater Petrochemical, steel manufacturing, mining and synthetic fuel processing are among several industries that generate wastewaters containing relatively high concentrations of phenols, cyanide, thiocyanate and ammonia. This paper describes an on-going laboratory investigation which evaluated the efficacy of an anoxic/oxic activated sludge system for treating this type of wastewater, with the following objectives: to compare the effect of cyanide concentration increase on an activated sludge system and an anoxic/oxic activated sludge system, and to report on the removal of cyanide and thiocyanate from both systems. To date, results from this study indicate that there are several advantages to the anoxic/oxic system over the activated sludge system in handling cyanide, thiocayanate laden phenolic wastewater. Cyanides and

thiocayantes are effectively removed in both the activated sludge system and the anoxic/oxic system in the presence of up to 45 mg/L CN(-). Overall total organic carbon (TOC) removal is consistent in both systems. The anoxic/oxic system reacts better to changes in cyanide concentration changes than does the activated sludge unit. The anoxic/oxic system also has an added advantage over the activated sludge system in terms of ammonia-nitrogen removal. It is possible to reduce ammonia-nitrogen to nitrogen gas.

Richardson, J.W., K.M. Le, and K.R. Riggs. Production casing erosion through annular erosion. In: Proceedings: 1988 SPE Annual Technical Conference and Exhibition. in Houston, TX. Key words: disposal, oil
Normal waste fluids disposal in North Slope, Alaska oilfields includes large-scale underground injection through well annuli. This cost-effective disposal method has produced severe erosion in some production casings. A series of tests were run to quantify significant parameters that cause erosion: fluid volume, fluid velocity and sand content. From the observed erosion rates, the calculated wear equation constants were found to be consistent with other published values. As a result of the test described several steps have been implemented to reduce casing erosion: reducing injection rates and volumes, monitoring sand content, and changing casing head outlet configuration. (Edited author abstract) 13 Refs.

Richardson, W.J. 1987. Importance of the eastern Alaskan Beaufort Sea to feeding Bowhead Whales, 1985-86. US Dep. Interior MMS OCS Study Report No. MMS 87-0037, (8 Microfiche with 574 pp.).
Key words: Mammal, Arctic Ocean, Petroleum, Contamination, Environmental Pollution, Oil Spill, Pollution Control Equipment, Remote Sensing

Richnow, H.H., A. Jenisch, W. Michaelis. 1992. Structural investigations of sulfur-rich macromolecular oil fractions and a kerogen by sequential chemical degradation." Org. Geochem. (1992): 19
Key words: petroleum, oil, bacteria

Ricketts, J. Current approaches in geographic information systems for coastal management. Mar Pollut Bull. 25(1-4):82-87.
Key words: Geographic Information Systems, Pollution Control, Oil Spill, Remote Sensing

Ridgway, H.F., D.W. Phipps, J. Safarik, F. Haag, and M. Reinhard. 1989. Investigation of the transport and fate of gasoline-hydrocarbon pollutants in ground water. Final report. Orange County Water District, Fountain Valley, CA (USA). 438.
Ground-water and aquifer solids from a shallow, semi-perched zone of silty/sandy alluvial deposits contaminated by 20 to 30 thousand liters of regular, unleaded gasoline were analyzed. Gasoline-degrading bacteria from the site were sorted into 111 distinct subpopulations on a battery of 15 specific hydrocarbons representing the major chemical groups in the gasoline; each of the hydrocarbons supported the growth of at least one bacterial isolate. Two-hundred-eighty-seven isolates capable of gasoline degradation were sorted into 59 distinct bacterial subpopulations. The aerobic, gasoline-degrading bacteria in the ground water varied inversely with the hydrocarbon toluene. Biotransformation and/or complete mineralization of selected aromatic gasoline constituents (e.g., toluene and p-xylene) was demonstrated under anerobic conditions.

Key words: aquifers, pollution control, hydrocarbons, biodegradation, anaerobic condition, denitration, organic compounds, gas chromatography.

Ries-Kautt, M., and P. Albrecht. 1989. Hopane-derived triterpenoids in soils. Chemical Geology. 76(1-2):143-151.
Key words: Bacteria, Soil Groundwater, Degradation
The occurrence, distribution and degradation pathways of hopanoid triterpenes have been studied in thirteen soil samples with varying degrees of biological activity. Hopanoids were shown to occur in all samples, suggesting that they are not only ubiquitous in subaquatic sediments, but also in soils. Hop-22(29)-ene was generally predominant in the hydrocarbons, whereas the 17 betaH,21 betaH-bishomohopanoic acid (C SUB 32) was the major component in the acids. The concentrations of hopanes were usually rather low, except in acidic peat. The distribution in carbon number of hopanes and hopanoic acids showed great similarities with those of moderately oxic subaquatic sediments. Intact bacteriohopane tetrol, widespread in microorganisms and the main precursor of geohopanoids, was identified in substantial amounts in a peat exposed to groundwater oscillations. -Authors.

Rifai, H.S., and P.B. Bedient. 1990. Comparison of biodegradation kinetics with an instantaneous reaction model for groundwater.Water Resources Res. 26(4):637 645.
Keywords: biodegradation, ground water, water pollution, bacteria, disposal, waste disposal

Rigterink, P.V., K.T. Meehan, and F.W. Koleszar. 1992. System concept definition for an oil spill emergency response computer system. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:215-222.
Key words: Geographic Information Systems, Oil Spill, Remote Sensing, Contamination

Rintala, J., S. Lepistoe, B. Ahring. 1993. Acetate degradation at 70[degrees]C in upflow anaerobic sludge blanket reactors and temperature response of granules grown at 70[degrees]C. Applied and Environmental Microbiology (United States). 59:6:1742-1746.
Several industrial production processes generate hot, concentrated process water and wastewater streams. Recent studies have demonstrated that hot industrial wastewaters can also profitably be treated anaerobically. Sludge granulation occurs at 55[degrees]C in thermophilic UASB reactors and the UASB process has been demonstrated feasible for industrial wastewater treatment at 55[degrees]C. However, very little is known about anaerobic wastewater treatment at temperatures above 55[degrees]C. This study investigates acetate degradation in UASB reactors at 70[degrees]C and characterizes the temperature response of the reactor sludges compared with sludge from a UASB reactor at 55[degrees]C. Results show that high concentrations of acetate can be efficiently converted to methane even at 70[degrees]C. However, the start-up of the UASB reactors was slower and the specific sludge activities were lower at 70[degrees]C than at 55[degrees]C. 21 refs., 3 figs., 2 tabs.
Key words: acetates, biodegradation, industrial wastes, chemical effluents, anaerobic.

Riss, A., and R. Schweisfurth 1988. Degradation of hydrocarbons by denitrification - investigations about in-situ-treatment. Z. dtsch. geol.

ges., stuttgart. 139(2): 535-544.
Key words: symposia, experimental studies, in situ, soils, aquifers, pollution, hydrocarbons, bacteria, purification, denitrification, environmental geology, experience, in situ test, purifying.

Riss, A., I. Gerber, M. Kessler-Schmitt, H.U. Meisch, and R. Schweisfurth. 1988. Nitrate dosage as a means to eliminate organics in the underground-Experiments in laboratory scale related to the degradation of fuel oil. Gas-und Wasserfach. Wasser, Abwasser. 12(1):32-40.
Key words: denitrification, bacteria, temperature, fuel oil, biodegradation, biological purification, ground water, laboratory study, environmental factor, hydrocarbon, pollutant behavior.

Ritchie, W., L.V. Kingham. 1991. The Esso-Bernicia oil spill, Shetland, 1978-79: Experiences and lessons. AAPG Bulletin (American Association of Petroleum Geologists) (United States). 75(3):662.
Key Words: Oil spills environmental effects, oil spills-oil pollution containment, oil spills pollution regualtions, aquatic ecosystems, cleaning, historical aspects, oil retention booms, planning, United Kingdom, United Kingdom Organizations, water pollution, water pollution control, developed countries, ecosystems, Europe, national organizations, pollution control, pollution control equipment.

Rivett, Michael O., John A. Cherry. 1991. The effectiveness of soil gas surveys in delineation of groundwater contamination; controlled experiments at the Borden field site. Ground Water Management. 8:107-124.
Key Words: Ontario, pollution, reclamation, environmental geology, ground water, hydrocarbons, natural resources, Borden, Eastern Canada, Canada, monitoring, volatile organic compounds, oil spills, organic materials, experimental studies, theoretical models, models, aquifers, gases.

Rizzo, J.A. 1992. Aboveground storage tanks - better safe than sorry. In: Proceedings of the 2nd Mater Technol Inst et al Aboveground Storage Tanks Symp, January 14-16, 1992, Houston, TX, 6p.
Key words: Aboveground Storage Facility, Leak, Legal, Soil Pollution, Groundwater, Oil Spill, Water Pollution

Robert J. Meyers, J. Larry Payne, and Ivan M. Lissauer. 1987 . Arctic oil spill response planning guide. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., 631. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Arctic, Oil Spill, Response.

Roberts, H.H., T.W. Neurauter. 1990. Direct observations of a large active mud vent on the Louisiana continental slope. AAPG Bulletin (American Association of Petroleum Geologists) (USA).1508.
High-resolution geophysical data taken in support of drilling offshore acreage frequently reveal impressive evidence for expulsion of fluids, gases, and sediments on Louisiana's continental slope.
Features resulting from extrusion of sedimentary materials at the sea floor range from small pock marks and vents a few meters in diameter to mud diapirs and volcano-shaped cones of sediment that can be greater than 1 km diameter. In September 1989, the Johnson Sea-Link research submersible was used to study a large active mud vent in the Green Canyon Area, Blocks 143-144. This accretionary feature had a positive relief of approximately 70 m and a diameter of about 300 m. Flanks of the volcano-shaped mud vent were composed primarily of

fine-grained sediment pocked by small burrows and grooved by gravity-driven downslope sediment transport. Lithification of the cone flanks was evident in isolated areas, many of which are undercut perhaps by escaping fluids and gas, and along ridges oriented down the cone sides. These ridges of the cone flank ridge and groove topography were found to have undergone surface lithification. The lithified materials were composed of both host sediments cemented with aragonite and Mg-calcite and isolated authigenic carbonate buildups. Analyses of both these carbonate features and cements in host sediments revealed that they were extremely C-13 depleted, suggesting an origin related to the microbial degradation of hydrocarbons. The crater at the apex of this feature was approximately 40 m in diameter and rimmed by levees <1m high, which marked former levels of fluid mud in the crater. Bacterial mats composed of a giant bacterium, Beggiatoa, covered the fluid mud surface within the crater. Gas escaping from the crater floor caused fine-grained sediments to be entrained in the water column. A turbid cloud was formed that subsequently cascaded down the crater flank. Sediments collected from the crater floor contained abundant crude oil and gas.
Key words: contintental slope, fumaroles, continental slope, carbon 13, volcanism, alkaline earth metal compounds.

Roberts, L. 1987. Discovering microbes with a taste for PCBs. Science (Washington, D.C.)(United States). 237:975 977.
Key words: PCBs, microorganisms, hydrocarbons, biodegradation, New York, pollution control
In the past few years microbial ecologists and microbiologists have been finding new organisms in the environment with unexpected abilities to degrade toxic chemicals. Efforts are now under way to harness those natural abilities and use them in cleaning up toxic chemicals, first by enhancing the performance of nonengineered microorganisms and later by endowing them with new capabilities through genetic engineering. This summer scientists began the first field test of a biological approach to degrade polychlorinated biphenyls in Schenectady, New York.

Roberts, P. O., C. B. Henry, Jr., and E. B. Overton. . Source targeting tar balls along the southern Louisiana coastline. . In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., 891. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Tar Balls, Louisiana, Coastline.

Roberts, P., L. Semprini, G. Hopkins, and P. McCarty. 1989. Biostimulation of methanotrophic bacteria to transform halogenated alkenes for aquifer restoration. National Water Well Association, Dublin, OH (US). 698(p):203-217.
Key Words: Bioreactors uses, oil spills biodegradation, oil spills water pollution abatement, aquifers, contamination, feasibility studies, ground water, halogenated aliphatic hydrocarbons, microorganisms, research programs, water pollution, chemical reactions, decomposition, hydrogen compounds, organic compounds, organic halogen compounds, oxygen compounds, pollution abatement.

Roberts, H., R. Sassen, and R. Carney. 1989. Geological and geochemical process structuring of hydrocarbon seep community environments. Oceans '89. 63-66:1719.

Extensive seepage of hydrocarbon to the sea floor throughout the upper continental slope province off Louisiana has set the stage for unexpected geological features and coexisting biologic communities. Numerous salt diapirs have penetrated slope sediments, creating dome/basin topography and complex fault networks that function as pathways for the movement of gases and crude oil to the surface. Microbial degradation of hydrocarbons has resulted in the precipitation of isotopically light (C-13 depleted) authigenic carbonates as a byproduct. Nodules in host sediment, hardgrounds, and mounds of various sizes (to over 20 m relief) have resulted from the process of authigenic carbonate formation. Biological communities that utilize reduced compounds for chemosynthesis in these carbonate-rich areas serve as indications of active seepage. Bacterial mats (largely Beggiatoa sp) appear to be the most reliable indicators of short-term seeps when large depth ranges are studied.
Key words: natural gas, environmental, petroleum, environmental transport, water pollution, chemistry.

Robertson, B.R., and D.K. Button. 1987. Toluene induction and uptake kinetics and their inclusion in the specific-affinity relationship for describing rates of hydrocarbon metabolism. Applied and Environmental. 53(9): 2193-2205.
Key words: toluene, biodegradation, kinetics, induction, concentration, degradation product, affinity, pseudomonas, pseudomonas putida, fresh water, seawater, microorganism culture, hydrocarbon, pollutant.

Robertson, S.B. 1990. Groundwater issues relating to an Alaskan methanol spill. Society of Petroleum Engineers, Richardson, TX (USA). 990(p):763-774.
Key Words: Alaska oil spills, ground water pollutants, methanol environmental transport, soils, alcohols, Federal Region X, hydrogen compounds, hydroxy compounds, mass transfer, North America, organic compounds, oxygen compounds, USA.

Robertson, I. 1991. Operational examples of in-situ burning: lessons from the burning of two recent diesel spills on the B.C. coast. In: Proceedings of the 14th Environ. Can. Arctic & Mar. Oil Spill Program Tech. Seminar, June 12 14 1991, Vancouver, Canada, pp. 411 419.
Key words: Abstract, Boom, British Columbia, Economic Factor, Pollution Control, Waste Disposal

Robertson, S. B. 1991. Environmental and permitting considerations for causeways along the Beaufort Sea, Alaska. In: Proceedings of the SPE WesterN Reg MTG, March 20 22, Long Beach, California. Pp. 143 151,
Key words: Oil Spill, Arctic Ocean, Water Pollution, Beaufort Sea, Alaska

Robeson, L.M., R.J. Axelrod, and T.A. Manuel. 1992 Fibrous Material for Oil Spill Clean-up. Patent No. US 5120598, 6 pp.
Key words: solid adsorbent, adsorbent, adsorption, collecting agent, contamination, environmental pollution, fiber, oil spill, sorbent, sorption, water pollution, (p) USA, adsorption capacity, Air Products & Chem Inc, business operation, chloroethylene homopolymer, cleaning, control, copolymer, data, decontaminating, deformation, elution, ethylene copolymer, ethylen homopolymer, extruding, forming, glycerol, lipophilic, manufacturing, mechanical property, oil waste, organic, particle size, physical property, physical separation, plasticity, plasticizer, pollution control, pollution control equipment, polymer, porosity, porous

media, propene homopolymer, salvaging, size reduction, solvent extraction, styrene copolymer, styrene homopolymer, surface property, table (data), thermoplastic, vinyl alcohol homopolymer, vinyl compound polymer, waste material, waste oil recovery, wettability, ecology & pollution

Robeson, Lloyd M., Robert J. Axelrod, and Thomas A. Manuel. Thermoplastic polymeric material as absorbent for cleaning up petroleum spills on water. Patent No. US 5120598_A, 6 pp.
Key words: Polyolefin fibers, Waste Solids, Petroleum, Oil Spills

Robilliard, G.A. 1993. Evaluation of compensation formulae to measure natural resource damages. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp.739 - 743. Tampa, Florida.: Washington, DC: American Petroleum Institute. Keywords - Compensation, Natural Resource, Damages.

Robilliard, Grodon A. and R. Glann Ford. 1987 . Computer-based contingency and emergency response plan for the national marine sanctuary program. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp.631. . Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Computer, Response, National Marine Sanctuary.

Robins, N. S. 1987. The allocation of aquifer resources in Scotland. Environmental Geology and Water Sciences 10(1):59 62.
Key words: Underground Disposal, Oil Spills, Water Pollution
The traditional role of aquifers for groundwater supply may not be appropriate in some areas of Scotland where high rainfall, low evapotranspiration, and abundant upland catchments and storage areas yield more than adequate surface water supplies. Some groundwater will always be required to satisfy specific needs but much aquifer potential will remain untapped. It is suggested that some of this potential could usefully be allocated to the disposal of wastes including oiled beach material, or the storage of heat or fluids, any of which could contaminate the aquifer. Care will be required to ensure that surface waters and other amenities are not put at risk. Resolution of conflicts between water supply and waste disposal usage of an aquifer requires guidelines; suggestions are made for their formulation and the need for legislative and planning controls is outlined.

Robinson, Joel. 1975. A Practical oil spill control training school. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., 75 - 77. San Francisco, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Control, Training.

Robinson, Capt. James L. 1991. Synergistic contingency planning by WRTs: an inland zone watershed response team contingency planning concept. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., 49 - 54. San Diego, CA.: Washington, DC: American Petroleum Institute.
Keywords - Contingency Planning, WRT, Watershed, Response, Contingency Planning.

Robinson, George C., and Phillip B. Bedient. 1991. Modeling a time-variant source of contamination. Ground Water Management. 8:531-540.

Key Words: Pollution, ground water, risk assessment, oil spills, models, time factor, water quality, transport, simulation, factors, underground storage.

Robinson, K. G. and J. T. Novak. 1991. Microbial utilization of adsorbed contaminants in groundwater systems. Proceedings of the 4th Tennessee Water Resources Symposium, September 24 26, 1991, Knoxville, TN, pp. 157 160.
Key words: Bacteria, Biodegradation, Groundwater, Monitoring, Water Pollution Both the migration rate and the concentration of hazardous chemicals in groundwater play a major role in determining how far these materials migrate, how risk factors are assessed, and what remedial action can be taken. These analyses require a thorough understanding of the biogeochemical behavior of the hazardous chemicals in soil-water systems. The purpose of this study was to investigate the availability of sorbed 2,3,6-TCP from biodegradation by acclimated bacteria. The target compound was chosen because it is on the US Environmental Protection Agency (EPA) list of priority pollutants, is a known carcinogen, and its presence in soil and groundwater has increased in recent years.

Robson, D.J. Absorption of hydrophobic water-immiscible liquids_using cellulosic plant material, pref. lignocellulose, in which the hydroxyl gps. have been modified e.g. by esterification. Patent No. GB 9021509_901003.
Key words: Esterification, Hydrocarbon, Pollution Control

Robson, David, James Lawther, and John Mark Hughes. 1992. Absorption of hydrophobic liquids using cellulosic agents. Patent No. GB 2248610_A1, 14 pp.
Key words: Fiber, Adsorbent, Oil Spills

Rodden, Graeme. 1993. Careers, environment rate high at Chemical Engineering conference. (Canadian Society for Chemical Engineering)(includes related articles). Canadian Chemical News. 45:22 29.

Rodstein, J.T., and G.L. Ott. 1992. Monitoring and tracking oil spills with side- looking airborne radar during operation desert storm. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:11-23. Key words: Oil Spill, Aerial Transportation, Remote Sensing, Pollution Control

Roe, S.F. 1988. Combined fixed biological film media and evaporative cooling media to solidify hazardous wastes for encapsulation and efficient disposal. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 489-503.
Key words: Biodegradation, Monitoring, Transport
Evaporation processes common in evaporative cooling for agriculture and industrial uses can be used in wastewater treatment in combination with biotechnology, volatile stripping, and other conventional unit operations to promote scaling or fouling the evaporative cooling media, encapsulating it, and disposing of it as a solid waste. A second possibility is to incinerate the evaporative cooling media containing the hazardous waste. Existing technology is discussed in terms of conventional evaporation, utility cooling tower evaporation, evaporative cooling, VOC stripping, and fixed film biotechnology. Possible evaporation techniques

include ambient-temperature evaporation, as well as evaporation/biotechnology combinations such as evaporation followed by anaerobic digestion, anaerobic digestion followed by aerobic treatment followed by evaporation, and evaporation followed by aerobic treatment. The evaporative cooling process is perhaps intermediate between evaporative ponds and multi-stage evaporators. This process shares the low energy and capital costs of evaporative ponds without the disadvantage of rain-water dilution suffered by evaporative ponds. Yet this process shares the chemical-plant heritage of multi-stage evaporators in that it is a predictable, reliable crossflow tower without the fouling problems of multistage evaporators. The evaporative process for hazardous waste concentration and disposal is certainly not a universal solution to all hazardous waste problems, but must be tailored to the properties of the waste. Then it must be evaluated on a pilot or full scale basis.

Roe, V.D., and W.M. Nash, J.D. Stuart, G.A. Robbins. 1989. Manual headspace method to analyze gasoline contamination of groundwater by capillary column gas chromatography. Pittsburgh conference 1989 and exposition on analytical chemistry and applied spectroscopy (Abstracts). Pittsburgh conference and exposition on analytical chemistry and applied spectroscopy. (vp.):1-1.
Key Words: Gasoline environmental transport, ground water quantative chemical analysis, ecological concentration, leaks, oil spills, tanks, underground storage, water chemistry, water pollution, chemical analysis, chemistry, hydrogen compounds, liquid fuels, mass transfer, oxygen compounds, petroleum products.

Roffey, R., A. Edlund, R. W. Hiley, R.E. Penfold, J.F. Pedley. 1988. Biodegradation of stored heavy fuel oil with production of methane in unlined rock caverns. In: Proceedings of the Third international conference on stability and handling of liquid fuels. Conference proceedings. pp. 90-100. During storage of heavy fuel oil on a waterbed in unlined rock caverns for long periods of time problems with degradation of oil and production of methane gas have been observed. In order to understand the factors responsible for the microbial methane production and to find methods to inhibit the methanogenic bacteria a study was undertaken. Chemical and microbiological investigations at two storage plants where problems had occurred showed that anaerobic conditions existed in the bedwater and that a complex microbial community was present. The methane production was calculated to be 2-37 g/day, m/sup 3/ bedwater. to study methods to inhibit the methanogenic activity laboratory model systems were used.
Four methods were evaluated which were increasing the oxygen level in the bedwater, increasing the pH to 9, using a biocide an isothiazolone compound or addition of nitrate. It was found that only nitrate addition gave a satisfactory inhibition at a concentration of 0.5 g/l in the water. Key words: fuel oils, biodegradation, bacteria, bench-scale, pH value, rock cavern, cavities, chemical reactions, petroleum products, nitrates, oxygen, elements, hydrocarbons, oils, nonmetals, organic compounds.

Rogne, T., A. Smith, I. Macdonald, M.C. Kennicutt, II, and C. Giammona. 1993. Multispectral remote sensing and truth data from the tenyo maru oil spill. In: Proceedings of the 1st Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1993, New Orleans, LA, Photogram eng remote sensing, 59(3):391-397.
Key words: Remote Sensing, Oil Spill, Aromatic Hydrocarbons, Contamination

Rohns, H.P., S. Schalenbach, L.E. Webb. 1990. Production of oil-degrading bacteria and their use in microbial remediation of contaminated soils. In: Proceedings of the Twelfth symposium on biotechnology for fuels and chemicals: Program and abstracts. Scheitlin, F.M. (ed.). 1, Paper 113:141. In order to achieve rapid and complete microbial remediation of soils contaminated with fuel oil, it is necessary to employ microorganisms which can be established in the soil and which degrade the contaminant under the sub-optimal conditions prevailing. The aim of this investigation is to develop methods for this production of bacterial biomass with emphasis on high yields and a high efficiency in degradation of the components of mineral oils, especially of the more persistent ones. Furthermore, practicable methods have to be developed to characterize the behavior of the bacterial population during a soil clean-up. For growth and production of the microorganisms on fuel oil, a two-stage fermenter system was constructed in which the separate stages were operated at different dilution rates. The oil was emulsified mechanically and, with the help of biogenic surfactants, formed in the first bioreactor. With influent oil concentratons ranging from 4 to 7 g/l, 80% of the oil was degraded within a retention time of 17 h in the first bioreactor. Further degradation of the oil up to 98% occurred in the second fermenter with a retention time of 85 h. The yield coefficient for the biomass, relted to organic carbon, amounted to 0.1 to 0.17 depending on the inflow oil concentration. The oil degradation rate of the microbial biomass, produced in the two-stage bioreactor, could be estimated in columns with contaminated soil and biomass. The microbial respiration rates, measured in the presence of a mixture of hydrocarbons or of individual hydrocarbons, also served as a measure of the microbial activity of the produced biomass.
Key words: fuel oils, biodegradation, biochemical reaction, quantitiy ratio, land reclamation, microorganisms.

Rolan, Robert G. and Ronald Gallagher. 1991. Recovery of intertidal biotic communities at Sullom Voe following the ESSO BERNICIA oil spill of 1978. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., 461 - 466. . San Diego, CA.: Washington, DC: American Petroleum Institute.
Keywords - Intertidal, Biotic, ESSO BERNICIA, Oil Spill.

Roland, J. V., G. E. Moore, and M. A. Bellanca. 1977 . The Chesapeake Bay oil spill, February 2, 1976: a case history. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., 523 - 528. New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Chesapeake Bay, Oil Spill.

Rome, D.D. 1989. Readiness planning for arctic offshore oil spill response. In: Proceedings of the U.S. Dep. Interior Minerals Manage. Serv. Alaska Arctic Offshore Oil Spill Response Technol. Workshop, November 29 April 1 1988, Anchorage, Alaska, No. 762, pp. 97-101.
Key words: Abstract, Additive, Business Operation, Chemical Cleaning, Contingency Planning, Economic Factor, Pollution Control Equipment

Ronan, C.B. Appts. for cleaning oil spill off beaches, uses vessel offshore to draw and heat water to spray rocks and sand and wash oil into boom. Patent No. US 470569_900126.
Key words: Barge, Beach, Boom, Containment, Skimmer, Water Pollutant

Rontani, J.F., P. Bonin. 1992. Utilization of n-alkyl-substituted cyclohexanes by a marine alcaligenes. Chemosphere. 24(10): 1441-1446. United Kingdom.
The metabolism of n-alkyl-substituted cyclohexanes by a marine alcaligenes isolated from surface foams was investigated. Due to the simultaneous participation of alpha and beta-oxidation in the degradation processes, this strain degraded very efficiently these petroleum hydrocarbons, known to be biolgically recalcitrant and frequently detected at the surface of the sea.
Key words: water pollutionc, seawater, petroleum product, air sea interface, cyclohexane, derivatives, biodegradation, oxidation, alcaligenes, foam(sea surface), effluent, refinery.

Rooney, Ann Hayward, and Jane Ledwin. 1989 . A priority approach to regional environmental sensitivity mapping. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., 463 - 472. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Environmental, Sensitivity, Mapping.

Rosen, Jerome. 1990. A regulatory tangle. (Degradable Plastics). Mechanical Engineering CIME. 112:60 63.
Key words: biodegradation, laws

Rosenberg, E. 1992. Petroleum bioremediation a multiphase problem. Biodegradation. (1992): 3
Key words: petroleum, hydrocarbons, oil, Israel, bacteria, biodegradation.
Since petroleum is a complex mixture of many different classes of hydrocarbons, of which any particular microorganism has the potential to degrade only part, it follows that the microorganisms must also have a mechanism for desorbing from 'used' oil droplets. The major limitations in bioremediation of hydrocarbon-contaminated water and soil is available sources of nitrogen and phosphorus. The usual sources of these materials, e.g. ammonium sulfate and phosphate salts, have a high water solubility which reduces their effectiveness in open systems because of rapid dilution. We have attempted to overcome this problem by the use of a new controlled-release, hydrophobic fertilizer, F-1, which is a modified urea-formaldehyde polymer containing 18% N and 10% P as P2O5. Microorganisms were obtained by enrichment culture that could grow on crude oil as the carbon and energy source and F-1 as the nitrogen and phosphorus source. The microorganisms and the F-1 adhered to the oil/water interface, as observed microscopically and by the fact that degradation proceeded even when the water phase was removed and replaced seven times with unsupplemented water a simulated open system. Strains which can use F-1 contain a cell-bound, inducible enzyme which depolymerizes F-1. After optimizing conditions in the laboratory for the use of F-1 and the selected bacteria for degrading crude oil, a field trial was performed on an oil contaminated sandy beach between Haifa and Acre, Israel, in the summer of 1992. The sand was treated with 5 g F-1 per kg sand and inoculated with the selected bacteria; the plot was watered with sea water and plowed daily. After 28 days the average hydrocarbon content of the sand decreased from 5.1 mg per g sand to 0.6 mg per g sand. Overall, there was an approx. 86% degradation of pentane extractables as demonstrated by dry weight, I.R. and GLC analyses. An untreated control plot showed only a 15% decrease in hydrocarbons. During the winter of 1992, the entire beach (approx. 200

tons of crude oil) was cleaned using the F-1 bacteria technology. The rate of degradation was 0.06 mg/g sand/day (10 degree C) compared to 0.13 mg/g sand/day during the summer (25 degree C).

Ross, S. L. 1975. Oil spill technology development in Canada. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., 329 - 336. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Canada.

Ross, S.L., and S.G. Potter. 1990. Proceedings of a workshop to establish Canadian marine oil spill research and development priorities. In: Proceedings of the Workshop to establish Canadian marine oil spill research and development priorities, March 6 7 1990, Ottawa, Canada, 61 pp.
Key words: Oil Spill Information Needs, Oil Spill Meetings, Water Pollution Control
A 2-day workshop was held to focus on the research requirements for improving the state of the art for controlling major marine oil spills. Workshop participants from Canada and other countries included those with industry, government, and consulting affiliation. The workshop consisted of a series of overview presentations in 5 technical areas related to oil spills, followed by group discussions leading to the setting of research and development priorities in each of those areas. Results are summarized in the form of descriptions and priority rankings of 77 research and development ideas within those 5 technical areas: surveillance, tracking and modelling; containment and recovery equipment; dispersants; in-situ burning and disposal; and shoreline cleanup and restoration.

Ross, S. L. Field test method for rapid determination of dispersant effectiveness at spill sites. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., 587. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Effectiveness, Spill.

Rossi, Steven S. 1977. Bioavailability of petroleum hydrocarbons from water, sediments, and detritus to the marine annelid, neanthes arenaceodentata. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., pp. 621 - 626. New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Bioavailability, Petroleum, Hydrocarbons, Water, Sediments, Detritus, Marine Annelid.

Rossiter, James R. 1990. Geophysical and remote sensing techniques for de tection and measurement of oil slicks on water. In: Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems. 1990:137-138.
Key words: Pollution, Remote Sensing, Oil Spills, Radar

Rothmel, R.K., R.A. Haugland, U.M.X. Sangodkar, W.M. Coco, and A.M. Ahakrabarty. 1990. Microbial degradation of synthetic chlorinated compounds: evolutionary implications (chapter 8). Book chapter. Illinois Univ., Chicago, IL (United States). Dept. of Microbiology and Immunology. Environmental release of synthetic chlorinated compounds in the form of herbicides/pesticides, solvents, refrigerants, etc., has

created major concerns with regard to their effects on human health because of the persistence of many such compounds. The persistence of these compounds is a result of the inability of natural microorganisms to utilize them as a sole source of carbon and energy. Many microorganisms can utilize simple chlorinated compounds such as 3-chlorobenzoate (3Cba) or 2, 4-dichlorophenoxyacetate (2,4-D) as their sole carbon source but cannot utilize higher chlorinated forms such as 2,4,5-trichlorophenoxy acetic acid (2,4,5-T) and others. Under strong selection in a chemostat with 2,4,5-T as the only major source of carbon (directed evolution), it has been possible to isolate a strain of Pseudomonas cepacia AC1100 that can utilize 2,4,5-T as its sole source of carbon and energy.
Key words: chlorinated aromatic, hydrocargon, biodegradation, acetic acid, bacteria, carbon, chemical preparation.

Roubal, William T. 1977. Flow-through system for chronic exposure of aquatic organisms to seawater-soluble hydrocarbons from crude oil: construction and applications. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., pp. 551 - 556. New Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords - Exposure, Aquatic Organisms, Hydrocarbons, Oil.

Rousseau, Christophe. 1993 . CEDRE's training activities. In Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp.851. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - CEDRE, Training.

Rowland, S. J. 1981. The fate and effects of dispersant-treated compared with untreated crude oil, with particular reference to sheltered intertidal sediments. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 283 - 296. Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Untreated, Oil, Sediments.

Rowsell, F.D. 1993. Method for herding and/or recovering spilled oil. Patent No. Us 5176831, 11pp.
Key words: collecting agent, adsorbent, compound, control, oil spill, organoclay complex, pollution control, solid adsorbent, sorbent, water treating, (p) USA, adsorption, adsorption capacity, alkali metal, alkaline earth metal, amine, beidellite, buoyancy, business operation, chemical formula, chemical process, chemical reaction, clay, clay content, clay mineral, complex formation, composition, contamination, data, decontaminating, deposit (geology), derivative (chemical), ecology, environment, environmental pollution, floating, hectorite, hydratable clay, lipophilic, manufacturing

Roy, Indrani, Ajit K. Mishra, and Anup Kumar Ray. 1991. Alkane and crude oil degrading bacteria from the petroliferous soil of India. In: Proceedings of the Battelle In Situ Bioreclamation Symp, San Diego, CA, 420-428.
Key words: Biodegradation, Microorganism, Oil Spills, Cleanup, Bacteria, Hydrocarbons
Nearly half a percent of transported crude oil is released into the oceans through spills and ballast discharge. Hydrocarbon-oxidizing bacteria have been used to decompose crude oil in spills and in tanker residues, but

they generally require exogenous sources of nitrogen. A strain of +i Psuedomonas stutzeri +r that can fix nitrogen and degrade alkane and crude oil was isolated in petroliferous soils in India.
Bacterial isolation and growth methods are detailed, and results of degradation studies are presented. P. stutzeri appears to surpass other bacterial strains in its degradation capability and crude oil emulsification potential.

Roy, K.A. 1991. New polymer bounces into sorbent market. Hazmat World (United States) 3. Spectacular spills like the Exxon Valdez capture headlines and dominate conversation, but most releases involve quantities too small to attract media attention. For these spills, companies often rely on sorbents to collect the oil and dispose it. These devices come in a variety of shapes, sizes and absorbent materials, including a new generation of products that offers solid results-literally. This paper reports on the Solidifier which absorbs oil, as well as chlorinated solvents, hydrocarbons and PCBs, and, as the name implies, solidifies into a rubber-like material. A polymer used extensively in the rubber industry is the key to the sorbent's success. Oil and other contaminants, act like catalysts. They dissolve into the polymer, causing its molecules to bond together and form a rubber-like mass. No. 2 diesel fuel oil can be bounced on the floor after it solidifies.
Key words: adsorbents, market, oil spills, sorbent, recovery, systems, polymers, sorptive properties, cleaning, environment, water pollution control, surface properties.

Rozich, A.F., R.J. Colvin and A.F. Gaudy. 1988. High-rate biological process for treatment of phenolic wastes. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 329-358.
Key words: Biodegradation, Monitoring, Wastewater
A proposed process flow scheme for a high-rate fluidized biological system for treating phenol wastes is presented. The key feature of this system is the use of two reactor each of which has different operating conditions. The first stage of the system is utilized for selective culture of organisms which are characterized by high-rate phenol degradation kinetics; the critical parameter for selecting these populations appears to be the maintenance of relatively high steady-state phenol concentrations in this reactor. The second stage of the system is operated in an extended aeration mode in order to achieve low effluent organic concentrations. The advantages of this process over conventional technology are significantly increased phenol degradation rates and lower sludge production rates; the results of the bench-scale pilot study indicate that the process may also be capable of delivering lower phenol concentrations than can a conventional single-stage technology. Equations were also derived which may be utilized, subsequent to additional developmental work on the process, for providing guidelines for design and operation. Provided the appropriate process controls are available, it should be feasible to use the process model to achieve treatment goals and optimize operation. Finally, application of the high-rate process technology is not contingent on the design of new facilities. The application can be made by modifying existing facilities. That is, the process can be applied by insuring that the appropriate level of controls and the two-stage flow scheme are achievable at a particular treatment facility.

Rucker, E. and A. Ryan. 1991. Applications for bioremediation practices

in the petroleum industry. In: Proceedings of the Hazmat '91 Central: Fourth Annual Hazardous Materials Management Conference, April 3 5, Rosemont, IL. Tower Conference Management Company: Wheaton, IL, pp. 209 234.
Key words: Oil Spills, Ground Water, Remedial Action, Superfund, Biodegradation
The use of biological treatment technologies for the remediation of oil spills and groundwater/soils contaminated with organic compounds has seen broad application over the past several years. This concept of bioremediation is not, however, a new technology as various types of biological processes have been used successfully for over 30 years in managing petroleum wastes and contaminated soils. Applications of the technology is becoming increasingly important in the field of hazardous waste management and Superfund cleanup due to its effectiveness, reasonable cost, and adaptability to on-site situations. This paper discusses the key bioremediation experience in the petroleum industry and areas where additional process studies could be helpful.

Rudolph, E.K., M. Bianchini, G. Gilla, C. Beuillard, D. Lyons. 1988. Performance of oil industry cross-country pipelines in western Europe...Statistical summary of reported spillages-1987. CONCAWE, Sticht. (Rep.) N.8/88 (Dec. 1988) 19pp.
Key Words: Cargo, corrosion, crude oil, crude oil (well), ground level, ground water, mathematics, oil less, oil waste, petroleum fraction, potable water, soil pollutant, statistical analysis, trun pipeline, waste disposal, waste material, water pollutant, Western Europe.

Rueddiger, G. 1987. Favorable conditions for in situ biological clean up of oil contamination in the form of mineral oils. Erdoel, Erdgas, Kohle. 103(7-8): 334-336.
Key words: soil pollution, hydrocarbon, mineral oil, decontamination, cleaning, biological method, biological degradation, environment, pollution control.

Rueddiger, G. 1987. Identification, evaluation and clean-up of oil-contaminated sites. Oil Gas--Eur. Mag. 13(2):28-33.
Key words: Abandoned Sites, Contamination, Land Pollution Abatement, Oil Spills
The paper offers an outline of the study being prepared by DGMK on the clean-up of oil-contaminated sites. This study covers all stages from identification, evaluation and clean-up to after-care. The individual methods are also discussed and their scientific-technical principles explained.

Rugge, C.D., and R.C. Ahlert. 1992. Ground and aerial survey of a peninsular landfill. Water Research. 26(4):519-526.
Key words: Remote Sensing, Oil Spills
Heavy metals, polychlorinated biphenyls (PCBs) and various organics have been detected in surface and subsurface water around two peninsular landfills. A possible source of this contamination is a large volume of PCB-contaminated oil floating on the water table of Pennsylvania Avenue Landfill (PAL); a similar lens is suspected at Fountain Avenue Landfill (FAL), but has not yet been defined. Analysis of historical aerial photography of FAL and chemical analysis of soil sampled around seeps indicate that historic liquid-containing structures may have held oil that is now seeping out of the landfill into surrounding surface water. The use of remote sensing provides a

tool to relate prior disposal locations to current topography for design of a cost-effective geo-exploration effort. (Author abstract) 7 Refs.

Russell, L.L., Y. Litwin. 1990. Conceptual aspects of ground water remediation programs. In: Proceedings of the Fourth national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods. National Water Well Association, Dublin, OH (US). 1333(p):143-150.
Key Words: Ground water contamination, oil spills remedial action, oil spills water pollution abatement, remedial action cost benefit analysis, remedial action economic impact, chlorinated alicyclic hydrocarbons, chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons, economic analysis, feasibility studies, petroleum, risk assessment, energy sources, fossil fuels, halogenated alicyclic hydrocarbons, halogenated alphatic hydrocarbons, halogenated aromatic hydrocarbons, hydrogen compounds, organic chlorine compounds, organic compounds, organic halogen compounds, oxygen compounds, pollution abatement.

Russell, D.C., and D. Dunbar, III. 1989. The regukation of underground storage tanks containing petroleum and other hazardous chemicals. In: Proceedings of the Pennwell Conf & Exhibit CO Petro-Safe 89 Conf, Oct. 3-5, 1989, Houston, TX, 1:197-201.
Key words: Inground Tank, Legal, Soil Pollution, Underground Storage Facility, Cleanup, Groundwater, Oil Spill, Water Pollution

Rutberg, R.J., D.G. Colley, G.M. Smolarski. 1986. Applications of thermal incinerators in the petroleum industry. In: Proceedings of the Pacific Coast Oil Show & Conf.
Key words: disposal, oil, in-situ, petroleum

Ryan, P. Bernard, Derek J. S. Brown. 1987. Oil pollution control and spill response capability in the ROPME sea area. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987. 9 14. Baltimore, MD: Washington, D.C.: American Petroleum Institute. 1987.
Keywords: oil pollution, control, spill response, ROPME, sea.

Ryan, P. 1983. HASBAH 6: oil companies response to oil pollution in the Arabian Gulf. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., 371 - 376. . San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - HASBAH 6, Oil, Pollution, Arabian Gulf.

Ryan, P.B., D.J.S. Brown. 1989. Support for regional oil spill response in the Ropme sea area. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 - 16, San Antonio, TX.
Key words: oil spill, response, Ropme Sea.

Ryan, P., Derek Bernard, and J.S. Brown. 1985. Gaocmao: industry's approach to cooperative spill response in the Arabian Gulf. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: Gaoocmao, spill response, Arabian Gulf.

Rytkonen, J., J.P. Hirvi, and R. Hakala. 1991. The Weathering of Spilled

Crude Oil in Coastal Water Environment. In: Proceedings of the 7th Amer Soc Civil Eng Et Al Coastal & Ocean Manage Symp (coastal zone 91) (Long Beach, Calif, 7/8-12/91) proc v 3, pp 2501-2511, 1991 (isbn 0-87262-809-4; 10 refs)
Key words: oil spill, arctic climate, Baltic Sea, climate, environment, environmental impact, Finland Gulf, meteorological phenomenon, seas and oceans, weathered oil, weathering, additive, adsorbent, analytical method, book, chart, chemical, chromatography, coast, composition, contaminati on, crude oil, data, dead oil, density, dispersant, economic factor, environmental pollution, evaporation, flow property, gas chromatography, graph, half life, hydrodynamic model, ice, index map, laboratory equipment, laboratory testing, low temperature, map

S., George. 1992. Positive and negative bias associated with the use of epa method 418.1 for the determination of total petroleum hydrocarbons in soil. Environment Sci & Eng Inc. In: Proceedings of the Api et al petrol hydrocarbons & org chem in ground water : prev,detection, & restoration conf (houston, 11/4-6/92) proc; ground water manage no 14, pp 35-52, 1992 (issn 10479023; 22 refs)
Key words: soil pollution, compound, contamination, economic factor, environmental Pollution, hydrocarbon compound, laborator testing, legal consideration, petroleum, procedure, regulation, testing, absorption spectroscopy, accuracy, administration, adsorbent, analytical method, ash, asphalt, bitumen, boiling point, busines operation, calibration, chart, chemistry, cleaning, comparison, concentration, coolant, data, dependent determining, diesel fuel

Sabins, Floyd F. 1993. Detection and monitoring of oil on water by remote sensing. In: Proceedings of the American Association of Petroleum Geologists 1993 annual convention, New Orleans, LA, p.176.
Key words: Arabian Sea, Atlantic Ocean, Oil Spills, Petroleum, Remote Sensing

Saenz, G., P.C. Goodell, and N.E. Pingitore. 1991. A method of soil analysis to detect and delineate subsurface hydrocarbon contaminants by means of aromatic hydrocarbons. Ground Water Management. 8:59-72.
Key Words: Soils, ground water, chemical analysis, organic materials, pollution, hydrocarbons, methods, X-ray, fluorescence, aromatic, hydrocarbons, analysis, toxic materials, oil spills.

Saenz, G., H.R. Fuentes, and N.E. Pingitore. 1988. A discriminating method for the identification of soils and groundwater contaminated by hydrocarbons. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:915-929.
Key words: Soil Pollution, Water Pollution, Groundwater, Inground Tank, Monitoring, Oil Spill

Safferman, Steven I. 1991. Selection of nutrients to enhance biodegradation for the remediation of oil spilled on beaches. In: Proceedings of the 1991 Oil Spill Conference (prevention,

behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: nutrients, biodegradation, remediation, oil spill, beaches.

Saggese, E. J., T. A. Foglia, G. Leather, M. P. Thompson, D. D. Bills, and P. D. Hoagland. 1985. Fractionation of allelochemicals from oilseed sunflowers and Jerusalem artichokes. In: The chemistry of allelopathy: Biochemical interactions among plants. American Chemical Society: Washington, D.C., pp. 99 112.
Key words: Aquatic Weeds, Lemna Minor, Allelopathins, Phytotoxicity
A variety of extraction and analytical procedures were used to separate and identify the components of the stems and leaves of sunflower and Jerusalem artichoke having phytotoxic activity as determined by their effects on the growth of Lemna minor. All fractions showed some phytotoxicity regardless of source or extraction procedure. Major phytotoxic components appeared to be phenolic and fatty acids.

Sahasrabudhe, A.V., and V.V. Modi. 1991. Degradation of isomeric monochlorobenzoates and 2,4-dichlorophenoxyacetic acid by a constructed Pseudomonas sp. Applied Microbiology and Biotechnology (Germany, F.R.). 34:4:556-557.
A 4-chlorobenzoate-degrading Pseudomonas sp. US1 was mated with a strain of Escherichia coli JMP 397 (harbouring the plasmid pJP4). An ex-conjugant designated Pseudomonas sp. US1 ex that could utilize all the isomeric monochlorobenzoates and 2,4-dichlorophenoxyacetate was obtained. The ex-conjugant released stoichiometric amounts of chloride when grown on these chloroaromatics as sole sources of carbon and energy. (orig.).
Key words: chlorinated aromatic hydrocarbons, biodegradation, culture media, dechlorination.

Sahu, S.K., K.K Patnaik, and N. Sethunathan. 1992. Dehydrochlorination of ..delta.. -isomer of hexachlorocyclohexane by a soil bacterium, pseudomonas sp. Bulletin of Environmental Contamination and Toxicology (United States). 48:2:0007-4861.
Commercial formulations of an insecticide, hexachlorocyclohexane (HCH), currently used on a large scale in India, contain {alpha}-, {beta}-, {gamma}-, {delta}- and other isomers. According to earlier reports these HCH isomers persist in aerobic soil and water systems, but disappear rapidly from predominantly anaerobic ecosystems such as flooded soils and lake sediments. Bacterial strains (facultative or strict anaerobes), isolated from these anaerobic systems rapidly degraded {alpha}- and/or {gamma}-isomer, but not {beta}- and {delta}-isomers of HCH under anaerobic conditions. Recent reports show that bacteria mainly Pseudomonads, isolated from aerobic soils could degrade not only {gamma}-isomer, but also {alpha}- and {beta}-isomers of HCH under aerobic conditions. There is no report of the degradation of {delta}-HCH in pure culture by either aerobic bacteria although it is a common constituent in widely used commercial formulations of HCH. The authors report the rapid degradation of {delta}-HCH by a Pseudomonas sp. under aerobic conditions.
Key words: chlorinated aromatic hydrocarbons, dechlorination, pseudomonas, metabolism, gas chromatography, sediments.

Salah M. Al-Mazidi, Omar Samhan. 1987. Oil spill incidents and dispersant applications in Kuwait. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., 247 - 254. Baltimore, MD.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Dispersant, Kuwait.

Sale, T., K. Piontek, M. Pitts. 1989. Chemically enhanced in situ soil washing. National Water Well Association, Dublin, OH (US). 98(p):487-503.
Key Words: Hydrocarbons removal, oil spills land pollution abatement, oil spills water pollution abatement, bench-scale experiments, feasibility studies field tests, ground water, porous materials, soils, washing, cleaning, hydrogen compounds, organic compounds, oxygen compounds, pollution abatement.
In porous media that have been saturated with petroleum products or organic chemicals, large concentrations of residual oils typically exist after gravity drainage and/or waterflooding. Due to the high concentrations of these residual oils and the low solubility of the individual constituents of the oils, residual oils often behave as long-term sources of groundwater contamination. Excluding technologies relying on excavation, limited means exist to remediate subsurface soils contaminated with residual oils. An option not relying on excavation is chemically enhanced in situ soil washing. Chemically enhanced in situ soil washing is an adaptation of enhanced oil recovery techniques commonly applied in the petroleum industry. Current research has demonstrated that this technique can reduce residual oil concentrations on a laboratory scale. Unfortunately, limited information exists about field applications of in situ soil washing technologies. This paper reviews aspects of in situ soil washing, including mechanisms of enhanced oil recovery, results of bench-scale and pilot-scale studies, and consideration for future applications. In summary, chemically enhanced in situ soil washing may have applicability at many sites, but its application will require site-specific evaluation and design.

Salinas, Jimmy, and William Bozzo. 1993. Environmental surveillance: an integral part of the spill contingency plan. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: environmental, spill contingency.

Salinas, Jimmy, and Mike Hampy. 1991. Community response to a simulated oil spill in Freeport, Texas. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: response, oil spill, Freeport, Texas.

Salisbury, John W., Dana M. D'Aria, and Floyd F. Sabins, Jr. 1993. Thermal infrared remote sensing of crude oil slicks. Remote Sens Environ. 45:225 231.
Key words: Infrared Remote Sensing, Oil Spill Detection
The infrared spectral emissivities of oil and seawater were determined in the laboratory to investigate possible thermal infrared detection of oil slicks. The spectra of mature slicks of five crude oils of different compositions and physical properties

were measured. The spectra proved to be relatively constant. Oil-slick thickness had little effect on spectral reflectance. In the 8-14 (gr)mm region, the presence of sea foam did not change the infrared spectrum appreciably, despite greatly different reflectances for foam and seawater in the visible region of the spectrum. If these results can be confirmed by field data, thermal infrared multispectral remote sensing could be used to detect oil slicks, since the spectral differences were well within the detection range of modern airborne scanners.

Salle., Gerard Barbouteau, Michel Angles, Yves Le Gal La. 1987. Dispersant spraying gun. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: dispersant.

Salt, D. 1992. State of the art of oil spill control equipment. In: Proceedings of the CONCAWE - DGMK Remediation of Oil Spills Scientific Seminar, May 18 21 1992, Hamburg, Germany, pp. N.2.1 49-58.
Key words: Additive, Belt, Boom, Coastal Area, Dispersant, Oil Waste, Pollution Control, Equipment, Skimmer, Vacuum

Salt, D. 1989. Oil spill response: mobilization exercise. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: oil spill, response, mobilization.

Salt, D. 1989. Mini wave-track: a portable system for wave monitoring during oil spill cleanup operations. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: monitoring, oil spill cleanup.

Salter, S.H. 1993. Oil-spill recovery equipment. Edinburgh Univ. (United Kingdom). 33(p).
Key Words: Oil retention booms oil pollution containment, weawater water pollution control, inventions, oil spills, hydrogen compounds, oxygen compounds, pollution control, pollution control equipment.

Samain, E., R. Moletta, H.C. Dubourguier, and G. Albagnac. 1987. Propionate conversion to butyrate in an anaerobic digester. Biotechnological advances in processing municipal wastes for fuels and chemicals. Antonopoulos, A.A. (ed.). 1. symposium on biotechnological advances in processing municipal waste for fuels and chemicals. 223-233:488.
During batch degradation of propionate by anaerobic sludge or by a highly purified culture, a transient accumulation of acetate and butyrate was observed. Labeling experiments and inhibition of methanogenesis by bromoethane sulfonic acid evidenced that butyrate is a facultative electron sink during acetogenesis rather than an end-product of acetate fermentation by butyric bacteria. The synthesis of butyrate and acetate during batch *degradation* of propionate, either by anaerobic sludge or by a highly purified culture is reported. The purified culture on propionate still contains butyrate degraders. This may be

explained by the synthesis of butyrate during batch degradation of propionate which allows maintenance of butyrate-degrading organisms which are present in high numbers in the digester microflora. The results of labeling experiments with the digester sludge strongly suggest that some bacterial species or consortia are able to synthesize butyrate from propionate. This is also sustained by numerations which never evidenced high numbers of acetate-fermenting butyrogens and by the dismutation of propionate in the presence of bromo ethane sulfonic acid, but metabolic pathways remain unclear. In fact, acetate and butyrate may originate from a single four-carbon intermediate or butyrate may be synthesized from acetyl-CoA as in Clostridia. Complete acetogenesis from propionate in some digesters proceeds not only through an oxidative decarboxylation but also through Beta-oxidation of butyrate by organisms similar to Syntrophomonas wolfei. 9 refs., 6 figs., 1 tab.|
Key words: acetates, biosynthesis, butric, bacteria, growth, propionic, metabolism.

Samain, J.F. 1979. Ecophysiological effects of oil spills from Amoco Cadiz on pelagic communities: preliminary results. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: ecophysiological, effects, oil spills, Amoco Cadiz, pelagic.

Samhan., Salah M., Omar Al-Mazidi. 1987. Oil spill incidents and dispersant applications in Kuwait. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: oil spill, dispersant, Kuwait.

Samuels, W. B., K. J. Lanfear, and D. Banks. 1983. An oil spill risk analysis for the Navarin Basin lease offering (March 1984). U.S. Geol Surv Open-File Rep No. 83 120.
Key words: Oil Spill, Bering Sea, Risk Assessment, Navarin Basin

Samuels, W. B., D. Banks, and D. Hopkins. 1983. An oil spill risk analysis for the Diapir Field (June 1984) outer continental shelf lease offering. US Geol Surv Open-File Rep No. 83-570
Key words: Oil Spill, Alaska

Samuels, W.B., K.J. Lanfear, D. Hopkins. 1981. An oil spill risk analysis for the southern California (Proposed Sale 68) outer continental shelf lease area. In U.S. Geol Surv Open-file Rep No 81-605, 4 PL Microfiche (211 Pp)
Key words: oil spill, oil disposal

Sandberg, Chet, Jim Holmes, Ken McCoy, and Heinrich Koppitsch. 1989. The application of a continuous leak detection system to pipelines and associated equipment. IEEE Trans Industry Applications. 25(5):906 909.
Key words: Pipeline Operation, Oil Spill Detection, Remote Sensing, Chlorinated Hydrocarbons, Fuel Storage Accidents Corrosion, fatigue, rupture, and other types of leaks can occur incrude oil, gasoline, or chlorinated solvent pipelines. The compensated volume balance method, acoustic traveling pig

approach, and thermal and electrooptical techniques currently employed for leak detection are briefly described. A flexible hydrocarbon sensing cable is touted as an innovative detector system. The cable can be installed along pipelines, in double containment tanks and piping, or in trenches to detect and locate leaks of common industrial hydrocarbon solvents or fuels while ignoring the presence of water. The simple electrical circuit, which locates and detects a leak anywhere along the length of the sensor, is detailed.

Sandberg, Frank H. 1988. Petroleum product absorption method and apparatus. Patent No. US 4784773_A, 5 pp.
Key words: Water Purification, Oil Spill Removal

Sander, P., R.M. Wittich, P. Fortnagel, H. Wilkes, W. Francke. 1991. Degradation* of 1,2,4-trichloro- and 1,2,4,5-tetrachlorobenzene by Pseudomonas strains. Applied and Environmental Microbiology (United States) 57:5:1430-1440.
In the present study, we demonstrate the enrichment, isolation, and characterization of two bacterial strains capable of using chlorinated benzenes as the sole source of carbon and energy and to release nitrite from 2,4,5-trichloronitrobenzene. In addition, we describe biochemical properties and provide information on the isolation and structure elucidation of degradation products, most of which are reported here for the first time. We also suggest a converging pathway for the biodegradation of both chlorobenzenes.
Key words: chlorinated aromatic hydrocarbons, biodegradation, pseudomonas.

Sandkvist, J., B. Forsman, and D. Thorell. 1991. Airborne detection of winter oil spills - a presentation of the swedish coast guard's build-up of response resources and operational manuals. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 93-99. Key words: Oil Spill, Contamination, Contingency Planning, Crude Oil, Environmental Pollution, Petroleum, Remote Sensing

Sandlofer, M.I. 1993. Oil Spill Rapid Response, Containment and Stoppage Method and Apparatus. North Wind Undersea Inst. Patent No. US 5203273, 12 pp.
Key words: pollution control|, adsorbent, coating material, containment, control, external coating, marine transportation, oil spill, ship,solid adsorbent, sorbent, spill, tanker, transportation, USA, accident, adsorption, anchoring, barrier, cargo, casings, change, chart, construction material, container, contamination, damage, ecology, engineering drawing, environment, environmental pollution, expansion, fastener, fitting, floating barrier, fluid loss, installing, leak, lipophilic, mechanical property, nonmetallic coating, North Wind Undersea Inst, ocean environment, oil swelling, physical property, plastic, plastic coating, pollution control equipment, polymer, prevention, protection, reel, reinforced plastic, reinforcing agent, safety, seal, sealing, solubility, sorption, spooling, storing, surface property, toughness, water pollution, water solubility, wear resistance, wettability, ecology & pollution.

Sangodkar, U.M.Z., T.L. Aldrich, R.A. Haugland, J. Johnson, R.K. Rothmel, A.M. Chakrabarty, P.J. Chapman. 1989. Molecular basis of biodegradation of chloroaromatic compounds. Acta Biotechnologia (German Democratic Republic). 9:4:301-316.
Chlorinated aromatic hydrocarbons are widely used in industry and agriculture, and comprise the bulk of environmental pollutants. Although simple aromatic compounds are biodegradable by a variety of degradative pathways, their halogenated counterparts are more resistant to bacterial attack and often necessitate evolution of novel pathways. An understanding of such evolutionary processes is essential for developing genetically improved strains capable of mineralizing highly chlorinated compounds. This article provides an overview of the genetic aspects of dissimilation of chloroaromatic compounds and discusses the potential of gene manipulation to promote enhanced evolution of the degradation pathways.
Key words: biodegradation, biochemical reaction, aromatic hydrocarbons, genetics, chemical reaction, organic compounds, halogenated aromatic hydrocarbons, microorganisms.

Sann, Alan, Edward C. Wayment. 1985. Protection of the marine environment from hydrocarbon pollution: an integrated planning approach for oil terminals. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: protection, marine, environment, hydrocarbon, pollution, oil terminals.

Sanning, D.E. 1990. Assessment of international remedial technologies for application to superfund sites. In: Proceedings of the 2nd Inst Gas Technol Gas, Oil, Coal, & Environ Biotechnol INT Symp, Dec. 11-13, 1989, New Orleans, LA, pp. 23-36.
Key words: Ground water, Bacteria, Biodegradation, In-situ, Japan, Netherlands, Oil Spill, Soil Pollution, Water Pollution

Sanocki, S.M., D.D. Johnson, E.M. Fischer. 1990. High Temperature Resistant Oil Boom Flotation Core. Minnesota Mining & Mfg. Co. 5(pp).
Key Words: Floating barrier, containment, fire resistance, high temperature, oil spill, physical property, pollution control, temperature, USA, alloy, alumina, aluminum oxide, boron oxide, buoyancy, ceramic, chemical process, chloroethylene homopolymer, coating material, combustion, construction material, contamination, engineering drawing, fabric, ferrous alloy, foamed glass, foamed plastic, inorganic, metallic coating, Minnesota Mining & Mfg. Co., nylon, ocean environment, organic, oxide, plastic coating, polymer, water pollution.

Sanseverino, J., C. Werner, J. Fleming, B.M. Applegate, J.M.H. King G.S. Sayler, and J. Blackburn. 1991. Molecular analysis of manufactured gas plant soils for naphthalene mineralization.In: Proceedings of the 3RD Inst Gas Technol (Chicago) Gas, Oil, Coal, & Environ Biotechnol Int Symp, December 3 5, 1990, New Orleans. pp. 39 54.
Keywords: bacteria, biodegradation, soil pollution, soil remediation

Sanseverino, J., B.M. Applegate, J.M.H. King, and G.S. Sayler. Plasmid-mediated mineralization of naphthalene, phenanthrene,and anthracene. Applied and environmental microbiology. 59(6):1931-1937.
Key words: Hydrocarbon, degradation, Bacteria
The well-characterized plasmid-encoded naphthalene degradation pathway in Pseudomonas putida PpG7(NAH7) was used to investigate the role of the NAH plasmid-encoded pathway in mineralizing phenanthrene and anthracene. Three Pseudomonas strains, designated 5R, DFC49, and DFC50, were recovered from a polynuclear aromatic hydrocarbon-degrading inoculum developed from a manufactured gas plant soil slurry reactor. Plasmids pKa1, pKA2, and pKA3, approximately 100 kb in size, were isolated from these strains and characterized. These plasmids have homologous regions of upper and lower NAH7 plasmid catabolic genes.

Santo, B. 1993. U.S., Japan gear up for micromachines. Electronic Engineering Times (Nov. 29):1

Sarathi, P.S. 1991. Environmental aspects of heavy oil recovery by thermal EOR processes. In: Proceedings of the SPE Western Reg MTG, Mar 20-22, 1991, Long Beach, CA, pp. 179-195.
Key words: Pollution Control, Environmental Impact, Legal, Oil Recovery, Groundwater, Oil Spill, Water Pollution

Sarnacki, Pete. 1993. Main features of the Valdez Star and Shearwater oil recovery ships. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: Valdez Star, shearwater, oil recovery, ships.

Sartor, J.M., F. Wehrenberg, J. McTague. 1993. Chevron oil spill contingency response plan template. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: Chevron, oil spill contingency, response.

Sartor, James D., Carl Foget. 1973. Oil/sorbent harvesting systems for use on vessels of opportunity. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil/sorbent, vessels.

Sartor, James D. 1971. Evaluation of selected earthmoving equipment for the restoration of oil-contaminated beaches. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: equipment, restoration, oil-contaminated, beaches.

Sartor, J.D., W.D. Couch, D.S. Kauffman. 1975. Oil spill contin-

gency plans for the Alyeska pipeline system. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil spill contingency plans, Alyeska pipeline.

Sasamura, Yoshio. 1985. Implementation of MARPOL 73/78. In:

Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: Marpol 73/78.

Sasek, Vaclav, Olga Volfova, Pavla Erbanova, B.R.M. Vyas, and Miroslav Matucha. 1993. Degradation of PCBs by white rot fungi, methylotrophic and hydrocarbon utilizing yeasts and bacteria. Biotechnol Lett. 15(5):521-526.
Key words: Biodegradation, Microorganism, Polychlorinated Biphenyls, Bacteria
The efficacy of selected white rot fungi individually and in combination with yeasts and bacteria was investigated for the degradation of PCBs in soil. Of the white rot fungi evaluated, only Hirneola nigricans and a Px-strain were able to degrade the PCBs to any extent alone. Methylotrophic- and hydrocarbon-utilizing yeasts and bacteria did not degrade the PCBs to any extent, but combinations of the organisms increased biodegradation. Best results were found for the combinations of Pleurotus ostreatus and Pseudomonas sp. strain B2, H. nigricans and Candida biodinii, and Lintinus edodes and C. lipolytica.

Sathish, N., J.C. Young, and H.H. Tabak. 1993. A protocol for determining the rate of biodegradation of toxic organic chemicals in anaerobic (wastewater treatment) processes. In: Proceedings of the ACS Industrial and Engineering Chemistry Division Symposium, October 1 3, 1991, Atlanta, GA, ACS Symposium Series N. 518 213-18.
Key words: water pollution, bacteria, biodegradation, US Environmental Protection Agency, water pollutant

Sauer, Ted, Paul Boehm. 1991. The Use of defensible analytical chemical measurements for oil spill natural resource damage assessment. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA. Key words: chemical measurements, oil spill, natural resource, damage.

Saunders, Wayne R., Robert W. Castle, Carl R. Foget. 1983. Delineation of subsurface petroleum spills using terrain conduc-

tivity measurements. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., 415 - 418. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Subsurface, Petroleum, Spills.

Sauriol, A., P. Hudon, and J. Primak. 1988. Recuperation of heavy hydrocarbons by hot water injection: Leaching and pumping. In: Proceedings of the Haztech Canada 88: dangerous goods and hazardous waste management conference, May 10 12 1988, Mississauga, pp. 199-208.
Key words: Oil Spills, Cleaning, Fluid Injection
At the electrolysis plant of Noranda Mines Limited in the East End of Montreal, an area of approximately 360 m{sup 2} was contaminated with heavy fuel oil. Generally, the oil was found in the first meter of the soil, more precisely at a depth of 30 to 90 cm. Excavation of the contaminated soil was excluded and

in-situ recovery of the oil was performed. During the summer of 1986, over a period of 16 weeks, water at an average temperature of 40 C was injected in a well. The use of hot water, rather than water at the ambient temperature, provided a better cleaning of the contaminated area and served, with temperature measurements in observation wells, to confirm the groundwater flow pattern. A recovery well, located at the source of the spill, ensured the drawdown of the groundwater table and the recovery of the hydrocarbons. The injection of hot water, the drawdown of the groundwater table and the skimming of the floating oil layer have led to the recovery of 2,320 liters of oil. 3 figs.

Savant-Malhiet, S.A., R.A. Ettinger, E.J. Stones, and I.J. Dortch. 1992. Prediction of the simultaneous evaporation and infiltration of ponded hydrocarbon mixtures. In: Proceedings of the 5th Annual Mass Univ et al. Hydrocarbons Contaminated Soils Conf, September 24 27, 1990, Amherst, MA. 2:357 373.
Keywords: soil pollution, biodegradation, oil spill

Savitsky, Basil. 1987. The Utilization of environmental sensitiv-

ity index data in a microcomputer-based geographic information system. In: Proceedings of the 1987 Oil Spill Conference (preven-

tion, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: environmental sensitivity, data, geographic information system.

Savitsky, Basil. 1989. Development of an oil spill response information system for Southwest Florida. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: development, oil spill response, information, FL.

Savitsky, Basil, Bonnie Preedom, Patrick L. Horton, John R. Jensen, and Elijah Ramsey. 1989. Coastal Zone '89. In: Proceedings of the Sixth Symposium on Coastal and Ocean Management, July 11-14, Charleston, SC. ASCE: New York, p. 4614.
Key words: Oil Spills, Gulf of Mexico, Dispersants, Computer Applications
Environmental Sensitivity Index (ESI) maps depict shoreline classes which are ranked for sensitivity to spilled oil. ESI atlases also depict the distribution of biological resources which could be affected by pollutants and information for spill response strategies which could be used to mitigate the impact of oil spills. Recent advances have utilized computer mapping software in order to make use of powerful interactive analytical capabilities, easier updating procedures, and available digital data sources. Of particular interest is the ability to use satellite data for areas that are remote, have extensive coastal zones, or lack sufficiently current or accurate maps. Algorithms are being din the U.S. Gulf of Mexico is under development and due for completion in early 1988. The system can predict the impact of an oil spill in the Gulf if it is either treated with dispersants of left untreated. The method works as follows. A computerized map of the untreated spill is produced showing the predicted location and concentration of the spilled oil as a

function of time after the initial discharge. This map is then compared with a series of computerized maps of 70 important Gulf resources that might suffer from the effects of the spill. A geographical information system (GIS) with extensive spatial analytical capabilities is then used to calculate the proportion of each resource that is affected by the spill at specified levels of oil concentration.

Saxena, V.N. 1988. UV laser fluorosensor for remote sensing. Def. Sci. J. (New Delhi)(India). 38:315-320.
Key words: Oil Spills, Monitoring, Data Processings, Remote Sensing, Water Pollution
It is shown how the spectral analysis of flourescence can be used to detect, monitor, and even quantify oil spills in the ocean. On the basis of the concentration of chlorophyll in water, it is possible to assess environmental conditions. Since chlorophyll in green plants fluoresces in the wavelength range of 650-750 nm, the best excitation is achieved by a laser in the 400-500 nm range. 11 references.

Sayler, G.S. 1993. Molecular Ecology of Bacterial Population in Environmental Hazardous Chemical Control. Annual rept. 15 Jan 92 14 Jan 93. Air Force Office of Scientific Researh, Bolling AFB, Washington, D.C. Report No. AFOSR-TR-93-346650, 12 pp.
Key words: microbiology, microorganisms, biodegradation, waste treatment
This research focuses on developing new molecular knowledge and techniques to develop a greater understanding of microbial degradation processes in the environment. A major goal of this research is to create a molecular strategy for quantitative biodegradation process monitoring and control in the environment and to predict success and failure patterns impinging on biodegradation of hazardous waste materials.

Sayler, G.S. 1993. 3 Molecular probes and bioluminescent reporters in ecological optimization of biodegradation. (FY 91 aasert). Annual report, 1 June 1992-31 May 1993. Tennessee Univ., Knoxville, TN (United States). 3.
The goal of the research supported by this grant is to determine the
role that biosurfactants and biosurfactant-producing microorganisms may play in enhancing the rate and/or extent of polycyclic aromatic hydrocarbon (PAH) biodegradation in particulate media. Biosurfactants, which are surface-active compounds produced by certain bacterial strains, have been shown to increase the apparent aqueous solubility of sparingly-soluble organic contaminants including PAHs. The biodegradation rate is often controlled by the aqueous concentration which in turn may be controlled by sorption/desorption equilibrium in particulate matrices. Biosurfactants may function as another phase for the contaminant to partition into, thereby increasing the available pool of the contaminant and, thus, its rate of degradation.
Key words: polycyclic, aromatic, hydrocarbons, biodegradation, surfactants, biochemical reaction kinetics.

Sayler, G. S. 1991. Molecular ecology of bacterial populations in environmental hazardous chemical control. Tennessee University,

Knoxville, TN. Report No. AD A 248493/9/XAB, 71 p.
Key words: Biodegradation, Pollutants, Toxicology
Basic research was conducted to develop and explore the use of modern molecular biology techniques in understanding the dynamics of microbial populations engaged in biodegradation of environmental pollutants. The research focused on (1) the use of environmental DNA extraction and gene probing techniques to quantify the presence and distribution of degrative genes in the environment, (2) characterizing new-degradative organisms and plasmids for eventual development of new catabolic gene probes for environmental use, and (3) construction of novel bioluminescent reporter bacteria to act as biosensors of catabolic activity in the environment.

Scales, Marilyn. 1992. Shipping lane could prompt boom north of Yellowknife. Norhtern Miner, p. 1.
The MV Arctic set sail this week from Halifax en route to the Nanisivik terminal on Baffin Island to pick up about 25,000 tonnes of lead and zinc concentrates before heading to Europe. In June, the ship will dock at the Polaris mine on Little Cornwallis Island, the most northerly mine in Canada, to pick up the first of three or four shipments of concentrates this year.^Although other ships are chartered to move a total of 100,000 tonnes from the Nanisivik mine and more than 250,000 tonnes from Polaris, it is the unique ice-breaking ability of the MV Arctic that makes it so valuable. It is the first ship into these frigid waters in the spring and can return as late as December.^The ship provides a reliable and economical method of moving goods in and out of the arctic, and that is essential to mining companies considering new developments in the far north. Canarctic Shipping of Ottawa, the consortium of private business and the federal government that owns the MV Arctic, sent the ship into Deception Bay on the northern tip of Quebec's Ungava Peninsula in March, 1990, improving the feasibility of development for Falconbridge of the Raglan nickel property.^Using a vessel such as this would extend the shipping season to 9-10 months, rather than the ice-free period lasting only a few weeks during the summer. Falconbridge is, however, waiting for stronger nickel markets before committing itself to development.^Canarctic is now in the middle of a $400,000 study to determine the prospects for shipping to the Coronation Gulf, between the western edge of the Northwest Territories and Victoria Island. The cost will be paid largely by mineral producers who have nearby deposits in various stages of exploration.

Schaap, D., C. J. Hoon, L. J. Stehmann. 1984. Design considerations for dutch offshore pipe lines. Pipe Line Ind 61(1):38 39
Key words: Underwater Pipeline, Oil Spill, Design

Schaffner, R. Jr., Yen Lee, B.H. Holdaway, A.L. Mayo, M.B. Borup, and R. Seeley. 1990. Bacterial pore-clogging as a primary factor limiting the enhanced biodegradation of highly contamination aquifers.In: Proceedings of petroleum hydrocarbons and organic chemicals in ground water: Prevention, detection, and restoration. 664(p):401-415.
Key Words: Ground water water pollution, ground water water

treatment, oil spills biodegradation, water wells formation damage, de-antifoulants, aquifers, bacteria, biological fouling, cleaning, dissloved gases, hydrocarbons, oxygen, permeability, petroleum, ph value, porosity, removal, water pollution abatement, chemical reactions, decomposition, elements energy sources, fluids, fossil fuels, fouling, gases, hydrogen compounds, microorganisms, nonmetals, organic compounds oxygen compounds, pollution abatement, solutes.

Scharfenstein, Charles F., Michael G. Hoard. 1977. Development of an Arctic oil spill recovery system for Arctic operations. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: Arctic, oil spill, recovery.

Schatzberg, Paul, Drew F. Jackson. 1973. Remote sampler for determining residual oil content of surface waters. In: Proceed-

ings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: residual, oil, content, waters.

Schatzberg, P. 1975. Oil-water separations with noncellulosic ultrafiltration systems. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil-water, separations.

Schatzberg, Paul, K.V. Nagy. 1971. Sorbents for oil spill remov-

al. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: sorbent, oil spill removal.

Schell, M.A. 1989. Regulation of the naphthalene degradation genes of plasmid NAH7: Example of a generalized positive control system in pseudomonas and related bacteria. Pseudomonas: Biotransformations, pathogenesis, and evolving biotechnology. Silver, S., Chakrabarty, A.M., Iglewski, B., Kaplan, S. 1989. Illinois Univ., Chicago, IL (USA). Dept. of Microbiology and Immunology. 165-176:432.
In this chapter, recent developments in genetic and biochemical analysis of the organization and regulation of naphthalene degradation genes are discussed. The focus is on plasmid NAH7 and the nahR gene that it uses to regulate its naphthalene degradation genes, because it is one of the most extensively studied plasmid-borne degradative gene systems in Pseudomonas spp. However, knowledge about the NAH7 regulatory system has implications for the many other systems with LysR-type activators, which probably use a very similar control mechanism.
Key words: Naphthalene, biodegradation, amino acid sequence, gene operons, genetic mapping, structural chemical analysis.

Schell, J.A. 1992. A system perspective for oil spill surveillance. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:115-125.

Key words: Oil Spill, Contamination, Remote Sensing

Schell, M.A., E. Faris, W.S. Reznikoff, C.A. Gross, R.R. Burgess, M.T. Record, J.E. Dahlberg, and M.P. Wickens. 1987. Transcriptional regulation of the nah and sal naphthalene degradation operons of plasmid NAH7 of Pseudomonas putida. RNA polymerase and the regulation of transcription. In: Proceedings of the 16. Steenbock symposium on RNA polymerase and the regulation of transcription. 455-458.
The nah and sal operons of the NAH7 plasmid of P. putida encode enzymes for metabolism of naphthalene via salicylate and are coordinately induced 20-fold by salicylate and the nahR gene product. Analysis of fusions of portions of the nah, sal, and nahR promoters to the E. coli galK gene showed that the promoter sequence between -83 and -45 is required for transcription activation of sal (and probably nah) by nahR. It may also be involved in autoregulation of the divergently transcribed nahR gene. An electrophoretic DNA binding assay and crude extract of E. coli cells containing the cloned nahR gene were used to demonstrate that the -83 to -45 sequence of the nah and sal promoters is required for specific binding of the nahR protein to each promoter. The inducer salicylate did not appear to alter binding.
Key words: gene operons, DNA sequencing, biodegradation, catabolism, genes, biochemical reactions, aromatics, phosphotransferases, gene regulation, escherichia.

Schepart, B.S., and J.B. Hyzy. 1992. Laboratory evaluation of biodegradation of crude oil contaminated tundra soil. In: Proceedings of the Fifteenth Arctic and Marine Oilspill Program technical seminar. 689-71A laboratory experiment was designed to evaluate oil degradation rates in heavily contaminated soil samples from an oil spill site under various redox and nutrient conditions. Reduction of total petroleum hydrocarbons (TPH) in the experiment by indigenous bacteria was found to be negligible under aerobic conditions for all nutrient amendments over a 12-week period. The unexpectedly poor performance of the aerobic treatment may have been due to the high concentration of TPH (153,487 ppM) and the slow rate at which indigenous bacteria grew, or the preferential use of biogenic carbon over petroleum hydrocarbons. In contrast, under anaerobic conditions TPH was reduced by 47% in high nitrogen and phosphorous microcosms. The unexpectedly good performance of anaerobic bacteria indicates that promotion of oil degradation in saturated subsurface soils is feasible. The best degradation rates, however, were achieved by application of bacterial amendments, which reduced TPH up to 60% over 12 weeks. The higher degradation rates using bacterial amendments were attributed to the relatively rapid rate at which the bacteria colonized the substrates. This result suggests that bacterial additions in the field would be useful for promoting more rapid degradation of oil, while the slower growing indigenous oil-degrading bacteria population is allowed to increase. 19 refs., 9 figs., 3 tabs.
Key words: oil spills, biodegradation, anaerobic condition, bench-scale, experiment, microcosms, soils, tundra.

Scherer, P.A., K.U. Schultz, and R. Meyer-Pittroff. 1990.

Comparison of methods to characterize the degradation rate of organic matter during solid state fermentations. 1990. Biochemical methods for water analysis (GDCh-Workshop), presentation of cell culture technology laboratories, microbial principles in bioprocesses, applied genetics, microbial material deterioration, environmental biotechnology. Lectures. Behrens, D., Kraemer, P. 1990. <Original Series/Collective> DECHEMA biotechnology conferences. 8. DECHEMA annual meeting of biotechnologists - 61. meeting of the European Federation of Biotechnology. 661-665: 688. Spent grains of the brewery of Weihenstephan have been fermented under strict anaerobic conditions at a concentration of 5% (w/v) in batch cultures at 37deg C for 10 days. One series was additionally pretreated with 0.4% (w/w) NaOH for 1 h at 80deg C on a shaker. Chemical fractions were obtained and compared for their suitability to characterize the minor advantage of alkaline and thermic pretreatment as well as the biodegradation rate of spent grains. The following methods were applied: a direct COD determination of solids, soluble COD, protein, anthrone sugars, DNA to estimate increase of microbial biomass, hemicellulose, cellulose + lignin + ash, methane and CO{sub 2}. The degraded material was mainly hemicellulose (appr. 85%). A correlation with only 5-8% deviation was found between the sum of biochemical fractions and COD-solids + COD-dissolved. Therefore the state of biodegradation can be estimated by only two COD determinations. (orig.).
Key words: stillage, anerobic digestion, batch culture, biodegradation, chemical oxygen, bioconversion, carbon dioxide.

Schiegg, H.O.,and J.F. McBride. 1987. Laboratory setup to study two-dimensional multiphase flow in porous media. In: Proceedings of the NWWA/API conference on petroleum hydrocarbons and organic chemicals in ground water: prevention, detection and restoration. 24.
Key Words: Bench-scale experiments design, multiphase flow two-dimensional claculations, porous materials multiphase flow, flow rate, fuel oils, ground water, oil spills, porosity, scale models, fluid flow, hydrogen compounds, liquid fuels, organic compounds, other organic compounds, oxygen compounds, petroleum products, structural models.

Schiwek, H. 1992. Floating Oil Absorber and Disposal in Pyrolysis Installations. World 92/19692, p 11/12/92, f 5/3/91 (Appl 91/242) (c09k-003/32; C02f-001/68) pct gaz v 1992, no 28, p 12967, 11/12/92 abstract only.
Key words: oil waste, absorbent, absorption, floating, glass, glass fiber, oil wastefate, sorbent, sorption, waste material, world, business operation, chemical process, cleaning, collecting agent, compound, contamination, conversion process, crude oil, disposal, environmental pollution, hazardous chemical, oil spill, petroleum, pyrolysis, removal, salvaging, silicone, spill, waste disposal, waste oil recovery, water pollution, ecology & pollution

Schlien, H.H. 1992. Physical and chemical characteristics of (crude oils and) mineral oils. In: Proceedings of the DGMK Remediation of Oil Spills Scientific Seminar (Hamburg, Germany

5/18-21/92) Proceedings (ISSN 0938-068X) N.1.1 1-13.
Key Words: Additive, air, benzene, benzene ring, C6, colloid/dispersion, composition, corrosion inhibitor, crude oil, crude oil (well), density, diesel fuel, diffusion, emulsification, emulsion, evaporation, explosivity, flammability, flash point, fuel oil, gas oil, ground water, hazard, heating fuel, hydrocarbon, kerosine, light gas oil, lubricant stock, mass transfer, meeting paper, mobil oil, motion, motor fuel, oil content, oil waste, oil-water emulsion, oxidation inhibitor, petroleum distillate, petroleum fraction, phase change, physical property, pollutant, pollution control, pour point, residual fuel oil, review, single structure type, soil (earth), soil pollutant, solubility, spreading, transition temperature, use, viscosity, waste material, water.

Schlittler, W.J. 1993. Removal of oil from produced sand using new oilfield technology. In: Proceedings of the 4th Annu Pennwell Conf & Exhibit Co Petro-safe 93 Conf (Houston, 1/26 28/93) Proc Book 2, Pp 181 190, 1993.
Key words: disposal, oil, legal, petroleum

Schloemann, M., D.H. Pieper, and H.J. Knackmuss. 1989. Enzymes of haloaromatics degradation: Variations of alcaligenes on a theme by pseudomonas. Silver, S., Chakrabarty, A.M., Iglewski, B., Kaplan, S. 1989. Pseudomonas: Biotransformations, pathogenesis, and evolving biotechnology. Illinois Univ., Chicago, IL (USA). Dept. of Microbiology and Immunology. 185-196.
The enzymology and molecular genetics involved in the degradation of haloarmatics are compared in Pseudomonas and Alcaligenes. The two organisms are similar in that they synthesize two separate sets of enzymes for the degradation of catechol and halocatechols via ortho cleavage. Despite this similarity the studies have revealed remarkable differences between the two strains and these differences are discussed in detail.
Key words: bacteria, biological pathways, hydrocarbons, biodegradation, biochemical reaction kinetics.

Schmidt, S.K. 1989. Enhanced Microbial Reclamation of Water Polluted with Toxic Organic Chemicals. Dept. of Environmental, Population, and Organismic Biology. Colorado Univ. at Boulder. Water Resources Div. Geological Survey, Reston, VA. Report No. Completion-152,USGS/G-1551-05, 27 pp.
Key words: bacteria
The research was undertaken to develop an inexpensive and easy to operate a microbiological system to reclaim waters contaminated with toxic organic chemicals. Groundwater pollution is a major environmental and public health problem in Colorado. Nitrophenols are widely used in industry as intermediates in the production of dyes, explosives and pesticides. Because of their widespread use, nitrophenols occur as contaminants in industrial effluents and hence in natural waters. The present study was designed to optimize conditions for the biodegradation of 2,4 dinitrophenol (DNP) and other toxic organic chemicals in sequencing batch reactors (SBRs). Optimal conditions for the destruction of toxic chemicals by these bacteria were determined in Sequencing Batch Reactors, a type of biological treatment system.

Schmidt, G.W., and P.E. Fairbanks. 1989. New field method providing for in-field extraction of volatile petroleum hydrocarbons in groundwater samples. In: The proceedings of the third national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods. National Water Well Association outdoor action conference. 1161(p):65-79.
Key Words: Ground water chemical analysis, ground water contamination, portable equipment accuracy, ecological concentration, feasibility studies, field tests, freons, gas spills, gasoline, oil spills, performance testing, vapors, water pollution, equipment, fluids, halogenated aliphatic hydrocarbons, hydrogen compounds, liquid fuels, organic compounds, organic halogen compounds, oxygen compounds, petroleum products.

Schmidt, S.K., R. Smith, D. Sheker, T.F. Hess, J. Silverstein, and P.M Radehaus. 1992. Interactions of bacteria and microflagellates in sequencing batch reactors exihibiting enhanced mineralization of toxic organic chemicals. Microbial ecology. 23(2):127 142.
Keywords: biodegradation

Schmidt, E. 1987. Response of a chlorophenols degrading mixed culture to changing loads of phenol, chlorophenol and cresols. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 27:1:94-99.
A phenol and solvents degrading mixed culture from soil and sludge supplemented with Pseudomonas sp. strain B 13 which harbors genes coding the sequence for chlorocatechol breakdown was acclimated to monochlorophenol degradation. Pyrocatechase activity was used as an indicator for the adaptation status of the culture. In the fully acclimated culture, strain B 13 was partially replaced by hybrid strains which had acquired the chlorocatechol degrading sequence. This culture degraded changing loads of phenol, chlorophenols and cresols without accumulation of DOC (dissolved organic carbon). When high cresol concentrations were supplied simultaneously with the chlorophenols, strains were enriched which degrade cresols and 3-methylbenzoate via ortho-cleavage pathway.
Key words: biodegradation, pseudomonas, halogenated aromatic hydrocarbons, adaptation, cresols, cell culture, sewage sludge, continuous culture.

Schmitt, E. K., M. T. Lieberman, J. A. Caplan, D. Blaes, P. Keating and W. Richards. 1991. Bioremediation of soil and groundwater contaminated with stoddard solvent and mop oil using the PetroClean bioremediation system. In: R. E. Hinchee and R. F. Olfenbuttel (eds.), In Situ Bioreclamation. Butterworth Publishers: Stoneham, MA, pp. 581 599.
Key words: Groundwater, Biodegradation, Oil Spills, Remedial Action
This paper reports that Environmental Science and Engineering Inc. (ESE) was contracted by a confidetnial industrial client to perform a three-phased project. Phase I involved characterizing the site and delineating the extent of subsurface contamination. Phase II included biofeasibility and pilot-scale evaluations, determining remedial requirements, and designing the full-scale treatment system. Phase III involved implementing and operating

the designed in-situ bioremediation system (i.e., PetroClean 4000) to achieve site closure.

Scholten, M., and J. Kuiper. 1987. The Effects of oil and chemically dispersed oil on natural phytoplankton communities. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: effects, oil, dispersed, phytoplankton.

Scholtz, R., A.M. Schmuckle, A.M. Cook, T. Leisinger. 1987. Degradation of Eighteen 1-monohaloalkanes by Arthrobacter sp. strain HA1. Journal of general Microbiology. 133(2): 267-274.
Key words: arthrobacter, biodegradation, dehalogenation, alkane, halocarbon, medium enrichment, growth, soluble enzyme, specific activity, hydrocarbon.

Scholze, Richard, Vladimir Novotny, and Rebecca Schonter. 1993. Efficiency of best management practices for controlling priority pollutants in runoff. Water Science and Technology. 28(3-5):215 224.
Key words: biodegradation, water pollution
All priority pollutants are removed from runoff via one or more of the following pathways: adsorption or precipitation and/or complexation followed by sedimentation or filtration, volatilization, biodegradation or photolysis. The more appropriate removal mechanism may be determined by examining certain chemical parameters, especially the octanol-water partitioning coefficient K//o//w, Henry's law constant K//H, vapor pressure and biodegradability. Best Management Practices may be divided into categories based on the pollutant removal mechanisms within the BMP. The most appropriate BMP may be selected by matching the process most likely to remove the pollutant to the removal process. (Author abstract) refs.

Scholze, R.J., E.D. Smith, J.T. Bandy, Y.C. Wu and, and J.V. Basilico. 1988. Biotechnology for degradation of toxic chemicals in hazardous wastes. Noyes Publications: Park Ridge, NJ, 697 pp.
Key words: Biodegradation, Industrial Wastes, Wastewater
The state-of-the-art of biotechnology for degradation of toxic chemicals in hazardous wastes is discussed in this book. In particular, it discusses the applicability of using biotechnology for the treatment of hazardous/toxic wastewaters. Full-scale application of biotechnology for the treatment of municipal and industrial wastewaters has been practiced for many years. However, whether this technology can be employed for detoxification and destruction of hazardous chemicals in aqueous and solid media is not yet fully understood. Removal of toxic and refractory organics in wastewater, groundwater, and leachate may be more efficient as a result of combining biological treatment with other treatment technologies such as chemical and physical methods. Development of standard techniques for biotoxicity detection and toxicity reduction evaluation is essential and extremely important to both technical determination and decisions on the future policy for hazardous waste management. The various chapters in the book describe current research in biotechnology for degradation of toxic chemicals in hazardous wastes.

Scholze, R.J., E.D. Smith, J.T. Bandy, Y.C. Wu and J.V. Basilico. 1988. Biotechnology for the treatment of hazardous waste contaminated soils and residues. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 359-375.
Key words: Biodegradation, Bioreactors, Microorganisms, Monitoring, Soils
This research deals with the development and use of biotechnology for treating contaminated soils and waste residues at the site of the problem. The major treatment methods include physical/chemical washing of soils and waste residues as a pretreatment followed by biological degradation. The micro-calorimeter is a device that offers a convenient and relatively quick way of determining the interaction of the microbiological community with a contaminant. The microbial activity in terms of heat output for a one gram sample is termed a thermogram. A normalization test performed on a sample that is the organic medium to sustain the microbiological community will reflect the endogenous activity of the microorganisms present. Adding a contaminant to sewage sludge at various rates will determine the input of the toxicant on the microbiological community. If the added compound is a toxicant, the heat output will be less than for the normalized thermogram. If the compound can be metabolized, the heat flux will be greater. The change in heat output may then be considered a measure of the degradation response of the microorganisms. A thermographic analysis on sewage sludge contaminated with 1,2,4-trichlorobenzene indicate that biodegradation can be used to decontaminate soils. However, additional organic toxicants and additional environmental parameters must be explored.

Schrader, Ed L. 1991. Remediation of floating, open water oil spills: comparative efficacy of commercially available polypropylene sorbent booms. Environmental Geology and Water Sciences. 17(2):157.
Key Words: Sorption rate, remediation, oil spill, floating, open water, efficacy, comparative, boom, polypropylene sorbent, commercially available.

Schrader, E.L. 1991. Testing sorbent booms for oil spill cleanup. Pollution Engineering. 23(5):72-75.
Key words: Adsorbent, Boom, Breakthrough, Crude Oil, Economic Factor, Pollution Control

Schreiner, O. 1989. Different environmental consequences from use of drilling fluids. In: Proceedings of the 4th Norwegian Petrol Soc N Europe Drilling Conf, October 30 November 1, 1989, Kristiansand, Norway.
Keywords: drilling waste disposal, Eurasia, Europe, legal consideration, Norway, biodegradation, drilling, environmental impact, government, monitoring, offshore, pipeline

Schriel, R.C. 1989. Application of the technology in the Netherlands. In: Proceedings of the Inst Petrol London Remote Sensing of Oil Slicks Int Mtg, May 17 18 1988, London, England, pp. 17-27.
Key words: Remote Sensing, Netherlands, Oil Spill, Contamination,

Pollution Control

Schriel, R.C. 1987. Operational air surveillance and experiences in the Netherlands. In: Proceedings of the 10th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Conf, April 6 9 1987, Baltimore, MD, pp. 129-136.
Key words: Netherlands, Oil Spill, Physical Properties, Remote Sensing, Contamination, Crude Oil, Legal Considerations

Schriel, R.C. 1989. Monitoring of operational discharges from oil production platforms. In: Proceedings of the INST Petrol London Remote Sensing of Oil Slicks Int Mtg, May 17 18 1988, London, England, pp. 77-86.
Key words: Remote Sensing, Oil Spill, Contamination

Schrier, Eric; Carl Eidam. 1979. Cleanup efficiency of a fuel oil spill in cold weather. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: cleanup, oil spill.

Schroeder, Roy A. 1991. Delineation of a hydrocarbon (weathered gasoline) plume in shallow deposits at the U.S. Naval Weapons Station, Seal Beach, California. Water-Resources Investigations.
Key Words: California, pollution, soils, ground water, environmental geology, oil spills, plumes, USGS, Pacific Coast, Western U.S., United States, Southern California, Seal Beach National Wildlife Refuge, Orange County California, U. S. Naval Weapons Station, underground storage, crude oil, transport, hydrochemistry, levels, hydrographs, pollutants, lead, metals.

Schroh, K. 1989. Oil spill strategy in the Federal Republic of Germany: New technical developments in mechanical spill response. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 265 71.
Key words: Additive, Boom, Crude Oil, Pollution Control, Waste Material

Schroh, K., and U.H. Bustorff. 1989. Monitoring of operational discharges in the federal republic of germany. In: Proceedings of the INST Petrol London Remote Sensing of Oil Slicks Int Mtg, May 17 18, London, England, pp. 87-103.
Key words: Remote Sensing, Oil Spills, Contamination, Pollution Control

Schropp, S.J., T.J. Phelps, A.T. Mikell, D.C. White, and D.L. Klass. 1987. The relationship of eubacterial and methanogenic community structure in anaerobic digesters. 10. annual symposium on energy from biomass and wastes. 1035-1044.
Anaerobic digesters contain a complex microbial community that carries out the degradation of organic compounds converting them to simple end products. Analyses of digester communities using conventional microbiological techniques suffer from several limitations, many of which can be overcome by using a suite of recently developed biochemical techniques. The authors review some of these limitations and discuss the use of biochemical

techniques. Using these techniques, microbial community structure can be defined, nutritional status determined, and the proportion of methanogenic archaebacteria and eubacteria examined in relationship to methane production from a digester.
Key words: methane, production, methanogenic, anaerobic digestion, bioreactors, nutrition, reviews, document types, hydrocarbons, alkanes, bacteria, chemistry, processing waste, microorganisms.

Schubert, Capt. Frederick P. 1977. IMCO and the evolving interna-

tional scheme for controlling marine pollution. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: international, controlling marine pollution.

Schultz, Donald P., W. Waynon Johnson, and Alice B. Berkner. 1983. A unique oiled bird rehabilitation operation: Myrtle Beach, South Carolina, February 1981. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., 525 - 528. San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords - Oiled, Bird, Rehabilitation, Myrtle Beach, South Carolina.

Schultz, Donald, L.B. Tebo, Jr. 1975. Boone Creek oil spill. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: Boone Creek, oil spill.

Schultz, L.A., P.C. Deslauriers. 1977. The Application of existing oil spill abatement to cold regions. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: application, oil spill abatement.

Schultz, T.W., S.T. Perry, J.N. Dumont. 1978. Reduced toxicity of an aqueous coal-conversion effluent following waste disposal treatment. Bull. Environ. Contam. Toxicol.(United States) (1978): 20
Key words: oil, disposal
Since the aqueous effluent from a single commercial conversion plant may range from 0.4 to 1.2 million gallons per day and contain hundreds or thousands of different compounds, it is essential to examine such effluents as potential environmental hazards. One of the more promising coal-conversion schemes is the Solvent Refined Coal (SRC) process which can produce fuel low in sulfur and ash from coals high in these substances. Chemical analyses of the untreated waste process-liquid stream from the SRC plant (Fort Lewis, Washington) show that it has a high pH and contains high concentrations of sulfur, phenol, and cresols in addition to process maphtha. This waste process-liquid stream, however, is fed through a waste-water-oil disposal system which includes a bio-reactor unit and sand and carbon filters. The liquid waste effluent from this water-oil disposal system has a nearly neutral pH and a greatly reduced sulfur and phenol content. The purpose of the present report is to examine the

biological effects of the liquid effluent stream from the oxycontact bio-reactor unit on a model system the ciliate Tetrahymena pyriformis. This model system has been used to examine the toxicity of untreated process streams and pure compounds from a variety of coal-conversion processes.

Schulze, R. 1990. Spill response trade-offs in a very large spill. Spaulding, M.L., and M. Reed. Oil Spills. In: Proceedings of the Oil spills management and legislative implications conference, May 15 18 1990, Newport, RI, pp. 232-239.
Key words: Oil Spills, Water Pollution Control, Oil Pollution Containment
This paper examines the physical limitaions on spill encounter rate and how these limitaions affect the are that can be covered in spill response. Since mechanical recovery devices may not be able to cover the affected area in a large spill, in situ burning must be considered as a response option. Further, effective recovered oil logistics is essential to successful response operations and keeping skimmers operating. A successful spill response effort in a very large oil spill often depends on: Prompt response, Skimmer encounter rate, Making a decision for in situ burning, Recovered oil logistics.

Schulze, Robert, Ivan M. Lissauer. 1985. An Overview of a field guide for Arctic oil spill behavior. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: Arctic, oil spill.

Schulze, Robert H. 1983. Probability of an oil spill on the St. Marys River. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: probability, oil spill, St. Marys River.

Schulze, Robert H. 1981. A Cost-effectiveness approach to oil spill response. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: cost effectiveness, oil spill, response.

Schulze, R.H. 1982. Oil spill response scenarios for remote Arctic environments. In: U.S. Environ Protect Agency Rep No EPA-600-S2-82-036, 1 PL Microfiche (7 Pp).
Key words: oil spill, Alaska, response, oil disposal, legal

Schwartz, Sol H. 1979. Performance tests of four selected oil spill skimmers. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: performance, oil spill, skimmers.

Schwartzberg, Henry G. 1971. The movement of oil spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: movement, oil spills.

Schwengel, E. 1992. Method and apparatus for confining and

reclaiming hydrocarbon contaminated land sites. Patent No. US 5120160920609, 12p.
Key words: Soil Remediation, Bacteria, Bioremediation, Oil Spill, Soil Pollution, Groundwater, In-situ, Water Pollution

Scott, J.D., Y. Liu, D.L. Caughill. Fine tails disposal utilizing nonsegregation mixes. In: Environ Can Oil Sands - Our Petrol Future CONF (Edmonton, Can, 4/4 7/93) Proc Pap No F18, 1993 (19 Pp; 4 Refs).
Key words: disposal, oil, sand, recovery

Scott, Brian F. 1979. Ecological effects of oil-dispersant mixtures in fresh water. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: ecological effects, oil-dispersant, water.

Scott, P.H. 1992. (A discussion of) the new wave of engineered geotechnical materials. Pollution Engineering. 24(14):58-60.
Key words: health, environment, land pollution, storage design, construction, water pollution control

Scovell, V.R. Appts. for recovering spilled oil on water surface, comprises self propelled vessel towing U-shaped boom, vertical weir in front of U-shaped apron and floating pump, etc. Patent No. US 620260_901130.
Key words: Boom, Containment, Economic Factor, Pollution Control, Skimmer, Storage Facility, Waste Material

Scribner, Johnathan W. 1971. Ballast water treatment: a major undertaking. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: ballast water treatment.

Searl, Thomas D., Hugh L. Huffman, Jr., James P. Thomas. 1977. Extractable organics and nonvolatile hydrocarbons in New York Harbor waters. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: organics, hydrocarbons, New York Harbor, waters.

Seebold, J.G. 1990. Leak detection and prevention: what Chevron has learned about tank bottom leaks. In: Proceedings of the Center for Energy & Environ Manage Above Ground Storage Tanks Conf, October 29 30 1990, San francisco, CA, 15 pp.
Key words: Aboveground Storage Facility, Oil Spill, Containment, Remote Sensing

Selby, D.A. 1991. A critical review of site assessment methodologies. In:Proceedings of the Annual West Coast Conference on Hydrocarbon Contaminated Soils, Feb. 1990, Newport Beach, CA. Lewis Publishers: Chelsea, MI, pp. 149 160.
Key words: Remedial Action, Oil Spills, Land Pollution, Groundwater
The ability to rapidly and accurately assess the nature and extent of petroleum hydrocarbon contamination is soil and groundwater is of significant importance to property owners,

regulatory agencies, consultants, and others involved in site investigations. As state and federal underground storage tank regulations have been enacted, the need for assessment has increased dramatically. This demand has resulted in development of some adccepted standard site assessment techniques and a number of innovative assessment methods that have yet to be proven. The site assessment normally forms the basis upon which subsequent actions are taken that may result in long-term liability and/or major expenditures for site remediation. As a result, it is extremely important that site assessment methods provide the most accurate and reliable information attainable. This paper focuses on the methods available to assess the extent, magnitude, and nature of petroleum hydrocarbon contamination in soil and groundwater. It includes an examination of factors that influence the accuracy of the techniques to assist investigators in the determination of appropriate methods for specific sites.

Selby, C.P., J. Calkins, H.G. Enoch. Model studies of carcinogenic properties of shale oil. In: Proceedings of the Commonwealth Kentucky Et Al East Oil Shale Symp (Lexington, Ky, 11/19 21/86).
Key words: toxic effect, oil, disposal, environment, petroleum

Seltzer, R. 1990. Plan to fight major oil spills unveiled. Chemical & Engineering News. 68(40):11.
Key words: Accident, Additive, Animal, Boom, Bulk, Crude Oil, Economic Factor, Oil Waste, Pollution Control, Equipment

Selzer, Seymour D. 1969. Oil pollution control experience and measures in the Delaware River Basin. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: oil pollution, control, Delaware River.

Sen Gupta, R. 1991. Gulf oil spill and India. Mar Pollut Bull, 22(9):423-424.
Key words: Oil Spill, Contamination, Arabian Sea, Environmental Pollution, Biodegradation, Remote Sensing

Senn, R.B., and M.S. Johnson. 1992. Sixty years later: Evaluation of passive remediation at an abandoned refinery. In: Proceedings of the 5. national outdoor action conference on aquifer restoration, ground water monitoring, and geophysical methods, May 13-16, 1991, Las Vegas, NV, pp. 455-469.
Key words: Biodegradation, Oil Spill, Soil Pollution, Groundwater, Hydrocarbons
Investigations at old, inactive refineries that have not undergone active remediation may provide valuable data to assist in evaluating cleanup goals. There currently is limited long-term data on remediation programs to efficiently judge the impacts caused by shortcomings in existing technology, particularly at large spill sites. At many refineries the recovery of free phase hydrocarbons has been on-going for many years without addressing the issue of ground-water or residual soil contamination. As a result, regulators have very little to base their technical judgements on when contemplating enforcement actions or compliance time frames. Realistic refinery cleanup goals can

better be understood by evaluating the results of passive or natural processes that have been affecting petroleum hydrocarbons at abandoned refineries. A comprehensive study was conducted at a refinery abandoned since the early 1930's. The presence of hydrocarbon staining in the vados zone was very prominant, providing evidence that a hydrocarbon plume had been present. However, analytical data reveal that the majority of the hydrocarbon components are no longer present at the site. Results of the study indicate that the petroleum hydrocarbons which were once present in the capillary fringe have been attenuated by various natural processes. The possible list of such processes includes dispersion, dilution, sorption, volatilization, and biodegradation. Bacteriological evaluation results from selected samples indicate the naturally occurring bacteria have been exposed to hydrocarbons and have adapted to degrade many of these compounds. The results of this investigation, and others like it, may provide guidelines for scoping remediation programs at sites with similar characteristics.

Separovich, R.A. 1991. Contaning Boom for Confining Waterborne Contaminates. 24(pp).
Key Words: Floating barrier, contaiment, contamination, environmental pollution, oil spill, pollution control equipment, water pollution, USA, anchor (marine), ballast, buoyancy, cable, chart, connector, coupling (mechanical), engineering drawing, fastener, fitting, flexibility, floating, guy line, installing, marine ecology, marine stabilization, marine transportation, mechanical property, mooring, mounting, ocean environment, physical property, pollution control, positioning, stabilization, stabilizer (mechanical), suspension device, workboat.

Sergy, Gary A. 1985. The Baffin Island oil spill (BIOS) project: a summary. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA. American Petroleum Institute: Washington, D.C. pp. 571 - 576.
Key words: Baffin Island, oil spill.

Sergy, G.A., B. Humphrey, E. Owens. 1991. On describing and estimating the fate of stranded oil. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: estimating, oil.

Sethness, E.D. Jr. 1990. New concept for improved oil spill containment in open waters. In: Proceedings of the Oil spills management and legislative implications conference, May 15 18, 1990, Newport, RI, pp.503 514.
Key words: oil pollution containment, oil spills, oil retention booms
In this paper a new concept for improved oil spill containment in open waters is presented. The proposed system is a combination oil boom and wave barrier. Waveguard International has taken its extensive experience as a designer of floating breakwaters and applied this knowledge into the design of a readily transportable, readily deployable floating oil boom with integrated wave attenuation capabilities as well. The new concept

is based on the attenuation of the two major natural causes of oil spill dispersion; first, horizontal dispersion caused by wind shear effects; and second, vertical entrainment into the water column caused by the mixing action of wave motion. The physical encirclement of an oil spill with a floating boom to contain horizontal dispersion is not a new concept. Existing systems, however, work best in calm water and rapidly loose efficiency as waves increase. The proposed system can not only physically surround the spill area, but is as much as 90% effective in stopping the transmission of wave energy. The oil boom thus minimizes vertical mixing of the contained oil slick.

Setti, L., G. Lanzarini, P.G. Pifferi, and G. Spanga. 1993. Further research into the aerobic degradation of n-alkanes in a heavy oil by a pure culture of a Pseudomonas SP. Chemosphere : (Oxford). 26(6):1151-1157.
Key words: degradation, Oil, Biodegradation, Microorganism, Hydrocarbon, Bacteria
The microbial degradation of the saturated fraction of a heavy oil was examined in aerobic conditions employing a pure culture of a Pseudomonas sp. isolated from soil. A new model of n-alkane degradation is proposed. The n-alkanes were divided into three degradation groups: i) liquid n-alkanes, C12-C16; ii) low solid n-alkanes, C17-C28; iii) high solid n-alkanes, above C28. Our results show that n-alkane degradation depends on chemical and physical factors such as solubility and surface tension.

Severn, S.R.T., and R.H. Adams. 1992. Bioremediation: the fact and fiction. In: Proceedings of the 2ND Environ Issues & Manage of Waste in Energy & Mineral Prod Int Conf, September 1 4, 1992, Calgary, Can. 2:847 852.
Keywords: biodegradation, environmental impact, oil spill, waste oil

Sevin, B. Produced water management. In: Proceedings of the 36th Annu Southwestern Petrol Short Course Ass Et Al MTG (Lubbock, Texas, 4/19 20/89)
Key words: disposal, oil, tank

Sewell, G.W., H.C. Aldrich, D. Williams, B. Mannarelli, A. Wilkie, R.B. Hespell, P.H. Smith, L.O. Ingram. 1988. Isolation and characterization of xylan-degrading strains of Butyrivibrio fibrisolvens from a napier grass-fed anaerobic digester. Appl. Environ. Microbiol.(United States). 54:5:1085-1090.
Six new xylanolytic bacterial strains have been isolated from a Napier grass-fed anaerobic digester. These strains were identified as Butyrivibrio fibrisolvens and were similar in many respects to ruminal isolates described previously. The new isolates exhibited a high degree of DNA homology with several ruminal strains of B. fibrisolvens. Xylan or xylose was required to induce the production of enzymes for xylan degradation, xylanase and xylosidase. Production of these was repressed in the presence of glucose. Xylanase activity was predominantly extracellular, while that of xylosidases was cell associated. The new isolates of B. fibrisolvens grew well in defined medium containing xylan as the sole carbon source and did not produce obvious slime or capsular layers. These strains may be useful for

future genetic investigations.
Key words: methane, biosynthesis, methanogenic, classification, xylans, anaerobic digestion, hemicellulose, synthesis, organic compounds, bacteria, alkanes, carbohydrates, bioconversion, alkanes, nucleic acids, saccharides, bioreactors, DNA, carbohydrates.

Sexton, W.J., M. Murday, S.R. Florey, J.R. Jensen, and C.J. Green. 1993. Environmental sensitivity index mapping of Abu Dhabi (UAE) - A computer based remotely-sensed and field mapping product. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 883-884.
Key words: Computerized Mapping, Contamination, Environmental Pollution, Oil Spill, Remote Sensing

Shafeeq, Mohammad, D. Kokub, Z.M. Khalid, A. M. Khan, and K.A. Malik. 1989. Degradation of different hydrocarbons and production of biosurfactant by Pseudomonas aeruginosa isolated from coastal waters. Mircen journal of applied microbiology and biotechnology. 5(4): 505-510.
The present studies were carried out to find out the role of indigenous bacteria on the fate of different hydrocarbon fractions of crude oils. Quantitative estimation of rate and extent of biodegradation and mineralization of known hydrocarbons will help in ascertaining the possible role of these *bacteria* in clean-up of polluted sea shore. In addition the use of the metabolites (crude biosurfactants) from these bacteria for the dispersion of crude oil will also be studied.
Key words: surfactant, production, hydrocarbon, biodegradation, quantitative analysis, mineralization, metabolism, pollution, pseudomonas aeruginosa.

Shafer, R.V. 1987. A computer-assisted planning system for oil spill response chemical Applications. In: Proceedings of the Amer. Soc. Testing Mater. Oil Dispersants: New Ecol. Approaches Symp, Sept. 12 14, Williamsburg, VA. Alaska Clean Seas, pp. 98 103.
Key words: Oil Spills, Water Pollution, Dispersant, Contingency Planning, Alaska

Shafer, R.V. 1987. Alaska clean seas meeting response needs for 1987 and beyond. In: Proceedings of the 1987 API - EPA - U.S. Coast Guard oil spill prev. behavior control cleanup conf., April 6 9 1987, Baltimore, MD, API PUBL. N.4452, pp. 145 49.
Key words: Additive, Adsorbtion, Boom, Business, Flame Retarder, Physical Separation

Shaheen, E.I. 1992. Technology of environmental pollution control, second edition. Pennwell publishing co, tulsa, 1992. (isbn 0-87814-367-x; 557 pp; over 40 refs).
Key words: pollution control, air pollution, contamination, control, economic factor, environmental pollution, legal consideration, noise, noise pollution, oil spill, regulation, water pollution.

Shams el Din, A.M., R.A. Arain, and A.A. Hammoud. 1991. A

contribution to the problem of trihalomethane formation from the Arabian Gulf water. Desalination. 85(1):13-32.
Key words: Marine Pollution, Persian Gulf
The Arabian Gulf water at Umm Al Nar (Abu Dhabi, UAE) is analyzed for components expected to influence trihalomethane (THM) formation in case of chlorination. Chromatograms of chlorinated clean seawater show four peaks corresponding to bromoform (BF), di-bromochloromethane (DBCM), di-chlorobromomethane (DCBM) and chloroform (CF). The BF peak, representing ca. 95% of the THMs, is suitable for detection of oil pollution. This has been substantiated during an actual oil spillage that affected the intakes. Recommendations are given for actions to be followed in case of oil pollution near a desalination plant. These aim to the complete elimination or considerable reduction in the concentration of THMs in potable water.

Shamshoom, S.M., T.S. Ziara, A.N. Abdul-Ritha, and A.E. Yacoub. 1990. Distribution of oil-degrading bacteria in the north-west Arabian Gulf. Marine pollution bulletin. 21(1):38-40.
Key words: Hydrocarbon, Bacteria, Degradation, Arabian Gulf

Sharkey, B. 1988. Shell (Oil Co.) intensifies crude spill cleanup near San Francisco. Oil Gas J. 86(19):21.
Key words: Animal, Boom, Crude Oil, Economic Factor, Pollution Control

Sharp, J.C., and T.C. Hazen. 1989. Biodegradation of vacuum pump oil by naturally occurring bacteria. Georgia Journal of Science (USA). 47:2:54-64.
Bacteria are able to degrade any type of hydrocarbon, given the right conditions and enough time. Indeed, many bacteria have been isolated that use toxic hydrocarbons as their only carbon and energy source. This study examines the biodegradation of vacuum pump oil by bacteria. bacteria that can use vacuum pump oil as their sole carbon and energy source were isolated from soil collected near a waste oil farming site and a fuel oil depot on the Savannah River Plant, near Aiken, South Carolina. degradation rates of vacuum pump oil were determined by measuring the amount of carbon dioxide produced by the bacteria in a controlled microcosm. Both high concentrations and low concentrations of vacuum pump oil were inhibitory to vacuum pump oil degradation. Phosphorus and nitrogen were found to be significant limiting factors to the rate of vacuum pump oil degradation in the microcosms. Iron, a common co-factor in hydrocarbon degradation, had no measurable effect on the rate of vacuum pump oil degradation. High concentrations of nitrogen and phosphorus combined, were found to have a greater stimulatory effect on vacuum pump oil degradation then either one alone. Hydrogen peroxide, an oxygen source, at very low concentrations had the greatest stimulatory effect on vacuum pump oil degradation of any of the nutrients tested. The degradation of vacuum pump oil by bacteria in microcosms shows great promise for being a controllable and efficient method for eliminating this common laboratory waste.
Key words: hazardous materials, biodegradation, carbon dioxide, hydrogen peroxide, waste disposal, carbon oxides, chemical reactions.

Shaw, D.G., T.E. Hogan, D.J. Mcintosh. 1985. Hydrocarbons in the sediments of Port Valdez, Alaska: consequences of five years' permitted discharge. Estuarine Coastal Shelf Sci (1985): 21
Key words: oil spill, Alaska, oil, disposal, Valdez area.

Shaw, D.G., A.J. Paul, E.R. Smith. 1977. Responses of the Clam macoma balthica to Prudhoe Bay crude oil. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: response, clam, Prudhoe Bay, oil.

Shaw, Sidney H., J. Stephen Dorrler. 1977. A Distributed reuseable-sorbent oil recovery system. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: sorbent, oil, recovery.

Shearon, M.S., A.R. Autry, and B. Archer. 1991. Advances in speed and performance of on-site bioremediation. In: Proceedings of the Pennwell Conf & Exhibit Co Petro-Safe 91 Conf, February 6 8, 1991, Houston, TX. 3:825 839.
Keywords: biodegradation, bioremediation, California, dispersant, environmental impact, in-situ, remediation, soil pollution

Shears, J.R. 1990. The environmental assessment of oil pollution. University of Southampton (UK), Dissertation, 354 pp.
Key words: Biomedical Technique, Business Operation, Contingency Planning, Oil Spill, Remote Sensing

Sheilds, M.S., S.O. Montgomery, and S.M. Cuskey. 1991. Mutants of Pseudomonas cepacia G4 defective in catabolism of aromatic compounds and trichloroethylene. Applied and Environmental Microbiology (United States). 57:7:0099-2240.
Pseudomonas cepacia G4 possesses a novel pathway of toluene catabolism that is shown to be responsible for the degradation of trichloroethylene (TCE). This pathway involves conversion of toluene via o-cresol to 3-methylcatechol. In order to determine the enzyme of toluene degradation that is responsible for TCE degradation, chemically induced mutants, blocked in the toluene ortho-monooxygenase (TOM) pathway of G4, were examined. Mutants of the phenotypic class designated TOM A{sup {minus}} were all defective in their ability to oxidize toluene, o-cresol, m-cresol, and phenol, suggesting that a single enzyme is responsible for conversion of these compounds to their hydroxylated products (3-methylcatechol from toluene, o-cresol, and m-cresol and catechol from phenol) in the wild type. Mutants of this class did not degrade TCE. Two other mutant classes which lacked 2-hydroxy-6-oxoheptadienoic acid hydrolase activity, were fully capable of TCE degradation. Therefore, TCE degradation is directly associated with the monooxygenation capability responsible for toluene, cresol, and phenol hydroxylation.
Key words: chlorinated aliphatic hydrocarbons, catabolism, biological, cresols, phenols.

Shell Western, Michigan Department of Natural Resources, Michigan Universities Hazards Waste Management Association, Michigan Oil &

Gas Association. August 1990. Michigan has embarked on a project to use bacteria to clean up spilled oil. Environmental Science & Technology. 24(8):1114.
Key Words: Academic, association, bacteria, benzene ring, biochemical reaction, biodegradataion, business operation, C6, C7, C8, crude oil, crude oil (well), District 2, economic factor, ethylbenzene, ground water, joint venture, Michigan, microorganism, North America, oil waste, pollution control, public affairs, saturated chain, Shell Oil, single structure type, soil (earth), soil pollutant, toluene, USA, waste disposal, waste material, xylene.

Shell western E&P. Fireproof boom for Contg. in-situ burning oil spillage, where boom has flotation member surrounded by water sorbent wick, enclosed in protective chain link fencing. Patent No. US 806575_851209.
Key words: Accident, Accidental Fire, Chlorohydrocarbon, Ferrous Alloy, Homopolymer

Shell Oil Co. 1988. California Marshland Oil Spill. Mar. Pollut. Bull. 19(7):306.
Key words: Adsorbent, Bird, Environmental Impact, Estuary, Pollution Control

Shell Oil Co. 1989. Shell oil spill damage settlement sets records. Oil & Gas Journal. 87(50):32.
Key words: Crude Oil, Diaster Control, Economic Factor, Legal Consideration, US Environmental Protection Agency

Shelton, R.G.J. 1969. Dispersant toxicity test procedures. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: dispersants, toxicity.

Sherman III., J.W. 1992. Historical perspective: marine oil spill detection by remote sensing. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:25-36.
Key words: Remote Sensing, Environmental Pollution, Oil Spill

Sherman III, J.W. 1992. Oil spill remote sensing - a perspective. Sea Technology. 33(8):10-16.
Key words: Pollution Monitoring, Remote Sensing, Oil Spill
Optical, microwave, and millimetre-wave remote sensors detect, monitor and measure oil slicks. Laser induced fluorescence and luminescence along with radar systems provide active methods for observation. The development, benefits and drawbacks of the various techniques are reviewed, with emphasis on progress made in the USA. The importance of data dissemination and the need for long-term research and development is highlighted. -S.J.Stone.

Sherrard, J.R., R.A. Walter. 1976. The burn-off of waste lubricating oils in Coast Guard powerplants. Executive Summary. In: Transportation Systems Center Cambridge Mass., 13p. Aug 76.
Key words: degradation, disposalreclamation
This report summarizes the results of a study to investigate the feasibility of utilizing waste lubricating oils as fuel in Coast

Guard powerplants. Adoption of this practice by the Coast Guard would conserve diesel fuel, as well as minimizing environmental degradation and eliminating costs associated with lube oil disposal. It was concluded that the Coast Guard can safely use this lube oil as fuel if it is properly filtered and mixed at the correct ratios with the fuel oil. Various filtering devices were tested and the correct mix ratios for diesel engines, boilers, and gas turbines were determined. It was found that with these safeguards the practice of lube oil burn-off will not adversely affect engine emissions, performance, maintenance, or wear characteristics. Final recommendations and conclusions were made to the Coast Guard for the adoption of this practice. (Author)

Shields, M.S., and M.J. Reagin. 1992. Selection of a Pseudomonas cepacia strain constitutive for the degradation of trichloroethylene. Applied and Environmental Microbiology (United States). 58:12:3977-3983.
Groundwater contamination by organic pollutants, particularly volatile organics including TCE, DCE, I,I-DCE, and vinyl chloride, is of concern throughout the industrialized world. The capability of biologically degrading such contaminants at the site of pollution should be of considerable treatment value. However, all TCE-degrading bacterial, with one exception, require the addition of an exogenous inducer substrate such as toluene, phenol, methane, isoprene, propane or 2,4-dichlorophenoxyacetic acid to induce the enzymes require for the degradation TCE. This paper describes a Tn5-induced mutant of Pseudomonas cepacia G4 (Tom-) that does not express toluene ortho-monooxygenase (TOM) but spontaneously reverts to the constitutive expression of TOM. This revertant no longer requires aromatic induction of the TOM pathway enzyme(s) in order to degrade TCE.
Key words: chlorinated, aliphatic, hydrocarbons, biological.

Shimizu,T., K. Kudo, Y. Nasu. 1993. Anaerobic waste-activated sludge digestion - A bioconversion mechanism and kinetic model. Biotechnology and Bioengineering (United States). 41:11:0006-3592.
The anaerobic bioconversion of raw and mechanically lysed waste-activated sludge was kinetically investigated. The hydrolysis of the biopolymers, such as protein, which leaked out from the biological sludge with ultrasonic lysis, was a first-order reaction in anaerobic digestion and the rate constant was much higher than the decay rate constant of the raw waste activated sludge. An anaerobic digestion model that is capable of evaluating the effect of the mechanical sludge lysis on digestive performance was developed. The present model includes four major biological processes - the release of intracellular matter with sludge lysis; hydrolysis of biopolymers to volatile acids; the degradation of various volatile acids to acetate; and the conversion of acetate and hydrogen to methane. Each process was assumed to follow first-order kinetics. The model approximately simulated the overall process performance of the anaerobic digestion of
waste-activated sludge. The model suggested that when the lysed waste-activated sludge was fed, the overall digestive performance remarkably increased in the two-phase system consisting of an acid forming process and a methanogenic process, which ensured

the symbiotic growth of acetogenic and methanogenic bacteria.
Key words: methane, biosynthesis, methanogenic.

Shimmin, Kathleen G. 1989. Regional response team-hosted public forum for shell oil spill, San Francisco Bay. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: response, shell, oil spill, San Francisco Bay.

Shipley, C.W., J.T. Boyd. 1991. Waste oil disposal problems. Pipeline Gas J (1991): 218.
Key words: oil, disposal, environment, petroleum, pipeline

Shipman, E.D. 1979. Clean Gulf associates: six years later. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: Gulf.

Shirai, Sakae. 1993. Historical buildup of oil spill response capability in Japan. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill, response, Japan.

Shirley, D., M.J. Mogford, and C.G. Ramsay. 1988. EIA (Environmental Impact Assessment) of onshore and offshore pipelines. In: Proceedings of the Pipes Pipelines Int & Aberdeen Univ Pipelines & the Environ Conf, March 8 10 1988, Bournemouth, England, 17 pp.
Key words: Environmental Impact, Pipeline, Legal Consideration, Pollution Control, Contamination, Crude Oil, Oil Spill, Remote Sensing

Shonting, D., E. McMarthy, E. Brainard II., and A. Chaves. 1989. Mini wave-track: a portable system for wave monitoring during oil spiil cleanup operations. In: Proceedings of the API et al Oil Spill (Prev, Behav, Contr, Cleanup) 20th Anniv Conf, February 13 16 1989, San Antonio, TX, pp. 580.
Key words: Remote Sensing, Oil Spill

Shores, K.E. 1992. Chemical industry hazardous waste minimization and disposal. In: Proceedings of Petro-Safe '92/3rd Annual Oil, Gas, and Petrochemical Industries Environmental and Safety Conference, January 27 29, 1992, Houston, TX, 3(7):609 614.
Key words: water pollution, biodegradation, legal, oil, soil pollution, disposal

Shouche, M. and R. S. Skeen. 1992. Use of a mathematical model for prediction of optimum feeding strategies for in situ bioremediation. In: Proceedings of the 14th Symposium on Biotechnology for Fuels and Chemicals, May 11 15, 1992, Gatlinburg, TN.
Key words: Biodegradation, In-Situ, Groundwater, Hanford, Soil
Liquid wastes containing radioactive, hazardous, and regulated chemicals have been generated throughout the 40+ years of operations at the US Department of Energy (DOE) Hanford site. Some of these wastes were discharged to the soil column and many

of the waste components, including nitrate, carbon tetrachloride (CCL4), and several radionuclides, have been detected in the Hanford groundwater. Current DOE policy prohibits the disposal of the contaminated liquids directly to the environment, and remediation of the existing contaminated groundwaters may be required. In-situ bioremediation is one technology currently being developed at the Hanford to meet the need for cost effective technologies to clean groundwater contaminated with CCL4, nitrate, and other organic and inorganic contaminants. This paper focuses on the latest results of an on-going effort to develop effective in-situ remediation strategies through the use of predictive simulations. In particular, strategies for nutrient injection are developed which minimize biomass accumulation within the flow field and thus extend the life of injection wells.

Shrarkman, N.B., K.S. Laurinavichyus, V.K. Akimenko. 1993. Pathways of the degradation of organic components of effluent water of (meth)acrylate-producing factories to methane by the community of microorganisms of acclimated and and unacclimated sludge. Microbiology (English Translation) (United States). 61:4: 506-512.
A comparative study was made of the pathways of degradation of the main components of effluent water of (meth)acrylate-producing factories (of the methyl ester of methacrylic acid, methyl and butyl esters of acrylic acid, methacrylic and acrylic acids, acetone, isopropanol, butanol, and methanol) by a community of anaerobic microorganisms from mesophilic, unacclimated, activated sludge of a UASB type reactor and from acclimated, activated sludge of a reactor of the contact type. It was demonstrated that the decomposition of the fatty acids and alcohols is accomplished in both types of sludge. The decomposition of methacrylic and acrylic acids and acetone proceeds only in acclimated sludge. The reversible conversion of acetone and isopropyl alcohol as well as the achievement of isomeric transitions of butyric and isobutyric acids are characteristic for both types of sludges. The results of the investigations consists in the accumulation of the biomass of microorganisms capable of hydrolyzing specific substrates to universal intermediate products: lower-molecular weight fatty acids and alcohols, which are metabolized further with the formation of methane and carbon dioxide. 12 refs., 1 fig., 5 tabs.
Key words: sewage sludge, biodegradation, activated sludge.

Shuba, Peter J., A.J. Heikamp, Jr. 1989. Toxicity tests on biological species indigenous to the Gulf of Mexico. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: toxicity, species, indigenous, Gulf of Mexico.

Shum, J.S., J.H. Nash. 1987. Evaluation and calibration of a dispersant application system. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: evaluation, calibration, dispersant.

Shum, J.S., M. Borst. 1985. OHMSETT tests of a rope-mop skimmer

in ice-infested waters. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: OHMSETT, rope-mop, skimmer, ice, waters.

Side, J., C. Herd, W. Grogan. 1985. Oil spill pollution: the North Sea experience of cooperative measures. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: oil spill pollution, North Sea.

Siegel, Donald I., David Stoner, Thomas Byrnes, Philip C. Bennett. 1990. A geochemical process approach to identify inorganic and organic ground-water contamination. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:1291-1301.
Key Words: Ground water, pollution, oxygen, isotopes, hydrogen, deuterium, pollutants, identification, O-18/O-16, D/H, geochemistry, organic materials, inorganic materials, water quality, stable isotopes, reactions, ratios, landfills, leaching, crude oil, oil spills, chloride ion, sodium ion, sulfate ion, calcium ion, oxidation, acidification, movement, geochemical methods.

Siegel, Donald I., Philip C. Bennett, Mary Jo Baedecker, Marian P. Berndt, David A. Franzi. 1988. Inorganic geochemistry of ground water and aquifer matrix; first-year results. Open-File Report (United States Geological Survey. 1978). C17-C20.
Key Words: Minnesota, hydrogeology, ground water, Beltrami County, Minnesota, USGS, Midwest, United States, northwestern Minnesota, Bemidji Minnesota, oil spills, pollution, aquifers, crude oil, inorganic materials, hydrochemistry.

Sikkema, J., J.A.M. Bont. 1993. Metabolism of tetralin (1,2,3,4-tetrahydronaphthalene) in Corynebacterium sp. strain C125. Applied and Environmental Microbiology (United States). 59:2:567-572.
Tetralin, widely used as a solvent in the petrochemical industry and in paints and waxes, degrades slowly in mixed cultures of microorganisms or in the presence of cosubstrates. This study reports on the metabolism of tetralin in the o-xylene-isolated Corynebacterium sp. strain C125. The researchers found that this organism attacks tetralin by an initial oxidation of the aromatic nucleus at positions C-5 and C-6 and they propose a four step inducible degradation pathway for tetralin starting at that point. The presence of the pathway makes this bacteria an excellent catalyst for the specific production of special cis-dihydro diols.
Key words: bacteria, metabolism, tetralin, industrial wastes, industry, microorganisms.

Silberman, Henry, and Edwin C. Weber. 1975. Maryland's experience in oil spill prevention and control. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: Maryland, oil spill, prevention, control.

Silveria, V. 1992. Basis UST leak detection systems. Plant Engineering 46(13):74 77.
Key words: Water Pollution, Leak Detectors
This paper reports that gasoline and other petroleum products are leaking from underground storage tanks (USTs) at an alarming rate, seeping into soil and groundwater. Buried pipes are an even greater culprit, accounting for most suspected and detected leaks according to Environmental Protection Agency (EPA) estimates. In response to this problem, the EPA issued regulations setting standards for preventing, detecting, reporting, and cleaning up leaks, as well as fiscal responsibility. However, federal regulations are only a minimum; some states have cracked down even harder. Plant managers and engeneers have a big job ahead of them. The EPA estimates that there are more than 75,000 fuel USTs at US industrial facilities. When considering leak detection systems, the person responsible for making the decision has five primary choices: inventory reconciliation combined with regular precision tightness tests; automatic tank gauging; groundwater monitoring; interstitial monitoring of double containment systems; and vapor monitoring.

Simmons, J.J. 1990. Method for Oil Spill Cleanup. Patent No. US 4959154, c 9/25/90, f 4/12/89 (Appl 336687) (c02f-001/28) (4 pp; 13 claims)
Key words: oil spill, adsorbent, adsorption, business operation, control, pollution control, salvaging, solid adsorbent, sorbent, sorption, waste oil recovery, wood, (p) USA, cellulose, chemical process, cleaning, collecting agent, combustion, composition, contamination, data, decontaminating, disposal, drying, ecology, environment, fuel, lake, lo pressure, manufacturing, natural resin, ocean, ocean environment, oil waste, organic, organic matter, particle, particle size, pressure, pump, sea, size reduction, soil (earth), soil pollution, solid fuel, stream, table (data), terrestrial environment, vacuum, vacuum pump, waste disposal, waste material, water content, water pollution, ecology & pollution

Simmons, C.S., J.F. McBride, R.J. Lenhard, and J.W. Cary. 1990. Organic liquid infiltration into unsaturated porous media. Battelle Memorial Inst Rep No PNL-SA-17612 (DE90015288) IAH Subsurface Contamination by Immiscible Fluids Conf, April 18-20, 1990, Calgary, Canada, 8pp.
Key words: Soil Pollution, Environmental Impact, Groundwater, Oil Spill, Vadose Water, Water Pollution

Simons, Edward A., Lt. Morgan Akin. 1987. Dead endangered species in a California oil spill. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: endangered species, California, oil spill.

Simons, Edward A. 1985. Natural resource protection in California. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: natural resource protection, California.

Simpson, W.F. 1987. Fireproof Boom. Patent No. US 4645376, c 2/24/87, f 12/9/85 (Appl 806575) (4 pp; 3 claims)
Key words: floating barrier, barrier, containment, control, float, oil spill, pollution control, wall, p) USA, absorbent, chart, coating material, contamination, ecology, engineering drawing, environment, external coating, fire resistance, floating, mounting, phase behavior, phase change, physical property, reinforcing agent, safety, Shell Western E&P Inc., sorbent, steam, vaporization, water, water pollution, water vapor, wire, ecology & pollution

Simpson, D. E. 1990. Designing flexibility into electronic and electromechanical controls. Appliance 47(Nov):S5
Key words: Microcontrollers

Sims, R.C., W.J. Doucette, J.E. McLean, W.J. Grenny and R.R. Dupont. 1988. Treatment potential for 56 EPA (Environmental Protection Agency) listed hazardous chemicals in soil. Final report, 1 September, 1983-28 February 1987. Report No. PB-88-174446/XAB, 120 pp.
Key words: Biodegradation, Environment, Hydrocarbons, Monitoring, Soil Pollution
Information is presented for quantitative evaluation of soil-treatment potential for 56 hazardous chemicals. The chemicals were organized into four categories: PAH, pesticides, chlorinated hydrocarbons, and miscellaneous chemicals. Treatability studies were conducted to determine: degradation rates, phase-partition coefficients, and transformation characteristics. Results of soil fate/transport predictions of two mathematical models were compared with laboratory and literature results to evaluate ability of models to predict behavior of selected chemicals. The experimental approach used was designed to characterize degradation, immobilization, and transformation potentials for the hazardous substances. Results indicated that significance of volatilization and abiotic-loss processes in influencing apparent loss rates of substances depended on class of substance. The processes were insignificant for majority of PAHs; biodegradation appears to be major process for PAH loss. Abiotic loss may also be important process for certain pesticides.

Siron, R., G. Giusti, and F. Blanc. 1987. Hydrocarbons in the water column of the Carteau Bay (Gulf of Fos-sur-mer, Mediterranean Sea). Marine Chemistry. 21(1):75-89.
Key words: Hydrocarbons, Water Pollution
The distribution of hydrocarbons in the water column seems to be affected by inputs from both interfaces of accumulation: the surface microlayer and the water/sediment interface. Volatilization and accommodation appear to be the major factors controlling the fate of hydrocarbons, especially in the dissolved phase, whereas some classes of particles are confirmed as important supports for the transport of such pollutants. In this respect, the 20-200 mu m planktonic fraction is less contaminated than the total suspended matter. This study gives evidence for intense bacterial degradation affecting the hydrocarbons in the whole water column. In spite of the chronic petroleum pollution, the predominance of n-alkanes in the (n-C16; n-C18) and (n-C27,

n-C29) boiling ranges have been observed, which could be used as biological markers in these highly polluted waters. (Authors' abstract)-A.W.H.

Siron, P., E. Pelletier, C. Brochu. 1991. Quantitative budget of chemically dispersed crude oil in icy seawater: an experimental approach. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: budget, chemically, dispersed, oil, icy seawater.

Siron, R., and E. Pelletier. 1993. The use of chromatographic indexes to study the biodegradation of crude oil in cold/icy seawater.In: Proceedings of the Environment Canada 16th Arctic and Marine Oil Spill Technical Seminar (Calgary 6/7-9/93) Proceedings V1 101-20 (1993).
Key words: accumulating, adsorption, analytical, bacteria, benzene ring, biochemical reaction, chromatography, concentration, brightness, branched chain, drop, emulsion, crude oil, colloid.

Sivadier, Henri O., and Paul G. Mikolaj. 1973. Measurement of evaporation rates from oil slicks on the open sea. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, 1973 Washington, D.C.
Key words: evaporation, oil slicks, sea.

Skeen, R. S., S. M. Cote, M. J. Treux and J. N. Peterson. 1992. Kinetics of in-situ bioremediation of Hanford groundwater. Pacific Northwest Lab., Richland, WA. Report No. PNL SA 20623, 12 pp.
Key words: Bioremediation, In-Situ, Hanford, Monitoring, Transport
quid wastes containing radioactive, hazardous, and regulated chemicals have been generated throughout the 40+ years of operations at the US Department of Energy's (DOE) Hanford Site. Some of these wastes were discharged to the soil column and many of the waste components, including nitrate, carbon tetrachloride (CCl_4), and several radionuclides, have been detected in the Hanford groundwater. Current DOE policy prohibits the disposal of contaminated liquids directly to the environment, and may require the remediation of existing contaminated groundwaters. In-situ bioremediation is one technology currently being developed at Hanford to meet the need for cost effective technologies to clean groundwater contaminated with CCl_4), nitrate, and other organic and inorganic contaminants. This paper focuses on the latest results of an on-going effort to quantify the biological and chemical reactions that would occur during in-situ bioremediation.

Skeen, R. S., K.R. Roberson, T.M. Brouns, J.N. Peterson, and M. Shouche. 1992. In situ bioremediation of Hanford groundwater. In: Proceedings of the 1992 Hazardous Materials Control Research Institute (HMCRI) federal environmental restoration conference and exhibition, April 15 17, 1992, Vienna, VA. Hazardous Materials Control Resources Inst.: Greenbelt, MD, pp.113 117.
Key words: Biodegradation, In-Situ, Monitoring, Water Pollution

Liquid wastes containing radioactive, hazardous, and regulated chemicals have been generated throughout the more than 40 years of operations at the US Department of Energy's (DOE) Hanford Site. Some of the wastes were discharged to the soil column and many of the waste components, including nitrate, carbon tetrachloride (CCI4) and several radionuclides, have been detected in the Hanford groundwater. Current DOE policy prohibits the disposal of contaminated liquids directly to the environment, and remediation of existing contaminated groundwaters may be required. In-situ bioremediation is one technology currently being developed at Hanford to meet the need for cost-effective technologies to clean up groundwater contaminated with CCl4 nitrate and other organic and inorganic contaminants. This paper focuses on the latest results of an ongoing effort to develop effective in-situ remediation strategies through the use of predictive simulations.

Skowlund, C.T. 1987. Theoretical study of a two-stage methanogenic reactor system. Univ. of Florida,Gainesville, FL. pp. 588.
A two-stage methanogenic reactor system consists of two biological reactors (acidogenic and methanogenic) connected in series. In order to derive a qualitative model of the acidogenic reactor it is important to understand the phenomena necessary for the degradation of the cellulosic material to take place. The sequence of events can be generally described as: (1) diffusion of the bacteria to the pores of the biomass, (2) diffusion of the bacteria into the pores, (3) adsorption of the cellulase enzymes onto the surface of the substrate, (4) degradation of the cellulose via cellulase enzymes, and (5) the conversion of the cellulose degradation products into organic volatile acids by a mixed consortia of anaerobic bacteria. The resulting set of simultaneous nonlinear equations for the above phenomena were solved numerically using a double collocation procedure. Comparisons of several modes of reactor operation (batch, semi-continuous, and continuous) and different modes of bacterial diffusion (Brownian, motility, and chemotaxis) were then made. The methanogenic reactor was assumed to be a packed bed biofilm reactor for which two reactor models are derived. One model, for low influent concentrations, utilizes a limiting substrate concentration to determine the thickness of the biofilm. The other model, derived for high influent concentrations, neglects internal diffusion in the biofilm. Both models agree very well with the exact numerical solutions.
Key words: bioreactors, mathematical models, adsoption, batch culture, cellulose, continuous culture, diffusion, porosity, numerical solution, organic acids, packed bed, semibatch culture, cellulase, bacteria.

Sleeter, Thomas D., James N. Butler, Jack E. Barbash. 1979. Hydrocarbons in sediments from the edge of the Bermuda platform. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: hydrocarbons, sediments, Bermuda.

Sleeter, T.D., A.H. Knap, I.W. Hughes. 1983. Oil spill contingency planning and scientific support coordination in

Bermuda: a successful model. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: oil spill contingency planning, support, Bermuda.

Small, S.W. 1969. The Submarine pipeline and single buoy mooring. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: submarine pipeline, buoy.

Smedley, J.B., J.G. Wainwright, and T.K. Ehman. December 1991. Tanker self-help spill recovery systems. Report. 176(p).
Key Words: Oil spills-water pollution control, tanker ships-oil spills, compiled data, oil pollution containment, technology assessment, numerical data, pollution control.

Smedley, J. Bruce. 1981. Assessment of aerial application of oil spill dispersants. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: assessment, aerial, oil spill, dispersants.

Smith, J.R., R.L. Weightman, and D.G. Linz. 1990. Treatment of pumped ground waters contaminated with petroleum and coal-tar associated chemicals in publicly owned treatment works. In: Proceedings of the API Et Al. Petrol Hydrocarbons & Org Chem in Ground Water: Prev, Detection, & Restoration Conf, October 31 November 2, 1990, Houston, TX. Ground Water Manage No 4:385 399.
Keywords: water pollution, biodegradation, government, legal, soil pollution

Smith, Craig L., William G. MacIntyre. 1971. Initial aging of fuel oil films on sea water. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: aging, fuel oil, sea water.

Smith, Capt. Rodney E., Case Management Staff. 1993. Removal costs and claims under the Oil Pollution Act of 1990. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: removal, claims, Oil Pollution Act.

Smith, K.P. 1990. Waste minimization in the oil and gas exploration and production industry. Argonne Nat Lab Rep No. ANL/EAIS/TM-45 (DE91010904) Sept 1990, 24 pp.
Keywords: biodegradation, legal consideration, petroleum, recycling, regulation, waste disposal

Smith, Al J. 1973. Successes and failures with oil spills in the Southeastern inland waters. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil spills, inland waters.

Smith, A.E., D. Cohan, F. Selker. 1987. A Model for managing

underground storage tanks. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: managing, underground, tanks.

Smith, David C. 1975. Rehabilitating oiled aquatic birds. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: aquatic birds, oil.

Smith, Randall W. and Robert Pavia. 1983. Dispersant use guidelines for federal regions IX and X. . In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983.,pp. 3 - 6. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Guidelines, Federal Regions IX and X.

Smith, Nelline K. and Anibal Diaz. 1985. In Place burning of Prudhoe Bay Oil in broken ice. In Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp. 405 - 410. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Burning, Prudhoe Bay, Oil, Ice.

Smith, J. Wardley. 1973. Occurrence, cause & avoidance of the spilling of oil by tankers. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, 1973., pp.15 - 20. Washington, DC. : Washington, DC: American Petroleum Institute.
Keywords - Occurrence, Spill, Oil, Tankers.

Smith, J. Wardley. 1969. United Kingdom ministry of technology work on oil pollution. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969., pp. 27 - 40. New York, NY.: Washington, DC: American Petroleum Institute.
Keywords - United Kingdom, Oil.

Smith, J.B.H., Capt. R. J. Asaro, and Cdr. H. Henderson. 1993. Oil, rats, and salvage: the grounding of the HYUNDAI #12. In Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 213 - 217. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Rats, Salvage, HYUNDAI #12.

Smith, J.B.H., C. McLellan, and L. R. Pintler. 1987. Development of an oil skimming system to meet Navy specifications. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Oil Skimming, Navy.

Smith, Gary F. and W. E. McCracken. 1977. Techniques for mixing dispersant treated oil slicks into the water. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977.,pp. 403 - 406. New Orleans, LA.:

Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Oil, Slicks, Water.

Smith, Forrest M. 1973. Devloping a total oil spill cleanup capability in the San Francisco Bay area. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, 1973., 21 - 26. Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Cleanup, San Francisco Bay.

Smith, Donald P. 1993. The Oil Pollution Act of 1990: a regional challenge. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 836 - 837. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Oil Pollution Act.

Smith, Donald P. 1991. A regional spill perspective and regulatory impact analysis. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991. San Diego, CA., pp. 714 - 715. Washington, DC: American Petroleum Institute. , 1991.
Keywords - Spill, Regulatory, Impact.

Smith, Donald P. 1989. A Complex multiple oil spill response. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., 572. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Response.

Smith, David D. and George H. Holliday. 1979 . API/SC-PCO Southern California 1978 oil spill test program. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979.,pp. 475 - 482. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - API/SC-PCO, California, Oil Spill.

Smith, P.C., D. Lawrence, A. Isenor, and S. Hurlbut. 1993. Trajectory modeling during CANUSLANT '92. In: Proceedings of the 1993 International oil spill conference: Prevention, reparedness, response, March 29 April 1 1993, Tampa, FL, p. 802.
Key words: Environmental Transport, Gulf of Maine
Canuslant '92 was an emergency response exercise conducted by the Canadian and US Coast Guards in the eastern Gulf of Maine and Bay of Fundy during late October 1992. In contrast to standard operational models, a new method for forecasting oil spill trajectories was tested in which ASA Consulting, Ltd.'s user-friendly OILMAP computer program was linked to a [open quotes]dynamic chart[close quotes] for the region. The dynamic chart keys real-time water level observations to numerical model currents in order to predict the circulation.

Smith, L.R. Water ballasted oil spill containment boom, made of flexible material having inner and outer chambers inflated with material of different densities. Patent No. US 466554_900117.
Key words: Air, Boom, Ballast, Economic Factor, Pollution Control

Smith, W.H. 1990. Advanced bioprocesses in methane from biomass systems. Annual report, 1989. Florida Univ., Gainesville, FL (United States). Inst. of Food and Agricultural Sciences.
The program continues to address the biotechnologies useful for improving biomass qualities that affect convertibility by microbial activities in the multiphases of anaerobic digestion. Modern breeding technology has produced new hexaploid lines of Pennisetum that produce significant quantities of seed. Pennisetum can be easily stored as silage for later conversion. The RFLP mapping technique produces simpler test cross ratios for linkage analyses, as well as identifying genotypes, that can facilitate breeding for convertible biomass. Techniques to cryopreserve tissue cultured cells of napiergrass have been developed, which will reduce the time and effort needed to establish and maintain new cell suspension cultures. The development of vectors for B. fibrisolvens will provide opportunities to improve the production of key enzymes needed for the *degradation* of plant structural polymers. Six bacteria possessing high cellulolytic, xylanolytic, or pectinolytic activities from a sorghum-fed digester were isolated, which will be used for developing an improved inoculum for the depolymerization of biomass. A probe providing real-time measurement of microbial community structure has been developed which will be capable of detecting instability in a glucose-fed digester more rapidly than traditional off line measurements. Methane producing fermentation of napiergrass PI 300086 can be limited by micronutrients, but the limitation can be modified by the addition of small amounts of sulfur, nickel, cobalt, molybdenum and selenium. Computer modelling has yielded an adaptive optimization algorithm that determines the optimum temperature which allows the increase of digester throughput.
Key words: gramineae, anaerobic digestion, biosynthesis, bacteria, biochemistry.

Smith, D.P., S.K. Novotny, and T.R. Wendel. 1989. Facility-specific contingency planning under the oil SPCC ((Spill Prevention, Control, and Countermeasures)) regulations. In: Proceedings of the API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 19 22.
Key words: Additive, Boom, Business Operation, Economic Factor, Pollution Control

Smith, L.H., and D.V. Venne. 1987. Surveillance of oil slicks at sea with U.S. coast guard airborne remote sensing equipment. Oil Chem. Pollut. 3(3):191-201.
Key words: Communication System, Oil Waste

Smith, W.H. 1989. Advanced biomass research program. Annual report for 1987. Technical progress report. Florida Univ., Gainesville, FL (United States). Inst. of Food and Agricultural Sciences. 235.
These results are from an interdisciplinary program researching plant growth and bioconversion processes for enhancing methane from biomass. Modern molecular and cellular biology approaches are being used to characterize the genes and to develop methods for accomplishing transformations to improve biomass quality by

regulating plant chemicals. Quality is being emphasized since quantities of 25 Mg/ha can be sustained for five years and conditions for higher yields of some grasses were identified. Breeding has succeeded in the development of hexaploids that produce seeds, and vegetative propagation from tissue cultures for asexual species. Gel seeding of tissue culture derived plantlets inoculated with mycrohizal to improve survivability has shown promise. Biological methane potential assays have revealed the effects of harvesting frequency, storage and the proportion of plant parts on methane yields. Non-hydrolytical depolymerization of polypectate and hydrolytic degradation of cellulose occur more rapidly at near neutral pH's. A gene encoding for the xylan-degrading enzymes was isolated. These enzymes are repressed by glucose. Kinetic modeling of these reactions is progressing. Methods of describing the microbial community structure in digesters are being developed and used to monitor digester health and performance. Polyclonal antibodies for 9 methanogenic bacteria were developed, propionate and butyrate inhibited dissimilation of large organic polymers, the cellular location of key enzyme were revealed and cellulolytic bacteria were found to attack cells from inside the lumen. Controls of formate production and conversion to gas were identified and the genes for the hydrogenase enzymes in the conversions were cloned. System analysis allows the authors to assess the impact of research progress on cost factors. Sixty scientific papers reporting program results were published in 1987.
Key words: biomass, research programs, genetics, anaerobic digestion, kinetics, clonings.

Smith, R.D. Oil containment system for oil spills etc., comprises deployable flotation canisters connected to structure and having chambers contg. stored curtain forming membranes. Patent No. US 458898_891229.
Key words: Alloy steel, Boom, Chlorohydrocarbon, Containment, Crude Oil, Pollution Control

Smith, J.B.H. 1987. Adapting techniques to conditions: cleanup of a waste oil spill. In: Proc. 1987 Oil Spill Conf., (Prevention, Behavior, Control, Cleanup), Tenth Biennial, (Baltimore, U.S.A.: Apr. 6-9, 1987), Washington, D.C., U.S.A., Am. Pet. Inst., 1987, p.23-25. (Am. Pet.Inst. Publication No. 4452)
Waste oil from an oil recycling facility in Portland, U.S.A., was discharged accidentally into nearby Smith Lake. The clean up effort was hampered by a number of factors, including vegetation in the lake and sub freezing temperatures. The recovery method that proved most successful consisted of washing the oil towards the shore, where it was picked up by rope mop and belt mop skimmers. Approximately 10,000gallons of emulsified oil was eventually recovered. Top soil was removed along the shoreline to a depth of two inches. The property owner (the Port of Portland) also required that eighteen inches of soil be removed in the area where the oil had entered the lake. New top soil was installed and seeded.

Smith, D., and R. Woeller. 1987. Remediation of a gasoline

problem using biological treatment method. Haztech Canada: Dangerous goods and hazardous waste management conference proceedings. 536(p):468-480.
Key Words: Ground water cleaning, oil spills cleaning, aeration, aquifers, biodegradation, chemical composition, field tests, gasoline service stations, iron, maps, oil pollution containmnet, Ontario, precipitation, site characterization, water treatment, water wells, Canada, chemical reactions, commercial sector, marketers, North America, oxygen compounds, retailers, separation processes, transition elements.

Smith, J.B.H. 1991. Development of Arctic River/Delta Boom and Helicopter Towing Techniques for Use in Shallow Water. In: Proceedings of the 14th Environ Can Artic & Mar Oil Spill Program Tech Seminar. pp. 483-488.
Key Words: Floating barrier, aerial transportation, aircraft, containment, helicopter, oil spill, pollution control equipment, towing, administration, Alaska, Arctic Area, bird, business operation, chordata, contamination, contingency planning, delta, employee relations, Endicott Oil Field, environmental impact, environmental pollution, fauna, field equipment, identification, installing, North America, North Slope Area, ocean environment, oil and gas fields, oil producing, oil spreading, oil waste fate, pollution control, reproductive behavior, sensitivity, shallow water, simulation, strategy, stream, table (data), training program, United States, vertebrate, waste material, water depth, water pollution.

Smith, M.R. 1990. The biodegradation of aromatic hydrocarbons by bacteria. Biodegradation : (Dordrecht). 1(2-3):191-206.
Key words: Biodegradation, Bacteria

Smock, R.W. 1982. New PCB destruction processes ease contaminated transformer-oil-disposal problem for utilities. Electr. Light Power(United States) (1982): 60:4
Two approved incinerators and three approved chemical destruction processes as well as several demonstrations of burning transformer oil contaminated with polychlorinated biphenyls (PCBs) are among the technologies available for PCB disposal. Some are based on a Goodyear process which strips off chlorine atoms and leaves a harmless non-chlorinated biphenyl. No decision has been made on whether the cleaned oil is reusable. Summaries of each of the technologies indicate that PCB disposal is coming under control for contaminated liquids, although problems remain for PCB capacitors and other solids. 1 table. hydrocarbons, disposal, management

Smolley, M. and J. C. Kappmeyer. 1991. Cone penetrometer tests and HydroPunch sampling: a screening technique for plume definition. Ground Water Monitoring Review 11(2):101 106.
Key words: Groundwater, Penetrometers, Oil Spills, Plumes
Cone penetrometer tests and HydroPunch sampling were used to define the extent of volatile organic compounds in groundwater. The investigation indicated that the combination of these techniques is effective for obtaining groundwater samples for preliminary plume definition. HydroPunch samples can be collected in unconsolidated sediments and the analytical results obtained

from these samples are comparable to those obtained from adjacent monitoring wells. This sampling method is a rapid and cost-effective screening technique for characterizing the extent of contaminant plumes in soft sediment environments. Use of this screening technique allowed monitoring wells to be located at the plume boundary, thereby reducing the number of wells installed and the overall cost of the plume definition program.

Smookler, A. L., J. W. Harden, Jr., and P. D. Conroy. 1977. Navy development of suitable shipboard bilge oil/water separators. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977.,pp. 423 - 428. New Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords - Navy, Bilge, Oil/Water.

Smookler, A. L. and J. W. Harden, Jr. 1975. Navy shipboard investigation of oily waste. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 189 - 194. San Francisco, CA.: Washington, DC: American Petroleum Institute.
Keywords - Navy, Shipboard.

Sniff, K.F., and M.G. McKinney. 1990. Environmental regulations affecting the oil and gas industry - existing and proposed. In: Proceedings of the Dallas Energy Counc et al Dallas Energy Symp, Jan. 23, 1990, Dallas, TX, 27p.
Key words: Environmental Impact, Water Pollution, Groundwater, Oil Spill, Tanker

Snow, N. B. and B. F. Scott. 1975. The effects and fate of crude oil spilt on two arctic lakes. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 527 - 534. San Francisco, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Arctic.

Snyder, Jr., Harold J. 1975. Federal regulatory control of oil spill removal methods. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 33 - 38. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Federal Regulatory Control, Oil Spill.

Soerensen, A.H., M. Winter-Nielsen, B.K. Ahring. 1991. Kinetics of lactate, acetate and propionate in unadapted and lactate-adapted thermophilic, anaerobic sewage sludge: The influence of sludge adaptation for start-up of thermophilic UASB-reactors. Applied Microbiology and Biotechnology (Germany, F.R.). 34:6:0175-7598.
A thermophilic anaerobic sludge digestor was adapted to lactate metabolism. The adapted sludge showed an improved capacity for lactate degradation when tested by a batch activity test, compared to the performance of unadapted sludge. Acetate was the major intermediate produced during the *degradation*. When adapted sludge was used as the inoculum for a lactate-fed, upflow anaerobic sludge blanket (UASB) reactor, the chemical oxygen demand reduction rate was higher than with unadapted sludge.

After 39 days, however, the difference vanished due to an extensive wash-out of sludge from the reactor inoculated with adapted sludge.
Key words: lactates, biodegradation, sewage sludge, anaerobic digestion.

Solsberg, L. B. 1977. A field evaluation of oil spill recovery devices. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977.,pp. 303 - 308. New Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Recovery.

Sondossi, M., M. Sylvestre, and D. Ahmad. 1992. Effects of chlorobenzoate transformation on the Pseudomonas testosteroni biphenyl and chlorobiphenyl degradation pathway. Applied and Environmental Microbiology (United States). 58:2:0099-2240.
Bacterial conversion of biphenyl (BP) and chlorobiphenyls (CBPs) to benzoates and chlorobenzoates (CBAs) proceeds by introduction of molecular oxygen at the 2,3 position, followed by a 1,2-meta cleavage of the molecule. Complete mineralization of CBPs requires the presence of two sets of genes, one for the transformation of CBPs into CBAs and a second for the degradation of CBAs. It has been shown previously that removal of the CBAs produced from the degradation of CBPs is essential for efficient degradation of CBPs. In this study the authors confirmed that CBAs inhibit BP and CBP transformation in Pseudomonas testosteroni B-356. Among the three monochlorobenzoates tested, 3-chlorobenzoate was the most effective inhibitor. Furthermore, they found that in strain B-356, CBA transformation is controlled by BP-induced oxygenases that are not present in benzoate-grown cells. They found that this BP-linked CBA transformation pathway transformed CBAs produced from CBPs into several metabolites, including chlorocatechols and corresponding muconic semialdehydes. These metabolites inhibited the 2,3-dihydroxybiphenyl 1,2-dioxygenase, while CBAs by themselves had no effect on this enzyme. Therefore, on the basis of this and other observations, it appears that when CBAs produced from CBPs accumulate in the growth medium, they are converted into unproductive metabolites that reduce the flux of the BP and CBP degradation pathway.
Key words: chlorinated aromatic hydrocarbons, oxygenases, genes.

Sonksen, M.K., D.V. Crawford. 1988. A cooperative effort to remediate a historical PCB disposal site. Aluminum Co. of America, Davenport Works, Davenport, IA (US). Proceedings of the 42nd industrial waste conference. 33-38.
Key Words: Biphenyl contamination, ground water monitoring, Mississippi River site characterization, sanitary landfills historical aspects, data analysis, environmental transport, government policies, ground disposal, land reclamation, oil spills, remedial action, aromatics, energy sources, fossil fuels, hydrocarbons, hydrogen compounds, fossil fuels, hydrogen compounds, mass transfer, organic compounds, oxygen compounds, surface waters, waste disposal, waste management.

Sontheimer, H., G. Nagel, and P. Werner. 1988. Restoration of

aquifers polluted with hydrocarbons. Ecological Studies. 73:320-334.
Key Words: Germany, ground water, environmental geology, reclamation, surveys, aquifers, oil spills, pollution, water quality, Karlsruhe, West Germany, Central Europe, Europe, Baden-Wurttemberg, injection wells, water treatment, experimental studies, tracers, geomicrobiology, Durlacher Wald.

Sordelli, Carlos and Nelson Garcia. 1985. Venezuelan national oil spill training program. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp. 631 - 634. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Venezuelan, Oil Spill, Training.

Sorensen, B.M. 1992. The European operational airborne oil pollution surveillance scenario. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 2:989-1003.
Key words: Pollution Control, Remote Sensing, Crude Oil

Sorkhoh, N.A., A.S. Ibrahim, M.A. Ghannoum, and S.S. Radwan. 1993. High-temperature hydrocarbon degradation by Bacillus stearothermophilus from oil-polluted Kuwaiti desert. Applied microbiology and biotechnology. 39(1):123-126.
Key words: Kuwait, Soil Pollution, Oil Spill, Biodegradation, Hydrocarbons
Kuwaiti desert samples contaminated with crude oil contained Bacillus stearothermophilus strains capable of growth on crude oil as a sole source of carbon and energy, obligately at high temperature. No thermophilic oil utilizers were present in water samples collected from the Arabian Gulf. rnost of the desert strains had an optimum temperature of 60 SUP o C and grew best on pentadecane (C SUB 1 SUB 5), hexadecane (C SUB 1 SUB 6) and heptadecane (C SUB 1 SUB 7). n-Alkanes with shorter and longer chains, n-alkenes, and aromatic hydrocarbons were less readily utilized.

Sorkhoh, N.A., M.A. Ghannoum, A.S. Ibrahim, R.J. Stretton, and S.S. Radwan. 1990. Crude oil and hydrocarbon-degrading strains of Rhodococcus rhodochrous isolated from soil and marine environments in Kuwait. Environmental Pollution. 65(1):1-17.
Key words: Oil, Hydrocarbon, Bacteria, Kuwait, Degradation
Mucor globosus was the most active oil degrading fungus isolated. Rhodococcus strains were the most efficient bacteria in oil degradation and, relatively speaking, the most abundant. -from Authors.

Sparks, D.M. 1988. Subsurface geology and petroleum potential of Shandon-San Juan Creek Area, Salinas basin, California. AAPG Bull. (United States). 72:3: 395.
The area of northeastern San Louis Obispo County described in this paper is underlain and laterally adjacent to granite basement rocks of the Salinian block, with a Miocene to Pleistocene sedimentary section overlying the granite. The sequence of middle to upper Miocene Monterey and Santa Margarita

Formations is virtually identical to the outcrop section flanking the La Panza Range to the south and west. The lower Miocene, however, consists of a very thick Vaqueros section, similar to the northern Carrizo Plain. Two distinct structural regimes are present: (1) the late Miocene to present-day right lateral shear, reflected in the San Andreas and Red Hills faults; and (2) an earlier (pre-transform margin) phase, which created the graben-like basement geometry underlying the Shandon area. The combination of these two tectonic phases has created a variety of complex stratigraphic and structural traps. The Monterey formation is typically organic-rich and comprised of familiar chemical facies. A high geothermal gradient and observed thermal alteration effects suggest an oil generation threshold perhaps as shallow as 5500 ft (1676 m). Seismic mapping of the Monterey indicates present-day burial depths of 6000-10,000 ft (1828-3048 m), suggesting that a significant hydrocarbon charge exists. To date, no wells have penetrated the Monterey within the +/- 100-mi/sup 2/ (258-km/sup 2/) area of maximum burial, and none have tested closed traps adjacent to the area. As much as 100 million bbl of oil are estimated to be recoverable from traps in the Shandon area. That volume of oil could be contained in reservoirs trapped below 6000 ft (1828 m), precluding bacterial degradation and yielding expected gravities in the 20/sup 0/ and above range, with associated gas.
Key words: California, petroleum deposits, exploration, geologic formations, resource potential, tertiary, seismic surveys, source rocks, maturation, reservoir rock.

Spaulding, M. L., and M. Reed. 1990. Oil spills. In: Proceedings of the Oil spills management and legislative implications conference, May 15-18, Newport, RI. American Society of Civil Engineers, pp. 366-374.
Key words: Oil Spills, Geographic Information System, Data Analysis, Rhode Island
This paper reports that the Rhode Island Geographic Information System database and the Environmental Data Center, a Geographic Information System (GIS) data processing laboratory at the University of Rhode Island, played an active role in the response to the management of the World Prodigy oil spill in June 1989. During the spill and the cleanup period following the spill, GIS tools were used to record the geographic distribution of oil in Narragansett Bay and Rhode Island Sound. These data were distributed to managers and scientists involved in spill management and analysis. GIS maps were regularly generated for presentations and use in status reports during the week after the spill. Spatial statistics derived from composites of daily oil sheen distributions were used in impact assessment analyses. GIS tools have an important role to play in environmental disaster management, especially those involving the environmental impact assessment of oil spills. The extent to which GIS can be effectively used during the disaster response is largely dependent on how well data systems are pre-adapted to the emergency with respect to data availability and technical preparedness.

Spaulding, M. L., and M. Reed. 1990. Oil spills. In: Proceedings of the Oil spills management and legislative implications

conference, May 15-18, Newport, RI. American Society of Civil Engineers, pp. 351-365.
Key words: Oil Spills, Rhode Island, Narragansett Bay, Coast Guard, Geographic Information System, Tanker, Water Pollution
This paper reports that the ASA oil spill trajectory model was applied to the lower portion of Narragansett Bay and Rhode Island Sound to forecast the motion of oil spilled from the World Prodigy. The tanker ran aground on Brenton Reef on the afternoon of June 23, 1989 releasing 922 metric tons of Number 2 fuel oil. ASA's forecasts were provided to NOAA, U.S. Coast Guard (USCG) and state and local government officials to assist the oil spill cleanup and decisions regarding public health concerns, such as beach and shellfish area closures. Two-day spill forecasts were initiated on June 24 and were performed once or twice per day until June 26 when the oil had largely dissipated. Tidal hydrodynamic data used as input to the *trajectory* model were based on prior, verified simulations for the study area. The winds were based on forecasts provided by the National Weather Service facility at Green Airport, located approximately 30 km north of the site. Updates on observed spill locations, necessary to re-initialize the model, were provided through a GIS based summary of aerial overflight data. Model forecasts were in general agreement with the spill observations and provided officials with advanced estimates for spill response planning. Accurate estimates of the winds were of paramount importance in reliable spill forecasting.

Spaulding, M.L., E.L. Anderson, T. Isaji, and E. Howlett. 1993. Simulation of the oil trajectory and fate in the Arabian Gulf from the Mina Al Ahmadi spill. Marine Environmental Research. 36(2):79-115.
Key words: Oil Spill Simulation, Mina Al Ahmadi Spill, Saudi Arabia
An oil spill response model, configured for operation on a personal computer, was applied to predict the transport and fate of oil from the Mina Al Ahmadi spill in the northern Arabian Gulf. The model predicts the drift, spread, evaporation, dispersion, emulsification, and shoreline interaction of the spilled oil. The model correctly predicted the spill path and size but overestimated the rate of transport in the forecast model. Hindcasts were in better agreement with the observations. -from Authors.

Spaulding, M.L., E. Howlett, K. Jayko, E. Anderson, T. Isaji. 1992. Shell approach to modeling oil spill trajectory and fate and search and rescue operations. In: Proceedings of the 2nd International Conference on Estuarine and Coastal Modeling, November 13 15 1992, Tampa, FL, pp. 157-174.
Key words: Applications, Water Pollution
A shell approach is employed to facilitate the application of an oil spill trajectory and fate and search and rescue model to a wide variety of geographic areas. In this strategy the model software, user interface, linkage to supporting data bases, and an embedded geographic information system remain the same among the various applications. Data to define the shoreline location, currents, wind, temperature, and other environmental information are user supplied for specific geographic areas. The user simply

selects the appropriate location data sets. The model system calculates the trajectory and fate of oil from user specified release points, assuming either instantaneous or time dependent spill. The user specifies the oil type using a boiling point cut representation. The oil spill model predicts the drift, spread, evaporation, dispersion and emulsification of the oil. The model can be employed in hindcast, forecast, and receptor modes. Model predictions can be either deterministic or stochastic. The search and rescue model allows the user to estimate the probable location of an object (e.g. disabled vessel, debris, etc.) based on an initial estimate of its location and environmental conditions. Calculations can also be made tracing sited debris backward in time (receptor mode) to determine its probable origin. Applications of the shell to selected oil spills and search and rescue use are presented. (Author abstract) 17 Refs.

Spaulding, M.L., E.A. Anderson, E. Howlett, T. Isaji, and K. Jayko. 1991. Oil spill model shell: Worldwide application. In: Proceedings of the Fourteenth Arctic and Marine Oil Program technical seminar, June 12 14 1991, Vancouver, Canada, pp. 1-26.
Key words: Oil Spill, Computer Simulation, Water Pollution
An oil spill model shell has been developed which is suitable for worldwide use. The shell consists of the model software and user interface which remain the same for each application. The user provides data on shoreline location, winds, currents, and temperature for a particular study area. Additional geographically-referenced data such as shore type, biological resources, and socioeconomic resources can be incorporated into the model through an embedded geographic information system. The user can rapidly switch from one area of interest to another by simply selecting the appropriate application, which can vary in geographic location or in resolution (detail) for a given geographic area. The model used in the shell predicts the trajectory and fate of oil to include drift, spreading, evaporation, dispersion, emulsification, and shoreline stranding. Forecast, stochastic, and receptor modes of model operation are available. To illustrate the utility of the model approach and to provide a practical demonstration of the model use, applications to two recent major spills and to two spill scenarios are presented. The advances of the shell model over existing spill models are discussed, and extensions of this approach to oil spill decision support model systems are also described. 28 refs., 7 figs., 1 tab.

Spaulding, M. L., E. A. Anderson, E. Howlett, T. Isaji, and K. Jayko. 1991.Oil spill model shell: worldwide application. In: Proceedings of the14th Environ. Can. Arctic & Mar. Oil Spill Program Tech. Seminar, June 12-14, Vancouver, Canada.
Key words: Oil Spills, Water Pollution, Gulf of Mexico, Persian Gulf

Spaulding, M. L., E. Howlett, E. Anderson, and K. Jayko. 1992. Oil spill software with a shell approach.Sea Technol. 33(4).
Key words: Oil Spills, Water Pollution, Contingency Planning, Computer Software

Spaulding, M. L., E. Howlett, E. Anderson, K. Jayko. 1992.

OILMAP(TM): A global approach to oil spill modeling. In: Proceedings of the Environment Canada 15th Arctic and Marine Oil Spill Technical Seminar, June 10 12, Edmonton, Alberta, Canada. Applied Science Associates, pp. 15 21.
Key words: Oil Spills, Contingency Planning, Water Pollution, Cathode Ray Tube

Spaulding, M.L., M. Reed. 1990. Predicting the movement of the World Prodigy spill. In: Proceedings of the Oil spills management and legislative implications conference, May 15 18 1990, Newport, RI, pp. 351-365.
Key words: Oil Spills, Petroleum, US Coast Guard
This paper reports that the ASA oil spill trajectory model was applied to the lower portion of Narragansett Bay and Rhode Island Sound to forecast the motion of oil spilled from the World Prodigy. The tanker ran aground on Brenton Reef on the afternoon of June 23, 1989 releasing 922 metric tons of Number 2 fuel oil. ASA's forecasts were provided to NOAA, U.S. Coast Guard (USCG) and state and local government officials to assist the oil spill cleanup and decisions regarding public health concerns, such as beach and shellfish area closures. Two-day spill forecasts were initiated on June 24 and were performed once or twice per day until June 26 when the oil had largely dissipated. Tidal hydrodynamic data used as input to the trajectory model were based on prior, verified simulations for the study area. The winds were based on forecasts provided by the National Weather Service facility at Green Airport, located approximately 30 km north of the site. Updates on observed spill locations, necessary to re-initialize the model, were provided through a GIS based summary of aerial overflight data. Model forecasts were in general agreement with the spill observations and provided officials with advanced estimates for spill response planning. Accurate estimates of the winds were of paramount importance in reliable spill forecasting.

Spear, C.E. 1992. EPRI/Alberta Research Council Clean Soil Process. Electric Power Research Inst., Palo Alto, CA (United States) Mill Creek Co., Houston, TX (United States) 61 pp. EPRI Distribution Center, 207 Coggins Drive, PO Box 23205, Pleasant Hill, CA 94523 ERA (Energy Research Abstracts), ETD (Energy Technology Data Exchange), INS (US Atomindex input) TIC (Technical Information Center)
The EPRI/Alberta Research Council Clean Soil Process can remove hydrocarbon contamination from waste material from manufactured gas plants. The process uses coal as an absorbent to remove hydrocarbons. For petroleum contaminated soils, the process can bring residual concentration of petroleum below 0.1 percent and polycyclic aromatic hydrocarbon (PAH) concentration to 1--5 ppM. For coal tar contaminated soils, the process can reduce tar concentrations to about 0.05-0.5 percent and the PAH concentration to about 10--60 ppM. Additional post-treatment may be required for some precleaned soils. The process yields by-product agglomerates suitable for combustion in industrial boilers. Light hydrocarbons such as benzene are vaporized from the soil, condensed and collected in the Process and disposed of off-site. The Clean Soil Process has been tested at pilot-plant scale. A conceptual design for a 200-tons-per-day plant yielded a

capital cost estimated at $3.1 million with a per-ton operating cost of $40.
Key words: coal--sorptive properties, coal gasification plants--land pollution, coal gasification plants--solid wastes, land pollution--remedial action, remedial action--pilot plants, soils--processing, solid wastes--ground disposal, cleaning, coal tar, epri, hydrocarbons, oil spills, polycyclic aromatic hydrocarbons, recommendations, aromatics, carbonaceous materials, energy sources,fossil fuels, fuels, functional models, hydrocarbons, industrial plants, management, materials, organic compounds, other organic compounds, pollution, surface properties, tar, waste disposal, waste management, wastes

Spears, R.E., S.E. Helton, A.L. Pease, and T.R. Wendel. 1991. Volunteers at oil spill cleanups: guidance for on-scene coordinators. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 161-165.
Key words: Administration, Business Operation, Economic Factor, Oil Spill, Training Program, Crude Oil, Contingency Planning, Petroleum, Pollution Control

Speitel, Jr., G.E., R.L. Segar, Jr.,and J.M. Leonard. 1990. Bioreactor technology for the treatment of trace levels of chlorinated solvents. In: Proceedings of petroleum hydrocarbons and organic chemicals in ground water: Prevention, detection, and restoration. Petroleum hydrocarbons and organic chemicals in groundwater: prevention, detection and restoration. 477-489:664.
Chlorinated aliphatic solvents, such as trichloroethylene (TCE), are common ground water contaminants and are of concern because of the possible adverse health effects associated with many of these chemicals. In many instances, the concentration of chlorinated solvents is quite small, less than 100 {mu}g/L. Treatment processes currently in use for the removal of these chemicals include air stripping and granular activated carbon (GAC) adsorption. A promising new treatment technique is aerobic biodegradation, using bacteria that cometabolize chlorinated solvents while growing on some other substrate. To date, three groups of bacteria have shown some ability to cometabolize chlorinated solvents, especially TCE (Tsien et al., 1989; Nelson, et al., 1987; Vannelli et al., 1990). In most cases the biotransformation rates are relatively slow in comparison to organic chemicals typically treated with biological processes. A variety of cultures of aromatic degraders were tested for their ability to degrade TCE. Only one pure culture of methanotrophs, Methylosinus trichosporium OB3b, was studied because degradation rates reported by others and confirmed in our laboratory (Thompson, 1990) were far greater than with other methanotrophs. The objectives of the research were: 1. isolation of a variety organisms capable of aerobic biodegradation of chlorinated solvents, 2. measurement and comparison of degradation kinetics in batch studies, 3. assessment of biotreatability in continuous-flow reactors, and 4. evaluation of process feasibility through mathematical modeling. Special emphasis was placed on treatment conditions and process limitations applicable to trace concentrations ({le}100 {mu}g/L) of chlorinated solvents in ground water. have examined concentrations well above 1 mg/L.

Key words: bioreactors, research programs, hydrocarbons, biodegradation, ground water, water pollution, removal.

Spencer, L.K. 1991. Submersible pneumatic pump for water table. Patent No. US 5013218910507, 15p.
Key words: Water Pollution, Groundwater, Oil Spill

Spengler, Dirk-Uwe. 1985. First German oil spill handbook for Hamburg harbor. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp. 183 - 188. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - German, Oil Spill, Harbor.

Spies, R.B., J.S. Felton, L. Dillard. 1984. Hepatic mixed-function oxidases in California flatfishes are increased in contaminated environments and by oil and pcb (Polychlorinated biphenyl) ingestion. Mar Environ Res (1984): 14
Key words: toxic effect, biodegradation, oil, disposal

Spitzer, Jame D. 1985. Developing marine pollution response capability in the wider Caribbean region. . In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp. 127 - 134. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Marine, Pollution, Response, Caribbean.

Spooner, R.A., M. Bagdasarian, and F.C.H. Franklin. 1987. Activation of the xylDLEGF promoter of the TOL toluene-xylene degradation pathway by overproduction of the xylS regulatory gene product. J. Bacteriol.(United States). 169:8:3581-3586.
The xylS regulatory gene of the Pseudomonas putida TOL plasmid (pWWO) has been cloned under the transcriptional control of the Escherichia coli tac promoter in a broad-host-range controlled-expression vector. Induction with isopropylthiogalactoside allowed overproduction and characterization of the xylS product by specific interaction with the TOL meta-cleavage pathway operator-promoter region (OP2) in vivo in E. coli. Examination of plasmid-specified polypeptides in E. coli maxicells led to identification of the xylS product as a 36-kilodalton polypeptide. The operator sequences required for xylS interactions lay upstream of the OP2 transcriptional start, and the xylS gene product recognized this region even in the absence of known coinducers.
Key words: biodegradation, gene regulation, genetic mapping, polypeptides, toluene, plasmids, transcription, cell culture, xylenes, DNA, cloning, alkylated aromatics, bacteria, escherichia coli.

Spotts, Ens. J.P. 1993. Trace metal analysis for fingerprinting oil spill samples. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., 881 - 882. . Tampa, Florida.: Washington, DC: American Petroleum Institute. , 1993. .
Keywords - Fingerprinting, Oil Spill.

Springer, N. 1993. A New Realism. Chemical Marketing Reporter

(April 12):SR18
Key words: Water Pollution, Remediation
After years of fits and starts in attempts to remediate contaminated groundwater in the US, it appears that federal and state regulators, private industry, and environmental consultants and engineers are on the verge of a concerted push toward cleaning up polluted aquifers. The widespread acceptance of the hard truth that there is no single technique or technology that will solve the problem is at the heart of the renewed endeavor to clean the nation's groundwater. This approach naturally encourages ongoing research into innovative treatments. And, given that each site presents a different snapshot of levels of contaminants and hydrogeologic conditions among other relevant factors it suggests that combinations of physical, chemical and biological treatments are usually necessary. An indicator of this new thinking is the growing understanding that some sites will never be totally cleaned up only stabilized so that they present no danger to human health and the environment. Indeed, some sites may be best left alone and allowed to recover through natural methods over the course of many years. We don't have to manhandle every site, says Evan Nyer, a groundwater consultant and vice-president of Geraghty & Miller, an environmental services firm located in Denver.

Spruill, T.B. 1990. Preliminary evaluation of the effects of an abandoned oil refinery on chemical quality of water in the Arkansas River Valley, Arkansas City, Kansas, 1985-86. US Geological Survey, Denver, CO. Report No. 89-4190, 59 p.
Key words: Groundwater, Oil Refinery, Oil Spill, Kansas, Lake, Soil Pollution

Srivastava, V.J., J. J. Kilbane, R. L. Kelley, W. K. Gauger and C. Akin. 1989. Accelerated bioremediation of old town gas plant sites. In: Proceedings of the 1989 Symposium on Biological Processing of Coal and Coal-Derived Substances, May 16 17, Palo Alto, CA.
Key words: Remedial Action, Oil Spills, Biodegradation,
Plants for the manufacture of gas from coal and crude oil often referred to as manufactured gas plants or town gas plants have existed in many parts of the world, including the United States, during the nineteenth and twentieth centuries. Today, the two gas industry has become extinct due to inroads paved by the current gas industry with its system of interstate natural gas pipelines. However, the legacy of town gas plants remains today. While these plants were operational, society and industry were not aware of appropriate disposal practices or potential problems and health concerns caused by on-site waste disposal. Consequently, many of these plants disposed of process wastes on-site, contaminating the soil with coal tar wastes, oil, spent oxides (from the gas cleaning operation), and ash. The Institute of Gas Technology (IGT) has been developing several techniques to improve biodegradation of two gas plant wastes such as multi-ring polynuclear aromatic hydrocarbons (PAH's). These techniques include the use of bioemulsifiers, chemical oxidants or biologically produced chemicals, PAH-degrading IGT cultures developed through enrichment techniques, and appropriate co-metabolic and/or enzyme-inducing substrates. Depending upon

the waste type and concentration, and geological characteristics of the site, a logical combination of any number of these techniques can be used to remediate the site. This paper discusses several liquid culture and soil treatment experiments conducted at IGT. Results show that PAH's in soils and in waters can be efficiently biodegraded by aerobic and possibly by anaerobic cultures and that chemical treatment and bioemulsifier applications enhance PAH biodegradation. The paper also mentions possible treatment scenarios consisting of various unit operations or remediation techniques.

St. Martin, J. W. 1987. Long-Term drift in the Beaufort Sea. In Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., 620. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Drift, Beaufort Sea.

Stacey, C.B., Rear Adm. Michael L. 1987. United Kingdom marine pollution contingency planning: a review of the last two years. In Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp. 167 - 170. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - United Kingdom, Marine, Contingency Planning.

Stacey, R. Adm. Michael L. 1983. Review of United Kingdom contingency planning and resource capability. In Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., pp. 195 - 198. Keywords - United Kingdom, Contingency Planning. San Antonio, TX. : Washington, DC: American Petroleum Institute.

Stacey, Rear Adm. Michael L. 1985. Marine pollution contingency planning: recent changes in United Kingdom organization. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., 89 - 92. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Marine, Pollution, Contingency Planning, United Kingdom.

Stacey, Rear Admiral Michael L. 1981. United Kingdom: a review of the need to minimise oil spillage in marine casualty situations. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 211 - 214. Atlanta, GA.: Washington, DC: American Petroleum Institute.
Keywords - United Kingdom, Oil Spill, Marine.

Stainken, Dennis M. 1975. Preliminary observations on the mode of accumulation of #2 fuel oil by the soft shell clam, mya arenaria. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 463 - 468. San Francisco, CA.: Washington, DC: American Petroleum Institute.
Keywords - Accumulation, Fuel, Oil, Clam.

Stalcup, D.L. 1992. Briefing on SPCC program and facility response plans. Interstate Oil Compact Commission Committee Bulletin (United States). 6(1):18-24.

Key words: Oil Spill, Groundwater, Pollution Control, Regulations
The Oil Pollution Prevention Program at headquarters in EPA is in the Emergency Response Division and we are sort of stepchildren to the Superfund Program. We don't spend the same money, but there are so many parallels in the response aspects in responding to oil spills and hazardous materials spills and in prevention program that we are organizationally put together and it really makes a lot of sense. We are able to help each other and work with each other on a lot of the concepts.

Standard Oil Co Ohio. Cationic terpolymer for emulsion prodn. and stabilisation, obtd. from (meth)acrylamide, water-insol. monomer with alkyl chain and vinyl monomer with basic Gp. Patent No. US 151051_880201.
Key words: Cleaning, Chlorine, Crude Oil, Emulsifier, Physical Separation, Pollution Control

Stanton, Philip B. Establishing a breeding eider duck population in Massachusetts. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., pp. 493 - 498. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Duck, Massachusetts.

Starr, J. 1987. An Experimental analysis of the factors influencing the accuracy of volumetric leak detection methods in underground storage tanks. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp. 629. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Analysis, Leak, Detection, Underground, Tanks.

Starr, T.F. 1991. Oil Absorbent. Patent No. US 5067984, c 11/26/91, f 12/19/89 (Appl 458562) (b08b-007/00; B01j-020/24) 3 pp.
Key words: solid adsorbent, additive, adsorbent, contamination, control, environmental pollution, oil spill, pollution control, remediation, soil pollution, soil remediation, sorbent, wetting agent, p) USA, absorbent, absorption, adsorption, applying, beach, cleaning, collecting agent, composition, compound, decomposition, decontaminating, deterioration, flow property, land reclamation, lipophilic, liquid viscosity, mixture, multicomponent mixture, natural resin, oil waste, oil waste fate, physical property, slurry, soil (earth), sorption, starch, surface active agent, surface property, suspension, viscosity, waste material, wettability, ecology & pollution

Starr, T.F. Petroleum or petroleum by-product degradation cpd., for removing land surface oil spills, comprises flour, mustard powder and wetting agent. Patent No. CA 7534_900110.
Key words: Adsorbent, Animal, Beach, Coastal Area, Crude Oil, Petroleum Fraction, Pollution Control

Steen, William C., and Timothy W. Collette. 1989. Microbial degradation of seven amides by suspended bacterial populations. Applied & Env Microbiology. 55(10):2545-2549.

Key words: Biodegradation, Bacteria, Hydrocarbons, Degradation
Microbial transformation rate constants for seven amides in natural pond water were determined. The transformation was described by a second-order mathematical rate expression. The relationship between the infrared spectra and the second-order rate constants for these amides was also studied. Second-order rate constants ranged from a low of 2 x 10-14 to a high of 1.1 x 10-9 l/organism/hr for niclosamide and propachlor, respectively. Microbially mediated hydrolysis was the mechanism of degradation, a process consistent with that for other organic chemicals previously studied.

Steinman, Capt. George C. and Walter B. Chappel. The Maritime administration program for the prevention and control of oil pollution from vessels. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975.,pp. 177 - 186. San Francisco, CA.: Washington, DC: American Petroleum Institute.
Keywords - Control, Oil, Pollution, Vessels.

Steinvall, O. 1987. Potential of laser remote sensing of oil below water surface. In: Proceedings of the Seminar on oil pollution questions, November 19 20 1986, Norrkoeping, Sweden, pp. 238-254.
Key words: Oil Spills, Monitoring, Bathymetry, Petroleum
Many sensors have been developed to indicate the presence of an oil spill. Successful operations have been demonstrated by multispectral cameras, radars, infra-red line scanners and microwave radiometers. However, the potential of identifying and quantifying the anomaly by the above sensors is limited. The depth penetration is also non-existing with the exception of the multispectral camera working in the visible part of the spectrum. In recent years lasers have found an increasing interest for hydrographic applications which will make it a valuable complement to other sensors for oil spill detection and identification. In this paper the principles and functions of a laser fluorosensor and a laser bathymeter are presented and finally a combination of the laser bathymeter with the fluorosensor is discussed.

Steiof, M. 1992. Investigations on the biodegradability of mineral-oil-hydrocarbons with different boiling ranges. Soil Decontamination Using Biological Processes. (1992): 6 9 December. Paper given at Int. Symp. Soil Decontamination Using Biological Processes, Karlsruhe, D, 6 9.12.92.
Key words: soil, decontamination, hydrocarbon, biodegradation, degradation
Laboratory degradation experiments use 4 oil fractions of diesel and vacuum gas oil inoculated by mixed bacterial cultures and supplied with R2A, diesel and gas oil agar as nutrient. The separated compounds are degraded by 72 to 97%, the not separated compounds by 5 to 41%.

Stekoll, M.S., L. Deysher, and T.A. Dean. 1993. Seaweeds and the Exxon Valdez oil spill. In: Proceedings of the 13th Bien API et al oil spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 135-140.

Key words: Alaska, Ecology, Oil Spill, Environmental Pollution

Stephanatos, B.N. 1988. Modeling the transport of gasoline vapors by an advective-diffusive unsaturated zone model. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:591-611.
Key words: Soil Pollution, Groundwater, Oil Spill, Vadose Water, Water Pollution, Map

Sterkenburg, A., J.G.van Andel. 1992. Availability of substrate during biotechnological treatment of extraction sludge containing polycyclic aromatic hydrocarbons. DECHEMA-Fachgespraeche Umweltschutz. (1992): 9.
Key words: soil, decontamination, degradation, hydrocarbon
Sludge from solvent extraction of soil from former gasworks is inoculated with PAH degrading bacteria and treated in batch culture for 40 days or in an airlift fermenter for 75 days. Phenanthrene and anthracene are decomposed at comparable rates. Supposedly sludge degradation enhances PAH degradation.

Sterkenburg, A., I. Oostenbrink, J.G. van Andel. 1992. Biodegradation xenobiotics viii. Microbiological degradation of naphthalene absorbed by activated carbon: A model system for extraction limitation. Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
Experimental research has been done on a model system that concerns the desorption of polycyclic aromatic hydrocarbons as a limiting factor for the biotechnological sanitation of soil fractions. The system was confined to the relatively well-degradable naphthalene, whereas the substrate was adsorbed as a vapor onto powdered activated carbon by means of a novel method. Adsorbed naphthalene was determined quantitatively by desorption, either by extraction with organic solvents, or by a novel method by which the compound was released from the adsorbents by heating and was detected subsequently by mass spectrometry. With the latter method, the impeding effect of water on the rate of desorption had no effect. Biomass was estimated from the protein content; the interfering effect of activated carbon was corrected for partly by using adsorption isotherms of bacterial protein.
Key words: polycyclic aromatic hydrocarbon, biodegradation.

Steven F. Railsback, Gordon A. Robilliard, and Jack R. Mortenson. 1987 . Strategy for monitoring the short-term distribution of dispersed oils. In Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987.,pp. 321 - 324. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Monitoring, Distribution, Dispersed Oils.

Stewart, Robert J. The Tanker/pipeline controversy. 1977. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., pp. 95 - 100. New Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords - Tanker/Pipeline, Microbiological, Coastal, Shoreline, Oil Spills, Contamination.

Stewart, Wilford S. 1975. Microbiological and natural product systems for the protection of coastal shorelines from oil spills and oil contamination.. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 425 - 430. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Microbiological, Coastal, Shorelines, Oil Spills, Contamination.

Stewart, P.L. 1988. Oil weathering. Eastern Offshore News (Canada). 10:1:26-27.
This paper comments on a continuing study of weathering of East coast hydrocarbons which begun in 1984 by the Department of Fisheries and oceans at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia. The study focused on determining rates and mechanisms of degradation with a view to eventual use in oil spill clean-up. Some of the major findings of the study are discussed. Hydocarbons deposited and mixed with sand on a beach break down slowly. The study also showed that Ventura condensate and Hibernia crude weather much more slowly than predicted on the basis of the volatility of their components. Most of the degradation of beached hydrocarbons were found to be carried out by bacteria. The project also showed that several products claiming to enhance biodegradation of hydrocarbons did not work in beach sediments. Effect of nutrients on weathering of oil on a sand beach are presented in graphic form. It was concluded that it may be possible to speed up degradation still further by better timing the application of the fertilizer and fine-tuning with ambient environmental conditions at the specific sites. 1 fig.
Key words: petroleum, weathering, decomposition, oil spills, chemical reactions, energy sources, fossil fuels.

Stieben, G.P., and G. Rai Mehdiratta. 1992. Foundation considerations for cylindrical steel storage tanks. In: Proceedings of the 2nd Mater Technol Inst et al Aboveground Storage Tanks Symp, January 14-16, 1992, Houston, TX, 14p.
Key words: Aboveground Storage Facility, Environmental Impact, Groundwater, Monitoring, Oil Spill, Soil Pollution, Tank, Water Pollution

Stirling, Cdr. Albert G. 1969. Prevention of pollution by oil and hazardous materials in marine operations. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969., pp.47 - 54. New York, NY.: Washington, DC: American Petroleum Institute.
Keywords - Pollution, Oil, Hazardous Materials, Marine.

Stokes, G.W. 1992. Oil Recovery System. Patent No. US 5173185 10pp.
Key words: oil skimming, adsorbent, collector, contamination, environmental pollution, oil spill, oil water separation, oil water separator, physical separation, separation equipment, solid adsorbent, sorbent, water pollution, (p) USA, adjustability, adsorption, business operation, chart, circular motion, connector, construction material, control,

coupling (mechanical), decontaminating, deflector, desorption, differential pressure, ecology, engineering drawing

Stokes, Vijay K. and Andrew C. Harvey. Drop size distributions in oil water mixtures. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, 1973., pp. 457 - 465. . Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Water, Mixtures.

Stokman, S.K. 1987. Estimates of concentrations of soluble petroleum hydrocarbons migrating into ground water from contaminated soil sources. National Water Well Assoc., Dublin, OH. 541-558.
Key Words: Ground water contamination, ground water pollution sources, hydrocarbons solubility, hydrocarbons toxicity, land reclamation remedial acton, soils contamination, environmental transport, flow models, health hazards, leachates, oil spills, quantitative chemical analysis, risk assessment, soil chemistry, unleaded gasoline, chemical analysis, dispersions, energy sources, fossil fuels, hydrogen compounds, liquid fuels, mass transfer, mathematical models, mixtures, organic compounds, oxygen compounds, petroleum products, solutions.

Stolls, Amy M. 1993. Oil spill legislation in the coastal United States since the oil pollution Act of 1990. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 643 - 648. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, United States.

Stone, R. 1991. Icy inferno: Researchers plan oil blaze in Arctic. Science. 253(5025):1203-1204.
Key words: Beaufort Sea, oil spills, petroleum, combustion, oil pollution
In the summer of 1992, industry researchers hope to spill and set ablaze tens of thousands of gallons of crude oil in the ice-choked waters of the Beaufort Sea off Alaska's northern coast. The researchers want to determine how well federal or industrial emergency response teams can deal with a future accidental oil spill in Arctic waters and learn whether fire can serve as an effective cleanup tool. First, however, they must convince federal and state regulators to sanction the test, and that's proving difficult. One reason for concern is that the standard approach to oil cleanup may not work in this area. Special hazards - the rough weather that often batters the Beaufort Sea, the darkness that envelops the area during most of the winter, and the ice - make it virtually impossible to deploy booms and collectors of the kind used for spills in warmer waters. The planned spill in the Beaufort Sea is an attempt to test alternative cleanup technologies. It is being sponsored by Alaska Clean Seas (ACS), a nonprofit organization composed of the major oil and gas companies operating in Alaska.

Stothoff, S.A., and G.F. Pinder. 1992. A boundary integral technique for multiple-front simulation of incompressible, immiscible flow in porous media. Water Resources Res.

28(8):2067-2076.
Key words: Porous Media, Simulation, Absorption, Groundwater, Oil Spill

Stover, Dawn. 1992. Toxic Avengers. Popular Sci. 241(1):70 75.
Keywords: petroleum, biodegradation, waste treatment, biodegradation
Bioremediation has been used successfully in the treatment of sewage, chemical, petroleum, paper mill, and food processing wastes. Examples of bioremediation programs for polyurethanes in the aircraft industry, carcinogenics produced by nucelar fuel processing, contaminated groundwater, and toxic chemicals illustrate the breadth of opportunity. With 30,000 hazardous waste sites identified in the U.S., a large market for bioremediation exists. Firms specializing in bioremediation are generally small, with an engineering or scientific perspective. In determining a remediation plan site geology and hydrology are evaluated; then, a bacterial mix appropriate to the contaminants is selected.

Stowe, G.B. 1991. Oil Spill Water Treatment. Clnzall Corp. Patent No.US 5035804, 7 pp.
Key words: solid adsorbent, additive, adsorbent, clay mineral, coating material, contamination, environmental pollution, expanded perlite, mineral, oil spill, silicate mineral, sorbent, vermiculite, water pollution, (p) USA, adsorption, alkali metal, buoyancy, business operation, carbon, chemical process, Clnzall Corp, composition, compound, control, data, decontaminating, density, element (chemical), environment, film, heat treatment, heating, iron sulfate, Feso4, lake, layer, lipophilic, manufacturing, nitrate, nonmetallic coating, ocean, ocean environment

Strand, S. E., M.D. Bjelland, and H.D. Stensel. 1990. Kinetics of chlorinated hydrocarbon degradation by suspended cultures of methane-oxidizing bacteria. WPCF Research J. 62(2):124-129.
Key words: Biodegradation, Microorganism, Hydrocarbons, Monitoring, Bacteria, Groundwater, Degradation
The stoichiometry and kinetics of methane utilization and biodegradation of trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA) were determined for a mixed methanotropic bacterial culture. The experiments were studied in a closed-system reactor. Mixed culture methane concentration rates were not affected by dissolved TCA concentrations of less than 7770 (gr)mg/l. Dissolved methane concentrations greater than 0.25 mg/l inhibited biodegradation rates of TCA but not TCE. The culture continued to degrade TCE and TCA in the absence of methane, but ceased after 104 hr. Biodegradation rates were lower when treating a mixture of TCE and TCA.

Strand, Stuart E., James V. Wodrich, and H. David Stensel. 1991. Biodegradation of chlorinated solvents in a sparged, methanotrophic biofilm reactor. WPCF Res J. 63(6):859-867.
Key words: Degradation, Hydrocarbons, Bacteria
Trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA) are widespread groundwater contaminants. The best available technologies for TCE and TCA contaminated water are air stripping

and carbon adsorption. Use of methanotrophic bacteria is a bioremediation alternative to these conventional methods. The cometabolic degradation rates of TCE and TCA were determined, using mixed-culture methanotrophic biofilms grown on glass beads in a complete-mixed, laboratory reactor sparged with methane gas. The degradation rates were approximated by a first-order model for both TCA and TCE. Preliminary design calculations suggest that a bench-scale reactor of this type could reduce TCA and TCE concentrations 500 (gr)mg/l to 200 and 5 (gr)mg/l respectively.

Strand, J. W., W. L. Templeton, and I. A. Lichatowich. 1971. Development of toxicity test procedures for marine phytoplankton. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 - 17, 1971., pp. 279 - 286. Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords - Toxicity, Phytoplankton.

Strand, J. 1993. Process to identify and evaluate restoration options. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 245 - 249. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Restoration, Options.

Strandberg, G.W. 1990. Solubilzation of coal by streptomyces. Wise, D.L. 1990. Bioprocessing and biotreatment of coal. 297-302,744.
Although much is known about the microbial degradation and utilization of coal-derived organic compounds, relatively little information has been reported concerning the ability of microorganisms to attack the organic framework of intact coal. Although several bacteria and fungi had been found to be associated with coal, these authors concluded that no one had definitively demonstrated that unaltered coal could be attacked by microorganisms. However, they stated (prophetically) that members of the genus Pseudomonas, by virtue of their ability to attack polycyclic hydrocarbons; Actinomycetes due to their role in humification; and several genera of fungi that could oxidize paraffins and humic acids were the logical organisms to consider in studying microbial coal oxidation. Members of all of the genera listed have since been found to be capable of solubilizing coal. In this report, certain aspects of what is known about coal solubilization by {ital S. setronii} are discussed and consideration is given to possible mechanistic aspects based on chemical coal-solubilizing processes.
Key words: biodegradation, streptomyces, uses, fuel slurries, lignin, polycyclic aromatic hydrocarbons.

Strandberg, G.W., T.L. Donaldson, L.L. Bolla, A.V. Palumbo, and W. Eng. 1988. Degradation of trichloroethylene and trans-1,2-dichloroethylene by a methanotrophic consortia in a trickle-type bioreactor. In: Proceedings of the 4. annual DOE model conference. 8.
A trickle-bed bioreactor containing a consortium of microorganisms utilizing methane as the primary carbon source was used to treat a synthetic groundwater containing trichloroethylene (TCE) and trans-1, 2-dichloroethylene (DCE).

With influent concentrations of TCE and DCE of 1 mg/L each and an average residence time of about 50 min, >50% of the TCE and >90% of the DCE was degraded. The reactor exhibited first-order kinetics with respect to TCE degradation. 5 refs., 1 tab.
Key words: bioreactors, chemical reaction, biodegradation, microorganisms, methane, bacteria, methanogenic bacteria, alkanes, decomposition, kinetics, water, reaction kinetics, oxygen compounds, halogenated aliphatic hydrocarbons, organic chlorine compounds.

Stransky, R., and M.S. Blanchard. 1989. An in-situ venting program for petroleum hydrocarbons in soil and water. In: proceedings of the third national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods. National Water Well Association outdoor action conference. 1161(p):607-621.
Key Words: Ground water contamination, oil spills land pollution abatement, soils contamination, aquifers, Florida, leaks, oxidation, removal, underground storage, vapors, volatile matter, water reclamation, chemical reactions, Federal Region IV, fluids, hydrogen compounds, matter, North America, oxygen compounds, pollution abatement, USA.

Straughan, Dale. 1977. The Sublethal effects of natural chronic exposure to petroleum on marine invertebrates. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., pp. 563 - 568. New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Exposure, Petroleum, Marine Invertebrates.

Straughan, Dale. 1979. Distribution of tar and relationship to changes in intertidal organisms on sandy beaches in Southern California. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., pp. 591 - 601. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Changes, Intertidal Organisms, Beaches, California.

Straughan, Dale. 1983. Sandy beach communities exposed to natural oil seepage. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., pp.485 - 490. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Beach, Oil, Seepage.

Straughan, Dale. 1971. The Influence of oil and detergents on recolonization in the upper intertidal zone. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 - 17, 1971., pp. 437 - 440. Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Detergents, Intertidal Zone.

Streeb, L.P., and F.G. Brown. 1992. The MEOR (microbial EOR)-Altamount/Bluebell Field project. In: Proceedings of the SPE 1992 Rocky Mountain Regional Meeting, May 18 21, Casper, WY, pp. 253 261.
Key words: biodegradation, microorganisms, oil, pollution

control, soil pollutant, Utah, waste disposal

Strietelmeier, B.A., P.A. Leonard, J.R. Brainard, and P.J. Unkefer. 1993. Toxicity of hazardous chemicals to an oil-degrading microbial consortium. In: Proceedings of the 205th ACS Nat Mtg, Denver, CO, March 28, 1993 April 2, 1993.
Keywords: biodegradation, petroleum, remediation, soil

Stringer, W. J., K. G. Dean, R. M. Guritz, H. M. Garbeil, J. E. Groves and K. Ahlnaes. 1992. Detection of petroleum spilled from the MV Exxon Valdez. International Journal of Remote Sensing 13(5):799 824.
Key words: Remote Sensing, Water Pollution, Gulf of Alaska, Landsat TM, Exxon Valdez
An analysis of remotely sensed imagery of the Exxon Valdez oil spill is described and the usefulness of the various wavelengths and platforms available is discussed. The utility and uniqueness of a multispectral TM signature developed to identify spilled oil is discussed in detail with reference to direct terrestrial measurements of oil reflectance and the possibility of other sources of the signature such as ocean vegetation and direct reflectance from some beach materials. Other directly observable ocean parameters such as sea surface temperature and suspended sediment were noted and incorporated into the analysis in terms of ocean circulation and the creation of weathered spill products such as tar balls. The mid-infrared (TM band 5) provided the strongest component of the oil signature. However, the spill was observable in other wavelengths as well, including the thermal infrared. These observations are discussed in terms of oil emissivity and reflected solar radiation.

Stringfellow, W.D., R.V. Hendriks, and N.L. Jacobs. 1993. Environmentally acceptable thread compounds: requirements defined. In: Proceedings of the 25th Annu Spe et al. Offshore Technol Conf, May 3 6, 1993, Houston, TX. 4:757 767.
Keywords: biodegradation, bioremediation, environmental impact, government, water pollution

Strom, G. D. 1990. The Norwegian coordinated program for preparation of ERS-1. In: Proceedings of the 41st International Astronautical Congress, Oct. 6 12, Dresden, Federal Republic of Germany. 6 p.
Key words: Real-Time Operation, Water Pollution, Oil Pollution, Synthetic Aperture Radar, In-Situ
The objectives of the Norwegian ERS-1 coordinated program, which include receiving, processing, distributing, storing, and use of real-time satellite data for maritime applications such as ship and ice monitoring, meteorological and oceanographic research, and oil-pollution monitoring are discussed. Since data are planned to be collected from coastal, remote, and Arctic areas, the offshore oil industry, fisheries, and fish-farming industry will also benefit from utilizing the results. The program can be divided into three parts including development/adaptation of algorithms, collection of in-situ data needed for the calibration of instruments, and use of the processed data in applications. For selected applications, automatic algorithms will extract information from SAR images.

Strong, Clyde B. 1983. Specialized training programs: oil spill simulation exercises and a tank truck rollover training course. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., pp. 237 - 242. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Training, Oil Spill, Tank, Training.

Stronkhorst, J. Rijkswaterstaat, T.J. Ysebaert, F. Smedes, P.L. Meininger, S. Dirksen, T.J. Boudewijn. 1993. Contaminants in Eggs of Some Waterbird Species from the Scheldt Estuary, SW Netherlands. Mar Pollut Bull. 26(10):572-7.
Key words: Netherlands, Waterfowl, Polychlorinated Biphenyls, Hydrocarbon, Wetlands, Monitoring
Eggs of Common Terns, Black-headed Gulls, Oystercatchers, Sandwich Terns, and Little Terns were collected from the Scheldt estuary in the Netherlands and analyzed for concentrations of mercury, chromium, copper, cadmium, zinc, PAHs, and PCBs. The most dominant PCB congener in all samples was PCB-153, and highest concentrations were found in eggs of Common Terns. Concentrations of Cd and Cr were below detection limits. Of the 13 PAH components analyzed, only phenanthrene, fluoranthene, and pyrene were above detection limits. When compared to data collected over the period 1919-40, eggshell thickness had not changed significantly. The risks on reproductive success of terns and Black-headed Gulls are discussed. Microcontaminant levels in eggs collected from brackish and coastal areas are compared.

Strotmann, U., R. Roeschenthaler. 1987. Toxicology and degradation of short-chain chlorinated hydrocarbons. German Society for Hygiene and Microbiology) (1987): 183(5 6).
Key words: Bacteria

Struzeski, Jr., E. J. and R. T. Dewling. 1969. Chemical treatment of oil spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969., pp. 217 - 222. New York, NY.: Washington, DC: American Petroleum Institute.
Keywords - Chemical, Treatment, Oil Spills.

Stuart, James D., Michael J. Lacy, Valerie D. Roe, Gary A. Robbins. 1989. Abstracts of Papers - American Chemical Society, National Meeting. 198.
Key Words: Eastern U.S., environmental geology, pollution, United States, underground storage, soils, gaseous phase, hydrocarbons, organic materials, oil spills, monitoring, water, field studies, laboratory studies, methods, butane, alkanes, aliphatic hydrocarbons, BTEX components, pollutants, New England.

Suess, Helmut, Konrad Gruener, and William J. Wilson. 1989. Passive millimeter-wave imaging a tool for remote sensing. Alta Frequenza. 58(5-6):457-466.
Key words: Remote Sensing, Oil Spills
This paper describes a program of airborne radiometric imaging at 90 GHz and 140 GHz at the German Aerospace Research Establishment (DLR) and the Jet Propulsion Laboratory (JPL). Using high sensitivity (below 1 K) and high angular resolution (0.5-1.0

degree), high quality images have been made. A series of unpublished results are presented in order to reveal the capabilities of airborne millimeter-wave radiometric remote sensing. The following measurements are discussed: cloud and fog penetration at 90 GHz, discrimination between agricultural and urban areas, discrimination between different vegetation types, detection of vehicles on roads, detection and classification of airports and airplanes, ship detection and quantitative oil spill sensing. The application of information enhancement techniques with
automatic and real time application aspects is also described and results of applied techniques for contrast and contour enhancement are shown. (Author abstract) 14 Refs.

Sugerman, Gerald. 1991. Polynorbornene-organotitanium phosphate compositions as selective absorbents. Patent No. US 5045579_A, 5 pp.
Key words: Absorbents, Hydrocarbons

Suhrkamp, I., and S. Jannsen. 1990. Degradation of high fat concentrations in a mixture of cattle manure and slaughterhouse waste water by means of a methanogenic mixed culture. 1990. Behrens, D., Driesel, A.J. Biochemical engineering, environmental biotechnology, recovery of bio-products, safety in biotechnology. Lectures. <Original Series/Collective> DECHEMA biotechnology conferences. 7. DECHEMA annual meeting on biotechnology and 58. meeting of the European Biotechnology Federations, and joint meeting of Society for Industry Microbiology (SIM). 3:871-875, 578.
The anaerobic degradation of oily and fatty waste water results in a high production of the natural gas biogas in comparison to the degradation of other organic compounds. In our work we tested the effect of different loads of fat (0.75 kg/m{sup 3}xd; 1.4 kg/m{sup 3}xd and 1.5 kg/m{sup 3}xd) at several hydraulic retention times (HRT) of about 10 days, 14.5 days and 46 days on the biogas production. The fermentation media consisted of a mixture of cattle manure and slaughterhouse waste water, enriched with fat. The biogas yield was 0.8 m{sup 3}/kg added VSS at a HRT of 14.5 days and 46 days, respectively and 0.6 m{sup 3}/kg added VSS at 10 days HRT. In all three fermentations biogas was formed out of the degradation of fat. Even a drastic increase of the HRT up to 46 days gave no appreciable degradation of the other organic substances. We concluded by this that the microbial population was fully adapted to the degradation of the fat fraction within the substrate.
Key words: manures, anaerobic digestion, meat industry, waste water, bacteria, production.

Sullivan, Daniel and Karen A. Sahatjian. 1993. Evaluation of laboratory tests to determine the Effectiveness of Chemical Surface Washing Agents. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 511 - 514. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Chemical, Washing.

Sullivan, P.J. 1986. Acid potential of eastern oil shale and

waste products. In: Commonwealth Kentucky Et Al East Oil Shale Symp (Lexington, Ky, 11/19 21/86)
Key words: waste disposal, disposal, oil

Sullivan, S.T. Floating boom for rapid oil spill containment, comprises collapsible inflatable and fluid ballasted boom wall stored in trays around ships side and projected by hydraulic cannon. Patent No. US 482765_900221.
Key words: Accident, Barge, Boom, Crude Oil, Pollution Control

Summerfield, M. 1993. Radiative evaporation of oil spills on seas or rivers. American Petroleum Institute. Washington, DC (United States). 849pp.
Key Words: Natural gas combustion, oil spills evaporation, oil spills remedial action, radiators cost, oil retention booms, chemical reactions, energy sources, fossil fuels, fuel gas, gas fuels, heat exchangers, oxidation, phase transformations, pollution control equipment, thermochemical processes.

Sunde, E., B.H.Melberg, and R. Josok. 1991. Successful environmental action on the Gullfaks field also reduced the drilling operation costs. In: Proceedings of the 1ST SPE et al. Health, Safety & Environ in Oil & Gas Explor & Prod Int Conf, November 11 14, 1991, the Hague, Netherlands. 2:257 264.
Keywords: biodegradation, drilling waste disposal, environmental impact, North Sea, offshore drilling

Sundstrom, D.W., B.A. Weir, T.A. Barber, and H.E. Klei. Destruction of pollutants and microorganisms in water by UV light ad hydrogen peroxide.
Key words: abstract, bacteria, batch process, chlorohydrocarbon, composition, concentration, effeciency, electromagnetic wave, exposure, film, flow reactor, hydrogen peroxide, kinetics, liquid, mixture.

Sung-Cheol Koh, Bowman, J.P., Sayler, G.S. 1993. Soluble methane monooxygenase production and trichloroethylene degradation by a type I methanotroph, Methylomonas methanica 68-1. Applied and Environmental Microbiology (United States). 59:4::960-967.
Soluble methane monooxygenase (sMMO), present in certain methanotrophic bacteria, can oxidize a wide range of carbon substrates including halogenated aliphatic compounds such as trichloroethylene (TCE), a significant ground water pollutant. This study reports the existence of sMMO activity in a type I methanotroph (Methylosinus trichosporium 68-1) isolated from a TCE-coner the apparent nonoptimal state of copper limitation. As a result, this strain may have considerable bioremediation potential. Further studies will be necessary to determine exactly how the 68-1 sMMO differs from the sMMOs of OB3b and Methylococcus capsulatus both in terms of DNA and protein sequences. 48 refs., 4 figs., 2 tabs.
Key words: ground water, contamination, halogenated aliphatic, hydrocarbons, biodegradation, methanotrophic, bacteria, decontamination.

Superfund Record of Decision (EPA Region 10): Northwest Transformer, Whatcom County, Washington (First Remedial Action),

September 1989. Final rept. 76.
Key Words: Site surveys, hazardous materials, waste disposal, salvage, transformers, insulating oil, cost analysis, ground water, agricultural products, law enforcement, substitutes, public health, eocology.

Superfund Record of Decision (EPA Region 4): Tri-City Conservationist Corporation Site, Temple Terrace, Florida (first remedial action), September 1987. Final report. 21 September 1987. Envirnomental Protection Agency, Washington, DC (USA). 41.
Key Words: Industrial wastes oils, land pollution remedial action, oil spills land pollution, superfund remedial action, waste oils oil spills, Florida, hazardous materials, site surveys, waste disposal, water pollution, Federal Region IV, North Aerica, organic compounds, other organic compounds, pollution laws, USA, waste management.

Superfund Week. 1992. Lead acid extraction may fix refining site. Superfund Week. 6:34.

Superfund Record of Decision (EPA Region 7): Arkansas City Dump Site, Arkansas City, Kansas (Second remedial action), September 1989. Final report. Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 19 September 1989. 24(p).
Key Words: Ground water contamination, Kansas pollution, petroleum environmental effects, soils contamination, hazardous materials, industrial wastes, land pollution, liquid wastes, municipal wastes, oil spills, progress report, remedial action, sanitary landfills, superfund, water pollution, document types, energy sources, Federal Region VII, fossil fuels, hydrogen compounds, North America, oxygen compounds, pollution laws, USA, waste disposal, waste management.

Superfund Record of Decision (EPA Region 1): O'Connor Company Site, ME. (First Remedial Action), September 1989. 27 September 1989. Final report: Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 226(p).
Key Words: Ground water contamination, Maine pollution, sediments contamination, soils contamination, surface waters contamination, benzene, chlorinated aromatic hydrocarbons ecological concentration, hazardous materials, industrial wastes, land pollution, lead, monitoring, organic compounds, polycyclic aromatic hydrocarbons, progress report, remedial action, sanitary landfills, site surveys, superfund, volatile matter, waste disposal, water pollution, aromatics, document types, Federal Region I, halogenated aromatic hydrocarbons, hydrogen compounds, North America, organic chlorine compounds, organic compounds, organic halogen compounds, oxygen compounds, pollution laws, waste disposal, waste management.

Superfund. 1992. L.A. Clark soil-flushing design nears. Superfund. 6:3.

Surprenant, N.F., W.H. Battye, P.F. Fennelly. 1983. Fate of hazardous and nonhazardous wastes in used-oil disposal and recycling. Final report. In: Report Numerical data, 246. Oct

1983.
Keywords: recycling.
The primary objective of this program was to identify the hazardous and nonhazardous compounds that might reasonably be found in used oil and to establish their fate under a variety of disposal and recycling scenarios. Those considered were sewer disposal, road oiling, combustion as a fuel, reprocessing by physical methods to produce a specification fuel, and various re-refining processes. A secondary objective was to assess the potential environmental impact of the contaminants in the waste and product streams associated with each scenario. The hazardous and nonhazardous compounds of major interest in waste oil were identified by literature review, interviews with participants in waste oil activities, and by laboratory analysis of 24 samples of waste oils obtained from recyclers and users. The contaminants were prioritized according to their concentrations in the oil and their health impacts, as determined by threshold limit values, drinking water standards, or other measures of multimedia health impacts. The prioritized listing formed the basis for the preparation of the COMPOSITE oil used in the experimental simulation studies of the waste oil disposal and recycling scenarios. The experimental simulation studies were designed to establish the fate, through material balance if possible, of specific contaminants under conditions that were representative of those normally encountered in each situation. In addition to the laboratory simulation studies, computer simulations were conducted to assess the physical transport of specific compounds during typical re-refining operations such as dehydration, light end removal, and vacuum distillation. 126 references, 15 figures, 93 tables.

Sutherland, G. B., I. W. Jones, and R. W. Smith. 1983. Oil spill protection planning for natural resources in Oregon.. In: Proceedings of the 1983 Oi Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983.,pp. 183 - 186. San Antonio, TX. : Washington, DC: American Petroleum Institute. Keywords - Oil Spill, Planning, Natural Resources, Oregan.

Suzuki, I., and K. Miki. Research and development of oil spill control devices for use in cold climates in Japan. In: Proceedings of the API - EPA U.S. Coast Guard oil spill prev. behavior control cleanup conf., April 6 9 1987, Baltimore, MD, API PUBL. N.4452, pp. 349 58.
Key words: Adhesion, Boom, Concentration, Crude Oil, Ice, Japan, Oil-Water Emulsion

Suzuki, Isao, Yoshihisa Tsukino, and Masamitsu Yanagisawa. 1985. Simulation tests of portable oil booms in broken ice. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985.,pp. 25 - 30. Los Angeles, CA. : Washington, DC: American Petroleum Institute. Keywords - Oil, Booms, Ice.

Suzuki, I., R. Tasaki, K. Miki, E. Kajita, and T. Yagi. 1989. Oil layer flow around skimming vessels. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., pp.167 - 174. San Antonio, TX.:

Washington, DC: American Petroleum Institute.
Keywords - Oil, Flow, Skimming Vessels.

Sveum, P., A. Danielsen, and T. Klokk. 1987. Oil at Shore and in Deposits. Succesive Report 1987. Report No. STF-21A87099, 25 pp.
Key words: Land Pollution, Oil Spills, Recovery
Two deposits of oil containing mass have been inspected, the Brattholmen in Troms and the Tenna at Helgeland. Degradation aspects are studied. Both deposits have anaerobic conditions and hydrocarbons are slowly degraded. The Tenna leaks oil. Principles for treating oil contaminated wastes in biologically active deposits are discussed, with process simplification in mind. Degradation rate is low and connected to the degradation. The time perspective is 9-10 years. The results are consequently not final. The oil contaminated mass stranded at the Utoey island following the wrecking of Deifovos, was degraded to a satisfactory level during 3-4 years. The mass had a low oil content. It is important to distinguish between depositing and composting. The latter method can lead to quite high degradation rates by mechanically keeping oxygen supply at an acceptable level. Three shores polluted by oil spills some years ago are visited, the Bratholmen and the Kiloey islands which were polluted in 1980 by the Deifovos wreck, and a shore at Agdenes experimentally polluted in 1983. The latter shore is restored from a botanic view-point. Areas treated with manure are restored quicker than untreated shores. The Brattholmen shore has still considerable oil quantities characterized as asphalt. The macrofauna, and to some extent the microfauna, are considerably restored. Macroalgae are however, colonizing more slowly than expected. The Kiloey shore is ''clean'' in the eulittoral zone and the macrofauna is mostly restored. The macroalgae have colonized the shore to a larger extent than at the Brattholmen. The vegetation is well developed in the supralittoral zone although asphalt is present in the soil and cracks. 7 drawings, 2 tabs.

Sveum, P, and C. Bech. 1992. Emerging new technologies...Oil spill treatment by open sea burning. In: Proceedings of the CONCAWE - DGMK Remediation of Oil Spills Scientific Seminar, May 18 21 1992, Hamburg, Germany, pp. N.2.2 59-76.
Key words: Water Pollution Control, Health & Environment, Boom, Oil Waste, Equipment

Sveum, P. 1990. Review of Arctic Norwegian Bioremediation Research. Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway). Div. of Applied Chemistry. Report No. STF21-A91060, 12 pp.
Key words: Biological Treatment, Remedial Action, Oil Pollution Removal, Oil Spills, Biodeterioration
The Exxon Valdez incident in Alaska gave rise to an increased concern about the use of bioremediation, i.e., biological cleaning techniques on oil contaminated beaches. Bioremediation can comprise several different ways of cleaning, e.g., biological mineralization, degradation or emulsification of the spilled oil. This situation has increased the focus on alternative methods for oil spill clean-ups, especially on shorelines. For shoreline clean-ups, the methods to be applied should be both labor-saving

and efficient. At the same time, they should decrease risks of oil contamination not exacerbate them. SINTEF Applied Chemistry has evaluated the application of fertilizers as a practical measure in oil spill treatment for years. Several fertilizers have been assessed, in different environments. The effect of these products is difficult to establish categorically since their efficiency seems to be greatly dependent on the environment in which the test is conducted, as well as the design of the test. The aim of this paper is to summarize and evaluate a series of tests conducted with INIPOL EAP22, an oil soluble fertilizer developed by Elf Aquitaine, and water soluble fertilizers. The paper will emphasize treatment failure and success, and point out some necessary prerequisites that must be met for fertilizers to work.

Sveum, Per, and Alain Ladousse. . Biodegradation of oil in the Arctic: enhancement by oil-soluble fertilizer application. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., San Antonio, TX. : Washington, DC: American Petroleum Institute. pp. 439 - 446.
Keywords - Biodegradation, Oil, Arctic.

Sveum, P., and C. Bech. 1992. Emerging new technologies...Oil spill treatment by open sea burning. In: Proceedings of the CONCAWE - DGMK Remediation of Oil Spills Scientific Seminar, May 18 21 1992, Hamburg, Germany, 2.2:59-76.
Key words: Boom, Dispersion, Containment, Fireproofing, Oil Waste, Pollution Control Equipment

Sveum, P., and L.G. Faksness. 1993. Enhanced biological degradation of crude oil in a Spitsbergen tundra site. In: Proceedings of the 16th Environ Can Arctic & Mar Oil Spill Program Tech Seminar, June 7-9, 1993, Calgary, Canada, 1:377-391.
Key words: Bioremediation, Bacteria, Hydrocarbon, Remediation, Soil Pollution, Biodegradation, Environmental Impact

Sveum, P., and C. Bech. 1991. Burning of oil in snow. In: Proceedings of the Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Report no. STF-21A91062, 13pp.
Key words: Oil Spill Combustion, Snow, Emergency Plans
A series of experiments with burning of oil/snow mixtures have been carried out at Spitsbergen. The objective was to develop practical methods for in situ burning of spilled oil to be implemented in the Reindalen 1 drilling contingency plan. This paper describes the results from the eight field experiments (1000 liters each) with naturally spread oil, and two series of burns in small experimental vessels. The oil types studied were Oseberg crude oil and diesel. Efficiencies between approximately 90% and 99% were obtained in all the burns. It was demonstrated that oil/snow mixtures with oil concentrations above 75% could be ignited with a rag soaked in petroleum, and that concentrations as low as 3 to 4% could be ignited after supply of additional petrol. Burning of oil in snow is recognized to be similar to burning of oil on water, with separation of oil and snow by melting, and formation of an oil layer on a meltwater pool as the

step that determines success. Wind herding is found to be an important regulating factor. Implementation of burning of oil/snow mixtures as an oil spill mitigation tool into the Reindalen 1 contingency plan is outlined at the end of the paper. 13 refs., 3 figs., 4 tabs.

Swaby, L. G. and A. F. Forziati. 1969. Remote sensing of oil slicks. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969., pp. 297 - 308. New York, NY.: Washington, DC: American Petroleum Institute.
Keywords - Remote Sensing, Oil, Slicks.

Swader, F. N. 1975. Persistence and effects of light fuel oil in soil. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 589 - 594. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Oil, Soil.

Swanson, C. 1991. Final report on development and testing of the microwave oil-water monitor. Department of Energy, Washington, DC. Report No. DOE/CE/15444-T3, 68pp.
Key words: Monitors, Petroleum, Computerized Control Systems
The oil-water monitor is a device invented by Dr. Claude Swanson of Applied Physics Technology to respond to the petroleum-loss problem in crude oil transfers. It is a device which measures water content in crude oil and other petroleum products, in a flowing pipe such as a pipeline or tanker manifold. It is capable of accurately measuring the water contamination levels in crude oil shipments, in real time as the crude oil flows through the loading manifold into the tanker, or at the receiving point as the oil is off-loaded. The oil-water monitor has application in the verification of oil volumes and concentration of contaminants at petroleum transfer points. The industry-estimated level of water loss at transfer points due to inadequate monitoring technology amounts to several billion dollars per year, so there is a definite perceived need within the petroleum community for this type of accurate water monitoring technology. News articles indicating the importance of this problem are shown. The microwave oil-water monitor measures the water content in the oil, whether in the form of small droplets or large globules. Therefore it can be applied to the crude oil as it flows through crude oil pipes into the ship, or at transfer points in a crude oil distribution system. 4 refs., 18 figs.

Swanson, M. J., D.L. Fiedler, and K. A. Leitch. 1989. Stabilization of enzymes for bioreactors. Final report on Phase 1. Bio-Metric Systems, Inc., Eden Prairie, MN. Report No. PB 93 173870/XAB, 12 pp.
Key words: Biodegradation, Bioreactors
The objective of the Phase I project was to develop new stabilization techniques for immobilized enzymes used in bioreactors. The rationale was to provide an environment for optimal stability surrounding the enzyme, then bind it together by copolymerization with vinyl monomers to obtain a large molecular weight, but soluble enzyme derivative that would then be immobilized. The enzyme chosen for the project was beta-

galactosidase from the Aspergillus oryzae which is used in enzyme reactors for hydrolyzing lactose from milk whey. Several methods were used to achieve covalent crosslinking of beta-galactosidase, the methods originally proposed did not give significant stabilization of immobilized beta-galactosidase was achieved by a modified crosslinking technique. The modified technique would have wide commercial applications for stabilizing enzymes used in bioreactors for the cheese and other dairy industries, food processing applications, pharmaceutical production, biodegradation of hazardous chemicals, and other scientific applications.

Swift, W.H., A.W. Bakinowski. 1988. Passive separate-phase recovery. In: Proceedings of the second national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods. Volume III national outdoor action conference on aquifer restoration, ground water monitoring and geophysical methods. 448(p):1225-1248.
Key Words: Ground water contamination, ground water hydrocarbons, hydrocarbons removal, New Hampshire, oil spills, separation processes, water pollution, water reclamation, water wells, Federal Region I, hydrogen compounds, North America, organic compounds, oxygen compounds, USA.

Swift, M.R., B. Celikkol, G. Le Compagnon, and C.E. Goodwin. 1992. Diversion Oil Booms in Current. Waterway Port Coastal Ocean Eng. 188(6):587-598.
Key Words: Floating barrier, diverter, oil spill, pollution control equipment, water current, anchoring, angle of repose, business operation, calibration, design criteria, Eastern US, environmental pollution, equipment layout, estuary, fluid loss, fluid velocity, load (force), mathematical model, New Hampshire, North America, oil waste fate, orientation, persistence, physical property, seepage, site preparation, standardization, tethering, transport property, transportation terminal, United States.

Swift, M.R., B. Celikkol, C.E. Goodwin, R. Carrier, and S.P. McDonald. 1991. Oil spill response engineering and planning. New Hampshire Univ., Durham. Water Resources Research Center. Geological Survey, Reston, VA. Water Resources Div. Report No. REPT-57^USGS/G-1576-04, 179 pp.
Key words: Oil Spills, Computerized Simulation, Terminal Facilities
Tanker and barge traffic associated with the five petroleum product terminals along the NH side of the Piscataqua River represents a constant oil spill threat to the contiguous Great Bay System, NH, an estuarine reserve. Several serious accidents have in fact taken place in the 1970's and two small spills in 1990. A major factor is that the Piscataqua channel is subject to high velocity tidal currents. Should a spill occur, problems arise in knowing where the slick will move and how to control it using booms. In the project, these problems were addressed by developing procedures for using diversion booms in high speed current environments and in revising and implementing a previously developed Oil Spill Trajectory Model.

Swift, M.R., B. Celikkol, and G.H. Savage. 1990. Diversion booms

in the Piscataqua River, NH. In: Proceedings of the Oil spills management and legislative implications conference, May 15 18 1990, Newport, RI, pp. 528 540.
Key words: oil pollution containment, oil spills, oil retention booms
In this paper the problem of oil spills originating at the five petroleum product terminals operating on the Piscataqua River, NH is addressed through the use of diversion booms. The Piscataqua is subject to high velocity tidal currents which make normal boom deployment difficult. Diversion deployment configurations and methods of analysis were developed and tested. Procedures were applied to containment and recovery of spills occurring while tanker or barge is at a terminal for unloading.

Swiss, J. J., N. Vanderkooy, S. D. Gill, and R. H. Goodman. 1987. Beaufort sea dispersant trial. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp.634. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Beaufort Sea, Dispersant.

Szelinski, B.A. 1980. German approach to water pollution control. In Chem. Ind. (London) (United Kingdom), 8:342 347. 8.
Keywords: Waste Oil Act, oil, disposal, Germany, recycling.
The German approach to water pollution control includes the Waste Oil Act, under which businesses that hold a permit for the disposal of waste oil must collect all spent motor oil accumulated in amounts more than 200 l in given districts. To finance waste oil disposal, a special fund has been created, which is supported by a compensation tax on certain products, including lubricating oils, gas oils, and greases. The fund is used to subsidize the disposal of waste oil by regeneration or incineration, but not by landfill. At present, about 27 companies are responsible for the collection of used oils in fixed areas throughout the country. An estimated 305,000 tons of waste oil were treated in 1975 with the assistance of the waste oil fund. Special ships are used to collect waste oils generated by inland navigation; these oils are sold to regeneration plants, which are also supported by the waste oil fund. Legislative control measures for other water pollutants are also discussed.

Tabak, H.H., J.R. Haines, A.D. Venosa, J.A. Glaser, S. Desai, and W. Nisamaneepong. 1991. Enhanced degradation of the alaskan weathered crude oil alkane and aromatic hydrocarbons by indigenous microbiota through application of nutrients. In: Proceedings of the 3rd Inst Gas Technol (Chicago) Gas, Oil, Coal, & Environ Biotechnol Int Symp, December 3-5, 1990, New Orleans, LA, pp.3-38.
Key words: Biodegradation, Bacteria, Alaska, Hydrocarbon, Oil Spill, Prince William Sound, Bioremediation, Soil Pollution, Water Pollution, Weathering

Tackett, B. A. 1991. A Common sense approach to planning accident response. Environ accident mgmt inc. Pennwell conf & exhibit co petro-safe 91 conf houston, february 6-8 proc book 1, pp 25-39, 1991.
Key words: contingency planning, accident, administration,

business operation, economic factor, environment, environmental impact, liability, management, mathematical analysis, mathematics, planning, response, risk analysis, safety, strategy.

Taeger, K., H.J. Knackmass,and E. Schmidt. 1988. Biodegradability of mixtures of chloro- and methylsubstituted aromatics: Simultaneous degradation of 3-chlorobenzoate and 3-methylbenzoate. Appl. Microbiol. Biotechnol.(Germany, Federal Republic of). 28:6:603-608.
Strains degrading 3-methylbenzoate (3MB) via ortho-cleavage were enriched by preselection with 4-carboxymethyl-2-methylbut-2-en-1,4-olide (2-methyllactone, 2ML) as sole carbon source or by counter selection of meta-cleaving strains using 3-chlorobenzoate (3CB) as suicide substrate. These strains and microorganisms obtained from continuous cultures with 3CB/3MB (Schmidt et al. 1985) or with chlorophenols and cresols (Schmidt 1987) were grouped according to their abilities to grow on 3CB, 3MB or 2ML and their mode of ring-cleavage during growth with aromatic substrates. Each group was tested for its capability to mineralize mixtures of 3CB and 3MB and the extent of DOC-removal was quantified.
Key words: chlorinates aromatics hydrocarbons, cell cultures, pseudomonas, toxicity, bacteria, chemical reactions, organic compounds, aromatics.

Talts, A., J. Bauer, C. Martin, and D. Reeves. 1977. Discovery, containment and recovery of a jet fuel storage tank leak: a case history. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977.,pp. 259 - 264. New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Containment, Recovery, Fuel, Tank, Leak.

Tammis, K. N. and F. Rojo. 1990. Design of new pathways for the catabolism of environmental pollutants. In: Proceedings of the 1989 Biotechnology and Biodegradation Conference, Lisbon, Portugal, pp. 61 82.
Key words: Biodegradation, Monitoring, Soil Pollution, Transport
Experimental evolution of new catabolic activities in microbes constitutes a powerful approach toward obtaining organisms that are capable of degrading toxic chemicals. Detailed in this paper are two current strategies for the evolution of novel or improved biodegradative routes for aromatic compounds. One strategy outlined involves stepwise restructuring of existing pathways, thereby gaining new substrate specificities, whereas the other method mentioned involves the construction of enzymes derived from different pathways in different microorganisms.

Tan, Ging Tuang. 1983. Oil spill preparedness in a tropical offshore area. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., pp. 211 - 218. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Tropical, Offshore.

Tanyolac, A., T. Durusoy, T. Oezbas, Y. Yuerem. 1992. Bioconversion of coal. Clean utilization of coal. <Original

Series/Collective> NATO Advanced Study Institute Series. Series C: Mathematical and physical sciences. 370:97-107.
An outline of lignite degradation, methane generation from lignite, bioprocessing of coal breakdown products and possible bioreactor configurations were presented under the title topic. Preliminary work has been done on the fungal and bacterial degradation of lignite and bacteria have been identified which decompose hard coals. The work is not likely to result in a useful economic process in less than a decade and, more likely, it will be 15 to 20 years before such a process is feasible, even given favorable progress with development work. Research has been continued on seeking new and mutant microorganisms for different biotransformations and on biodegradation of organic compounds as models for microbial studies such as destructions of lignin, organic sulfur compounds, carboxyl groups and organic nitrogen bonds. 4 figs., 2 tabs., 25 refs.
Key words: bioreactors, biodegradation, configuration, coal, bacteria, coal liquids, methane.

Tardif, G., C.W. Greer, D. Labbe, P.C.K. Lau. 1991. Involvement of a large plasmid in the degradation of 1,2-dichloroethane by Xanthobacter autotrophicus. Applied and Environmental Microbiology (United States). 57:6:0099-2240.
Xanthobacter autotrophicus GJ10 is a bacterium that can degrade short-chain halogenated aliphatic compounds such as 1,2-dichloroethane. A 200-kb plasmid, pXAU1, was isolated from this strain and shown to contain the dhlA gene, which codes for haloalkane dehalogenase, the first enzyme in the degradation pathway of 1,2-dichloroethane by GJ10. Loss of pXAU1 resulted in loss of haloalkane dehalogenase activity, significantly decreased chloroacetaldehyde dehydrogenase activity, and loss of resistance to mercuric chloride but did not affect the activity level of haloalkanoate dehalogenase, the second dehalogenase in the degradation of 1,2-dichloroethane.
Key words: chlorinated aliphatic hydrocarbons, biodegradation, bacteria, mercury halides, organic compounds.

Taricco, T.L. 1992. Oil Boom and Method. Pct Gaz. 1992(28):13034.
Key Words: Floating barrier, collecting agent, contamination, environmental pollution, oil spill, pollution control equipment, water pollution, world, additive, business operation, foamed plastic, oil spreading, marine transporation, mechanical property, oil waste fate, physical property, polymer, waste oil recovery, workboat.

Tarzwell, C. M. 1969. Standard methods for the determination of relative toxicity of oil dispersants and mixtures of dispersants and various oils to aquatic organisms. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969.,pp. 179 - 186. New York, NY.: Washington, DC: American Petroleum Institute.
Keywords - Toxicity, Oil Dispersants, Aquatic Organisms.

Tatara, G.M., M.J. Dybas, and C.S. Criddle. 1993. Effects of medium and trace metals on kinetics of carbon tetrachloride transformation by pseudomonas sp. strain KC. Applied and Environmental Microbiology (United States). 59:7:2126-2131.

In recent years, interest has increased degradation of hazardous contaminants in situ by stimulating selected bacterial populations or by addition of novel organisms to contaminated sites. Advantages of introduced organisms include extensive study in the laboratory which improves prospects for control of their activities in the field. Chloroform (CF) is a common end product of carbon tetrachloride (CT) but is more presistant and is a suspected carcinogen. Metabolic pathways that do not produce CF are of interest. This study reports on the kinetics of CT transformation by Pseudomonas sp. strain KC and describes experiments to evaluate the role of trace metals in CT transformation kinetics. Evidence is provide that accelerated CT transformation can be obtained in iron-rich ground waters and soil slurries by adding strain KC after pH adjustment. 9 refs., 9 figs., 1 tab.
Key words: carbon, tetrachloride, biodegradation, copper, biological effects, iron, pseudomonas, growth.

Taylor, Tim. 1992. Keeping an eye on the environment. (Cierra Inc.'s waste management services) (Corporate Conservation, part 3). Arkansas Business. 9:23.

Taylor, S. 1992. 0.45- to 1.1-micrometers spectra of prudhoe crude oil and of beach materials in Prince William Sound, Alaska. Cold Regions Research and Engineering Lab., Hanover, NH. Report No. CRREL-SR-92-5, 19pp.
Key words: Beaches, Crude Oil, Alaska, Environemental Impact, Remote Sensing, Land Pollution
The spectral response in the visible and near-infrared (wavelengths of 0.45 to 1. 10 micon) of different amounts of Prudhoe crude oil on water was measured. Spectral reflectance measurements were made of selected beaches and beach materials in Prince William Sound to provide ground truth data for the MEIS 11 imagery collected during the Exxon Valdez spill. A spectral mixing model was used to predict how different amounts of oil would change the spectra of beach materials in Prince William Sound. Beaches Pollution Detectability Spectral reflectance Oil Visible, near IR wavelengths.

Taylor, S. 1992. 0.45 - to 1.1-mm spectra of prudhoe crude oil and of beach materials in Prince William Sound, Alaska. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, PROC 1:237-248.
Key words: Spectral Analysis, Alaska, Contamination, Crude Oil, Environmental Pollution, Oil Spill, Prince William Sound, Petroleum

Taylor, P. M. 1991. A pipeline spill into the mersey estuary, england. In: Proceedings of the 12th bien api et al oil spill (prev, behav, contr, cleanup) int conf, (san diego, 3/4-7/91) proc pp 299-303.
Key words: crude oil, current, england, eurasia, europe, fluid loss, industrial plant leak, oil refinery, petroleum, pipeline leak, united kingdom, water current.

Teal, Andrew R. 1985. Innovative response techniques for Major

River systems. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp. 173 - 176. . Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Response, River.

Teas, Howard J. 1989. Mangrove restoration after the 1986 REFINERIA PANAMA oil spill. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., pp. 433 - 438. San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords - Mangrove, REFINERIA PANAMA, Oil Spill.

Teas, H.J., R.R. Lessard, G.P. Canevari, C.D. Brown, and R. Glenn. 1993. Saving oiled mangroves using a new non-dispersing shoreline cleaner. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 147-151.
Key words: Cleaning, Contamination, Environmental Pollution, Environmental Impact

Teas. H.J. 1991. Upland soil and fertilizer in Rhizophora mangrove growth on oiled soil. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: upland soil, fertilizer, mangrove, oiled.

Teasdale, RN (Retd.), Lt. Cdr. Geoffrey. 1987. Royal Navy oil spill response posture: developments since the Mid 1970s. In Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987.,pp. 171 - 176. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Royal Navy, Oil Spill, Response.

Teasdale, Lt. Cdr. Geoffrey. 1991. The trident oil containment boom project. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., pp.728 - 730. San Diego, CA.: Washington, DC: American Petroleum Institute.
Keywords - Trident Oil, Containment, Boom.

Technion Res & Dev Found. Expanded graphite having vermicular structure_used to remove contaminating oil from water surfaces and recover oil. Patent No. IL 92872_891225.
Key words: Adsorbent, Boom, Operating Condition, Petroleum, Solvent Extraction

Technology Development Branch, Ottawa (Ontario). 1992. Arctic and Marine Oilspill Program Technical Seminar: Proceedings. SSC-EN 40-11/5-1992, 833 pp.
Key words: Oil Spill Meetings
Proceedings of the seminar, covering the behaviour and fate of oil; assessment; activity reports from Washington State, Germany, Alaska, British Columbia and Michigan; remote sensing; countermeasures; in situ burning; bioremediation; biological effects; and shoreline cleanup.

Technology Management Services. 1992. Summary of breakout Session H1: H1, in-situ burning. In: Proceedings from the first international oil spill R D forum, June 1 4 1992, McLean, VA, pp. 261-267.
Key words: Oil Spill Mitigation, Petroleum, In-situ Combustion, Oil Pollution Containment, Research Programs
The discussions in breakout session H1 are summarized. The topics discussed include definition of terms for in-situ burning, operational research, tradeoffs associated with in-situ burning, direction of research and development for in-situ burning, permit application procedures, and the need for intentional releases of oil for research purposes. The general consensus of the session is outlined.

Technology Management Services, Inc. 1992. Summary of breakout Session F1: F1, decision support systems - technical databases. In: Proceedings from the first international oil spill R D forum, June 1-4, 1992, McLean, VA.,pp. 221-223, pg (340 p).
The discussions in breakout session F1 are summarized. The topics discussed include oil properties database, case histories database, technical experts database, sorbents database, dispersants database, equipment inventories, and response information. General comments and concerns were discussed and major research issues outlines.
oil spills--information validation, oil spills--mitigation, data analysis, data base management, oil pollution containment, research programs, sorption, surfactants, control, management, pollution control, testing, validation Petroleum Environmental Aspects
Environmental aspects of petroleum(1992-)

Technology Management Services. 1992. Proceedings from the first international oil spill R D forum. In: Proceedings of the 1. international oil spill R and D forum, June 1 4 1992, McLean, VA, 340 pp.
Key words: Oil Spill Mitigation, In-situ Combustion, Petroleum
The Proceedings of the First International Oil Spill R & D Forum are presented. The conference was held at McLean, Virginia, June 1-4, 1992. Sessions were devoted to oil pollution legislation and regulation, surveillance and remote sensing, fate and modeling, chemical countermeasures, mechanical recovery and disposal/storage, effects, decision support systems, bioremediation, in-situ burning, and future strategies and methods for collaboration.

Telford, A. S. and H. A. Quam. 1979. Oil recovery from under river ice. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., pp. 397 - 402. . Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Recovery, River, Ice.

Tell, Jr., William K. 1971. Summary of laws and regulations governing spills and discharges of oil. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 - 17, 1971., pp. 3 - 10. Washington, DC.: Washington, DC: American Petroleum Institute.

Keywords - Laws, Regulation, Spill, Discharges, Oil.

Temmes, A., and A. Mettaelae, and S. Nitisinprasert. 1989. Degradation of cellulose to methane by defined mixed cultures. Svensson, B. 1989. The biogas process in the Nordic countries. Research and Application. Conference on the biogas process in the Nordic countries: research and application. 20-25.
Bacteria that take part in the cellulose degradation in anaerobic waste treatment processes, were isolated and cocultured in different combinations. In general cellulose degradation was more efficient in cocultures than in pure cultures. The effects varied in different cellulolytic bacteria. The methanogenic bacterium used was shown to fix molecular nitrogen and cellulose degradation, and cellulose degradation was shown to proceed even in nitrogen free medium.
Key words: cellulose, anaerobic digestion, ammonia, methane, methanogenic bacteria, digestion, hydrides, hydrogen, nitrogen, management.

Templeton, W. L. 1975. Oil pollution studies on Lake Maracaibo, Venezuela. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25, 1975, pp. 489 - 496. San Francisco, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil Pollution, Lake Maracaibo, Venezuela.

Tennyson, E. J., H. Whittaker. June 7-9, 1988. The 1987 Newfoundland Oil Spill Experiment: an Overview. Env Canada Arctic & Marine Oilspill 11th Technical Sym, Vancouver. 221(7).
Key Words: Oil spill cleanup, Newfoundland, oil spill anaylsis, surfactants, oil booms, oil skimmers, marine pollution equipment, Canada.

Tennyson, E.J. 1989. Arctic aspects of the technology assessment and research program of the Minerals Management Service. In: Proceedings of the US Dep Interior Minerals Manage Serv Alaska arctic Offshore Oil Spill Response Technol Workshop, November 29 December 1 1988, Anchorage, Alaska, (NIST SPEC Publication No. 762) pp. 111-116.
Key words: Oil Spill, Contamination, Water Separation, Pollution Control, Cleaning, Crude Oil, Remote Sensing

Tennyson, Edward J. 1993. Results from minerals management serviced funded oil spill response research 1991-1993. In: Proceedings of the Eighth Symposium on Coastal and Ocean Management. Part 1 (of 2), New Orleans, LA, pp. 455-465.
Key words: Oil Spills, Environmental Protection, In-situ
Large oil spills from tankers have reaffirmed the need for continuing technology assessment and research to improve oil spill response capabilities. This paper discusses Minerals Management Service (MMS) concerns, as reinforced by the acceleration of its research program in 1990. It briefly describes research results for several major aspects of spill response, including remote sensing, open-ocean containment and recovery, in situ burning, use of chemical treating agents, beachline cleanup, and oil behavior. Results of specific research projects that have begun to yield information that will improve detection and at-sea equipment performance are emphasized.

Current research projects, including the development of an airborne base fluorosensor, which determines whether apparent slicks contain oil, are also discussed. Additional projects involve the development of improved strategies for responding to an oil spill in the marine environment, for gaining an improved understanding of the fate and behavior of spilled oil as it affects response strategies, and for defining the capabilities of available dispersants and development of improved formulations. Recent progress on the development of safe and environmentally acceptable procedures to burn spilled oil in situ is also discussed. The Ohmsett facility has been reopened and is necessary for testing prospective improvements in chemical treating agents, remote sensing and for the development of standard procedures for testing and evaluating response equipment. (Author abstract) Refs.

Tennyson, E. J. and H. Whittaker. The 1987 Newfoundland oil spill experiment. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., pp. 101 - 104. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Newfoundland, Oil Spill.

Tennyson, E.J. 1989. The oil and hazardous materials simulated test tank program efforts: arctic oil spill response technology assessment and development. In: Proceedings of the U.S. Dep. Interior Minerals Manage. Serv. Alaska Arctic Offshore Oil Spill Response Technol. Workshop, November 29 December 1 1988, Anchorage, Alaska, (Nist Spec. Publication No. 762) pp. 103 109.
Key words: Abstract, Arctic Area, Boom, Pollution Control Equipment, Skimmer, Spill

Tennyson, E.J., and H. Whittaker. 1988. The 1987 Newfoundland oil spill experiment. In: Proceedings of the Oceans '88, October 31 November 2 1988, Baltimore, MD, pp. 853 856.
Key words: Atlantic Ocean, oil spills, oil pollution containment, testing, oil spills, water pollution control, equipment, skimmers
A joint Canadian-United States exercise involving the intentional spilling of 18,000 gallons of specially treated crude oil was conducted off Newfoundland in September 1987 to evaluate the containment and recovery capabilities of three state-of-the-art booms and skimmers. As part of the exercise, data were collected on a specially instrumented oil spill boom in an attempt to verify a proposed performance test procedure for open-ocean oil spill booms. A visco-elastic chemical additive was used after the equipment evaluation was completed to enhance recovery operations. Additional observations were made on the persistence of spilled oil slicks in advanced sea states.

Tennyson, E.J. 1990. Method of detecting oil spills at sea using a shipborne navigational radar. Patent No. US 4933678900612.
Key words: Oil Spill, Contamination, Radar, Petroleum, Remote Sensing

Tennyson, E.J. 1993. Results from oil spill response research - an update. In: Proceedings of the 1993 International oil spill Conference: Prevention, preparedness, response, March 29 April 1

1993, Tampa, FL, pp. 541-544.
Key words: Oil Spills, National Government Research Programs, Petroleum, Remote Sensing
Recent large oil spills from tankers have reaffirmed the need for continuing technology assessment and research to improve oil spill response capabilities. This paper discusses Minerals Management Service concerns, as reinforced by the acceleration of its research program in 1990. It briefly assesses current state-of-the-art technology for major aspects of spill response, including remote sensing, open-ocean containment and recovery, in-situ burning, use of chemical treating agents, beachline cleanup, and oil behavior. Specific research projects have begun to yield information that will improve detection and at-sea equipment performance; current projects include the development of an airborne laser-fluorosensor to determine whether apparent slicks contain oil. Additional projects involve the development of improved strategies for responding to oil in broken-ice conditions, for gaining an improved understanding of the fate and behavior of spilled oil as it affects response strategies, and for defining the capabilities of available dispersants and development of improved formulations. Recently, progress has been made on the development of safe and environmentally acceptable strategies to burn spilled oil in situ. The Ohmsett facility has been reopened and will be used to test prospective improvements in chemical treating agents and to develop standard procedures for testing and evaluating response equipment. Results of research published since the last Oil Spill Conference are discussed.

Tennyson, E.J. 1992. In-situ burning of spilled oil. In: Proceedings from the first international oil spill R D forum, June 1 4 1992, McLean, VA, 259-260.
Key words: Oil Spill Mitigation, Petroleum, In-situ Combustion
This presentation provided an overview of results from the Minerals Management Service's (MMS) funded research on in situ burning of spilled oil. The program began in 1983 to determine the limitations of this innovative response strategies. Specific physical variables evaluated were slick thickness, degree of weathering (sparging), sea state, wind velocities, air and water temperatures, degrees of emulsification and degree of ice-coverage. All of the oils tested
burned with 50 to 95 percent removal ratios as long as emulsification had not occurred. Slick thickness of 3mm or thicker were required to sustain ignition and extinguishment occurred when the slick reached approximately 1mm thick. The next phase of the research involved quantitative analysis of the pollutants created by in situ burning including chemical composition of the parent oil, burn residue, and airborne constituents. These studies were conducted at the National Institute of Standards and Technology (NIST) with emphasis on particulate, and gaseous components created by the burning process. Research efforts over several years, and a variety of crude oils, yielded data which indicated that aldehydes ketones, dioxans, furans, and polyaromatic compounds (PAHS) were not formed in the burning process. The airborne pollutants reflected similar concentrations of these compounds that were present in the parent oil. Lighter molecular weight PAHs tended to be

converted to higher molecular weight compounds. Heavier molecular weight compounds are considered less acutely toxic than lighter molecular weight PAHS. Predominant burn products released into the air were by weight: 75% carbon dioxide, 12% water vapor, 10% soot, 3% carbon monoxide and 0.2% other products including those listed above.

Tennyson, E. 1990. Recent results from oil-spill response research. Spaulding, M.L., and M. Reed. Oil spills. In: Proceedings of the Oil spills management and legislative implications conference, May 15 18 1990, Newport, RI, pp. 117-128.
Key words: Oil Spills, Research Programs, Pollution Control Equipment, Remote Sensing
Recent large oil spills from tankers have reaffirmed the need for continuing technology assessment and research to improve oil-spill response capabilities. The Minerals Management Service (MMS) remains a lead agency in conducting these studies. This paper discusses MMS concerns, as reinforced by the acceleration of its research program in 1990. It briefly describes assessment of the current state-of-the-art technology for major aspects of spill response, including remote sensing, open-ocean containment, recovery, in-situ burning, chemical treating agents, beachline cleanup, and oil behavior. The paper emphasizes the results of specific research projects that have begun to yield information that will improve detection and at-sea equipment performance. The paper also stresses current research projects, including the development of an airborne, laser-assisted fluoresensor, which determines whether apparent slicks contain oil.

Tennyson, E. 1991. Recent results from oil spill response research. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 673-676.
Key words: Oil Spill, Contingency Planning, Pollution Control Equipment, Remote Sensing, Crude Oil

Tennyson, E.J. 1988. Shipborne radar as an oil spill tracking tool. In: Proceedings of the eleventh Arctic and marine oil spill program technical seminar, June 7 1988, Vancouver, Canada, pp. 385-390.
Key words: Oil Spills, Remote Sensing, Radar
The capabilities of two x-band shipborne navigational radar units to detect oil slicks were evaluated off the Nova Scotia coast. Two series of spills were conducted, each of five releases of 5 bbl. The behavior of these slicks was monitored until the slicks had visually dissipated. Radar was used to track the slicks and the radar images were compared with the visual observations when conditions permitted. This evaluation of shipborne radar was predicated on the damping of short period waves by the slick and the ability of radar to detect and represent difference in the short period wave field. It was found that about 2 hours were initially required to adjust the gain and sea/rain clutter filters of the radar units to optimize the representation of the sea return. The presence of large swells coupled with breaking wind driven waves obscured the slicks when winds exceeded 30 knots. Fog and rain had no effect on detection capability. There

was an apparent correlation between the observed thicker portion of the slicks and the radar image. It is concluded that shipborne x-band radar can readily detect oil spills in a range of sea conditions if properly tuned. The technique could be used to guide recovery vessels. Further evaluation is required to quantify the limits of this technique. 4 refs., 4 figs.

Tennyson, E.J. 1991. Results from selected oil-spill response research. In: Proceedings of the 7th Amer. Soc. Civil Eng. et al. Coastal & Ocean Manage. Symp. (Coastal Zone 91), July 8 12 1991, Long Beach, CA, 3:2479-2490.
Key words: Abstract, Beach, Pollution Control, Remote Sensing

Tennyson, E. 1991. Results from selected oil spill response research by the minerals management service. In: Proceedings of the 11th Annu. US MMS Gulf of Mex. Inform. Transfer Mtg., November 13 15 1990, New Orleans, LA, pp. 292-297.
Key words: Beach, Bulk Carrier, Business Operation, Economic Factor, Pollution Control Equipment

Tennyson, Edward J. 1993. Results from minerals management serviced funded oil spill response research 1991-1993. In: Proceedings of the Coastal Zone'93 Coastal Zone: Proceedings of the Symposium on Coastal and Ocean Management, 1(1993):455-465.
Key words: Oil Spills, Environmental Protection
Large oil spills from tankers have reaffirmed the need for continuing technology assessment and research to improve oil spill response capabilities. This paper discusses Minerals Management Service (MMS) concerns, as reinforced by the acceleration of its research program in 1990. It briefly describes research results for several major aspects of spill response, including remote sensing, open-ocean containment and recovery, in situ burning, use of chemical treating agents, beachline cleanup, and oil behavior. Results of specific research projects that have begun to yield information that will improve detection and at-sea equipment performance are emphasized. Current research projects, including the development of an airborne base fluorosensor, which determines whether apparent slicks contain oil, are also discussed. Additional projects involve the development of improved strategies for responding to an oil spill in the marine environment, for gaining an improved understanding of the fate and behavior of spilled oil as it affects response strategies, and for defining the capabilities of available dispersants and development of improved formulations. Recent progress on the development of safe and environmentally acceptable procedures to burn spilled oil in situ is also discussed. The Ohmsett facility has been reopened and is necessary for testing prospective improvements in chemical treating agents, remote sensing and for the development of standard procedures for testing and evaluating response equipment. (Author abstract) Refs.

Tennyson, E.J. 1989. Shipboard navigational radar as an oil spill tracking tool. In: Proceedings of the API et al Oil Spill (Prev, Behav, Contr, Cleanup) 20th Anniv Conf, February 13 16 1989, San Antonio, TX, pp. 119-121.
Key words: Oil Spill, Business Operation, Petroleum, Remote

Sensing

Testa, Stephen M., and William E. Halbert. 1989. Geochemical fingerprinting of free phase liquid hydrocarbons. Natl. Water Well. Assoc., Dublin, OH, United States. 29-44.
Key Words: California, environmental geology, pollution, seepage, factors, underground installatins, alkanes, aliphatic hydrocarbons, organic materials, nitrogen, sulfur, N-15, isotopes, stable isotopes, S-34, soils, ground water, Southern California, Pacific Coast, Western U.S., United States, benzene, aromatic hydrocarbons, ethylene, alkenes, distribution, carbon, C-13/C-12, oil spills, trace metals, geochemistry, water table.'

Testa, Stephen M. 1990. Hydrocarbon product characterization; applications and techniques. In: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:1259-1275.
Key Words: Organic materials, pollution, carbon, isotopes, deuterium, hydrogen, analysis, methods, oil spills, characterization, C-13/C-12, geochemistry, D/H, applications, techniques, stable isotopes, gas chromatography, wet methods, trace-element analyses, aliphatic hydrocarbons, hydrocarbons, aromatic hydrocarbons, chemical analysis.

Texaco Refining & Marketing Inc. 1991. Texaco Refining & Marketing Inc's (refinery oil spill). Oil & Gas Journal. 89(9):18.
Key words: Accident, Alaska, Crude Oil, Economic Factor, Pollution Control

Texaco Inc. 1989. Milford Haven (oil) spill. Mar. Pollut. Bull. 20(1):2.
Key words: Accident, Animal, Crude Oil, Economic Factor, Pollution Control

Texas Industry Environmental Advisor. 1993. Oil spill cleanup standards. Texas Industry Environmental Advisor. 6(18):24.

Thengs, N., and J.D. Olsen. 1993. Oil Collector. Patent No. US 5181802 4 pp.
Key words: collector, adsorbent, collecting agent, contamination, environmental pollution, oil spill, oil water separator, separation equipment, solid adsorbent, sorbent, wa ter pollution, p) USA, absorbent, absorption, adsorption, adsorption capacity, articulated, barrier, business operation, cellulose, chart, cleaning, connector, construction material, container, control, coupling (mechanical), ecology, engineering drawing, environment, fabric, fiber, fitting, floating barrier, hook, lipophilic, module, natural resin, ocean environment, oil skimming,

Thomas, J.M., G.M. Leong. 1991. The biological treatment of groundwater contaminated with chlorinated and nonchlorinated volatile organic compounds: A continuous-flow pilot-scale treatability study. In: Proceedings of the AWMA 84th Annual Meeting (Vancouver, B.C. 6/16-21/91) Proceedings N.91-19.1 V11 20pp.

Key words: aerobic microorganism, air pollutane, benzene, biochemical reaction, cellular, chloroethylene, dechlorination, composition, bioremediation, bacteria, homopolymer, concentration.

Thomas, Debra H., and J. Joseph. 1991. A gas chromatographic/chemical indicator approach to assessing ground water contamination by petroleum products. Ground Water Monitor Rev. 11(4):90-100.
Key words: Oil Spill, Underground Storage Facility, Water Pollution
The results of EPA Methods 602, 610, and 625 analyses allowed the identification of several indicator compounds in the water-soluble fractions of individual samples of an unleaded gasoline, kerosene, and diesel fuel. Benzene and numerous substituted benzenes were present in the unleaded gasoline, kerosene, and diesel fuel, but high concentrations of these compounds generally indicated gasoline contamination. Dimethylnaphthalines, anthracene, n-dodecane, and n-tetradecane were chemical indicators for kerosene and diesel fuel contaminaiton. Normal octadecane and phenanthrene were indicative of diesel fuel contamination. Water-soluble fractions of unleaded gasoline, kerosene, and diesel fuel cannot be differentiated solely by quantitative or qualitative results using Method 602 alone. The results of Method 610 can be misleading and should be verified by an alternative method.

Thomas, J. M., K. L. Duston, P. B. Bedient and C. H. Ward. 1992. In-situ biorestoration of contaminated aquifers and hazardous waste sites in Texas. In: Proceedings of PETRO-SAFE '92: 3rd Annual Environmental and Safety Conference for the Oil, Gas, and Petrochemical Industries, Jan. 27 29, Houston, TX. PenWell Conferences and Exhibitions: Houston, TX, pp. 889 898.
Key words: Oil Spills, Biodegradation, Groundwater Pollution, In-Situ Bioremediation
Texas is one of the nation's most polluted states, and its aquifers are at risk from contamination by numerous industrial and hazardous waste sites (Texas Water Commission, 1989). Because groundwater supplies a significant amount of drinking water for the state, contamination of Texas aquifer is a major concern. One method that is sometimes used to remediate contaminated groundwater and subsurface materials is in-situ bioremediation (ISB). This paper discusses ISB and its potential application to remediate groundwater and subsurface materials in Texas. To assess application of ISB in Texas, aquifer characteristics and groundwater to pollution as well as the location of possible contamination sources are determined to locate those areas of the state that are at risk from groundwater contamination.

Thomas, D.J., and C. S. Johnston. 1985. The development and current status of environmental monitoring programmes in the North Sea. In: Proceedings of the 8th Annu Int Soc Petrol Ind Biol n Hydrocarbon Develop Environ Probl Solving Mtg, September 24 26, Banff, Canada. Pp. 309 318.
Key words: Oil Spill, Water Pollution, North Sea

Ryan, P. B., and D.J.S. Brown. 1985. GAOCMAO (Gulf Area Oil

Companies Mutual Aid Organisation) Industry's approach to cooperative spill response in the Arabian Gulf. In: Proceedings of the 9th BIEN API et al. Oil Spill (Prev, Behav, Contr, Cleanup) Conf, February 25 28, Los Angeles, California. Pp. 607 613.
Key words: Oil Spill, Water Pollution, Arabia Sea, GAOCMAO

Thomas, Randy. The Gulf's eco-war expands. (oil spill in Persian Gulf). Canadian Dimension. 25:5 8.

Thomas, J.A., E.L. Stover, and G. Ganapathi. 1990. (A review of the treatment methods for the wastes generated from) petroleum processing and synthetic fuels. Research Journal of the Water Pollution Control Federation (Annual Review Issue). 62(4):487-92.
Key Words: Activated charcoal, adsorbent, adsorption process, biochemical reaction, biodegradability, biodegration, charcoal, coal gasification, coal liquefaction, gasification, ground water, Group VIA, humidity, incineration, landfarming, liquefacation process, oil waste, oxidation reaction, physical property, physical separation, pollution control, prior treatment, reclaiming, sludge, sorption process, tar sand, waste disposal, waste material, water content.

Thomas, Dick and Madeleine McDonagh. Underwater Releases of Oil. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., pp. 724. San Diego, CA.: Washington, DC: American Petroleum Institute. , 1991.
Keywords - Underwater, Releases, Oil.

Thompson, Lt. Edmond P., Timothy W. Kana, and Robert Pavia. 1981. BURMAH AGATE: chronology and containment operations. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., pp. 131 - 138. Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - BURMAH AGATE, Containment.

Thompson, Jack H. and Thomas J. Bright. 1977. Effects of drill mud on sediment clearing rates of certain hermatypic corals. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., pp. 495 - 498. New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Drill Mud, Sediment, Corals.

Thompson, C. Hugh. 1971. Oil versus other hazardous substances. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 - 17, 1971., pp. 209 - 212. Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Hazardous Substances.

Thorhaug, Anitra and Jeffry Marcus. 1985. Effects of dispersant and oil on subtropical and tropical seagrasses. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985.,pp. 497 - 502. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Oil, Subtropical, Tropical, Seagrasses.

Thorhaug, A., F. McDonald, B. Miller, J. McFarlane, M. Anderson, P. Gayle, and B. Carby. 1989. Dispersed oil effects on tropical habitats: Preliminary laboratory results of dispersed oil testing on Jamaica corals and seagrass. In: Proceedings of the 1989 API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 455-58.
Key words: Animal, Biology, Biomedical, Pollution Control, Environmental Protection Agency

Thorn, Kevin A., and George Aiken. 1991. Sources in crude oil of nonvolatile organic acids downgradient from an oil body at Bemidji, Minnesota. Water-Resources Investigations. 654-658.
Key Words: Minnesota, pollution, organic materials, ground water, environmental geology, oil spills, transport, detection, organic acids, USGS, Midwest, United States, North-Central Minnesota, Bemidji, Minnesota, Beltrami County, Minnesota, NMR spectra, water wells, hydrochemistry.

Thornton, D.E., M. Fingas, and G. Sergy. 1992. A Canadian perspective on oil-spill treating-agent research. In: Proceedings from the first international oil spill R&D forum. Technology Management Services, Inc. Gaithersburg, MD (United States). 340(p):109-113.
Key Words: Oil spills mitigation, oil spills removal, Canada, cleaning, environmental transport, oil pollution containment, performance, pollution control equipment, surfactants, coastal regions, developed countries, mass transfer, North America, pollution control.

Thornton, D.E., M.F. Fingas, H. Whittaker, and G. Sergy. Apr-Jun 1992. AMOP: The Arctic and marine oilspill program. AMOP: Le programme de lutte contre les deversements d'hydrocarbures en mer et dans l'ocean Arctique. Spill Technology Newsletter (Canada). 17(2):1-20.
Key Words: Oil spills-research programs, Arctic Regions, Canada, offshore operations, cryosphere, developed countries, North America, polar regions.

Thornton, D.E. 1990. AMOP: The Arctic and Marine Oilspill Program. In: Proceedings of the petroleum industry's sixteenth frontier workshop, April 29 May 2 1990, Fairmont, Canada, pp. 161-176.
Key words: Oil Spills, Research Programs
Research work performed and in progress under the Arctic and Marine Oilspill Program (AMOP) is summarized. AMOP began in 1977, with an initial focus on the southern Beaufort Sea, and its primary objective continues to improve the knowledge base and technology for combating arctic and marine spills. Some of the achievements of AMOP are described under the headings of detection and tracking, properties, behavior and modelling, remedial measures, and chemical treating agents. Highlights include investigating the use of remote sensing techniques for detecting and evaluating oil spills, the Baffin Island oil spill experiment on the effects of crude oil on arctic shorelines, examination of oil behavior in ice, a catalogue of the properties of oils that could be spilled in Canada or adjacent waters,

testing of booms and skimmers, evaluation of chemical dispersants, and development of a capability to incinerate oil in the Arctic. Future research plans are also outlined. 2 refs.

Thorpe, J.W., K.E. Hellenbrand. 1987. Microbial degradation of hydrocarbon mixtures in a marine sediment under different temperature regimes. Environmental studies research funds, No. 083. 78.
A laboratory study measured over 11 months the rate of degradation of three hydrocarbon mixtures under simulated conditions of a marine sediment at temperatures of 15/sup 0/, 10/sup 0/, and 5/sup 0/C. The aim was to predict from the results rates of degradation that may be expected at temperatures below 5/sup 0/C. Low concentrations (1-3%) of the three hydrocarbons were mixed with sand and these samples were incorporated into sediment in which a flow of sea-water was maintained comparable to that of interstitial water in a sublittoral sediment influenced by moderate waves. Total counts of aerobic bacteria in the hydrocarbon-containing sediment remained high throughout. Changes in the three hydrocarbon mixtures resulting from biodegradation were determined using solvent extraction and analysis by capillary gas chromatography. Under the experimental conditions chosen was a significant leaching of the more-volatile water-soluble hydrocarbons from the crude oil and particularly from the condensate. From the biodegradation rates the Q/sub 10/ value (change in rate per 10/sup 0/C change in temperature) for crude oil was estimated to be 3.1 which is in excellent agreement with other published data. Daily biodegradation rates for crude oil at 0/sup 0/ and -5/sup 0/C are estimated to be 8.4 and 4.2 mg/m/sup 2/, respectively. In reality these rates are likely to be even lower. 4 figs., 18 tabs., 19 refs.
Key words: hydrocarbons, biodegradations, experiments, chemical reactions, decomposition, waste processing, temperature effects, fossil fuels, management, organic compounds, sea bed, sediments.

Thorpe, J.W., and K.E. Hellenbrand. 1987. Microbial degradation of hydrocarbon mixtures in a marine sediment under different temperature regimes. Can Environ Stud Res Funds. Rep No 083 Sept 1987, 82 p.
Key words: Beach, Biodegradation, Oil Spill, Weathered Oil, Arctic, Bacteria

Thorpe, D., P. Tayler. 1985. Subsea template drilling in the North Sea, experience gained during the initial stages of the balmoral development. In: Offshore Europe 85 Conference. in Aberdeen, Scotl.
Key words: offshore, disposal, oil recovery, North Sea
Operations, procedures and experience relating to drilling through the Balmoral Template are described. Special equipment and techniques including cuttings disposal, safety and cementing are detailed along with directional drilling experience. Drilling employed an expensive low toxic oil based mud and to reduce costly losses, a specially developed oil recovery system, employing a high speed decanting centrifuge, was constructed and installed. The system is described and its operational features are highlighted. (Edited author abstract) 1 ref.

Tibbetts, A.M. 1975. Training a cleanup response team. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 59 - 64. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Training, Cleanup, Response.

Tiedje, J.M., S.A. Boyd, B.Z. Fathepure. 1985. Anaerobic degradation of chlorinated aromatic hydrocarbons. Developments in industrial microbiology. 27:117-127.
Key words: review, biodegradation, anaerobe, organochlorine compounds, benzenic, compound, phenols, polychlorobiphenyl, dechlorination, pesticides, bacteria, pollutant behavior, Congress.

Tiehm, A., and W. Zumft. 1992. Mobilization and biodegradation of polycyclic aromatic hydrocarbons in the presence of technical surfactants. Soil Decontamination Using Biological Processes. December 1992:6 9.
Key words: bacteria, degradation, biodegradation, soil
Addition of surfactants improves desorption, mass transfer to the aqueous phase, and bioavailability of PAH. Using isotridecylethoxylate with phenanthrene there is exponential bacterial growth and temporary accumulation of 1-hydroxy-2-naphthoic acid. Degradation is accelerated and fastest for anthracene, fluoranthene and pyrene. Paper given at Int. Symp.

Tintera, J.J. 1993. State of Texas jurisdiction and response to inland water spills. In: Proceedings of the SPE - EPA Exploration & Production Environmental Conference, March 7 10, 1993, San Antonio, TX, pp. 353-59.
Key words: environment, transport & storage, health, legal considerations, liquid wastes, pipeline operating problems, pollution control

Tissier, M. and J. L. Oudin. 1973. Characteristics of naturally occurring and pollutant hydrocarbons in marine sediments. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, 1973., pp. 205 - 214. Washington, DC. : Washington, DC: American Petroleum Institute.
Keywords - Hydrocarbons, Marine Sediments.

To, N. M., H. M. Browm, and R. H. Goodman. 1987. Data analysis and modeling of dispersant effectiveness in cold water. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 9, 1987. 303 306. Baltimore, MD: Washington, D.C.: American Petroleum Institute. 1987.
Keywords: analysis, dispersant, water.

Torgrimson, Gary M. 1981. A Comprehensive model for oil spill simulation. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., pp. 423 - 428. Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Simulation.

Torossian, H., M.M. Avedesian, and A. Limonchik. 1990. Soil and industrial waste decontamination. Patent No. CA 1266573A.
Key words: Chlorinated Aromatic Hydrocarbons, Decontamination
A process and an apparatus for the decontamination of industrial waste and the revitalization of soil containing industrial waste, having dioxins and/or polychlorinated aromatic compounds, without depletion of the valuable nutrient contained in said soil The process comprises contacting a soil or industrial waste with supercritical carbon dioxide, an ecologically acceptable fluid, bringing the carbon dioxide to temperature and pressure to maintain said fluid in its supercritical state to dissolve the dioxins and/or polychlorinated aromatic compounds, while producing an insoluble and a soluble fraction. The soluble fraction is then separated from the insoluble fraction. The insoluble fraction contains the decontaminated industrial waste and/or soil and trace amount of an ecologically compatible fluid. The pressure-temperature conditions of the soluble fraction are then modified to cause the carbon dioxide in supercritical fluid to vaporize and separate from the soluble dioxins and/or polychlorinated aromatic compounds. An apparatus is also disclosed, as well as means to recycle industrial waste. The process is unique in that it would permit the revitalization of soils around various industrial sites such as chemical plants, oil exploration and production fields, beaches contaminated by oil spills, and the recovery and recycling of industrial waste.

Tortell, Philip. 1981. Prevention and control of oil pollution in New Zealand. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., pp.551 - 556. Atlanta, GA.: Washington, DC: American Petroleum Institute.
Keywords - Control, Oil, Pollution, New Zealand.

Townsend, D., G. Rieter, J. Kitchener, D. McGovern. 1991. Millions of dollars later: Nothing new (in oil recovery methods). Oilweek. 42(5):13-14.
Key words: Accident, Alaska, Crude Oil, Diaster Control, Economic Factor, Legal Consideration, Pollution Control

Train, Russell E. 1969. Research and engineering are mandatory to reduce the risk of oil spills. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969., pp.41 - 46. New York, NY.: Washington, DC: American Petroleum Institute.
Keywords - Research, Risk, Oil Spills.

Tramier, Bernard and Andre Sirvins. 1983. Enhanced oil biodegradation: a new operational tool to control oil spills. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., pp. 115 - 122. San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Biodegradation, Control, Oil Spills.

Trattner, Richard, and Beverly K. Lawson. 1990. Biological degradation of hazardous wastes. Advances in Env Technology & Management. 1:137-203.

Key words: Biodegradation, Microorganism, Bacteria, Hydrocarbons
A review of recent research underscores the applicability of biological systems to the treatment of hazardous wastes. Biological treatment techniques described include land composting, activated sludge processes, and filters. Laboratory research and bench-scale studies have demonstrated the utility of aerobic *bacteria* for the
biodegradation of hazardous wastes. Other topics covered are: testing for recalcitrance; anaerobically based biodegradation systems; and laboratory- or pilot-scale studies of PCB, trichloroethene, PAH, PCP, aniline, and chlorophenol biodegradation.

Travis, M.D. July 1990. Bioremediation of petroleum spills in arctic and subarctic environments: A feasibility study. Updated report. Alaska Dept. of Transportation and Public Facilities, Fairbanks, AK (USA). Statewide Research. 28(p).
Key Words: Oil spills biodegradation, aeration, Alaska, ambient temperature, by-products, contamination, coverings, fertilizers, field tests, fluid injection, ground water, growth, heating, hydrogen peroxide, land pollution, mass transfer, metabolism, microorganixms, nitrogen, oxygen phosphorus, potassium, Purdhoe Bay, soils, water pollution, alkali metals, Arctic Ocean, bays Beaufort Sea, chemical reactions, decomposition, elements, Federal Region X, hydrogen compounds, metals, nonmetals, North America, oxygen compounds, peroxides, surface waters, USA.

Tremblay, D.L. 1993. Overcoming barriers to the use of innovative corrective action technologies (for soil and groundwater cleanup) at underground storage tank sites. In: Proceedings of the AWMA 86th Annual Meeting, June 13 18, 1993, Denver, CO, Paper No. 93FA166.03.
Key words: transport, soil pollution, storage, water pollution, biodegradation, ground water, tank, legal, soil pollution, water pollution

Trimmel, M.L., S.M. Testa, D.L. Winegardner. 1989. Optimization of free phase liquid hydrocarbon recovery systems. In: Proceedings of the 6th national conference on hazardous wastes and hazardous materials. National conference and exhibition on hazardous wastes and hazardous materials. 720(p):451-453.
Key Words: Petroleum oil spills, pollution control equipment, soils water pollution control, storage facilities, land pollution control, ground water, recovery, tnaks, leaks, containers, energy sources, fossil fuels, hydrogen compounds, oxygen compounds, pollution control.

Troop, P. M., Q.C. and Capt. M. S. Greenham. 1991. Ship-source oil pollution fund: 20 years of Canada's experience. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., pp. 683 - 688. . San Diego, CA.: Washington, DC: American Petroleum Institute.
Keywords - Ship, Oil, Pollution, Fund, Canada.

Trowbridge, Bretton E., James J. Malot. 1990. Soil remediation and free product removal using in-situ vacuum extraction with catalytic oxidation. In: Proceedings of the Proceedings of the

National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods. 4:559-570.
Key Words: Reclamation, soils, ground water, natural resources, pollution, oxidation, catalysis, geochemistry, vacuum methods, volatiles, water table, oil spills, chlorinated hydrocarbons, aromatic hydrocarbons, hydrocarbons, organic materials.

Troy, M.A. and D.E. Jerger. 1992. Bioremediation of diesel fuel contaminated soils. In: Proceedings of Special Symposium on Emerging Technologies for Hazardous Waste Management, Sept. 21 23, Atlanta, GA. American Chemical Society (ACS): Washington DC, pp. 747 748.
Key words: Biodegradation, Remedial Action, Oil Spills, Water Pollution
Bioremediation techniques were successfully employed in the cost-effective cleanup of approximately 8400 gallons of diesel fuel, which had been accidentally discharged at a warehouse in New Jersey. Surrounding soils were contaminated with the diesel fuel at concentrations exceeding 1,470 mg/kg total petroleum hydrocarbons as measured by infrared spectroscopy (TPH-IR, EPA method 418.1, modified for soils). This paper reports on treatment of the contaminated soils through enhanced biological land treatment, which was chosen for the soil remediation pursuant to a New Jersey Pollutant Discharge Elimination System Discharge to Groundwater (NJPDES-DGW) permit. Biological land treatment of diesel fuel focuses on the breakdown of the hydrocarbon fractions by indigenous aerobic microorganisms in the layers of soil where oxygen is made available. Metabolism by these microorganisms can ultimately reduce the hydrocarbons to innocuous end products. The purpose of biological land treatment was to reduce the concentration of the petroleum hydrocarbon constituents of the diesel fuel in the soil to 100 ppm total petroleum hydrocarbons (TPH).

Trudel, B.K., R. C. Belore, B. J. Jessiman, and S. L. Ross. 1987. Development of a dispersant-use decision-making system for oil spills in the U.S. Gulf of Mexico. Spill Technol. Newsletter 12(4):101-110.
Key words: Oil Spills, Dispersant, Gulf of Mexico, Geographic Information System
A computerized system to aid in making real-time dispersant-use decisions for oil spills in the U.S. Gulf of Mexico is under development and due for completion in early 1988. The system can predict the impact of an oil spill in the Gulf if it is either treated with dispersants of left untreated. The method works as follows. A computerized map of the untreated spill is produced showing the predicted location and concentration of the spilled oil as a function of time after the initial discharge. This map is then compared with a series of computerized maps of 70 important Gulf resources that might suffer from the effects of the spill. A geographical information system (GIS) with extensive spatial analytical capabilities is then used to calculate the proportion of each resource that is affected by the spill at specified levels of oil concentration.

Trudel, B.K. 1989. A Microcomputer-based spill impact assessment system for untreated and chemically dispersed oil spills in the

U.S. and Gulf of Mexico. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., pp. 533 - 538. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - Microcomputer, Impact, Assessment, Untreated, Chemically, Dispersed, Oil Spills, U.S., Gulf of Mexico.

Trudel, B.K. and S. L. Ross. 1987. Method for making dispersant-use decisions based on environmental impact considerations. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp. 211 - 216. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Decisions, Environmental Impact.

Trzilova, B., and L. Miklosovicova. Microbial oxidation of crude oil hydrocarbons in Danube water. Archiv fuer Hydrobiologie Supplementband. (1990): 84 (1).
Key words: hydrocarbons, danube, bacterial degradation.
Bacterial degradation of soluble hydrocarbons in water of the river Danube was studied experimentally. Total organotrophic bacteria as well as bacteria of the genera Pseudomonas, Flavobacterium and Chromobacterium survived and grew in contaminated Danube water under static conditions and with aeration. This applied to hydrocarbon concentrations of up to 500 mg/l. Growth rate of bacteria and degradation rate of soluble hydrocarbons were high during the first three days. Due to the changing composition of the bacterial community, respiratory activity of the bacterial cells increased between day 3 and 7. Bacterial cells became larger in contaminated Danube water.

Trzilova, B., and L. Miklosovicova. 1987. Bacterial degradation of crude oil hydrocarbons in Danube waters. Archiv fuer Hydrobiologie. Supplementband. Monographische Beitraege. 68(3-4): 343-350.
Key words: stream, biodegradation, hydrocarbon, bacteria, pseudomonas, fresh water, crude oil, water pollution.

Trzilova, B., E. Horska. 1988. Biodegradation of aromates and alkanes in aquatic environment. Biologia (Bratislava). (1988): 43(3).
Key words: biodegradation, bacteria, hydrocarbon, degradation, Danube River, Europe
The ability of selected microorganisms to degrade model mixtures of aromates (C9-C11) and alkanes (C10-C17) their survival, physiological activity and degrading capacity in aquatic environment were studied. Organotrophic bacteria as whole, bacteria of the genus Pseudomonas and yeasts of the genus Candida utilized alkanes more intensively than aromates which was manifested by higher plate counts and by higher metabolic activity and hydrocarbon degradation rate. Aromate mixtures were degraded only by bacteria and not by yeasts. Elimination of crude oil hydrocarbons from aquatic environment was affected by the concentration of microorganisms, their generic composition and physiological activity and the type of aquatic environment.

Tsahalis, Demos T. 1979. Contingency planning for oil spills: riverspill--a river simulation model. In: Proceedings of the 1979

Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., pp. 27 - 36. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Contingency Planning, Oil Spills.

Tsai, G., and G.T. Tsao. 1988. Processing cellulosic solids for methane production by a combined chemical and biological process. FY 1987 anaerobic digestion: Annual report. 128-139.
Cellulosic solids are pretreated by calcium hydroxide to produce salts of volatile organic acids and other water-soluble substances. Pure cellulose, sawdust, and waste paper are used as model substances for the study of alkaline degradation. It was found that sawdust is more difficult to degrade than the other two substances. The cooking conditions for high conversion of model substance and high yield of organic acids are found to be 275/sup 0/C to 300/sup 0/C with the corresponding reaction time from 30 to 15 minutes. The cooking liquor can be readily fermented in an anaerobic fluidized-bed digester for methane production. The cooking liquor from different reaction conditions can all be digested by the methanogens. Higher than 90% of COD can be removed under the conditions of low organic loading rate (< 2.0 g COD/l/day) and low hydraulic retention time (1.5-2.0 days).|
Key words: cellulose, alkaline, hydrolysis, methane, organic acids, anaerobic digestion, wood wastes, temperature dependence, bioconversion, calcium compounds, carbohydrates, bacteria, bioreactors, data, fluidized beds, alkanes.

Tsang, Gee, Nick Vanderkooy. 1979. Development of a novel ice boom for flowing waters. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: development, ice, boom, waters.

Tsang, Gee. 1979. Recovery of oil spilled under river ice cover. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., pp. 387 - 396. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Recovery, Oil Spilled, River, Ice.

Tsao, G.T. 1988. Processing high solids concentration of municipal solid waste by anaerobic digester for methane production. Purdue Univ., Lafayette, IN (USA). 39pp.
Cellulosic solids are pretreated by calcium hydroxide to produce salts of volatile orangic acids and other water-soluble substances. Pure cellulose, sawdust, and waste paper are used as model substances for the study of alkaline degradation. It is found that sawdust is more difficult to degrade than the other two substances. The cooking conditions for high conversion of model substances and high yeild of orangic acids are found to be 275/degree/C to 300/degree/C with the corresponding reaction time from 30 minutes to 15 minutes. The cooking liquor can be readily fermented in an anaerobic fluidized-bed digester for methane production. The cooking liquor from different reaction conditions can all be digested by the methanogens. Higher than 90% of COD can be removed under the conditions of low organic loading rate (<2.0 g COD/1/day) and low hydraulic retention time (1.5 to 2.0

days). 14 refs., 10 figs., 2 tabs.
Key words: cellulose, anaerobic digestion, biomass conversion plants, solid waste, bacteria, waste management, methanogenic bacteria, alkanes, organic compounds, saccharides, hydrocarbons, digestion.

Tseng, Florina S. 1993. Care of oiled seabirds: a veterinary perspective. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oiled seabirds.

Tsukino, Y. (Tsukuba Institute (Japan)). 1992. Research and development on recovering techniques for response of major oil spill incident in offshore (research activity of Tsukuba Institute, Ship and Ocean Foundation). In: Proceedings of the first international oil spill R&D forum. Technology Management Services, Inc. Gaithersburg, MD (United States). 340(p):153-157.
Key Words: Oil spills mitigation, oil spills research programs, Japan, offshore operations, oil pollution containment, petroleum shores, Asia, coastal regions, developed countries, energy sources, fossil fuels, pollution control.

Tthengs, N., and J.D. Olsen. 1990. Oil Collector. Norva Invest As World 90/4683, p 5/3/90, f 10/23/89, pr norw 10/27/88 (Appl 884779) (e02b-015/04) pct gaz v 1990, no 10, p 2918, 5/3/90.
Key words: collector, oil spill, oil waste, removal, waste material, wood, p) world, absorbent, absorber, absorption, body (geometric), casings, chart, cleaning, connector, containment, contamination, control, coupling (mechanical), crude oil, cylinder, cylindrical shell, design, diagram, engineering, fastener, fitting, flexibility, geometry, impregnation, mathematics, mechanical property, mounting, Norva Invest As, oil skimming, oil water separation, permeability, petroleum, physical property, physical separation, pollution control, protection, separation equipment, shape, size, sorbent, sorption, water pollution, ecology & pollution

Tucker, R.K. 1990. Problems dealing with petroleum contaminated soils: A New Jersey perspective.
Kostecki, P.T., and E.J. Calabrese. 1990. Petroleum contaminated soils: <Original Series/Collective> Remediation techniques environmental fate risk assessment. National conference on environmental and public health effects of soils contaminated with petroleum products. Lewis Publishers, Chelsea, MI (USA). 357(p):37-54.
Key Words: New Jersey petroleum refineries, petroleum products land pollution control, petroleum refineries waste management, environmental exposure pathway, environmental transport, ground water, oil spills, plastics, water pollution control, Federal Region II, hydrogen compounds, industrial plants, mass transfer, North America, oxygen compounds, petrochemicals, petroleum products, pollution control, synthetic materials, USA.

Tucker, William A., Frank L. Hearne. 1989. Risk assessment: tools for reducing liability from underground storage tanks. In:

Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: risk assessment, liability, underground, tanks.

Tuler, F. R. 1984. Risk assessment offshore oil and gas operations. Mech Eng106(11):24 30
Key words: Risk Assessment, Oil Spill, Mathematical Analysis

Tumeo, M.A., and B. Davidson. 1993. Hydrocarbon exclusion from ground water during freezing. Journal of Environmental Engineering (New York) (United States). 119(4):715-724.
Key words: Groundwater, Alaska, Oil Spill, Soil Pollution, Water Pollution, Monitoring
Bench-scale studies were conducted using a constant-head ground-water flow chamber and natural soil. Initial experiments with chlorides and dye were conducted to test the hydraulic and adsorptive characteristics of the chamber. A constant flow of phenol was then introduced into the chamber and contaminant movement with time was monitored under freezing and nonfreezing conditions. The chamber was located in a controlled-temperature room, and freezing fronts were induced from the soil surface downward using cooled Freon circulated through freezer pads placed on the surface of the soil. The results conclusively demonstrate that phenol is excluded from the freezing front and pushed downward through the system. Extensive exclusion of the chemical occurs even though the freezing point of phenol (43 C) is significantly higher than water. The information gained through this research is applicable in cold regions outside Alaska and the Arctic where ground water systems may undergo periodic freezing, and may also be of extreme importance in artificial-freezing scenarios such as those currently being investigated by the Environmental Protection Agency (EPA) as a method of contaminant containment.

Tunnell, Jr., John W. 1981. Effects of the IXTOC I oil spill on the intertidal and subtidal infaunal populations along lower Texas Coast barrier island beaches. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: IXTOC I, oil spill, intertidal, subtidal, infaunal populations, Texas, beaches.

Turbini, W., E. Fresi, and F. Bambacigno. 1993. The Haven incident: lessons learned with particular reference to environmental damages. In: Proceedings of the 13th Bien API et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29 April 1 1993, Tampa, FL, pp. 179-183.
Key words: Oil Spill, Contamination, Crude Oil, Petroleum, Pollution Control Equipment, Remote Sensing

Turner, L.R. 1991. Treatment of oil sands and heavy oil production wastes using the aostra (Alverta oil sands technology & research authority) Tacuik process. In: Proceedings of the 5th Unitar Et Al Heavy Crude & Tar Sands Int Conf (Caracas, Venezuela, 8/4 9/91)
Key words: disposal, oil, hydrocarbon, sediment, sand oil

Turner, O.M. 1973. Oil spill prevention practices in pipelines and terminals. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil spill, prevention, pipelines.

Twardawa, P., G. Couture. 1983. Incendiary devices for the in-situ combustion of crude oil slicks. In: Quebec Def Res Estab Valcartier Rep No DREV-R-4282/83, 62 Pp.
Key words: pollution control, oil, disposal, recovery, in-situ, oil spill, petroleum

Tyndall, R.L., K. Ironside, C.D. Little, S. Katz, J. Kennedy. 1990. Isolation of amoebic-bacterial consortia capable of degrading trichloroethylene. In: Proceedings of the Twelfth symposium on biotechnology for fuels and chemicals: Program and abstracts. Scheitlin, F.M. Oak Ridge National Lab., TN (United States).
Groundwater from a waste disposal site contaminated with chlorinated alkenes was examined for the presence of amoebic-bacterial consortia capable of degrading the suspected carcinogen, trichloroethylene (TCE). Consortia were readily isolated from all of four test wells. They contained free-living amoebae, and heterotrophic and methylotrophic bacteria. Electron microscopic examination showed bacteria localized throughout the amoebic cytoplasm and an abundance of hyphomicrobium, but not Type I methanotrophs. The presence of Type II methanotrophs was indirectly indicated by lipid analysis of one consortium. The consortia have been passaged for over two years on mineral salts media in a methane atmosphere, which would not be expected to maintain the heterotrophs or amoebae separately. The methanotrophic bacteria apparently provided a stable nutrient source, allowing the persistence of the various genera. By use of {sup 14}C-radiotracer techniques, the degradation of TCE by the consortia was observed with {sup 14}C eventuating predominantly in CO{sub 2} and water-soluble products. In a more detailed examination of one consortia, the amoebae and heterotrohic components did not degrade TCE, while a mixed culture of heterotrophs and methanotrophs did degrade TCE, suggesting the latter component was the primary cause for the consortium's ability to degrade TCE. Amoebic-bacterial consortia may play a role in stabilizing and preserving methylotrophic bacteria in hostile environments.
Key words: bacteria, detection, chlorinated aromatic hydrocarbons.

U. S. Marine Mammal Commision. 1983. Assessment of past, present & future risks of oil spills in & near the present sea otter range in California, Final report, No. MMC-83/01.
Key words: Oil Spills, Risk Assessment, California, Sea Otter

U.S. Department of the Interior. St. George basin sale 89. Draft environmental impact statement. Mineral Manage Serv Rep No. MMS 84-0017.
Key words: Oil Spill, Environmental Impact

U.S. Department of Energy. 1988. Tar sands program plan: FY 1988. In U.S. Dep Energy Rep No DOE/FE-0121 JUNE 1988, 1988.

Key words: oil recovery, in-situ, Canada, oil, disposal, environment, petroleum

U.S. Department of Energy. 1978. Naval petroleum reserve no. 1 (Elk Hills) Kern County, California: supplement to final environmental impact statement for crude oil transport: Elk Hills/Coalinga Conveyance System. Report, No. DOE/EIS-0019.
Key words: Oil Spill, Elk Hills, California

U.S. Department of the Interior. 1992. Proposed comprehensive outer continental shelf natural gas and oil resource management program for 1992-1997 environmental impact statement. Report No. MMS92-0004, Microfiche, 3 vols., 149 pp.
Key words: California, Oil Spills, Offshore Drilling, Water Pollution

Curtis II, B. W., and C. E. Kirchof, Jr. 1993. Purchase/sale of property : the black hole of corporate liability ways to minimize risk. In: Proceedings of the 1st SPE/EPA Explor & Prod Environ Conf., March 7-10, San Antonio, TX. Pp. 229-247.
Key words: Oil Spills, Contingency Planning, Risk Analysis

Weber, B. J., and K. S. Mudan. 1992. Arcitc Pipeline Risk Assessments. In: Proceedings of the 2nd isope et al. int offshore & polar eng conf., June 14-19, San Francisco, CA. Vol 2, pp. 15-20.
Key words: Arctic Area, Oil Spill, Pipeline

U.S. Department of the Interior. 1984. Final environmental impact statement ocs sale no. 90. Proposed 1985 outer continental shelf oil and gas lease sale offshore the South Atlantic States. Minerals Manage Serv Rep No OCS EIS MMS 84-0070, 635
Key words: Oil Spill, Environmental Impact

U.S. Dept. of the Interior. 1985. Draft environmental impact statement. North aleutian basin sale 92. Minerals Manage Serv Rep No OCS EIS MMS 85-0001, 692
Key words: Oil Spill, Environmental Impact

Uchida, S., H. Takeshita, Y. Seike. 1977. Development of oil spill recovery ship. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil spill, recovery, ship.

Uchino, I., A. Mori, A. Hirosawa, and K. Yamazaki. 1992. Device for detecting oil pollution. PCT GAZ. 1992(23):9934.
Key words: Hydrocarbon, Oil Spill, Pollution Control, Equipment

Uchiyama, Hiroo. 1989. Aerobic degradation of trichloroethylene at high concentration by a methane-utilizing mixed culture. Agric. Biol. Chem. (1989): 53
Key words: degradation, hydrocarbons, bacteria

Ufheil, J. 1991. (In a new wastewater-treatment process,) microbes munch on a toxic lunch. Chemical Engineering. 98(12):11.
Key words: biodegradation, chlorohydrocarbon, microorganism, New

York, pollution control, water pollutant

UK Offshore Operators Association. 1990. UKOOA ((United Kingdom Offshore Operators Association)) contains oil spills. Marine Pollution Bulletin. 21(6):264-65.
Key words: Accident, Additive, Boom, Crude Oil, Oil Waste, Pollution Control, western Europe

United States Coast Guard. 1990. Oil recovery systems for coast guard coastal buoy tenders. Volume 1. Technical Report. Coast Guard Research and Development Center, Groton, CT. Report No. USCD-D-04-91-VOL-1, 128pp.
Key words: Booms, Coast Guard, Oil Spills, Recovery, Separation, Storage Tanks
Available oil spill recovery systems were investigated for their applicability to be deployed from existing and proposed U.S. Coast Guard buoy tenders. These systems for use in ocean environments and coastal regions, included containment boom and skimming devices. Storage for the recovered fluid and possible separation of oil and water from the recovered fluids were investigated. It was found that the limited low speed maneuvering capability of the buoy tenders restricted the overall efficiency of the recovery process and the selection of the recovery systems. Additionally, the buoy tenders will have to be deployed with a barge or utilize floating dracones for storage as onboard tankage is not available for use. Suggestions for deployment are provided as well as recommendations for further investigations.

United States Coast Guard. 1993. (USCG has issued an interim final rule requiring) response plans for marine transportation-related ((MTR)) facilities. Federal Register. 58(23):7330-76.
Key words: environment, transport & storage, health, legal considerations, pollution control, boom

United States Congress. 1991. Environmental and Energy Study Conference Floor Brief: Dire Emergency Supplemental Appropriations for Fiscal 1991. House-Senate Conference Report HR 1281, 4 pp.
Key words: Energy, Water, Law, Government Policies
A House-Senate conference committee early today completed work on a supplemental appropriations bill that contains $623 million sought by the Bush administration for environmental cleanup work and other operations at the Energy Department's nuclear weapons plants, and $25 million to help the Bureau of Reclamation respond to the drought in the West. The measure, HR 1281, is one of two supplemental appropriations bills Congress is working on to meet unforeseen expenses for the fiscal year that ends Sept. 30. The other bill, HR 1282, is devoted entirely to military costs associated with Operation Desert Shield/Desert Storm. HR 1281, also known as the dire emergency supplemental appropriations bill, is a catch-all measure that contains additional funding for defense, etc. It is this bill that includes money for DOE nuclear weapons cleanup, BuRec drought relief efforts and other environmental
initiatives.

Univ Edinburgh. Compact oil-spill recovery equipment, includes inflated boom towed on surface of sea to collect oil in bag along whole length where oil enters bag through gap between water filled and air filled tubes. Patent No. GB 9114926_910710.
Key words: Boom, Failure, Physical Property, Pollution Control, Skimmer

Unterman, R., D.L. Bedard, M.J. Brennan, L.H. Bopp, F.J. Mondello, R.E. Brooks, D.P. Mobley, J.B. McDermott, C.C. Schwartz, D.K. Dietrich, G.S. Omenn. 1988. Biological approaches for polychlorinated biphenyl degradation. Environmental biotechnology: reducing risks from environmental chemicals through biotechnology. Reducing risks from environmental chemicals through biotechnology. 253-279.
Several years ago a research program was designed to isolate and characterize new and better strains of PCB-degrading bacteria and to characterize those biotransformations that are occurring in nature. Recently, this research program was expanded in an effort to explore the possibility of using one or more of the authors new bacterial isolates for the decontamination of PCB-laden soil. Corynebacterium sp. MB1, A. eutrophus H850, and P. putida LB400 had all been shown to have excellent PCB-degrading capabilities; however, little was known about their ability to oxidize PCBs adsorbed to soil. The authors initial studies using sand as a model demonstrated that PCBs were biodegradable even when bound to a solid substrate. They have continued with model biodegradation studies using PCB-laden soil containing either Aroclors or pure PCB congeners. They have extended their Aroclor biodegradation studies to higher concentrations and more difficult Aroclors. In addition to their Aroclor studies they have been conducting resting-cell assays using soil-bound pure PCB congeners in an effort to define the rates of degradation of selected PCB cogeners and to determine the metabolites produced from these biotransformations. Other research topics include: modeling nonbiological sources of apparent biodegradation; and biodegrading soil-bound polychlorinated biphenyls by genetically engineered bacteria.
Key words: genetic engineering, decontamination, hydrocarbons, biodegradatin, mathematical models, decomposition, aromatics, metabolism, chlorinated aromatic hydrocarbons, soils.

Unterman, R., M.J. Brennan, R.E. Brooks and C. Johnson. 1988. Biological degradation of polychlorinated biphenyls. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp 376-386.
Key words: Bacteria, Biodegradation, Disposal, Hydrocarbons, Monitoring, Soils
The release and accumulation of polychlorinated biphenyls (PCBs) in the environment, and possible effects on human health have sparked an intensive interest in devising technologies for their destruction or safe disposal. Biodegradation of various soil-bound PCBs under a variety of conditions using both pure and mixed cultures of Corynobacterium sp., Alcaligenes eutrophus, and Pseudomonas putida, is demonstrated in this study. The authors conclude that it should be possible to biologically degrade PCBs on contaminated soil in the environment with appropriate cell

concentrations and moisture conditions. Continuing studies are now focusing on experimental conditions that most closely model an actual site decontamination process.

Unterman, R., F.J. Mondello, M.J. Brennan, R.E. Brooks, D.P. Mobley, J.B. McDermott, and C.C. Schwartz. 1987. Bacterial treatment of PCB-contaminated soils. Prospects for the application of recombinant DNA technology. In: Proceedings of the second international conference on new frontiers for hazardous waste management. 259-264:591.
The authors have assessed the efficacy of several natural bacterial isolates for decontaminating PCB-laden soil. Initial studies using Aroclor-spiked laboratory soil demonstrated extensive biodegradation by Pseudomonas putida strain LB400. More recent studies have focused on actual PCB-contaminated soil containing 525 ppm of transformed Aroclor 1242 (similar in composition to Aroclor 1248). Under laboratory conditions, 50% of these PCBs were degraded in three days, whereas using experimental conditions more suitable to an in situ application of bacteria, 50% degradation was achieved in 15 weeks. They are currently making final preparations for conducting a PCB biodegradation field test. In parallel studies they recently cloned from strain LB400 the genes which encode the first several enzymes in the pathway for PCB biodegradation. These recombinant degrading organism (this strain improvement is currently under way). They describe herein possible approaches for studying the biodegradation of soil-bound PCBs by genetically-e.
Key words: biphenyl, biodegradation, soils, decontamination, genes, genetic, biomass, waste processing plants, energy sources, enzyme activity, field tests.

Unterman, R., M.J. Brennan, R.E. Brooks, D.P. Mobley, J.B. McDermott, C.C. Schwartz. 1987. Bacterial degradation of PCBs in soil. In: Proceedings of the 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. 135-138.
This paper describes biodegradation studies using PCB-laden soil containing either Aroclors or pure PCB congeners. Three bacterial isolates proved capable of oxidizing PCB's adsorbed to soil: Corneybacterium sp. MB1, Alcaligenes eutrophus H850, and Pseudomonas putida LB400. Each strain exhibited congener-specific activity; the additive effect of using a mixed culture was readily apparent from gas chromatographic profiles. Field tests at a dragstrip site where PCB oils were used for dust control showed significant PCB biodegradation in the topmost (< 1 cm. deep) soil layer. PCB's were degraded at all depths when soil was mixed after inoculation.
Key words: chlorinated aromatic hydrocarbons, biodegradation, soils, land pollution, oxidation, pseudomonas, field tests, gas chromatography, adsorption, bacteria, molecular structure, bench-scale experiments.

Urbanek, M., T. Strycek, and M. Goldner. 1988. Use of bromobenzoate for cross-adaption of anaerobic bacteria in Lake Ontario sediments for degradation of chlorinated aromatics. Proceedings of the technology transfer conference. Part B: Water quality research. 1988 technology transfer conference. 311-315.
Studies were undertaken in order to investigate the potential of

sediment microorganisms for anaerobic degradation of halogenated pollutants. Sediments were collected from sites along the Toronto waterfront in Lake Ontario. These were anaerobically incubated with monohalogenated benzoates. Following adaptation, as measured by the rate of substrate disappearance, the sediments were subsequently incubated with polysubstituted benzoates. Cross-adaptation to these complex aromatics was assessed by high pressure liquid chromatography. The findings demonstrate a potential for breakdown of halogenated contaminants by anaerobic microorganisms found in Lake Ontario sediment. This points to the feasibility of applications of preadapted microbial consortia for anaerobic degradation of xenobiotics under controlled conditions. 10 refs., 2 figs., 2 tabs.
Key words: chlorinated aromatic hydrocarbons, anaerobic conditions, sediments, decomposition, organic halogen compounds, surface waters, decomposition, organic halogen compounds.

US Dept of Energy. 1989. Environmental survey preliminary report, strategic petroleum reserve, Texas and Louisiana gulf coast. US DOE, Washington, D.C. Report No. DOE/EH/OEV-34P, 544p.
Key words: Environmental Impact, Environment, Offshore, Underground, Water Pollution, Disposal, Groundwater, Louisiana, Oil Spill, Texas

US Dept of Energy. 1990. 1989 Annual environmental report for the strategic petroleum reserve. US DOE, washington, D.C. Report No. DOE/PO/21431-T8, 150p.
Key words: Leak, Pipeline, Wastewater, Groundwater, Oil Spill

US Coast Guard. 1992. Proceedings of the 1st International Oil Spill R and D Forum, June 1 4 1992, McLean, Virginia, 342 pp.
Key words: International Cooperation, Oil Pollution, Remote Sensing
The First International Oil Spill R and D Forum was held in McLean, VA during June 1-4, 1992. Its purpose was to provide an opportunity for information exchange among the international oil pollution research community in order to promote cooperation on R and D. Cooperation on R and D is mandated by Section 7001 of the Oil Pollution Act of 1990 and Article 8 of the International Convention on Oil Pollution Preparedness, Response and Cooperation of 1990. The Forum included plenary sessions and breakout sessions on the following topics: surveillance and remote sensing, fate and modeling, chemical countermeasures, mechanical recovery, effects, decision support systems, bioremediation, in-situ burning.

US Congress Office of Technology Assessment. 1990. OTA ((Office of Technology Assessment)): No improvement in US spill cleanup response. Oil & Gas Journal. 88(17):37.
Key words: Accident, Additive, Alaska, Bulk Carrier, Containment, Diaster Control, Economic Factor, Legal Consideration, Pollution Control

USCG. 1991. (US) Coast Guard picks sites for spill response. Oil & Gas Journal. 89(31):25.
Key words: Accident, Alaska, Boom, Crude Oil, Economic Factor, Environmental Protection, Pollution Control

USCG. 1991. North Slope activity not seen hiking oil spill threat. Oil & Gas Journal. 89(13):38.
Key words: Accident, Alaska, Boom, Bulk, Crude Oil, Economic Factor, Oil Waste, Pollution Control

Usher, D. 1989. Innovative cleanup and equipment use on the Pittsburgh oil spill (by Marine Pollution Control Inc. (MPC)). In: Proceedings of the 1989 API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 85-86.
Key words: Adsorbent, Coastal Area, Pollution Control

Uthe, Edward E. 1992. Application of airborne lidar to oil-spill emergency response decision-support systems. In: Proceedings of the 1st Thematic Conference on Remote Sensing for Marine and Coastal Environments, New Orleans, LA. 1930(1) Publ by Int Soc for Optical Engineering, Bellingham, WA, USA. p 159-169.
Key words: Optical Radar, Oil Spills, Environmental Impact, Remote Sensing
Oil-spill decision-support systems are being designed to improve spill-response capability through contingency planning, training, and decision-making during emergency spill-response operations. Accurate prediction of spill behavior requires use of validated technical data bases, including environmental conditions at specific locations and environmental effects on oil spills. Although the data bases will provide input for initial emergency response decisions, real-time information on the exact state of the environment and oil spill must be rapidly input to the decision support system for it to guide the best course of action. SRI plans to demonstrate capabilities of existing airborne lidar systems to the following oil-spill applications: Detection and characterization of thin oil on water surfaces using airborne UV-lidar fluorescent and Raman scattering techniques. Development of an ocean-currents and oil-spill time-of-arrival data base using airborne lidar tracking of fluorescent dyes. Analysis of transport and diffusion of air pollution in coastal areas resulting from burning spilled oil as a remediation process. (Author abstract) 10 Refs

Vacca-Torelli, Rear Adm. Marcello, Alberto L. Geraci, and Antonio Risitano. 1987 . Dispersant application by Hydrofoil: high speed control and cleanup of large oil spills. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., 75 - 80. Baltimore, MD: Washington, DC: American Petroleum Institute. , 1987. .
Keywords - Dispersant, Hydrofoil, Control, Cleanup, Oil Spill.

Vaishnav, D. D., and E.T. Korthals. 1990. Comparative Toxicities of Selected Industrial Chemicals to Microorganisms and Other Aquatic Organisms. Archives Env Contam & Tox. 19(4):624 628.

Valocchi, Albert J., Bruce E. Rittmann, and Philippe Baveye. 1990. Analysis of microbial activity in aquifer bioremediation; degradation kinetics, clogging, and modeling. Eos, Transactions, American Geophysical Union. 71(43):1323.
Key words: Pollution, Groundwater, Biodegradation, Bacteria

van Bernem, K.H., A. Muller, J. Dorjes. 1989. Environmental oil sensitivity of the German North Sea Coast. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: environmental, oil, German, North Sea, coast.

van den Broek, W.M.G.T., and R. Plat. 1991. Characteristics and possibilities of some techniques for de-oiling of production water. In: Proceedings of the first international conference on health, safety and environment in oil and gas exploration and production, November 11 14 1991, The Hague (Netherlands), pp. 47-54.
Key words: Oil Fields, Water Treatment Plants, Pollution Control, Oil Spills
This paper discusses briefly a number of separation techniques for the treatment of water produced during oil production and gives some advantages and drawbacks. Plate separation and centrifugation are subject to investigation in our laboratory; these techniques are treated in more detail. The characteristic parameters critical oil droplet diameter and separator capacity are defined, and for both plate separation and centrifugation on example of a calculation with these parameters is given. Furthermore some results of laboratory experiments are presented. Finally, ideas for improving both the plate separation technique and the centrifugation technique are discussed. it is expected that critical oil droplet diameters of about 10 {mu}m (plate separation) and less than 1 {mu}m (centrifugation) are achievable.

van Oudenhoven, Joseph A.C.M. 1983. The Hasbah 6 (Saudi Arabia) Blowout: the effects of an international oil spill as experienced in Qatar. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.

van Drimmelen, Nico J. 1981. Design aspects of the first slicktrail dredger, the Cosmos. In: Proceedings of the 1981 Oil Spill Conference (prevention, behavior, control, cleanup), March 2 5, Atlanta, GA.
Key words: design, dredger, Cosmos.

Van Eden, Capt. A. 1983. Beach cleaning tests in the Netherlands at Hook of Holland, September October, 1980. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: beach, cleaning, Netherlands.

Van den Berg, R., J.H.A.M. Verheul, and D.H. Eikelboom. 1989. In-situ biorestoration of a subsoil contaminated with gasoline. Interim report. Rijksinstituut voor Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Report No. PB-90-247727/XAB, 32 pp.
Key words: Gasoline, Biodegradation, Decontamination, Land Pollution, Petroleum Products
The objective of the research project In situ biorestoration of an oil contaminated subsoil is to study the technical and

financial feasibility of this technique. In the report the results of the pilot plant scale column studies are given and discussed. Moreover, a description of the site and the design of the actual clean-up operation are given. In the undisturbed soil columns the gasoline was removed by two processes: leaching and (bio)degradation. By leaching predominantly the aromatic compounds were removed and especially in the first few weeks. Considerable (bio)degradation, besides leaching, was observed only in the cases of hydrogen peroxide used as additional oxygen source, recirculation of the effluent and a combination of these two. Both aromatic and especially aliphatic compounds were biodegraded.

Van Drimmelen, Nico J. 1981. Design aspects of the first Slicktrail dredger, the COSMOS. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 667 - 674. Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - Design, Dredger, COSMOS.

Van Valkenburg, M. E. 1991. Laboratory determination of gas-side mass transfer coefficients applicable to soil-venting systems for removing petroleum hydrocarbons from vadose-zone soils. Air Force Institute of Technology: Wright-Patterson AFB, OH, 87 p. Thesis.
Key words: Oil Spills, Decontamination, Remedial Action, In-Situ, Soil Venting
Contamination of the subsurface environment by organic solvents has become a national problem. The EPA's Superfund list (40 CFR Part 300, 1990) continues to grow, with continual discovery of new hazardous waste sites. Various techniques are employed to remediate these sites, including excavation and removal of the contaminated soil for proper disposal, pumping and treatment of contaminated groundwater and an organic phase if present, containment by slurries soil-bentonite cut-off barriers, in-situ biological treatment of the organic wastes, and vadose zone soil venting for gas absorption of volatiles. Each technique, or combination, may have merit at a given site. The soil venting process, an inexpensive but relatively successful technique for removal of contaminants form the vadose (unsaturated) zone, is the focus of the research.

Van Den Wijngaard, A.J., K.W.H.J. Van Der Kamp, J. Van Der Ploeg, F. Pries, B. Kazemier, D.B. Janssen. 1992. Degradation of 1,2-dichloroethane by Ancylobacter aquaticus and other facultative methylotrophs. Applied and Environmental Microbiology (United States). 58:30099-2240.
Cultures of the newly isolated bacterial strains AD20, AD25, and AD27, identified as strains of Ancylobacter aquaticus, were capable of growth on 1,2-dichloroethane (DCE) as the sole carbon and energy source. These strains, as well as two other new DCE utilizers, were facultative methylotrophs and were also able to row on 2-chloroethanol, chloroacetate, and 2-chloropropionate. In all strains tested, DCE was degraded by initial hydrolytic dehalogenation to 2-chloroethanol, followed by oxidation by a phenazine methosulfate-dependent alcohol dehydrogenase and an NAD-dependent aldehyde dehydrogenase. The resulting chloroacetic acid was converted to glycolate by chloroacetate dehalogenase.

The alcohol dehydrogenase was induced during growth on methanol or DCE in strain AD20, but no activity was found during growth on glucose. However, in strain AD25 the enzyme was synthesized to a higher level during growth on glucose than on methanol, and it reached levels of around 2 U/mg of protein in late-exponential-phase cultures growing on glucose. The haloalkane dehalogenase was constitutively produced in all strains tested, but strain AD25 synthesized the enzyme at a level of 30 to 40% of the total cellular protein, which is much higher than that found in other DCE degraders. The nucleotide sequences of the haloalkane dehalogenase (dhlA) genes of strains AD20 and AD25 were the same as the sequence of dhlA from Xanthobacter autotrophicus GJ10 and GJ11. Hybridization experiments showed that the dhlA genes of six different DCE utilizers were all locate on an 8.3-kb EcoRI restriction fragment, indicating that the organisms may have obtained the dhlA gene by horizontal gene transmission.
Key words: chlorinated aliphatic hydrocarbons, biodegradation, alcohol dehydrogenase, DNA hybridization, molecular biology.

Van Voris, P., G.W. Dawson, J.K. Fredrickson, D.A. Cataldo, L.E. Rogers, C.M. Novich, and J. Meuser. 1987. Approaches to the assessment of injury to soil arising from discharges of hazardous substances and oil. U.S. Dep Interior Report. June 1987, 68 pp.
Keywords: biodegradation, environmental imact, government, legal, liability, oil spill, response, soil pollution

Van Cleave, Henry D. 1973. Spill prevention: phase II. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: spill prevention.

Vanderhorst, J.R. 1977. Effects of a continuous low-level No. 2 fuel dispersion on laboratory-held intertidal colonies. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: low-level, fuel, dispersion, intertidal.

Vanderkooy, N.E. 1991. The Development of the Beaufort Sea shoreline cleanup response and operations manual. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: development, Beaufort Sea, shoreline, cleanup, response.

Vandermeulen, J.H., and S.E. Hrudey. 1987. Oil in freshwater: Chemistry, biology, countermeasure technology. 512(p).
Key Words: Fresh water contamination, hydrocarbons biodegradation, petroleum environmental impacts, de-adsorbents, environmental transport, ground water, leading abstract, oil spills, polycyclic aromatic hydrocarbons, runoff, sorbent recovery systems, water pollution, abstracts aromatics, chemical reactions, decomposition, document types, energy sources, fossil fuels, hydrogen compounds, mass transfer, organic compounds, oxygen compounds, pollution.

Vandermeulen, J.H., C.W. Ross. Oil spill response in freshwater

environments. Impact on the environment of cleanup practices. Health and Environmental Sciences. API Publication Number 4567. July 1993.
Key Words: API Publication, biology, business operation case history, containment, data, ecology, efficiency, environmental impact, fresh water, ground water, lake management, oil waste, pollutant, pollution control, potable water, waste material, water pollutant, water pollution.

Vandermeulen, J.H. 1992. Review of natural resource damage assessments in freshwater environments. Task 2. Effects of oil releases into freshwater habitats. Health and Environmental Sciences, API Publication No. 4514, January 1992. API Publication N.4514, 125 pp.
Key words: Animal, Biology, Characterization, Economic Factor, Environemtnal Impact, Pollution Control

Vandermeulen, J.H., P.D. Keizer, W.R. Penrose. 1977. Persistence of non-alkane components of Bunker C oil in beach sediments of Chedabucto Bay, and lack of their metabolism by molluscs. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: non-alkane, Bunker C oil, beach sediments, Chedabucto Bay, molluscs.

Vannelli, T., M. Logan, D.M. Arciero, A.B. Hooper. 1990. Degradation of halogenated aliphatic compounds by the ammonia-oxidizing bacterium Nitrosomonas europaea. Pub. in Applied and Environmental Microbiology, Vol. 56, No. 4, 1169-1171(Apr 1990).
Suspensions of Nitrosomonas europaea catalyzed the ammonia-stimulated aerobic transformation of the halogenated aliphatic compounds dichloromethane, dibromomethane, trichloromethane (chloroform), bromoethane, 1,2-dibromoethane (ethylene dibromide), 1,1,2-trichloroethane, 1,1,1-trichloroethane, monochloroethylene (vinyl chloride), gem-dichloroethylene, cis- and trans-dichloroethylene, cis-dibromoethylene, trichloroethylene, and 1,2,3-trichloropropane. Tetrachloromethane (carbon tetrachloride), tetrachloroethylene (perchloroethylene), and trans-dibromoethylene were not degraded.
Key words: halogenated aliphatic hydrocarbons, catalysis, bacteria, aerobic conditions, chemical reactions.

Vaux, W.G., S.A. Weeks, D.J. Walukas. 1971. Oil spill treatment with composted domestic refuse. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 17, Washington, D.C.
Key words: oil spill, composted.

Vecchioli, G.I., M.T. Del Panno, and M.T. Painceira. 1990. Use of selected autochthonous soil bacteria to enhance degradation of hydrocarbons in soil. Environ Pollut. 67:249-258.
Key words: Bacteria, Bioremediation, Microorganism, Soil Pollution

Velicogna, D., A. Koundakjiian, I. Beausejour, and K. Volchek.

1992. The separation of stable water-in-oil emulsions. In: Proceedings of the 15. Arctic and Marine Oilspill Program Technical Semin., June 10 12 1992, Edmonton, AB, pp. 467-477.
Key words: Oil Spills, Emulsions
A method for the separation of stable water-in-oil emulsions into clean dischargeable water and reusable oil is being investigated. The technique involves the use of a recyclable solvent and subsequent distillation and/or membrane treatment. This method would be used as a post treatment for recovered emulsions and should significantly reduce the volume of recovered oils. This paper describes results of experiments carried out on a bench scale level.

Veltkamp, A.G., A.A. De Boer. 1991. Results of biorestoration of a subsoil on an industrial site. In: Proceedings of the Inst Petrol Remediation of Ind Sites Conf, Oct 22, 1991, London, England, pp. 63-75.
Key words: Bioremediation, Groundwater, Soil Pollution, Biodegradation, Monitoring, Oil Spill

Veltkamp, A. G. and J. J. M. Mathijssen. Cleanup of contaminated soil and groundwater: a location specific cleanup operation at the Sappemeer gas production site. In: Proceedings of the First International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production, Nov. 11 14, The Hague, Netherlands. Society of Petroleum Engineers: Richardson, TX, pp. 499 504.
Key words: Groundwater, Oil Spills
This paper reports on soil and groundwater that have been contaminated with volatile aromatic hydrocarbons and mineral oil at the Sappemeer gas production site. The extent and degree of contamination were determined in an extensive site investigation. The cleanup operation has been designed so that normal plant operation can continue during the cleanup period. A combination of three techniques has therefore been selected: excavation of heavily polluted soil; vacuum extraction of the heavily polluted unsaturated zone; and groundwater abstraction in the shallow and deep aquifer at a rate of 5000,000 m (sup 3)/year. The design for the cleanup operation was finalized on the basis of test results from two pilot projects: a pumping test for groundwater abstraction and a vacuum test for vacuum extraction. The initial results of the operation, which started in October 1990, are very satisfactory. Removal of 1 kg of contaminants costs US$ 300. Clearly prevention and active monitoring of soil contamination will always be cheaper than an end of pipe solution, such as a soil cleanup operation.

Venkataramani, E.S., and R.C. Ahlert. 1988. Aerobic and anaerobic treatment of high-strength hazardous liquid wastes. Journal of Hazardous Materials. 17(2):169 188.
Key words: biotechnology, biodegradation, pollution control, microorganism
Leachate was obtained from a disposal site that had received residential, industrial and hazardous wastes. After separation of an oily floating layer, the remaining aqueous phase contained very high concentrations of dissolved salts and soluble organic matter, together with dispersed oil. Mixed microbial populations

were obtained from sewage treatment plants and acclimated to this leachate. Both aerobic and anaerobic systems were studied;bacterial growth rates and hazardous chemical utilization rates were measured. Large reductions in Dissolved Organic Carbon (DOC) were achieved with both types of cultures, however, neither was quantitative. Control of pH is important in all cases; added nutrients and the presence of a preferred carbon source appeared to be less critical. These laboratory observations suggest that sequential anaerobicaerobic reactions will be required to achieve total destruction of dissolved organic matter. (Author)

Venkatesan, M.I., I.R. Kaplan. 1989. Program of mineralization and cycling in marine systems: Organic geochemistry of particulates and sediments (CaBS): Technical progress report, November 15, 1988--May 14, 1989. 3.
The principal objective of the current on-going project is to understand the processes involved in the cycling of organic carbon in the southern California Bight. This involves the evaluation of the relative flux of planktonic carbon to the seafloor versus the import of terrestrial carbon components and the determination of the rate of decomposition of sedimenting organic matter in the water column. These goals were achieved by the chemical characterization of sedimenting particles (from traps) as well as in the near surface sediments. The organic matter in the marine regime comprises contribution from land plants, marine productivity (plankton and bacteria) as well as anthropogenic sources. At UCLA, we have been focusing on the chemical characterization of selected classes of organic carbon compounds derived from these various sources to understand the vertical flux and the chemical composition of the particulate organic matter which are controlled by complex transport, transformation, degradation and remineralization processes.
Key words: coastal waters, carbon cycle, organic compounds, spatial distribution, document types, North America, surface waters, geochemistry.

Venkatesan, M.I., E. Ruth,and I.R. Kaplan. 1990. Triterpenols from sediments of Santa Monica Basin, southern California Bight, U.S.A.: Advances in organic geochemistry 1989. II, Molecular geochemistry, Paris, France, 18-22 September 1989. 1990. Organic geochemistry. 16(4-6): 1015-1024.
Key words: California, diagenesis, biodegradation, chromatogram, biogenic origin, chromatograms, shallow-water environment, bacteria, hydrocarbons.

Venkatesh, S., T.S. Murty. 1993. Modeling the drift and spread of oil slicks in the Arabian Gulf. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: drift, spread, oil slicks, Arabian Gulf.

Venkatesh, S., H.S. Sahota, A.S. Rizkalla. 1979. Prediction of the motion of oil spills in Canadian Arctic waters. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil spills, Canadian Arctic waters.

Venkateswaran, K., H. Tanaka, S. Komukai, H. Toki, T. Iwabuchi, and S. Miyachi. 1993. Ecodynamics of oil-degrading bacteria and significance of marine mixed populations in the degradation of petroleum compounds. In: Proceedings of the 13th Bien Api et al Oil Spill (Prev, Preparedness, Response & Coop) Int Conf, March 29-April 1, 1993, Tampa, FL, pp. 427-434.
Key words: Hydrocarbon, Bacteria, Biodegradation, Bioremediation, Oil Spill, Alaska

Venosa, A.D., et al. 1993. Testing the efficacy of oil spill bioremediation products. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill, bioremediation.

Venosa, A.D. 1991. Protocol for testing bioremediation products against weathered Alaskan crude oil. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: bioremediation, weathered, Alaskan, oil.

Vervalin, C.H. 1989. Loss prevention information resources. Hydrocarbon Process. 68(6):80-82.
Key words: Accident, Business Operation, Crude Oil, Diaster Control

Vervalin, C.H. 1989. Bioremediation on the move. Hydrocarbon processing. 68(8):50-52.
Key words: Oil Spill, Bioreactor, Groundwater

Vestal, J.R. 1989. The antarctic cryptoendolithic microbial ecosystem as a model for studying microbes in shale and coal. Bayer, P.E. 1989. Bioprocessing of fossil fuels workshop. Proceedings. USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). USDOE Idaho Operations Office, Idaho Falls, ID (USA)| Idaho National Engineering Lab., Idaho Falls, ID (USA). Center for Bioprocessing Technology. 431-452:493.
In the Ross Desert (Dry Valley) region of Antarctica, there exists a complete microbial ecosystem which lives hidden within the pore spaces of sandstone (cryptoendolithic). This community is protected from the harsh Antarctic environment of adapting to living inside the rock. Studying microbes within this solid matrix has presented certain technical problems which have been overcome. This has allowed studies to be conducted which have shown the effects of the physical and chemical environment on growth and metabolism of the microbes in these rocks. Similar microbial communities have recently been discovered which can exist within the solid matrix of shale and coal. Even though the community and environment are different from the Antarctic microbes, many of the methods and hypotheses regarding their existence are the the same. Answers to questions relating how and why these microbes exist in shale and coal may have important implications for coal desulfurization, or *degradation* of the shale matrix to release hydrocarbons.
Key words: bioassay, coal, desufurization, biodegradation, oil shales, measuring, microorganisms, moisture.

Vianna, Marcio Luiz, Alexandre Pereira, and Viviane Testa. 1991. Submarine Resource Development and Preservation in the Brazilian Continental Shelf: the Impact of TM-Landsat Imagery on Formulation of Management Policies. In: Proceedings of the Environ Research Inst of Michigan/et al Proc Remote Sensing of Environ 24th Int Symp, May 27 31 1991, Rio de Janeiro, 2:947 955.
Key words: Remote Sensing, Satellite Imagery, Lobsters, Oil Drilling
Algal mats on the continental shelf off of the northeastern coast of Brazil represent an exploitable resource in the eyes of scientists and local industry; the mats also provide habitat for a lobster fishery. Underlying the mats are oil deposits, which are extracted by the firm Petrobras. Thematic Mapper Landsat imagery of the ocean bed in the region could provide important information to support analyses of lobster ecology. Prudent resource management in the region requires accurate subkilometer evaluation and reconnaissance of benthic ecosystems.

Vielvoye, Roger. 1989. Papua New Guinea poised to play a major in Far East petroleum. The Oil and Gas Journal. 87:21 25.

Vikoma International Ltd. 1990. Fast boom from Vikoma. Petroleum Review. 44(527):646.
Key words: Boom, Coastal Area, Pollution Control

Vikoma International. 1991. Oil spill containment. Marine Engineers Review. 35.
Key words: Boom, Economic Factor, Oil Refinery, Oil Pollution Control, Waste Material

Vilker, V. L. and J. B. Horowitz. 1991. Development of a bacterial monooxygenase for remediation and control of trace contaminants in aqueous systems. Proceedings of the American Chemical Society (ACS) National Meeting, April 14 19, 1991, Atlanta, GA, Paper BIOT 67.
Key words: Bacteria, Biodegradation, E. Coli, Groundwater, Waste Management
Cytochrome P-450cam monooxygenase, produced intracellularly by P. putida induced with camphor, is a highly active enzyme system with broad substrate specificity which has been well characterized. Commercial applications of interest include hazardous waste detoxification, chemical synthesis and electroenzymology. One aspect of the authors' research involves increasing biomass and enzyme productivity in culture conditions, and improving and developing extended-culture techniques. Batch, fed-batch and chemostat results will be discussed in this context. A second phase of their research is concerned with application of this enzyme system in destruction of hazardous organic pollutants, at trace levels, in groundwater and industrial wastewaters. Their intent is to increase biochemical activity by improving culture and purification methods as well as application techniques, and to evaluate and model biodegradation kinetics for process design and scale-up. Data will be presented for the batch conversion of several classes of compounds using resting cell suspensions and reconstituted enzyme obtained from E. coli clones.

Villar, H.J., W. Puettmann, M. Wolf. 1988. Organic geochemistry and petrography of Tertiary coals and carbonaceous shales from Argentina. Org. Geochem.(United States). 13:4/6:1011-1021.
A series of eight Tertiary coal and carbonaceous shale samples with vitrinite reflectance values between 0.50 and 0.58% were extracted, fractionated and the saturated and aromatic hydrocarbons analysed for characteristic components by GC and GC-MS. Additionally, a microscopical study was undertaken in order to obtain a more precise picture of the samples under investigation. The saturated hydrocarbon fractions displayed the typical n-alkane distribution for coals of this rank, with CPI values between 2.0 and 3.1. Among the branched/cyclic compounds, pristane and ..cap alpha.., ..beta..-homohopane were recognised as relevant components pointing to an oxic depositional environment. Detection of benzohopanes (C/sub 32/-C/sub 35/) in the aromatic hydrocarbon fractions suggests that bacteriohopanetetrol was a significant constituent of the coal biomass. Taking into consideration the Pr/Ph ratios, ash contents and microscopical characteristics of the samples, aspects of the possible degradation of hopanetetrol to homohopane are discussed. Resin-derived diterpenoids with the phyllocladane and kaurane skeleton were tentatively identified and, although minor compounds, they are interpreted to be a sign of the contribution of Podocarpaceae and Araucareaceae to the coal swamp. Aromatic compounds were dominated by alkylnaphthalen derivatives, presumably formed by C-ring cleavage and aromatisation of higher plant-derived pentacyclic triterpenoids, which were main components in the high-boiling range of the fractions investigated. Angiosperms (especially Fagaceae) are postulated as source for these polycyclic compounds and, hence, for some of the polyalkylated aromatic bicyclics detected.
Key words: coal, organic matter, oil shales, structural chemical analysis, geochemistry, fossil fuels, chromatography, mass spectroscopy, alkylated aromatics, ash content, bitumious materials.

Villar, Hector J. and Wilhelm Puettmann. 1990. Geochemical characteristics of crude oils from the Cuyo Basin, Argentina. Organic Geochemistry. 16(1-3):511-519.
Key words: Argentina, Hydrocarbons, Bacteria, Degradation

Villaume, J.F., B.H. Herre, D.P. Voykin. 1979. Cleanup of an oil spill into ground water at Williamsport, Pennsylvania: a case history. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: cleanup, oil spill, Pennsylvania.

Viney, I., and R.J.F. Bewley. 1990. Preliminary studies on the development of a microbiological treatment for polychlorinated biphenyls. Archives Env Contam & Tox. 19(5):789-798.
Key words: Biodegradation, Soil Contamination, Groundwater, Bacteria, Hydrocarbons
A three-part study was done to assess PCB degradation. The ability of microorganisms to degrade known mixtures of PCB congeners was assessed using bacteria found in contaminated

sludge or soil. Of the several strains tested, two from contaminated soil, BTL331 and BTL333, degraded compound containing 2-5 chlorine atoms, except at the 4,4' position. Hexachlorobiphenyls were not degraded by these organisms. The other microorganisms, and the fungus Phanerochaete chrosysporum, were able to degrade the more stubborn congeners. Subculturing of organisms on media containing biphenyl enhanced degradation capability. The ability of four surfactants to desorb PCBs from sand was also studied. TritonX-100 was an efficre discussed. Type II methanotrophs are especially suitable for environmental remediation of chlorinated ethylene wastes. The ability of these organisms to degrade low molecular weight halogenated hydrocarbons is linked to the synthesis of soluble methane monooxygenase, which is regulated by copper concentration and the cell mass in a growing culture.

Violette, G. G., K. T. B. MacQuarrie and A. J. Valsangkar. 1991. Fuel oil leak, Smythe Street School, Fredericton, N. B. Site characterization and emergency remedial action. In: Proceedings of the First Canadian Conference on Environmental Geotechnics, May 14 16, Montreal, Canada. BiTech Publishing: Vancouver, BC, pp. 363 370.
Key words: Oil Spills, Bioremediation, In-Situ, Groundwater, New Brunswick, Land Pollution
A sudden leak of ca 5500 liters of fuel oil occurred at the Smyth Street School located ca 300 m east of the city water supply in Fredericton, New Brunswick. The local hydrogeological conditions indicated that the release of hydrocarbons posed a threat to the supply of groundwater extracted by the city production wells. To understand and control the potential effects of the leak, immediate remedial action included removal of the leaky reservoir, characterization of the site soils and the local groundwater regime, and installation of a 305 mm diameter, 16.7 m deep recovery well to collect free product and/or dissolved hydrocarbons. Less than 50 liters of oil was recovered by pumping. Laboratory soil retention tests were carried out on the site soils and results indicated that the mass of fuel oil should be retained by the surficial unsaturated sandy soil. In addition to the recovery well, a combination of soil venting and bioremediation was implemented as part of the in-situ remediation. There are no indications that the loss of hydrocarbons has affected the supply of groundwater to the city well field. 9 refs., 9 figs., 1 tab.

Viraraghavan, T., and G.N. Mathavan. 1988. Treatment of Oil-In-Water Emulsions Using Peat. Oil chem pollut v 4, no 4, pp 261-280.
Key words: oil skimming, contamination, emulsion, emulsion treater, mixture, oil in water emulsion, oil spill, oil water separation, oil water separator, organic matter, peat, physical separation, separation equipment, water pollution, additive, adsorbent, adsorber, adsorption, adsorption capacity, adsorption process, area, buildings, chart, control, crude oil, data, demulsifier, diagram, effluent control, environmental data, experimental data, filter, filtration, graph, industrial plant, laboratory testing, mineral oil, oil refinery, oil waste, oil waste fate, petroleum, petroleum fraction, pollution control,

removal, sorbent, sorption, sorption process, specific surface, surface area, table (data), testing, waste material, waste water, ecology & pollution

Vogelsang, K.G. 1991. Nonpoint-pollution discharge permit testing and control strategies at Naval Air Station Whidbey Island. Master's thesis. Washington Univ., Seattle, WA. Report No. AD-A-240648/6/XAB, 76p.
Key words: greases, ecological concentration, military facilities, pollution, oils
The purpose of this study was to analyze systematically a nonpoint storm water monitoring program at Naval Air Station Whidbey Island, Washington, to determine if more relevant data can be obtained at lower cost by revising the sampling location, frequency, or pollutants of interest. Current remedial investigations of contaminants in sediments, station hazardous material use information and station management plans provided the bulk of the data. Review of watersheds indicated that potential contamination by 26 compounds may be present in the storm runoff. Testing to identify the presence of these compounds is required to renew an existing National Pollution Discharge Elimination System permit for the air station. It was also found that the frequency of sampling could be reduced from 52 events per year to about 30 with no significant loss of statistical accuracy, thereby reducing the recurring cost of the sampling program. Also discussed are management practices and structural improvements that are technically feasible for controlling the two most significant pollutants, oil and grease and suspended solids. Best Management Practices are recommended to prevent or clean the spill of aviation fuel at the spill location. Use of synthetic oil-sorbent booms is recommended in lieu of the existing baffle treatment system.

Volkering, F. Breure, A. M. Sterkenburg, and J. Van Andel. 1992. Microbial degradation of polycyclic aromatic hydrocarbons: effect of substrate availability on bacterial growth kinetics. Applied microbiology and biotechnology. 36(4): 548-552. Federal Republic of Germany.
Key words: polycyclic aromatic, compound, biodegradation, kinetics, microorganism growth, microorganis, culture, solubilization, availability, theoretical study, bacteria, pollutant.

Volkman, J.K. 1988. Pigment and lipid compositions of algal and bacterial communities in Ace Lake Vestfold Hills Antarctica. Hydrobiologia (1988): 165(0).
Key words: Antarctica, bacterial, hydrocarbons, degradation.
The compositions of carotenoids, chlorophylls and lipids at four depths in Ace Lake have been determined as a means of studying the vertical zonation of species in the lake and for comparison with the lipids found in the bottom sediments. The four major species of phytoplankton found in the lake were identified by electron microscopy. The most abundant phytoplankter was Pyramimonas gelidicola McFadden (Chlorphyta, Prasinophyceae) which occurred in greatest numbers at 10 m, the base of the oxylimnion. The pigments and lipids at this depth were mainly derived from this alga. At 11 m (the top of the anoylimnion) only

traces of lipids and pigments attributable to P. gelidicola were found, indicating only limited settling of algal cells through to the anoxylimnion, at least in summer. The pigments at 11 m were dominated by bacteriochlorophylls c derived from green photosynthetic bacteria Chlorobium spp. These pigments were also abundant at 23 m suggesting the presence of intact bacterial cells which had settled out from higher in the water column. Major non-polar lipid classes in the sediments included sterols, alcohols, hydrocarbons and an unusual suite of very long-chain unsaturated ketones and esters which have not previously been reported from antarctic environments. Several novel compounds, not found previously in either sediments or organisms, are reported. These include tri- and tetra-unsaturated straight-chain C39 methyl ketones and C40 ethyl ketones and the methyl ester of a tetra-unsaturated straight-chain C36 fatty acid. The distributions of lipids in the sediment were markedly different from those in the water column indicating extensive bacterial degradation and recycling of labile lipids.

Von Chong, Cesar, John C. Gordon, and Ricardo Gutierrez. 1983. The Texaco Connecticut's oil spill incident in the Panama Canal. In: ProceedVon Chong, Cesar, John C. Gordon, and Ricardo Gutierrez. . The TEXACO CONNECTICUT's oil spill incident in the Panama Canal. . In Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., 369 - 370. San Antonio, TX. : Washington, DC: American Petroleum Institute.
Keywords - TEXACO CONNECTICUT, Oil Spill, Panama Canal.

Vorbach, Cdr. Joseph E., Lt. Joseph F. Ahern. 1979. The internationalization of superfund. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: internationalization, superfund.

Voskamp, Wayne E. 1993. Pre-spill dispersant authorization in the Gulf of Mexico. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: dispersant, authorization, Gulf of Mexico.

Vrvic, M.M., V. Matic, J. Vucetic, and D. Vitorovic. 1990. Demineralization of an oil shale by Bacillus circulans siliceous bacteria: advances in organic geochemistry 1989. II, Molecular geochemistry, Paris, France, 18-22 September 1989. Organic geochemistry. 16(4-6): 1203-1209.
Key words: biodegradation, silicates, oil shale, leaching, experience, kerogen, bacteria, hydrocarbons, experimental studies, organic residues, sedimentary rocks.

Vujasinovic, S. and D. I. Matic. 1990. Subsurface soil and water pollution by diesel fuel at Bozdarevac railway station near Belgrade and remedial measures. In: Proceedings of the Pollution Protection and Control of Groundwater: IAWPRC International Seminar, Sept. 20 21, Porto Alegre, Brazil. Water Science and Technology 24(11):205 209.
Key words: Oil Spills, Water Pollution, Belgrade

An excessive pollution of groundwater and the hydrogeologic environment by naphtha and its derivatives spilled on the surface has been recorded in Yugoslavia. The similar accidents in Serbia (Obrenovac, Uzicka Pozega, Beograd-Makis, Beograd-Danube railway station, Leskovac, Bozdarevac, etc.) have increased in number in the last several years. Transportation of naphtha and its derivatives, either by road or river, from the refineries to the consumers is obviously contributing much to the environmental pollution hazard. For the wide range of use and the specific effect on groundwater, this pollutant can be taken for one of the first order. This paper discusses a case example.

Waarde, J.J., R. van der Kok, D.B. Janssen. 1993. Degradation of 2-Chloroallylalcohol by a Pseudomonas sp. Applied and Environmental Microbiology (United States). 59:2:528-535.
Halogenated aliphatic hydrocarbons are an important class of environmental pollutants. Biodegradation can be useful in clean-up of contaminated water and soil, provided efficient microorganisms are available. This study describes microbial growth on 2-chloroallylalcohol and proposes a degradation pathway. Bacteria cultures able to grow on this substrate were isolated and identified as Pseudomonas sp. Degradation of the chemical (via 2-chloroacrylic acid) was accompanied by dechlorination, indicating detoxication. The results suggest that the catabolic pathway of chloroallyalcohol and its dechlorination are specific for this chlorinated compound.
Key words: halogenated aliphatic, hydrocarbons, biodegradation, pseudomonas.

Wachett, L.P., G.A. Brusseau, S.R. Householder, and R.S. Hanson. 1989. Survey of microbial oxygenases: Trichloroethylene degradation by propane-oxidizing bacteria. Applied and Environmental Microbiology (USA). 55:11:0099-2240.
Microorganisms that biosynthesize broad-specificity oxygenases to initiate metabolism of linear and branched-chain alkanes, nitroalkanes, cyclic ketones, alkenoic acids, and chromenes were surveyed for the ability to biodegrade trichloroethylene (TCE). The results indicated that TCE oxidation is not a common property of broad-specificity microbial oxygenases. Bacteria that contained nitropropane dioxygenase, cyclohexanone monooxygenase, cytochrome P-450 monooxygenases, 4-methoxybenzoate monooxygenase, and hexane monooxygenase did not degrade TCE. However, one new unique class of microorganisms removed TCE from incubation mixtures. Five Mycobacterium strains that were grown on propane as the sole source of carbon and energy degraded TCE. Mycobacterium vaccae JOB5 degraded TCE more rapidly and to a greater extent than the four other propane-oxidizing bacteria. At a starting concentration of 20 {mu}M, it removed up to 99% of the TCE in 24 h. M. vaccae JOB5 also biodegraded 1,1-dichloroethylene, trans-1,2-dichloroethylene, cis-1,2-dichloroethylene, and vinyl chloride.
Key words: chlorinated aliphatic hydrocarbons, biodegradation, mycobacterium, metabolism, propane.

Wade, T.L. 1993. Oysters as biomonitors of the Apex Barge oil spill. In: Proceedings of the 1993 Oil Spill Conference (preven-

tion, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oysters, biomonitors, Apex Barge, oil spill.

Wagemans, L.C. Oil spillage emergency recovery floating boom for storage on oil tanker, has tubular body made of inflatable sections stored in containers around vessel deck perimeter and inflated from gas bottles in pouches in sections. Patent No. AU 915174_910321.
Key words: Boom, Carbon, Carbon Dioxide, Containment, Crude Oil, Pollution Control

Waggoner, Jeff. 1989. Canada: northern lightwaves keep giant country in touch. (development and application of photonics). Photonics Spectra. 23:128 133.

Wagner, R.B., D.R. Hampton, and J.A. Howell. 1989. A new tool to determine the actual thickness of free product in a shallow aquifer. National Water Well Association, Dublin, OH (US). 698(p):45-59.
Key Words: Ground water contamination, oil spills volumetric analysis, portable equipment performance testing, aquifers, feasible studies, field tests, petroleum, water pollution, chemical analysis, energy sources, fossil fuels, hydrogen compounds, oxygen compounds, pollution, quantitative chemical analysis.

Wahl, T., K. Eldhuset and S. A. Skoeelv. 1993. Ship traffic monitoring using the ERS-1 SAR. In: ESA, Proceedings of the 1st ERS-1 Symposium on Space at the Service of Our Environment. 2:823 828.
Key words: Oil Slicks, Remote Sensing, Synthetic Aperture Radar, Oil Pollution
A fast processing and distribution chain for ERS-1 Synthetic Aperture Radar (SAR) images was developed in Norway. Large quantities of ERS-1 images were used to assess the ship detection and wake imaging capability of ERS-1. Also, there is an ongoing campaign for detection of oil spill from ships along the Norwegian coast. Automatic detection and analysis of ships and ship wakes using the 30 m resolution SAR fast delivery product was demonstrated. For oil spill detection, 100 m resolution images of high radiometric quality are used. Ships above 120 m in length are generally seen in ERS-1 images under most weather conditions. Ships smaller than 100 m may sometimes become practically invisible in the SAR images because of the strong backscatter from the sea surface at some wind speeds. The main cause of this detection problem is the rather steep incidence angle of ERS-1. Ship wake signatures in ERS-1 images are very similar to those in Seasat images. Thge most frequent wake feature is the dark turbulent wake. Several confirmed observations of oil slicks have been reported. At low wind speed, natural surface slicks may in some cases be classified as oil slicks.

Wahl, Terje. 1991. Satellite SAR as a new tool for Coast Guard applications. In: Proceedings of the 11th Annual International Geoscience and Remote Sensing Symposium, June 3 6, Espoo,

Finland. 3:1651 1653.
Key words: Synthetic Aperture Radar, Oil Slicks, Coast Guard
Typical coastal guard operations in northern waters include monitoring fishing activity and offering assistance in emergency situations. For these purposes, the potential of detecting ships, sea ice, and oil slicks from space makes the use of satellite SAR (synthetic aperture radar) an interesting alternative. There will be a considerable Norwegian activity on testing these matters during the ERS-1 mission. Such characteristics as incidence angle and polarization, and swath width vs resolution are discussed, and it is noted that the most promising area for running ERS-1 demonstration campaigns for coast guard purposes is in the ocean zone around the Svalbard archipelago, centered at 78 deg. N, 15 deg. E.

Wakamiya, W. 1980. Shale oil-wastewater treatment by evaporation. In: Battelle Memorial Inst Rep No PNL-SA--8270, 33 Pp., 1980.
Key words: water treating, disposal, oil, recovery

Wakeham, Stuart G. 1988. Microbial alteration of organic compounds at the oxic/anoxic interface of the Cariaco Trench. Eos, Transactions, American Geophysical Union. 69(44):1137.
Key words: Hydrocarbons, Bacteria, Degradation

Waldichuk, M. 1989. Burrard Inlet (at the City of Vancouver, B.C.) oil spills. Mar. Pollut. Bull. 20(9):423-24.
Key words: Accident, Animal, Boom, Legal Consideration, Oil Waste, Pollution Control

Waldichuk, M. 1990. A (247 m BP Oil Ltd-operated) tanker (American Trader) leaks oil off southern California. Marine Pollution Bulletin. 21(5):221.
Key words: Accident, Beach, Bird, Boom, Crude Oil, Hull, Oil Waste, Pollution Control, Tanker

Waldron, Cdr. Darryle M. 1989. Financial management of pollution response effort: before, during, and after the spill. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: financial management, pollution, response.

Waldron, Darryle. 1993. A Pro-active spill response training program. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: spill response, training.

Walia, S., A. Khan and, N. Rosenthal. 1990. Constructing and applications of DNA probes for detection of polychlorinated biphenyl-degrading genotypes in toxic organic-contaminated soil environments. Applied and Environmental Microbiology. 56(1):254-259.
Key words: Bacteria, Biodegradation, Hydrocarbons, Microorganisms, Monitoring, Polychlorinated Biphenyl(PCB), Soils
Several DNA probes for polychlorinated biphenyl (PCB) 34 degrading genotypes were constructed from PCB-degrading bacteria.

These laboratory-engineered DNA probes were used for the detection, enumeration, and isolation of specific bacteria degrading PCBs. Dot blot analysis of purified DNA from toxic organic chemical-contaminated soil bacterial communities showed positive DNA-DNA hybridization with a 32P-labeled DNA probe (pAW6194, cbpABCD). Less than 1% of bacterial colonies isolated from garden topsoil and greater than 80% of bacteria isolated from PCB-contaminated soils showed DNA homologies with 32p-labeled DNA probes. Some of the PCB-degrading bacterial isolates detected by the DNA probe method did not show biphenyl clearance. The DNA probe method was found to detect additional organisms with greater genetic potential to degrade PCBs than the biphenyl clearance method did. Results from this study demonstrate the usefulness of DNA probes in detecting specific PCB-degrading bacteria, abundance of PCB-degrading genotypes, and genotypic diversity among PCB-degrading bacteria in toxic chemical polluted soil environments. We suggest that the DNA probe should be used with caution for accurate assessment of PCB-degrading capacity within soils and further recommend that a combination of DNA probe and biodegradation assay be used to determine the abundance of PCB-degrading bacteria in the soil bacterial community.

Walker, D. A. 1991. Using remote sensing imagery to locate subsurface structures in low relief basins. In: Proceedings of the Annual Meeting of the American Association of Petroleum Geologists, Apr. 7 10, Dallas, TX. AAPG Bulletin 75(3):688.
Key words: Remote Sensing, Texas, Landsat, Mapping, Petroleum Deposits
Surface indications of deep subsurface structure can be identified from remote sensing imagery. This technique can locate structures in the low relief basins of west Texas and the Gulf Coast. Interpretation of Multispectral Scanner (MSS) and Thematic Mapper (TM) Landsat and National High Altitude Photography Program (NHAP) images can identify changes in surface geology, topography, drainage patterns, and soil moisture associated with subsurface structures. In the Gulf Coast surface structures associated with salt diapirs, listric normal faults, and rollover anticlines have been identified from imagery. In west Texas, differential compaction and drape over carbonate buildups are reflected in the surface geology and can be located by image analysis. Computer manipulation improves interpretation by accuretely integrating image, surface, and subsurface data. Potential surface structures are compared by computer to geographically correlated subsurface structure, seismic, production, gravity, and magnetic maps. Image analysis can guide data acquisition relative to surface anomalies and interpreted structures in areas where little subsurface information exists. Satellite imagery is a useful exploration tool enabling the interpretation of regional structural styles and the surface geology of entire basins. Prospective structures in frontier basins can be identified from imagery when other data are lacking or of poor quality. Image analysis combined with subsurface data can be used in mature basins to locate structures overlooked by other methods. Integrating multiple image, surface, and subsurface data can identify structures that have escaped detection.

Walker, C. 1992. Outfall design aided by ocean current radar. Water & Wastewater International 7(2):27 28.
Key words: Water Pollution, Contingency Planning, Oil Spills, Remote Sensing

Walker, M. 1993. Comparison of observed and predicted changes to oil after spills. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: changes, oil, spills.

Walker, D.A. 1991. Using remote sensing imagery to locate subsurface structures in low relief basins. In: Proceedings of the Annual meeting of the American Association of Petroleum Geologists (AAPG), April 7 10 1991, Dallas, TX.
Key words: Natural Gas Deposits, Remote Sensing
Surface indications of deep subsurface structure can be identified from remote sensing imagery. This technique can locate structures in the low relief basins of west Texas and the Gulf Coast. Interpretation of Multispectral Scanner (MSS) and Thematic Mapper (TM) Landsat and National High Altitude Photography Program (NHAP) images can identify changes in surface geology, topography, drainage patterns, and soil moisture associated with subsurface structures. In the Gulf Coast, surface structures associated with salt diapirs, listric normal faults, and rollover anticlines have been identified from imagery. In west Texas, differential compaction and drape over carbonate buildups are reflected in the surface geology and can be located by image analysis. Computer manipulation improves interpretation by accurately integrating image, surface, and subsurface data. Potential surface structures are compared by computer to geographically correlated subsurface structure, seismic, production, gravity, and magnetic maps. Image analysis can guide data acquisition relative to surface anomalies and interpreted structures in areas where little subsurface information exists. Satellite imagery is a useful exploration tool enabling the interpretation of regional structural styles and the surface geology of entire basins. Prospective structures in frontier basins can be identified from imagery when other data are lacking or of poor quality. Image analysis combined with subsurface data can be used in mature basins to locate structures overlooked by other methods. Integrating multiple image, surface, and subsurface data can identify structures that have escaped detection.

Walker, John D. 1990. Review of chemical fate testing conducted under section 4 of the Toxic Substances Control Act. Chemicals, tests, and methods. In: Proceedings of the 13th Symposium on Aquatic Toxicology and Risk Assessment, April 16 18, 1989, Atlanta, GA. ASTM: Philadelphia, PA, pp. 77 90.
Key words: environmental testing, biodegradation, substances control act
Since the implementation of Section 4 (testing chemical substances and mixtures) of the Toxic Substances Control Act (TSCA), the U.S. Environmental Protection Agency (EPA) has received numerous environmental effects, chemical fate, or health effects testing recommendations for several hundred chemicals.

This paper provides information on the types and numbers of Federal Register (FR) notices that EPA has published in response to these testing recommendations. In addition, this paper provides detailed discussions of the chemicals and tests for which chemical fate testing has been conducted under TSCA Section 4 and the methods used to conduct those tests. As of 31 December 1988, 182 TSCA Section 4 FR notices (including 65 TSCA Section 4 FR notices mentioning chemical fate testing, and 15 TSCA Section 4 FR notices requesting chemical fate testing) had been published by EPA in response to numerous testing recommendations. For the 51 chemicals in the 15 TSCA Section 4 FR notices requesting chemical fate testing, test data for 105 of the requested 120 chemical fate tests had been received by 31 December 1988. The 28 test methods used for the 105 chemical fate tests were evaluated; modifications were proposed for a few test methods to improve test data reliability. (Author abstract) 13 refs.

Walker, Ann Hayward, and Donald R. Henne. 1991. The Region III Regional Response Team technical symposium on dispersants: an interactive, educational approach to enlightened decision making. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: response, dispersants.

Walker, J.D., R.R. Colwell, L. Petrakis. 1975. A Study of the biodegradation of a South Louisiana crude oil employing computer-

ized mass spectrometry. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: biodegradation, Louisiana, oil, computer, mass spectrometry.

Walker, Ann Hayward, and L. Jay Field. 1991. Subsistence fisheries and the Exxon Valdez: human health concerns. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: fisheries, Exxon Valdez, health.

Walker, John D., Louis Cofone, Jr., and Joseph J. Cooney. 1973. Microbial petroleum degradation: the role of cladosporium resinae. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, DC.
Key words: microbial, petroleum, degradation, cladosporium resinae.

Walker, John D., and Rita R. Colwell. 1973. Microbial ecology of petroleum utilization in Chesapeake Bay. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: microbial, ecology, petroleum, Chesapeake Bay.

Walkup, P.C. 1969. Study of equipment and methods for removing oil from harbor wastes. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: methods, removing oil, harbor.

Wallace, Capt. Sidney A. 1975. Legal aspects of the 1973 marine pollution convention: comments and reflections. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: legal, marine, pollution.

Wallace, R.B., D.C. Wiggert, M.D. Shabana, and L. Chevalier. 1991. Experimental observation of the effect of surfactant on an oil lens present at the capillary fringe. Eos, Transactions, American Geophysical Union. 72(17):129.
Key Words: Ground water, pollution, water treatment, physical models, transport, capillary water, experimental studies, oil spills, hydrodynamics, surfactants.

Walter, R. A., R. C. Digregorio, K. J. Kooyoomjian, and T. L Eby. 1985. An analysis of oil spills during transport. In: Proceedings of the 9th BIEN API et al. Oil Spill (prev, Behav, Contr, Cleanup) Conf, February 25 28, Los Angeles, California. Pp. 153 160
Key words: Oil Spill, Transportation

Walter, U., M. Beyer, J. Klein, and H.J. Rehm. 1990. Biodegradation of polycyclic aromatic hyrocarbons by a bacterial mixed culture. Biochemical methods for water analysis (GDCh-Workshop), presentation of cell culture technology laboratories, microbial principles in bioprocesses, applied genetics, microbial material deterioration, environmental biotechnology. Lectures. Behrens, D., Kraemer, P. 1990. <Original Series/Collective> DECHEMA biotechnology conferences. 8. DECHEMA annual meeting of biotechnologists - 61. meeting of the European Federation of Biotechnology. 489-492: 688.
The microbial degradation of polycyclic hydrocarbons (PAHs) is of particular concern for the biological treatment of contaminated soil from coal processing industries. For the enrichment of a bacterial mixed culture, that is able to degrade several PAHs, anthracene oil, a destillation product obtained from coal tar, was used as a defined model substrate. The major PAH-components of anthracene oil were naphthalene (3.5 mg/g), dibenzofuran (20 mg/g), fluorene (62 mg/g), dibenzothiophene (12 mg/g), phenanthrene (170 mg/g), anthracene (4 mg/g), fluoranthene (89 mg/g), pyrene (71 mg/g), benz(a)anthracene (0.7 mg/g) and chrysene (0.5 mg/g). The degradation of anthracene oil was examined in a 2 l fermentor under optimum conditions. During four weeks of incubation the total PAH-content of the culture fluid decreased from 395 mg/l to 0.54 mg/l. The time course of the degradation individual PAHs was investigated in batch experiments. (orig./EF).
Key words: coal gasification plants, environmental impacts, polycyclic, aromatic hydrocarbons.

Walton, B.T., and T.A. Anderson. 1992. Plant-bicrobe treatment systems of toxic waste. Current Opinion in Biotechnology. 3(3):267 270.
Key words: waste treatment, biodegradation
A review with 17 references, which focuses on microbial degradation of hazardous organic chemicals in the rhizosphere; no

attempt is made to examine the extensive literature on plant interactions with inorganic compounds or radionuclides.

Walton, W.D., H. Koseki, E.J. Tennyson, D.D. Evans, K.B. McGrattan, and H. Baum. 1993. In situ burning of oil spills: Mesoscale experiments and analysis. In: Proceedings of the Environment Canada 16th Arctic and Marine Oil Spill Technical Seminar, June 7 9 1993, Calgary, Alberta, 2:679-734.
Key words: Air Pollution, Crude Oil, Louisiana, Pollution Control

Wang, X, X. Yu, and Bartha R. 1990. Effect of Bioremediation on Polycyclic Aromatic Hydrocarbon Residues in Soil
Rutgers Univ. Environ Sci Technol V 24, NO 7, pp 1086-1089.
Key words: biodegradation, aromatic hydrocarbon, business operation, compound, contamination, diesel fuel, fuel, hydrocarbon compound, land reclamation, metabolic behavior, motor fuel, polycyclic hydrocarbon, salvaging, soil pollution, acidity/basicity, adsorbent, analytical method, bacteria, biology, chart, chromatography, control, data, experimental data, fertilizer, gas chromatography, graph, hydrocarbon analysis, identification, lime, material handling, microbiology, mixing, nutrient, oil spill, persistence, ph, physical property, physical separation, pollution control, quantitative, residue, silica gel, simulation, soil farming, solid adsorbent, solvent extraction, sorbent, table (data), testing, toxic effect, ecology & pollution

Wang, Y.H. 1987. Low cost shoreline stabilization. In: Proceedings of the 1987 Proc. Coastal & Port Engineering in Developing Countries,Second Int. Conf., (Beijing, China: Sep. 7-11, 1987), vol.I, Nanjing,China, China Ocean Press, 1987, Group A, p.404-411. (ISBN 7-5027-0052-8). The energy input to the coastal zone is expended by shaping up the nearshore bottom configuration to reach an equilibrium. This paper proposes a scheme to encourage the offshore sand to move on shore by tipping off this equilibrium. During a favourable beach accretion period the equilibrium beach profile is gently modified by removing a small amount of sand from the beach face, the energy in the coastal zone will restore the equilibrium profile by sending sand ashore. A large amount of sand volume can be derived by repeating the sand removal process. These sands are placed along the duneline and held there by sand fence and vegetation for shoreline stabilization and erosion control. This scheme also has applications in sand mining, oil spill clean up and others. A quantitative estimtural recolonization of a chronically oil-polluted mangrove soil after a de-pollution process.

Wang, J., and J. Qian. 1989. Oil shale research in China. In: Proceedings of the 22nd Colo Sch Mines Et Al Oil Shale Symp (Golden, Colo, 4/20/89)
Key words: China, oil recovery, oil disposal, petroleum

Wang, Y.T., M.T. Suidan, J.T. Pfeffer, and I. Najm. 1988. Effects of some alkyl phenols on methanogenic degradation of phenol. Appl. Environ. Microbiol.(United States). 54:5:1277-1279.
The effects of six phenolic compounds (o-, m-, and p-cresol and 2-,3-, and 4-ethylphenol) on the anaerobic biodegradation of

phenol was examined in batch methanogenic cultures. Results showed that ethylphenols were more inhibitory of phenol degradation than were cresols. The inhibitory effects of the three isomers of cresol and ethylphenol did not vary with the isomer but rather with the substituted functional group.
Key words: methane, biosynthesis, phenols, batch culture, inhibition, anaerobic digestion, waste management, bioconversion, hydroxy compounds, alkanes, aromatics, bacteria, waste processings.

Warburton, J.G., and J.F. Hurst. 1990. Small diameter dual pump pollutant recovery system. Patent No. US 4934458900619, 27p.
Key words: Groundwater, Oil Spill, Tank, Storage Facility, Water Pollution, Soil Pollution

Ward, C.H., J.T. Wilson, D.H. Kampbell, and S. Hutchins. 1993. Performance and cost evaluation of bioremediation techniques for fuel spills. S. Kerr Environmental Research Lab. Environmental Protection Agency, Ada, OK. Report No. PB-93-175545/XAB, 10p.
Key words: Oil Spills, Biodegradation, Cost, Groundwater, Pollution Control
Soils and ground water beneath the US Coast Guard Air Station at Traverse City, MI, have been contaminated with separate spills of aviation gasoline and JP-4 jet fuel. Contamination from both plumes has affected a shallow water table aquifer consisting of a medium grained sand. This site has been the location of a cooperative effort between the US Coast Guard and US EPA to extensively characterize the site to determine three dimensional extent of contamination, local hydrogeology, geochemistry of the solids and water, and nature of microbial activity. Evaluation concerning feasibility and cost of three innovative bioremediation techniques has also been completed at the Air Station. One evaluation demonstrated the use of hydrogen peroxide as the electron acceptor to enhance aerobic biodegradation in a portion of the aviation gasoline area. Nitrate was used as the electron acceptor for a portion of the JP-4 jet fuel contamination. Bioventing of a second portion of the aviation gasoline contamination was the third innovative technique evaluated. Each treatment reduced benzene levels to less than 5 micrograms/l, with 25% to 60% reduction in total fuel levels. For these evaluations, bioventing had the lowest capital and operating costs, followed by nitrate addition and finally hydrogen peroxide.

Ward, C.H., J.M. Thomas, S. Fiorenza, H.S. Rifai, P.B. Bedient, J.M. Armstrong, J.T. Wilson, and R.L. Raymond. 1988. A quantitative demonstration of the raymond process for in situ biorestoration of contaminated aquifers. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection & Restoration Conf, November 9-11, 1988, Houston, TX, 2:723-743.
Key words: Bioremediation, Oil Spill, Water Pollution, Groundwater, In-situ, Microorganism, Monitoring, Coast Guard

Warner, J.S. 1975. Determination of sulfur-containing petroleum components in marine samples. In: Proceedings of the 1975 Confer-

ence on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: sulfur, petroleum, marine.

Warner, D.G. 1973. Spill prevention in offshore petroleum producing facilities. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, DC.
Key words: spill, prevention, offshore, petroleum.

Warrenchak, James Francis, and Edward Francis Phelan. 1991. Silica absorbents for oil spill clean-up. Patent No. EP 417577_A1, 5 pp.
Key words: Oil Spill Removal

Warrenchak, J.F., and E.F. Phelan. Treated Silica for Oil Absorption. Patent No. US 5037557, 4 pp.
Key words: solid adsorbent, adsorbent, coating material, contamination, environmental pollution, oil spill, silica fume, siloxane, sorbent, water pollution, (p) USA, adsorption, area, cleaning, composition, control, data, decontaminating, ecology, environment, floating, General Electric Co., inorganic, lake, lipophilic, mixing, nonmetallic coating, ocean, ocean environment, organic, organosilicon compound, particle, particle size, physical property, pollutio control, remediation, sea, selectivity, silica, sorption, specificsurface, surface area, surface property, table (data), wettability, ecology & pollution

Warrington, J.E., E.B. Forsberg, and H. Auksi. 1990. Oil Spill Clean-up Material. Eco Corp. World 90/14159, p 11/29/90, f 5/22/90, pr can 5/23/89 (Appl 600404) (b01j-020/26; c02f-001/68) pct gaz v 1990, no 27, p 8831.
Key words: oil spill, cleaning, contamination, control, environmental pollution, ethylene homopolymer, foam, mixture, pollution control, polymer, water pollution, p) world, crude oil, Eco Corp, environment, environmental impact, network, ocean environment, petroleum, physical property, physical separation, porosity, recycling, sea water, sorbent, sorption, sorption process, surface water, system (assemblage), waste material, water, ecology & pollution

Wasik, Stanley P., Robert L. Brown. 1973. Determination of hydrocarbon solubility in sea water and the analysis of hydrocarbons in water-extracts. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: hydrocarbon, solubility, sea, analysis.

Water & Environment Int. 1992. Rainbow's End. Water & Environment Int. , 2(18), p 23.
Absorbents for the removal of visible oil films on shallow water are described. Polypropylene-based absorbents are reported to be the simplest, cheapest and most effective answer to thin surface layers.They are available in the form of sweeps, booms, rolls and pads. Examples of applications are discussed. (D.W.T.)
Key words: oil spills, removal, absorption, polypropylene

Waters, Paul, and Albert F. Hadermann. 1987. The Efficiency of Elastomers in Oil Spill Cleanup. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: elastomers, oil spill, cleanup.

Waterworth, Michael D. 1987. The Laser ignition device and its application to oil spills. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: laser, oil spill.

Watkin, A.T. and W.W. Eckenfelder. 1988. Technique to determine inhibition in the activated sludge process using a fed-batch reactor. In: Proceedings of the Conference on Biotechnology for Degradation of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp. 244-259.
Key words: Biodegradation, Monitoring, Wastewater
While many toxic organic compounds have been successfully treated in laboratory activated sludge units receiving steady-state inputs, difficulty arises in plants when unsteady-state or slug inputs occur. Modeling of an activated sludge systems' response to unsteady state inputs of a known inhibitory compound is the primary focus of this paper. The fed-batch reactor technique is believed to provide an excellent method to rapidly determine unsteady-state inhibition effects of toxic organics in activated sludge. The test is quite precise and requires a minimum amount of time. Distinctly different inhibition constants were obtained for three sludges with different histories. These differences were shown to be statistically significant by Tukey's method at a global significance level of 5%. A sludge acclimated to 2,4-dichlorophenol (DCP) and glucose demonstrated a mean inhibition constant (KI) value of 17.4 mg/L. This value was significantly higher than for sludge which was previously but not currently acclimated to DCP, demonstrating an inhibition constant of 6.5 mg/L. A third sludge which like the others was acclimated to DCP, demonstrated the highest mean KI value of 40.4 mg/L. From these results it is apparent that there is no universal inhibition constant for DCP on glucose removal. The inhibition constant for DCP appears to be highly dependant on the specific enzyme system involved, which in turn is dependant on the history and population dynamics of the sludge.

Watton, Lt. (jg) Dan. 1985. A Coastal marshland rebuilding technique with Spartina alterniflora after singular seasonal oil spills. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup), February 25 28, Los Angeles, CA.
Key words: coastal, marshland, rebuilding, Spartina alterniflora, oil spills.

Watts, J.R., K.W. McLeod, J.C. Goery. 1978. Land application studies of industrial waste oils and solvents: Effects of waste oil disposal on soils and subsequent plant communities aslo fate of the waste oil. In: Du Pont de Nemours (E.I.) and Co., Aiken, SC (U.S.A.). Savannah River Lab. 18. Chicago, IL, U.S.A.:

American Society of Agronomy, 1978.
Key words: waste oil, soil, biodegradation, plant growth, environment, monitoring
Investigations to determine if mixing waste oil with soil could prove to be an environmentally acceptable method of oil disposal were begun in 1975 at the Savannah River Plant. Waste oil (21.3 1/m/sup 2/) was applied to 12 of 24 soil plots and mixed thoroughly into the top 15 cm of soil. Four fertilizer levels were applied and the plots were tilled for aeration at two and nine months after the oil was applied. Soil core samples, taken at three-month intervals, show negligible vertical migration of oil and a steady decline in oil content of the soil. One year after initial application, microbial activity was six times as great on the sites which had oil applied as on adjacent control sites without oil. Oil biodegradation was not affected by the fertilizer levels. By the summer of 1977, approximately 50% of the applied oil was lost from the soil profile through biodegradation or volatilization indicating an annual loss rate of approximately 15,000 kg/ha. Plant growth on the oil treated plots was negligible in 1975, was restricted in 1976, and productivity of a crabgrass community showed no significant difference in 1977 between oil and non-oil plots. Almost all of the vegetation was crabgrass (Digitaria sanguinalis) on the oil plots. On the non-oil plots Digitaria was the most common species, but Richardia scabra and Diodia teres were also present in significant quantities. Soil biodegradation is an environmentally acceptable method for disposal of waste oil. Oil applied to the soil did not migrate either to the water table or surface stream and appearance has been restored to pre-oil conditions. This study is continuing to evaluate the ultimate effects of the oil application.

Watts, J.R., T.V. Crawford. 1978. Oil biodegradation study. In: Savannah River Laboratory environmental transport and effects research. Annual report, 1977. 41 43.
Key words: biodegradation, oil, disposal, industrial wastes, soils
Waste lubricants and other organic liquids are a byproduct of most large industrial complexes. These materials are discarded by two methods: ponding (biodegradation) or burning. Both techniques have environmental impacts. Oak Ridge, Tennessee, and Deer Park, Texas, studies found oil biodegradation in soil is acceptable for routine oil disposal. At the Savannah River Plant (SRP), most waste oils are burned in an onsite power plant as a supplemental energy source to coal. However, some organic fluids are not acceptable for burning because of chemical or heavy metal contamination. In July 1975, Savannah River Laboratory (SRL) began investigating oil biodegradation in soil as a method to dispose of nonburnable organic liquids. To be an acceptable method, biodegradation must permit no oil migration to the water table of to surface streams during the degradation process and must allow the restoration of the fertility and appearance of the land to the preapplication level.

Watts, R.J., P.N. McGuire, and R.E. Hoeppel. 1993. A simple method for conducting laboratory treatability studies to assess potential for in situ bioremediation. Biotechnology techniques.

7(5):385-390.
Key words: Hydrocarbon, Petroleum, Biodegradation, In-situ, Bacteria
A simple, sealed flask system for conducting laboratory treatability studies to assess potential for in situ bioremediation was developed, evaluated, and compared to treatability studies which were open to the atmosphere. The treatability studies were conducted in 40 ml volatile organic analysis (VOA) vials fitted with Teflon septum caps. Contaminant loss was significantly less in the sealed-flasks relative to systems open to the atmosphere.

Weaver, J. W., B. K. Lien, R. S. Kerr and R. J. Charbeneau. 1991. Exposure assessment modeling for hydrocarbon spills into the subsurface. In: Proceedings of the Annual Colloid and Surface Science Symposium: Transport and Remediation of Subsurface Contaminants: Colloidal, Interfacial and Surfactant Phenomena, June 17 19, Norman, OK. American Chemical Society: Washington, DC, pp. 217 233.
Key words: Oil Spills, Groundwater, Water Pollution, Remedial Action
Hydrocarbons that enter the subsurface through spills or leaks may create serious, long-lived groundwater contamination problems. Conventional finite difference and finite element models of multiphase, multicomponent flow often have extreme requirements for both computer time and site data when applied to field scale problems. Often, data limitations result in situations where application of complex models is not scientifically justifiable. Simplified models of the separate phase flow of the hydrocarbon and its dissolution into groundwater may be appropriate for gaining insight into the significant phenomena, emergency response, or generic simulation for regulatory development. This paper outlines the components of a set of screening models for this problem and focuses on parameter sensitivity. Tabulated values of soil properties are used to model releases in typical soil materials. The availability of standard deviations of parameter values allows assessment of model response with regard to typical parameter variability.

Weaver, J.W., and R.J. Charbeneau. 1990. Hydrocarbon spill exposure assessment modeling. In: Proceedings of the API et al Petrol Hydrocarbons & Org Chem In Ground Water : Prev, Detection, & Restoration Conf, October 31 November 2, 1990, Houston, TX. Ground Water Manage NO 4: 233 247.
Keywords: hydrodynamic, ground water, oil spill, water pollution, biodegradation

Weaver, CWO2 David A., Cdr. Harlan Henderson. 1993. Hurricane Val in American Samoa: a case study. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: Val, Samoa.

Webb, Caroline L.F. 1985. Offshore oil production in the Baltic Sea: a coastal sensitivity study. In: Proceedings of the 1985 Oil Spill Conference (prevention, behavior, control, cleanup),

February 25 28, Los Angeles, CA.
Key words: offshore, oil, Baltic Sea, coastal.

Webb, M., and A.C. Turner. 1991. Beach cleaning trials: newhaven 1989. In: Proceedings of the 12th Bien API et al Oil Spill (Prev, Behav, Contr, Cleanup) Int Conf, March 4 7 1991, San Diego, CA, pp. 153-160.
Key words: Cleaning, Beach, Oil Spill, Crude Oil, Pollution Control, Remote Sensing

Weber, A.S., M.R. Matsumoto, J.G. Goeddertz and A.J. Rabideau. 1988. Effects of extended idle periods on hazardous waste biotreatment. In: Proceedings of the Conference on Biotechnology of Toxic Chemicals in Hazardous Wastes, August 1986, Arlington, VA, pp.221-243.
Key words: Biodegradation, Bioreactors, Groundwater, Industrial Wastes, New York
An experimental study was conducted to assess the technical feasibility of biological processes treating hazardous waste when extended periods of in-operation are imposed on operational protocol. The impetus for this study was to develop a process that could provide cost effective treatment of leachate and contaminated groundwater from a former hazardous waste handling facility in Upstate New York. Waste collection rates at the site are expected to be low and as such, intermittent process operation will be desired or necessary. Based on the reported findings of the experimental study, intermittent biological treatment can achieve significant removal of waste pollutants. In this study the rate of chemical oxygen demand (COD) removal was adversely affected by decreases in operation frequency and decreased operating temperatures. However, if reaction periods are extended, all biodegradable COD removal can be removed in bioreactors using long lag periods. Addition of powdered activated carbon was tested under one operating scenario and hypothesized to be advantageous in reducing aeration times for conditions of low temperature and extended lag periods. While the feasibility of intermittent biological treatment was studied using a groundwater contaminated with hazardous waste substances, other potential applications exist. They include: (1) leachate treatment of municipal and hazardous waste landfills; (2) industrial waste flows released on an intermittent basis; and (3) other waste sites requiring remediation.

Weeden, Scott L. 1987. PACT treatment targets toxic wastewater removal. (sludge-powdered activated carbon treatment). The Oil Daily. June 25, 1987, p.2.
Keywords: oil, petroleum, runoff, environmental aspects

Weisbrod, Roberta E. 1991. Case histories of major oil spills in the kills: government response. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: oil spills, kills, government response.

Weishaupt, M.A., S.I. Jardine, D.A. Patterson, N.P. Omsberg. 1991. Rig computer system improves safety for deep HP/HT (High Pressure/High Temperature) wells by kick detection and well

control monitoring. In: Proceedings of the SPE Offshore Europe Conf, September 3 6 1991, Aberdeen, Scotland, 1:227-234.
Key words: Automatic Drilling Equipment, Computer Control, Oil Spill, Pollution Control

Weiskopf, F.B., and M.S. Uzuner. 1977. Oil slick spreading beneath a uniform ice cover in the presence of a current. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: oil slick, ice.

Weissenfels, W., M. Beyer, J. Klein. 1990. 3 Bacterial degradation of naphthalene, phenanthrene, fluorene and fluoranthene by pure strains. Biochemical engineering, environmental biotechnology, recovery of bio-products, safety in biotechnology. Lectures. Behrens, D., Driesel, A.J. 1990. <Original Series/Collective> DECHEMA biotechnology conferences. 7. DECHEMA annual meeting on biotechnology and 58. meeting of the European Biotechnology Federations, and joint meeting of Society for Industry Microbiology (SIM). 3:867-870,578.
Polycyclic aromatic hydrocarbons (PAH) are widespread in nature due to permanent emission by natural processes like volcanism and open burnings. Nevertheless anthropogenic activities play the major role in the PAH-deposition in nature. PAH are formed mainly during industrial combustions like coke production, catalytic cracking or power generation using fossil fuels. Because of the cancerogenic and genotoxic effects of PAH the fate of these compounds in nature has been well investigated. Thus much is known about the biological metabolism of the lower condensed PAH naphthalene, phenanthrene and anthracene. Furthermore studies on the biodegradability of the higher condensed PAH were carried out in complex systems like microcosms. However there is a lack of information on the microbial degradation of the these compounds by pure bacterial cultures. Since it is known that most of the products formed during microbial metabolism of PAH are more or as toxic as the substrates, the total mineralization of pollutants is required for biological land-reclamation. Therefore we tried to isolate microorganisms being able to mineralize completely, the PAH fluorene and fluoranthene as sole source of carbon. Furthermore the physiology of PAH-degradation was investigated concerning the influence of pH and temperature.
Key words: fluorene, biodegradation, air pollution, exhaust gases.

Weissenfels, W.D., M. Beyer, and J. Klein. 1990. Degradation of phenanthrene fluorene and fluoranthene by pure bacterial cultures. Applied Microbiology and Biotechnology. (1990): 32(4).
Key words: degradation, bacterial, hydrocarbons, biodeterioration.
Bacterial mixed cultures able to degrade the polycyclic aromatic hydrocarbons (PAH) phenanthrene, fluorene and fluoranthene, were obtained from soil using conventional enrichment techniques. From these mixed cultures three pure strains were isolated: Pseudomonas paucimobilis degrading phenanthrene; P. vesicularis degrading fluorene and Alcaligenes denitrificans degrading fluoranthene. The maximum rates of PAH degradation ranged from 1.0 mg phenanthrene/ml per day to 0.3 mg fluoranthrene/ml per day

at doubling times of 12 h to 35 h for growth on PAH as sole carbon source. The protein yield during PAH degradation was about 0.25 mg/mg C for all strains. Maximum PAH oxidation rates and optimum specific bacterial growth were obtained near pH 7.0 and 30.degree. C. After growth entered the stationary phase, no dead end-products of PAH degradation could be detected in the culture fluid.

Weissenfels, W.D., H.J. Klewer, and J. Langhoff. 1992. Adsorption of polycyclic aromatic hydrocarbons (PAHs) by soil particles: Influence on biodegradability and biotoxicity. Applied Microbiology and Biotechnology (Germany). 36:5:0175-7598. Polycyclic aromatic hydrocarbon (PAH) biodegradation was investigated in contaminated soils from two different industrial sites under simulated land treatment conditions. Soil samples from a former impregnation plant (soil A) showed high degradation rates of PAHs by the autochthonous microorganisms, whereas PAHs in material of a closed-down coking plant (Soil B) were not degraded even after inoculation with bacteria known to effectively degrade PAHs. As rapid PAH biodegradation in soil B was observed after PAHs were extracted and restored into the extracted soil material, the kind of PAH binding in soil B appears to completely prevent biodegradation. Sorption of PAHs onto extracted material of soil B follows a two-phase process (fast and slow); the latter is discussed in terms of migration of PAHs into soil organic matter, representing less accessible sites within the soil matrix. Such sorbed PAHs are suggested to be non-bioavailable and thus non-biodegradable. By eluting soil B with water, no biotoxicity, assayed as inhibition of bioluminescence, was detected in the aqueous phase. When treating soil A analogously, a distinct toxicity was observed, which was reduced relative to the amount of activated carbon added to the soil material. The data suggest that sorption of organic pollutants onto soil organic matter significantly affects biodegradability as well as biotoxicity.
Key words: polycyclic aromatic hyddrocarbons, biodegradation, pollution control, abandoned sites.

Welch, J., A.M. Stolls, D.S. Etkin. 1991. Worldwide oil spill trends. In: Proceedings of the 1991 Oil Spill Conference (preven-

tion, behavior, control, cleanup), March 4 7, San Diego, CA.
Key words: oil spill.

Welch, Jeff, and Faith Yando. 1993. Worldwide oil spill incident database: recent trends. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: oil spill, database.

Weldon, Roy A. 1979. Biodisposal farming of refinery oily wastes. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: biodisposal, oily wastes.

Wellbaum, E.W. 1973. Oil spill prevention Measures for the Trans-Alaska Pipeline System. In: Proceedings of Joint Conference

on Prevention and Control of Oil Spills, March 13 15, Washington, D.C.
Key words: oil spill, prevention, Alaska pipeline.

Wells, S.L. 1990. Extraction system with a pump having an elastic rebound inner tube. Patent No. US 4974674901204, 24p.
Key words: Groundwater, Oil Spill, Water Pollution

Wells, G.G., and K.L. Crook. 1989. Nonwoven Oil Absorbing Material and Method. Hollingsworth Wheels Inc.
US 4832852, c 5/23/89, f 4/6/87 (Appl 34449) (c02f-001/40; e02b-015/04) (7 pp; 20 claims)
Key words: oil skimming, absorbent, cellulose, control, fabric, oil spill, oil water separation, physical separation, pollution control, sorbent, (p) USA, absorption, barge, belt, business operation, chart, collecting agent, collector, compression, construction material, contamination, decontaminating, diagram, ecology, environment, fiber, Hollingsworth Wheels Inc., lipophilic, manufacturing, marine transportation, natural resin, ocean environment, oil waste, oil water separator, physical property, raw material, reel, salvaging, separation equipment, sorption, surface property, transportation, waste material, waste oil recovery, water pollution, wettability, ecology & pollution

Wells, S.L. 1989. Pressure extraction pump system for recovering liquid hydrocarbons from ground water. Patent No. US 4826406890502, 13p.
Key words: Groundwater, Pump, Oil Spill, Water Pollution

Wells, J., D. Brinkman, and K.Q. Stirling. 1988. Groundwater contamination from refinery operations : final report. US Dep. of Energy, Washington, D.C. Report No. NIPER-274, 42p.
Key words: Water Pollution, Groundwater, Oil Refinery, Biodegradation, Oil Spill

Wells, R.C. 1991. Apparatus and method for separating and removal of floating pollutants from a water surface. Patent No. US 5022987910611.
Key words: Oil Skimming, Contamination, Environmental Pollution, Oil Spill

Welsh, S. 1992. Assessment and management of risks to the environment. In: Proceedings of the Inst Chem Eng Major Hazards Onshore & Offshore Symp, October 20 22, 1992, Manchester, England. ICHE Symp Ser No. 130:85 110.
Keyword: biodegradation

Wendel, Thearin R., Sandra K. Novotny. 1989. Facility self-inspection components. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: inspection.

Werner, P. 1989. Experiences in the use of micro-organisms in soil and aquifer decontamination. In: Kobus, H.E., and W. Kinzelbach (eds.). Contaminant transport in groundwater. Proc. symposium, Stuttgart, 1989, pp. 59-63.

Key words: Decontamination, Soil Pollution, Microorganism, Hydrocarbon, Degradation
Because of the decreasing capacity of land fill, especially for hazardous wastes, there is a high interest in biological treatment of contaminated soil by in-situ and on-site measures. Microbial degradation is a natural process which leads to a mineralization of the pollutants by low energy consumption. The application of biodegradation in the case of soil polluted with hydrocarbons is presented. The requirements of the contaminated sites are discussed. Besides the problems of biodegradation the problems of the availability of the pollutants for the bacteria are pointed out and ways to achieve a higher efficiency are demonstrated. -Author.

West, Mark and Allister Brown. 1987. Computer software packages for oil spill contingency planning. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: computer, oil spill contingency planning.

Westergaard, R. H. 1989. How can we cope with the blowout risk? In: Proceedings of the 1st Scanews et al. Fish & Offshore Petrol Exploit Int Conf (PETROPISCIS), September 23 25, Bergen, Norway.
Key words: Blowout, Oil Spills, Arcitc Ocean, Barents Sea, Contingency Planning, Risk Analysis

Westergaard, R.H. 1987. Oil pollution control in the years 1987-2000. In: Proceedings of the Conference on oil pollution control towards the year 2000, September 23 25 1987, Bergen, Norway, p. 30.
Key words: oil spills, cleaning, coastal waters, oil retention booms, pollution control equipment, skimmers, risk assessment, skimmers
Changes to be expected in oil pollution control are: Preparedness based on booms and skimmers will be given up for use on the open ocean. It will still be used in coastal waters but to a lesser extent. Dispersion from boats will be more used in smaller spills. Underwater oil blowouts will be dispersed by injecting dispersants into the well. Dispersion of oil on the sea far from land using airplanes, will be given up. Emphasis will skift from corrective to preventive measures. In connection with petroleum drilling it is expected that the responsible authorities will define three danger classes, based on the probability of blowout and the oil spill damage potential. The required preparedness and the restrictions posed will, more than today, be tailored to meet the actual risk. Risk analysis and computer aided risk management will gradually be introduced to the offshore industry in order to be able to manage the continuously changing risk level. The ''freedom'' to pollute the waters, enjoyed by commercial ships, will be drastically reduced. 13 refs.

Westergaard, Rich H. 1977. Underwater blowout oil connection. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: underwater, blowout, oil.

Westerholm, Lt. Cdr. David G., Lt. David H. Dickey. 1989.

Comparing monitoring efforts and oil transfer spill occurrence. In: Proceedings of the 1989 Oil Spill Conference (prevention, behavior, control, cleanup), February 13 16, San Antonio, TX.
Key words: monitoring, oil transfer spill.

Westerlind, J., and M. Parsons. 1993. A remote oil spill detection system. In: Proceedings of the 1992 fuel oil utilization workshop, October 14 15 1992, Atlanta, GA, 3.165-3.171. (297 pp.).
Key words: Oil Spill Detection, Remote Sensing, Water Pollution Monitors
Early detection of spills during loading/unloading of crude oil or petroleum products is essential for quickly stopping the spill, and minimizing its impact. Such detection is particularly difficult at night or in remote areas. While a number of passive and active sensors have been discussed in the literature, no reliable, inexpensive system for this application has been identified in today's market. A market search conducted by Exxon Research and Engineering Company (ER E) in 1990 for oil spill detectors, uncovered several potential devices that had been developed in past years. However, they were no longer in production or were not applicable in tidal or river current areas. One device that appeared promising was an oil spill detection buoy system that had been developed and successfully tested in the early to mid-1970s by Spectrogram Corporation in North HAven, Connecticut. ER E approached Spectrogram, which agreed to re-design and fabricate an oil spill detection buoy system using state-of-the-art electronics, materials, software, etc. The project has evolved into two phases. Phase I, managed by ER E, has just been completed. During this phase Spectrogram designed and fabricated a complete prototype oil spill detection buoy system, which ER E successfully tested at its Bayway Refinery in Linden, NJ. The second phase, which is about to begin, will be managed by Con Edison. The design and development of the oil spill detection system is discussed.

Westermeyer, W.E. 1991. Oil spill response capabilities in the United States. Environmental Science and Technology (United States). 25:2:196-201.
The Exxon Valdez incident has been a catalyst for the US to reexamine its technology and policies for fighting oil spills. Many organizations are now at work on the problems highlighted by this sill, including federal and state agencies and the oil industry. It is hoped that the attention generated by the Exxon Valdez will result in fewer spills and a greatly improved capability to fight the ones that will still occur. Cleaning up a discharge of millions of gallons of oil at sea under even moderate environmental conditions is an extraordinary problem. Current national capabilities to respond effectively to such an accident are marginal at best. Response technologies must and will improve, but in addition and perhaps more importantly, many improvements can be made in the way the country has organized itself to fight major spills. Nonetheless, prevention is still the best medicine.
Key words: oil spills, emergency plans, Gulf of Alaska, land pollution control, sorbent, recovery systems, water pollution control, seas, surface waters.

Westlake, K. 1989. Cellulolytic bacteria in sanitary landfill. Lawson, P., Alston, Y.R. 1989. Landfill microbiology: R and D workshop. pp. 20-33, 179.
The objectives of this study are to provide information on the bacterial species responsible for the anaerobic degradation of cellulose, as paper, in landfills, with the ultimate aim of enhancing the rate and extent of cellulose breakdown within landfill, thereby resulting in greater production of methane gas. Enhanced methanogenesis would greatly increase the capacity for generation of electricity from landfill gas and render energy production from this renewable resource a more economically viable proposition. (author).
Key words: sanitary landfills, biodegradation, anaerobic conditions, cellulolytic activity, cellulose, paper.

Westree, Barbara. 1977. Biological criteria for the selection of clean-up techniques in salt marshes. In: Proceedings of the 1977 Oil Spill Conference (prevention, behavior, control, cleanup), March 8 10, New Orleans, LA.
Key words: biological, cleanup, marshes.

Wetzel, R.S., C.M. Durst, D.H. Davidson, D.L. Sarno. 1987. In-situ biological treatment test at Kelly Air Force Base. Volume 2. Field test results and cost model. Final report, 1 June 1985-31 May 1987. Science Applications International Corp., McLean, VA (USA). 171.
The objective of this effort was to field test in-situ biodegradation to treat aquifer contaminants. In-situ biodegradation is enhanced by stimulating in indigenous subsurface microbial population by the addition of nutrients and an oxygen source to promote degradation of organic contaminants. In-situ treatments affects contaminants with a mixture of organic and inorganic chemicals. The treatment system consisted of an array of nine pumping wells and four infiltration wells. These wells circulated groundwater and transported the treatment chemicals throughout the 2800-square-feet treatment area. Oxygen was supplied by means of a hydrogen peroxide solution. Nutrients were principally ammonium and phosphate salts. The system was operated for 9 months. Data showed evidence of both aerobic and anaerobic biodegradation. Decreases in tetrachloroethylene and trichloroethylene concentrations in groundwater correlate with anaerobic microcosm tests. Aerobic biodegradation was indicated by acid and carbon dioxide production, and increases in petroleum hydrocarbon concentrations in groundwater, However, any biodegradation of these hydrocarbons was too small to be quantified. The study confirms that indigenous bacteria can be enhanced to degrade organic contaminants. The problems with in situ treatment are primarily those of delivery of chemicals and minimizing adverse reactions between injection chemicals and subsurface minerals.
Key words: aquifers, water pollution, biodegradation, biology, bacteria, minerals, pollutants, progress reports, chalcolgen, bacteria, hydrogen peroxide, minerals, carbon dioxide, chlorine compounds, field tests, chemical reactions.

Whidden, M.B. Inflatable boom deployed for containment of oil

spills, boom is stored on reels and deployed, sections are joined and inflated by tubing connected between valves in each section. Patent No. US 571148_900823.
Key words: Beach, Boom, Chlorohydrocarbon, Containment, Oil Waste, Pollution Control

Whidden, M.B. Valve assembly for inflation-deflation of floating spill containment boom, in which valve is cylinder with ports and has sliding diaphragm which is spring closed and opened by the inflation air pressure. Patent No. US 804588_911210
Key words: Air, Blower, Boom, Chlorohydrocarbon, Economic Factor, Oil Waste

Whidden, M.B. Carrier vessel contg. rapid deployment boom for contg. oil spills, in which boom sections are stored on reels in the carrier hold, reels are unwound by drive wheel on hydraulic crane allowing deployment of two boom sections simultaneously. Patent No. US 804410_911210.
Key words: Boom, Cap, Containment, Economic Factor, Hydraulic System, Pollution Control, Waste Material

Whidden, M.B. Reel assembly esp. suitable for holding section of oil boom, includes two or more parallel inflatable chambers joined by weighted curtain and number of reels are compactly arranged in vessel hold. Patent No. US 804409_911210
Key words: Blower, Boom, Internal Combustion Engine, Pollution Control Equipment, Skimmer, Waste Material

Whipple, Cdr. F.L. 1993. A Program approach for site safety at oil spills. In: Proceedings of the 1993 Oil Spill Conference (prevention, preparedness, response), March 29 April 1, Tampa, FL.
Key words: safety, oil spills.

White, I.C., J.A. Nichols, M.J. Garnett. 1979. Ten-year overview of oil spill cleanup at sea. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil spill cleanup, sea.

White, I.C., and J.A. Nichols. T he cost of oil spills. In: 8th Bien API, EPA & U.S. Coast Guard Oil Spill (Prev, Behav, Contr, Cleanup) Conf (San Antonio, 2/28/83 3/3/83).
Key words: oil spill, cost analysis, disposal, oil, legal, liability, soil

White, Capt. W.W., Lt. (jg) J.T. Kopeck. 1979. Oil spill control and abatement techniques used at the SS Sans: ENA explosion site: a Coast Guard perspective. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: oil spill, control, abatement, SS Sansinena, Coast Guard.

White, Jan, and Terrie Williams. 1991. Saving endangered species in major oil spill cleanup efforts. In: Proceedings of the 1991 Oil Spill Conference (prevention, behavior, control, cleanup),

March 4 7, San Diego, CA.
Key words: endangered species, oil spill cleanup.

White, Cdr. James R., Lt. Cdr. Richard E. Schmidt. 1983. United States Coast Guard progress in oil spill surveillance. In: Proceedings of the 1983 Oil Spill Conference (prevention, behavior, control, cleanup), February 28 March 3, San Antonio, TX.
Key words: United States Coast Guard, oil spill, surveillance.

White, Lt. Cdr. James R., Lt. Richard E. Schmidt, Lt. William E. Plage. 1979. The Aireye remote sensing system for oil spill surveillance. In: Proceedings of the 1979 Oil Spill Conference (prevention, behavior, control, cleanup), March 19 22, Los Angeles, CA.
Key words: aireye remote sensing, oil spill surveillance.

White, Lt. G.P., Lcdr. A.V. Arecchi. 1975. Surveillance systems: a summary of the Coast Guard's research and development activities local area pollution. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: surveillance, Coast Guard, research.

Whitney, P.M., and C.R. Greer. 1991. Evaluation and comparison of closed-loop wash-water systems. In: Proceedings of the 1ST SPE et al. Health, Safety & Environ in Oil & Gas Explor & Prod Int Conf, November 11 14, 1991, the Hague, Netherlands. 2:505 519
Keywords: biodegradation, disposal, environmental impact, legal, liability, oil water separation, recycling, regulation, soil pollution, transportation, waste water, water pollution

Whitney, P. M. and C. R. Greer. 1991. Evaluation and comparison of closed-loop wash-water system. In: Proceedings of the First International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production, Nov. 11 14, The Hague, Netherlands. Society of Petroleum Engineers: Richardson, TX, pp. 505 519.
Key words: Oil Spills, Closed-Loop Control, Groundwater
Effluent from vehicle and equipment cleaning is known to contain a variety of potential pollutants, the most common being hydrocarbons and suspended solids. Proper treatment and discharge of this effluent is a growing concern as environmental awareness increases. In the United States, discharge of this effluent to municipal sewage treatment systems requires a permit from local authorities, discharge to surface waters requires a federal permit and, in most cases, discharge to the ground is prohibited. Furthermore, discharge to ground and surface waters can cause soil or groundwater contamination resulting in property devaluation, adverse impact on human health, fines from regulatory agencies, expensive cleanup, and negative publicity. Effluent from vehicle washing typically does not meet the minimum pollutant levels allowed by regulatory agencies for discharge to surface waters or sewage treatment plants. Because of the liability associated with discharge to ground and surface waters and the difficulty in meeting municipal sewer discharge permit requirement, closed-loop wastewater treatment is an attractive

alternative to discharge. Evaluation and comparison of systems from each category constitute the basis of this paper. Factors involved in selecting a system and available water treatment technologies are discussed. The conclusion summarizes the results of the system comparison and makes recommendations for selecting and installing closed-loop water treatment systems for vehicle and equipment cleaning.

Whittaker, Harry. 1987. Laser ignition of oil spills. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: laser ignition, oil spills.

Whittaker, H. 1992. The USCG/environment Canada/ASTM standards development program. In: Proceedings from the first international oil spill R D forum, June 1 4 1992, McLean, VA, pp. 173-175.
Key words: Oil Spill Mitigation, Petroleum, Research Programs, Oil Pollution Containment
Environment Canada's Emergencies Engineering Division (EED) has been charged, as a result of the Public Review Panel on Tanker Safety and Marine Emergency Response report, with increased R D in marine oil spills. This activity will, of necessity, include development of standards and guidelines for the testing and/or usage of oil spill cleanup equipment. The United States Coast Guard (USCG) has been charged with implementing the provisions of the Oil Pollution Act of 1990 (OPA-90), as it pertains to marine transportation vessels and facilities. Among the provisions are requirements for vessel and facility owners and operators to develop comprehensive response plans that specifically match response resources to spill removal requirements. Meeting the response plan provisions of OPA-90 requires common standards for testing, selecting and assigning resources to anticipated response needs and objectively evaluating response plans for adequacy. In August of 1991, the USCG OPA-90 office approached ASTM to determine the feasibility of developing standards through that organizations procedures. Meetings were then held between the OPA-90 staff and members of the ASTM Committee F-20 on Hazardous Substances and Oil Spill Response. An agreement was reached to commence standards development in the areas of: Barriers, Skimmers, Treating Agents, Pumps, Beach Clean-up, Sorbents, Bioremediation, In-situ Burning, Temporary Storage Devices, Communications, Remote Sensing. It was recognized that ASTM and other organizational standards existed in several of these areas, but there were those where none were known to exist. Standards development was, therefore, expected to be a complicated and time-consuming process. Both the USCG OPA-90 and EC/EED offices required standards to be developed quickly, without subverting the ASTM process. Mechanical containment and recovery was considered to be the primary area of concern for both groups.

Wicks III, Moye. 1969. Fluid dynamics of floating oil containment by mechanical barriers in the presence of water currents. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 17, New York, NY.
Key words: oil, containment, barriers.

Widawsky, Arthur. 1975. Development of harbor oil spill removal-recovery systems: Phase I. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 27, San Francisco, CA.
Key words: oil spill, removal-recovery.

Widdowson, M.A., F.J. Molz, and L.D. Benefield. 1988. Modeling multiple organic contaminant transport and biotransformations under aerobic and anaerobic (denitrifying) conditions in the subsurface. In: Proceedings of the API et al. Petrol Hydrocarbons & Org Chem in Ground Water (Prev, Detection & Restoration Conf) November 9 11, 1988, Houston, TX. 1:397 416.
Keywords: bacteria, biodegradation, ground water, oil waste, soil pollution

Wiebe, Wayne. 1987. Containment and recovery of oil from muskeg areas. In: Proceedings of the 1987 Oil Spill Conference (prevention, behavior, control, cleanup), April 6 9, Baltimore, MD.
Key words: containment, oil, muskeg.

Wiebe, Wayne O. and Paul Wotherspoon. 1991. Task force on oil spill preparedness: a canadian on-shore evaluation. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., pp. 15 - 18. San Diego, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Preparedness, Canadian, On-Shore, Evaluation.

Wiechert, J. 1991. Development of dispersant pre-approval for Washington and Oregon coastal waters. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., pp. 435 - 440. San Diego, CA.: Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Washington, Oregan, Coastal.

Wiesel, I., S.M. Wuebker, and H.J. Rehm. 1993. Degradation of polycyclic aromatic hydrocarbons by an immobilized mixed bacterial culture. Applied microbiology and biotechnology. 39(1):110-116.
Key words: Degradation, Hydrocarbons, Microorganism, Bacteria
The mixed bacterial culture MK1 was capable of degrading a wide spectrum of aromatic compounds both as free and as immobilized cells. By offering anthracene oil or a defined mixture of phenol, naphthalene, phenanthrene, anthracene and pyrene (in concentrations of 0.1-0.2 mM, respectively) as sources of carbon and energy, a specific degradation pattern correlating with the condensation degree was observed. Regarding the defined mixture of aromatic hydrocarbons, complete metabolism was reached for phenol (0.1 mM) after 1 day, for naphthalene (0.1 mM) after 2 days and for phenanthrene (0.1 mM) after 15 days of cultivation.

Wijngaard, A.J. van den, R.E. Wind, D.B. Janssen. 1993. Kinetics of bacterial growth on chlorinated aliphatic compounds. Applied and Environmental Microbiology (United States). 59:7:0099-2240.
Halogenated aliphatic compounds are frequent constituents of industrial waste gases. Because of the environmental and

biological toxic effects of these compounds, there is a growing interest in technologies for their removal. Biological waste gas purification is an option if specialized bacterial strains that use halogenated aliphatics as sole carbon and energy sources can be used. Elimination efficiency of the compounds depends not only on the process technology but on the degradation properties of the bacterial strains. Important aspects of bacterial growth are the Monod half-saturation constant and the maximum growth rate. In this study the kinetic properties of the organisms (Ancylobacter aquaticus AD20 and AD25, Xanthobacter autotrophicus GJ10, Pseudomonas sp. strain AD1) were measured during growth in continuous cultures and wer compared with the kinetic properties of the first catabolic enzyme involved in the degradation of the growth substrate. The results indicate that the growth of the strains examined followed Monod kinetics. Stains AD20 and GJ10 showed growth rates on DCE somewhat higher than predicted from the amount of haloalkane dehalogenase present in the cells, while strain AD25 was much lower. 33 refs., 3 figs., 4 tabs.
Key words: bacteria, growth, chlorinated.

Wilcox, M.J., and W. Goodman. 1992. Environmental assessments and audits are different. Amer Oil Gas Reporter. 35(3):36-40.
Key words: Environmental Impact, Environmental Pollution, Legal, Soil Pollution, Water Pollution, Government, Groundwater, Oil Spill

Wilcox, J. D. 1975. A Hydrodynamically effective horizontal oil boom. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp.363 - 364. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Hydrodynamic, Oil Boom.

Wilcox., Howard, J. Teas, Eirik O. Duerr, and J. Ross. 1987. Effects of South Louisiana Crude Oil and Dispersants on Rhizophora Mangroves. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987 in Baltimore, MD.
Key words: Louisiana, Oil, Dispersants, Mangroves

Wilkes, Daniel. 1971. State jurisdiction over oil spills in a federal system. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, June 15 - 17, 1971., 57 - 67. Washington, DC. Washington, DC: American Petroleum Institute.
Keywords - Jurisdiction, Oil Spills, Federal System.

Wilkinson, T. G. and R. McEwan. 1983. An environmental impact study and pollution contingency plan for an ecologically sensitive area in the North Sea. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983., pp. 135 - 142. San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords - Environmental Impact, Pollution, Contingency Plan, North Sea.

Willatt, R. M. 1991. The functional and safety aspects of the location of submarine pipeline risers. In: Proceedings of the Inst Mech Eng et al. Saftey Develop in the Offshore Oil & Gas Ind

Int Conf, April 23-24, Glasgow, Scot. Pp. 31-43.
Key words: Oil Spills, Pipeline, Safety

William J. Lehr, Robin W. Lardner, and Robert J. Fraga. 1987. Oil spill simulation from the Marjan offshore oil field. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp.625. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Marjan, Offshore, Oil Field.

Williams, Glen N. and Wesley P. James. 1975. Predicting the fate of oil in the marine environment. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 a 27, 1975., pp.567 - 572. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Oil, Marine Environment.

Williams, J., R. Johnson. 1987. Installation Restoration Program Phase 2. Confirmation/quantification Stage 2. Bulk fuel-storage area fuel-spill investigation. Final report, 8 February 1985-30 September 1987. 205.
Key Words: Jet fuels oil spills, military facilities waste disposal, oil spills remedial action, waste disposal water pollution, water pollution remedial action, benzene, drinking water, ground water, migration, progress report, water wells, xylenes, alkylated aromatics, document types, hydrocarbons, hydrogen compounds, organic compounds, oxygen compounds, waste management.

Williams, R.S., Jr., J. Heckman, and J. Schneeberger. 1991. Environmental consequences of the persian gulf war 1990-1991: remote sensing datasets of Kuwait and environs. Res Explor 1991. (Special Issue)
Key words: Environmental Impact, Remote Sensing, Crude Oil, Pollution Control

Willmann, J.C. 1983. Case history: OPEC (Organization of the Petroleum Exporting Companies) in southern Idaho. In: 8th Bien API, EPA & U.S. Coast Guard Oil Spill (Prev, Behav, Contr, Cleanup) Conf (San Antonio, 2/28/83 3/3/83)
Key words: oil spill, disposal, oil, liability

Wilson, J.T., D.H. Kampbell and R.S. Kerr. 1989. Challenges to the practical application of biotechnology for the biodegradation of chemicals in ground water. American Chemical Society, Division of Environmental, Chemistry, Preprints. 29(1):74-76.
Key words: Biodegradation, Coast Guard, Groundwater, Monitoring, Petroleum, Underground Tank
Results are presented of a demonstration project supported by the US EPA and the US Coast Guard on the in-situ bioremediation of fuel spill. Aviation gasoline was spilled from an underground storage tank at the Coast Guard Air Station at Traverse City, Michigan. Biodegradation of hazardous organic chemicals in groundwater is not limited by the metabolic capability of microorganisms. Practical application of biotechnology in the subsurface depends on an accurate three-dimensional understanding of the position and concentration of the contaminates, of the

hydrology of the contaminated material, and an estimate of the quantity of oxygen or other electron-acceptor required to remediate the site.

Wilson, F.D. 1990. The right material for the right job. Materials Performance. 29(2):32-35.
Key words: Chemical Plants, Safety, Oil Spills
The oil patch, while producing the raw materials that go into manufacturing thermoset epoxy and polyester resins, have created corrosion problems that are solved with the epoxy and polyester resins. The authors could call this the corrosion chain of events. The oil industry has always been aggressive testing and using materials that solve corrosion, structural, and safety problems. Without the willingness of the industry personnel to try different materials and use educated gambles, the coatings and linings industry would be 20 years behind. The Resource Conservation Recovery Act (RCRA) has the full attention of the industry. No products (even clean water) shall contaminate the soil. Secondary containment is now as important as primary containment. In the past year the authors have been exposed to more new chemical environments to protect than ever before. Prior to RCRA, the industry was satisfied with concrete containment and asphalt expansion joints to contain spills. If the concrete deteriorates, imply bust out and replace. Some companies did not even bother with this fix. There has been a tremendous increase in the use of secondary containment coatings using epoxies and polyesters to protect the environment. The criteria for selection and uses of these materials are discussed in general terms.

Wilson, K. W., E. B. Cowell, and L. R. Beynon. 1973. The Toxicity testing of oils and dispersants: a european view. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, 1973.,pp. 255 - 262. Washington, DC. : Washington, DC: American Petroleum Institute.
Keywords - Toxicity, Oils, Dispersants, European.

Wilson, B.H., J. T. Wilson, D. H. Kampbell, B. E. Bledsoe and J. M. Armstrong. 1991. Biotransformation of monoaromatic and chlorinated hydrocarbons at an aviation-gasoline spill site. Geomicrobiology 8:225 240.
Key words: Biodegradation, Oil Spills, Groundwater, Underground Storage
Loss of petroleum products from underground storage tanks, pipelines, and accidental spills are major sources of contamination of unsaturated soils, aquifer solids, and a shallow water table aquifer under the U. S. Coast Guard Air Station at Traverse City, MI, has acclimated to the aerobic and anaerobic transformation of monoaromatic hydrocarbons (BTX) released from an aviation gasoline spill. The aquifer also exhibits reductive dechlorination of a chlorinated solvent spill adjacent to the aviation gasoline spill. The groundwater is buffered near neutrality. The aviation gasoline plume is methanogenic and the aquifer contains enough iron minerals to support significant iron solubilization. Field evidence of both aerobic and anaerobic biotransformation of monoaromatics was confirmed by laboratory studies of aquifer material obtained from the site. In the laborarory studies, the removal of the monoaromatics in the

anaerobic material was rapid and compared favorably with removal in the aerobic material. The kinetics of anaerobic removal of monoaromatics in the laboratory were similar to the kinetics at field scale in the aquifer. Biotransformation of the chlorinated solvents was not observed until late in the study, when daughter products from reductive dechlorination of the chlorinated solvents were identified by GC/MS.

Wilson, Jack E. and Jack Gallagher. 1979. Cleanup of the 32,000-barrel crude oil spill at the West Hackberry dome storage site in Louisiana. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., 437 - 442. . Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Cleanup, Oil Spill, Hackberry, Louisiana.

Wilson, J. E., P. F. Nadeau, and J. S. Premack. 1975. Navy harbor oil spill cleanup: a progress report. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975., pp. 373 - 378. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Navy, Harbor, Oil Spill, Cleanup.

Wilson, Hugh B. 1981. Development and testing of a weir boom for oil recovery at sea. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 643 - 648. Atlanta, GA. : Washington, DC: American Petroleum Institute.
Keywords - Weir Boom, Oil Recovery, Sea.

Wilson, J., L. Leach, J. Michalowski, S. Vandergrift, R. Callaway. March 1990. In situ reclamation of spills from underground storage tanks: New approaches for site characterization, project design, and evaluation of performance. Environmental research conference on groundwater quality and waste disposal, Washington, DC (USA). 30.1-30.16.
Key Words: Benzene biodegradation, ground water sampling, ground water pollution, oil spills, site characterization, tolune biodegradation, xylenes biodegradation, hazardous materials spills, leaks, Michigan, storage facilities underground facilities, alkylated aromatics, chemical reactions, decomposition, Federal Region V, hydrocarbons, hydrogen compounds, North America, organic compounds, oxygen compounds, USA.

Wilson, J.T., and C.H. Ward. 1987. Opportunities for bioreclamation of aquifers contaminated with petroleum hydrocarbons. Pub. in Developments in Industrial Microbiology, Vol. 27, 109-116(1987).
Key Words: Aquifers water reclamation, ground water water reclamation, hydrocarbons biodegradation, oil spills water pollution control, microorganisms, plumes, chemical reactions, decomposition, hydrogen compounds, organic compounds, oxygen compounds, pollution control.

Wilson, John T. 1988. Degradation of halogenated hydrocarbons. Biosensors and Environmental Biotechnology (Gustav Fisher).

pp.75-77.
Key words: Biodegradation, Microorganism, Hydrocarbons, Groundwater, Wastewater, Bacteria
Understanding of microbial transformations in aquifers has exploded over the last decade. Microorganisms present in these aquifers can, in the presence of oxygen, degrade a variety of organic pollutants. But, they do not degrade many of the chlorinated hydrocarbons such as trichloroethylene and trichloroethane. Microorganisms that grow on gaseous aliphatic hydrocarbons can also degrade a variety of chlorinated solvents. The capability of the alkane-metabolizing bacteria forms the basis for an emerging biotechnology. Gaseous aliphatic hydrocarbons have advantages as the feedstock to support the accidental metabolism of the chlorinated hydrocarbons.

Wingenroth, J. 1993. Advances in data telemetry, geolocation via argos. Sea Technol. 34(8):77-83.
Key words: Data Presentation, Oil Spill, Environmental Impact, Computerized Mapping, Remote Sensing

Winterberg, R., S.M. Schoberth, and H. Sahm. Microbial degradation of protein in anaerobic two-stage wastewater treatment plants. (1990): 3b.

Winters, Kenneth and Patrick L. Parker. 1977. Water soluble components of crude oils, fuel oils, and used crankcase oils. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., 579 - 582. . New Orleans, LA. : Washington, DC: American Petroleum Institute. Keywords - Water Soluble, Oils.

Wirkowski, Edward M. 1981. Clean harbors cooperative. In: Proceedings of the 1981 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 2 - 5, 1981., 557 - 562. Atlanta, GA. : Washington, DC: American Petroleum Institute. Keywords - Clean Harbors.

Wise, N., P.A. Brunk. 1977. Black oil disposal techniques. In: Proceedings of the 1977 oil spill conference (prevention, behavior, control, cleanup) in New Orleans, LA.
Key words: burners, oil spills, disposal, Chesapeake Bay, monitoring
One of the most complex and frustrating problems encountered in any oil spill is the disposal of recovered product. This paper will discuss an alternative utilizing relatively simple and inexpensive techniques as developed in the Chesapeake Bay Spill of February 1976, in which 125,000 gallons of contaminated black oil was burned at a total cost of $7,000. This is not, however, an endorsement of burning as a more desirable method, nor an endorsement of any particular product or brand, but rather a ''limited application'' technique to be considered where warranted. Indeed, the varying degrees of air pollution problems generated and their effect on ambient air quality standards may preclude any burning at all. Other alternatives must be considered, which could be more feasible or acceptable, depending on the local problems confronted in each instance. Therefore, other methods explored and exhausted before resorting to the

brush burner are briefly mentioned, such as recycling, road use, burial, and a mechanical pit burner. The main thrust of this paper is the use of the brush burner, a compact gasoline powered propellar fan which forces a high volume air supply to sustain a fire hot enough to burn contaminated black oil. Given the requisite circumstances a relatively isolated and unpolluted area, a high water table which precluded pit-burning or burial, and very large quantities of recovered product the brush burner proved to be an efficient, convenient, and highly cost effective disposal technique.

Wise, William, R. Robinson, C. George, Phillip B. Bedient. 1990. Modeling contaminant leaching from residual oil. Ground Water Management. 4:271-280.
Key Words: Pollution, ground water, reclamation, seepage, leaching, natural resources, aquifers, transport, benzene, aromatic hydrocarbons, organic materials, toluene, xylene, ethylbenzene, partitioning, oil spills.

Witte, Sr., John Arnold. 1993. Preventive salvage: the gap in OPA pollution defenses. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., 659- 661. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Salvage, OPA, Pollution.

Witte, F. 1991. The Archimedes IIa experiment: remote sensing of oil spills in the North Sea. International Journal of Remote Sensing. 12(4):809-821.
Key words: Archimedes IIa, Remote Sensing, Oil Spills, North Sea
The need for an operational tool to detect, quantify and classify oil slicks on the sea surface increases year by year. In this field of remote sensing, the Institute for Radio Frequency Technology of the German Aerospace Research Establishment (DFVLR) has investigated different methods with active and passive microwave sensors to solve these problems. Since 1983 two European scientific experiments (Archimedes I and II) were carried out in the North Sea. Data collected from the radar systems show good ability to detect thin oil slicks and even monomolecular layers on the water surface, whereas the data collected from the microwave radiometer enables the quantity to be calculated. In this paper the DFVLR-SLAR measurements are reported. -from Author

Wittich, R.M., H.G. Tast, and H.J. Knackmuss. Degradation of naphthalene-2,6- and naphthalene-1,6-disulfonic acid by a Moraxella sp. Appl. Environ. Microbiol.(United States). 54:7:1842-1847.
A naphthalene-2,6-disulfonic acid (2,6NDS)-degrading Moraxella strain was isolated from an industrial sewage plant. This culture could also be adapted to naphthalene-1,6-disulfonic acid as growth substrate. Regioselective 1,2-dioxygenation effected desulfonation and catabolism to 5-sulfosalicylic acid (5SS), which also could be used a the sole carbon source. 5SS-grown cells exhibited high gentisate 1,2-dioxygenase activity. Neither 5SS- nor gentisate-grown cells oxidized 2,6NDS; therefore, 2,6NDS or an early metabolite must serve as an inducer of the initial

catabolic enzymes(s).
Key words: bacteria, enzyme, activity, biodegradation, sulfur compounds, chemical reactions, organic compounds, condensed aromatics, catabolism, oxidoreductases, decomposition, enzymes, hydrocarbons.

Wojtanik, D.R. 1992. Remote sensing: A tool for the coast guard to enforce pollution laws and support pollution response efforts. In: Proceedings of the 1st US Environ Protect Agency et al Remote Sensing for Mar & Coastal Environ Thematic Conf, June 15 17 1992, New Orleans, LA, 1:273-277.
Key words: Remote Sensing, Oil Spill, Water Pollution

Wojtanowicz, A.K. 1991. Oilfield environmental control technology. A synopsis. In: Proceedings of the 1991 SPE Annual Technical Conference and Exhibition. in Dallas, TX.
Key words: waste, disposal, oil, environmental protection
This overview paper discusses the scope and development of a new area in petroleum engineering: environmental control technology (ECT). This new area is defined as intrinsic in and integrated with an oilfield process and its preventive function is distinguished from the remediating nature of conventional waste disposal technology. ECT is also contrasted to waste management programs by reviewing social, legal, and economic mechanisms of the oilfield environmental compliance developed over the last decade. The mechanisms include the evolution of environmental regulation, and the technical feasibility of ECT for petroleum engineering. Oilfield processes of drilling and production are analyzed as engineering systems to identify their ECT components. Also examined are ECT methods and techniques being developed for the production process: (1) in-situ reduction of produced water (tailpipe water sink, alteration of relative permeability, and gel plugging); (2) source separation (passive and rotating hydrocyclones, crossflow filtration, disc-centrifuging, and electrolytic treatment); (3) recycling through subsurface injection (control of internal and external integrity of injection wells). Results of multiple regression analysis of existing systems for produced water treatment are also presented. The paper introduces several new concepts with the intention to help the oil industry integrate preventive measures for the environmental issue with oilfield technology. (Author abstract) 73 Refs.

Wolf, D.M., L.C. Quinn,and H.J. Reisinger II. 1989. The use of soil vapor contaminant assessments to aid in the delineation of subsurface petroleum spills. In: Proceedings of the Can Petrol Ass et al Prev & Treat of Groundwater & Soil Contamination in Petrol Explor & Prod Conf, May 9-11, 1989, Calgary, Canada, pp. 22-30.
Key words: Oil Spill, Soil Pollution, Groundwater, Hydrocarbon, Water Pollution

Wolf, Daniel E., Donald F. Kidd, and Bradley A. Legg,. 1989. A comparison of empirically generated and actual mass transfer coefficients in air stripping towers from the removal of dissolved gasoline constituents from ground water. Natl. Water Well. Assoc., Dublin, OH, United States. 441-455.

Key Words: Waste disposal, ground water, pollution, liquid waste, methods ,oil spills, aromatic hydrocarbons, hydrocarbons, organic materials, xylene, benzene, toluene, Henry's law, temperature, diffusion, rates, organic compounds.

Wolfram, J.H., R.D. Rogers, D.M. Higdem. 1992. Microbial processing of volatile organics in industrial waste streams. Journal of Environmental Science and Health, Part A: Environmental Science and Engineering (United States). A27:4:1115-1125.
A strain of Pseudomonas putida has been isolated which tolerates and metabolizes toluene and p-xylene. In the authors laboratory, this isolate has undergone selection and adaptation and presently is able to grow under a layer of 100% p-xylene. From batch studies the initial rates of degradation are 1-3 mg/min/L. This strain of P. putida also tolerates the presence of a nonionic surfactant while still maintaining its metabolic activity. Preliminary testing using this isolate under chemostat conditions indicates that the potential for developing a bioprocess to treat these waste solvents may be possible.
Key words: toluene, biodegradation, bacteria, waste processing, hydrocarbons.

Wolfram, J.H., R.D. Rogers, D.M. Higdem, and D.A. Nowers. 1990. Continuous biodegradation of waste xylene. American Society of Mechanical Engineers (ASME) winter annual meeting. 7.
Use of selected microorganisms for the degradation and/or detoxification of hazardous organic compounds is gaining wide acceptance as an alternative waste treatment technology. The INEL Biotechnology Unit is developing the technology for the in-plant treatment of waste industrial solvents. The work centers around the use of microorganisms specially selected for their ability to degrade common industrial solvents such as benzene, toluene, xylene, etc. Because these waste solvents are often contaminated with other materials (heavy metals, water, detergents, etc.) they are difficult and expensive to dispose and many times are not economical to recover through recycling. Even if the disposal option is used, the generator is still faced with continued liability in the event of mishandling or improper disposal of the waste. Biological treatments offers the option of reducing these solvents into harmless by-products provided that both the requisite microorganisms and the proper processing technology are successfully brought together. Work on the optimization of a bioreactor process for the degradation of xylene will be discussed. 15 figs., 7 refs.
Key words: xylenes, biodegradation, benzene, biochemical oxygen, solvents, pseudomonas, toluene.

Wolfson, Lt. Marc W. 1979. VLCC lightering operations in Southern California. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979., pp.119 - 120. . Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - VLCC, California.

Wollrich, G.W. 1990. Method of using a diatomaceous earth containing absorbent. C02F 1/28, 10pp. Patent and Trademark

Office, Box 9, Washington, DC 20232 (United States) ETD (Energy Technology Data Exchange), INS (US Atomindex input) IMS (DOE contractor).
A method of adsorbing petroleum oil from a petroleum oil containing material is described which comprises contacting said material with an effective amount of an adsorbent composition consisting essentially of sugar, vinegar, and diatomaceous earth combined in relative amounts which result in a composition capable of effectively adsorbing petroleum oil.
Key words: diatomaceous earth--sorptive properties, petroleum--adsorption, chemical composition, citric acid, cleaning, mixtures, oil spills, saccharose carbohydrates, carboxylic acids, disaccharides, dispersions, energy sources, fossil fuels, fuels, hydroxy acids, oligosaccharides, organic acids, organic compounds, saccharides, sorption, surface properties

Wong, J.M. and P.M. Maroney. 1990. Pilot plant comparison of extended aeration and PACT for toxicity reduction in refinery wastewater. In: Proceedings of the 44th Industrial Waste Conference, May 9-11, 1989, Chelsea, MI, pp. 685-694.
Key words: Biodegradation, Petroleum Refineries, Pollution Control, Water Pollution
During the 1970s, water pollution regulation focused primarily on controlling conventional pollutants - oxygen-demanding materials, heat, and suspended solids. These pollutants had caused severe degradation of rivers, lakes, and streams. In response to these regulations, industries and municipalities spent billions of dollars constructing facilities to control the discharge of these pollutants. By the mid-1980's, regulators considered conventional pollution problems to be largely under control. Their focus shifted to the control of toxic chemicals and toxicity in general. The case study described in this paper is an example of how one petroleum refinery is dealing with the need industrial waste managers are facing today controlling toxicity in wastewater treatment plant effluent.

Wood, P. A. 1991. Soil and groundwater remediation technology overview. In: Proceedings of the Warren spring lab, inst petrol remediation of ind sites conf (London, Engl, 10/22/91) proc pp 43-51, Oct 1991
key words: soil remediation, contamination, control, environmental pollution, land reclamation, petroleum industry, pollution control, remediation, soil pollution, water pollution.

Wood, F.S., and H. Whittaker. 1993. Oil spill and hazardous substance response equipment and systems standardization program. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 591 - 593. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Hazardous Substance, Response, Standardization.

Wood, C. 1991. Effects of wetland regulations on oil and gas exploration. In: Proceedings of the Pennwell Conf & Exhibit Co Petro-safe 91 Conf (Houston, 2/6 8/91).

Key words: wetland, legal, oil, disposal

Woods, I., T.D. Shirley, and P. H. Bottelberghs. 1991. Environmental risk in the offshore industry. In: Proceedings of the 1st SPE et al. Health, Safety & Environ in Oil & Gas Explor & Prod Int Conf., November 11-14, The Hague, Netherlands. V 2, pp. 129-137.
Key words: Risk Analysis, Oil Spills

Woods, W. B. 1991. Bioremediation of soil and groundwater impacted with organic contaminants. In: Proceedings of the American Association of Petroleum Geologists (AAPG)/ Society of Economics, Paleontologists, and Mineralogists (SEPM)/ Society of Exploration Geophysicists (SEG)/ Society of Professional Well Log Analysts (SPWLA) Pacific Section Annual Meeting, Mar. 6 8, Bakersfield, CA. AAPG Bulletin 75(2):386.
Key words: Groundwater, Oil Spills, Biodegradation, Bioremediation
Two case studies demonstrate the controlled use of microorganisms to degrade organic contaminants under aerobic and anaerobic conditions. The aerobic study illustrates the degradation of hydrocarbons in a soil matrix. Data are presented that show a two-phase degradation of total petroleum hydrocarbons (TPH) from about 1,300 ppm TPH to cleanup levels of 100 ppm or less in two months. Total aerobic microorganism and substate-specific degrader counts were tracked throughout the study. Typical total aerobic counts of 10 (sup 6) colony forming units (CFU)/g and hydrocarbon degrader counts of 10 (sup 4) CFU/g were observed. Hydrocarbon degraders were enumerated on minimal salts media incubated in the presence of hydrocarbon vapors. The anaerobic study documents the successful use of a supplemental carbon source and fertilizers to stimulate indigenous microbe to degrade ketones. A nutrient mix of s polysaccharide, a nitrate electron acceptor and an inorganic orthophosphate was used to augment 100,000 yd (sup 3) of soil contaminated with ketones at about 1,000 ppm. The key elements of a biotreatment project are discussed (i.e., site characterization, treatability studies, biotreatment design, site construction, system maintenance, final disposal, and site closure). Lastly, the benefits of bioremediation vs. other remediation alternatives such as landfill disposal, incineration, and stabilization/fixation are discussed in terms of cost and liability.

Woods, S., K. Williamson, R. Ely, K. Gardner, P. Defarges. 1987. Use of submerged aerobic biofilm processes for degradation of halogenated organic compounds. 194. National Meeting of American Chemical Society, Division of Environmental Chemistry. 41-44.
This paper describes the use of a submerged aerobic biofilm reactor for enhanced biodegradation of organic chlorine compounds. Studies were conducted under both aerobic and anaerobic conditions. Two methods of operation were used, one for the degradation of chlorinated aromatics, the other for the degradation of low molecular weight organic solvents by methane-oxidizing bacteria.
Key words: methanotrophic bacteria, metabolism, biodegradation, aerobic conditions, microorganisms, halogenated aromatic hydrocarbons, permeability, decomposition, chemical reactions,

organic solvents, membranes, chlorinated aromatic hydrocarbons.

Woodward, D. 1991. Bioremediation of Soils. In: Proceedings of Petro-Safe '91: 2nd International Environment and Safety Conference and Exhibition for the Oil, Gas, and Petrochemical Industries, Feb. 6 8, Houston, TX. PenWell Conferences and Exhibitions Co.: Houston, TX, pp. 867 874.
Key words: Bioremediation, Water Pollution, Biodegradation, Oil Pollution, In-Situ
Bioremediation of hydrocarbon contaminated soils has evolved from the refinery land treatment units of thirty years ago to the modern slurry reactors of today. Modifications in the process include engineering controls designed to prevent the migration of hydrocarbons into the unsaturated zone, the saturated zone and groundwater, and the atmosphere. Engineering innovations in the area of composting and bioaugmentation that have focused on further process control and the acceleration of the treatment process will form the basis for future improvements in bioremediation technology. Case studies for established methods that have survived this development process and continue to be used as cost effective biological treatments like engineered land farms, soil heap treatment and in-situ treatment will be discussed.

Woodward, R., and D. Ramsden. 1990. In-situ bioremediation at the French limited site. In: Proceedings of the 2nd Ist Gas Technol Gas, Oil, Coal, & Environ Biotechnol Int Symp, December 11 13, 1989, New Orleans, LA. pp. 59 66.
Keywords: bacteria, soil pollution, biodegradation, disposal, in-situ, Texas

Woodward, R., and D. Ramsden. 1989. Biodegradation of hazardous wastes at the French limited superfund site. In: Proceedings of the Pennwell Conf & Exhibit Co Petro-Safe 89 Conf, October 3 5, 1989, Houston, TX. 2:723 729
Keywords: bioremediation, biodegradation, disposal, Environment Protect Agency, government, in-situ, monitoring

Wooten, David C. 1973. Mechanical control of oil spills utilizing a streamlined boom. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, 1973., pp. 383 - 390. Washington, DC.: Washington, DC: American Petroleum Institute.
Keywords - Control, Oil Spills, Boom.

Wotherspoon, P., L. Brown, and M. Sawyer. 1993. Risk assessment of the upstream petroleum industry's oil spill response Equipment capability in Western Canada. In; Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., pp. 828. Tampa, Florida.: Washington, DC: American Petroleum Institute.
Keywords - Risk Assessment, Upstream, Petroleum, Industry, Oil Spill, Response, Canada.

Wright, M. A. The Effluent society. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, December 15 - 17, 1969., pp. 223 - 228. New York, NY.: Washington, DC: American

Petroleum Institute.
Keywords - Effluent.

Wright, Dennis G. 1979. A plan for scientific response to an oil spill in the Beaufort Sea. In: Proceedings of the 1979 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 19 - 22, 1979.,pp. 525 - 532. Los Angeles, CA. : Washington, DC: American Petroleum Institute.
Keywords - Scientific, Response, Oil Spill, Beaufort Sea.

Wright, Stephen R. 1991. Carbon treatment of kerosene impacted ground water at a gas station in northeastern Ohio. Abstracts with Programs - Geological Society of America. 23(3):67.
Key Words: Ohio, environmental geology, pollution, Midwest, United States, reclamation, ground water, oil spills, northeastern Ohio.

Wright, Judith A. 1977. Current applications of remote oil monitoring equipment. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977. New Orleans, LA.,pp. 209 - 210. Washington, DC: American Petroleum Institute.
Keywords - Remote, Oil, Monitoring.

Wrotenbery, L. 1993. Oil field cleanup and waste management: Update on Railroad Commission (of Texas) programs. In: Proceedings of the Petro-Safe '93/4th Annual Oil, Gas, and Petrochemical Industries Environmental and Safety Conference, January 26 28 1993, Houston, TX, Book 1(1):165-88.
Key words: Crude Oil, Oil Recovery, Underground Storage Facility

Wu, Q. K. and H. Wen. 1989. Micro-gas sensor for monitoring anesthetic agents. In: Transducers '89: Proceedings of the 5th International Conference on Solid-State Sensors and Actuators and Eurosensors III. Part 1, June 25 30, Montreux, Switzerland. Swiss Soc for Sensor Technology (SSST): Switzerland, pp. 183 187.
Key words: Sensors, Gases
A silicon-based SnO/2 gas sensor has been fabricated for the monitoring of anesthetic agents commonly used in hospitals. The sensor and its characteristics responses to these agents have been investigated. The response to anesthetic agents, when the temperature is cycled with various temperature-time waveforms, shows that the response curve is repeatable with a definite pattern for each agent. The response with temperature cycling may be used to identify the anesthetic agents being monitored and to improve selectivity. (Author abstract) 7 Refs.

Wu, W., M.K. Jain, and E. Conway de Macario. 1992. Microbial composition and characterization of prevalent methanogens and acetogens isolated from syntrophic methanogenic granules. Applied Microbiology and Biotechnology (Germany). 38:2: 282-290.
The microbial species composition of methanogenic granules developed on an acetate-propionate-butyrate mixture was characterized. The granules contained high numbers of adhesive methanogens (10[sup 12]/g dry weight) and butyrate-, isobutyrate-, and propionate-degrading synthrophic acetogens (10[sup 11]/g dry weight), but low numbers of

hydrolytic-fermentative bacteria (10[sup 9]/g dry weight). Prevalent methanogens in the granules included: Methanobacterium formicicum strain T1N and RF, Methanosarcina mazei strain T18, Methanospirillum hungatei strain BD, and a non-filamentous, bamboo-shaped rod species, Methanothrix/Methanosaeta-like strain M7. Prevalent syntrophic acetogens included: A butyrate-degrading Syntrophospora bryantii-like strain BH, a butyrate-isobutyrate degrading non-spore-forming rod, strain IB, a propionate-degrading spore-forming oval-shaped species, strain PT, and a propionate-degrading non-spore-forming sulfate-reducing rod species, strain PW, which was able to grow syntrophically with an H[sub 2]-utilizing methanogen. Sulfate-reducing bacteria did not play a significant role in the metabolism of H[sub 2], formate, acetate and butyrate but they were involved in propionate degradation. (orig.).
Key words: methanogenic, bacteria, detection, sludges, biosynthesis, butyric acid.

Wu, J. 1989. Suppression of oceanic ripples by surfactant-spectral effects deduced from sun-glitter, wave-staff and microwave measurements. J. Phys. Oceanogr. 19(2):238-245.
Key words: Wave Damping, Oil Spills, Pollution Detection, Remote Sensing
Experimental results on suppression of fine sea-surface structures by surfactant in terms of the roughness length obtained from wind profiles and of the wave-energy density from sun-glitter photographs, wave-staff measurements, and microwave returns are analyzed. The suppression was shown to be most effective at low winds, say below 7 m s super(-1), and for wave components with their lengths between 2 and 40 cm. Both wave-staff and microwave measurements further indicate that the maximum suppression can be up to about 95%, occurring at surface-wave lengths of 4-5 cm. Other features of reported experiments were also discussed.

Wuerdemann, S., H. Harder, and Th. Hoepner. 1990. Hydrocarbon biodegradation in sediments and soils: a systematic examination of physical and chemical conditions. (part 1: grain size, surface area and soil type). Erdol und Kohle, Erdgas, Petrochemie: Hydrocarbon Technology. 43:217 224.
Key words: petroleum, soil, degradation, biodegradation, soil pollution

Wuerdemann, S., H. Harder, T. Hoepner. 1990. Grain size, surface area and soil type. Erdoel und Kohle, Erdgas, Petrochemie - Hydrocarbon Technology. (1990): 43
Key words: microorganism, oil, hydrocarbon, degradation
Laboratory experiments were carried out to investigate the effects of several ecological parameters, such as grain size and surface area, on the aerobic biodegradation of n-hexadecane in various sediments and soils. In addition, grained materials, silica gel and acid treated and glowed sand were examined as model substances with defined properties. The complex system hydrocarbonssoilsmicroorganisms is not only influenced by soil parameters such as grain size and specific surface,but also by parameters such as temperature, water content, nutrients, pH value, oxygen partial pressure, and composition of the

hydrocarbons and the degrading bacteria. The relation between the type of soil, its specific surface and the degradation potential of the soil microorganisms was established under optimal oxygen support and water saturation (either fresh water or sea water). In addition, the results indicated that the degradative process was supported by the presence of surface-rich material, demonstrating the positive effect of increasing absorptive surface. The correlation between the surface of the soils and the biological degradation, however, was superimposed by the influence of the qualitative composition of the soil materials.

Wunderlich, M. 1985. Measures for combating oil pollution at coast and sea in the federal republic of Germany. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp. 650. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Pollution, Coast, Sea, Germany.

Xun, L. 1989. Microbial physiology of an anaerobic propionate-degrading consortium. California Univ., Los Angeles, CA (USA). 183.
A methanogenic propionate-degrading consortium, comprised of a strictly anaerobic chemoheterotroph and two types of methanogenic bacteria, is responsible for the complete conversion of propionate to CH{sub 4} and CO{sub 2} via the intermediate formation of acetate, H{sub 2}, and CO{sub 2}. Propionate oxidation by the heterotroph to acetate, H{sub 2} and CO{sub 2} proceeds only if H{sub 2} is removed through oxidation by CO{sub 2}-reducing methanogens. Acetate may only be catabolized anaerobically by one specific physiological group of bacteria, the aceticlastic methanogens, which produces CH{sub 4} and CO{sub 2} by cleaving acetate. Representatives of all three of these organisms have been studied. The effects of environmental factors such as temperature, pH, and nutrients on anaerobic propionate degradation was studied by enrichment cultures. From the propionate enrichment, the H{sub 2} using methanogen (strain LX1) and the propionate-degrading organism (strain LX2) were isolated. Both organisms have been characterized. In regard to the aceticlastic reaction, Methanosarcina mazei S-6 isolated by Mah (1980), was studied as the third member of the consortium. By changing the culture conditions, the morphology of M. mazei was manipulated from an aggregated to single cell form.
Key words: methane, biosynthesis, methanogenic, physiology, metabolism, chemical composition, carbon compounds, carbon hybridization.

Yadav, J.S., and C.A. Reddy. 1993. Degradation of benzene, toluene, ethylbenzene, and xylenes (BTEX) by the lignin-degrading basidiomycete phanerochaete chrysosporium. Appl Environ Microbiol. 59(3):756 762.

Keywords: bioremediation, biodegradation

Yadav, L., P.K. Yadava, R. Dwivedi and S.K. Srivastava. 1990. Hydrogen gas micro sensor based on SiO/sub 2/ and TiO/sub 2/ systems. Journal of the Institution of Electronics and Telecommunication Engineers 36(3 4):195-197.
Key words: Sensors, Gases
Comparative study of the sensing properties of the two systems Pd/SiO/sub 2//Si and Pd/TiO/sub 2//Si for hydrogen gas has been done. Two samples of both the systems were fabricated and their C-Vcharacteristics were studied without and with the exposure of hydrogen gas in nitrogen ambient. In both the cases, it is found that upon exposure to hydrogen there is reduction in capacitance value and simultaneously flat-band voltage, V/sub FB/, also changes. These changes are attributed to the change in work function of the gate metal as well as the interface states. Though, the sensing mechanism in both the MOS structures is almost similar, higher polarizability of TiO/sub 2/ lattice and more diffusibility of hydrogen in TiO/sub 2/ results in larger change in capacitance in TiO/sub 2/ system as compared to SiO/sub 2/ system. Hence, Pd/TiO/sub 2//Si system is more suitable for hydrogen gas detection.

Yang, E.J., H.L. Schultz, P.F. Scodari, R.C. Dower, P. Abel, and C. Burch. 1987. Assessing natural resource damages from hazardous substances an examination (has been made) of existing assessment approaches. Environ. Law Inst. Versar Inc. API PUBL. N.4451, 103 pp. Ammonia, Animal, Benzene Ring, Business Operation, Economic Analysis, Environmental Impact, Legal Consideration, Pollution Control

Yaniga, P. 1989. Recovery and clean-up from crude oil production, transmission and processing facilities. In: Proceedings of the Can Petrol Ass et al Prev & Treat of Groundwater & Soil Contamination in Petrol Explor & Prod Conf, May 9-11, 1998, Calgary, Canada.

Yaniga, P. M. 1990. Groundwater abatement techniques for removal of refined hydrocarbons. In: Hazardous Materials Control. Hazardous Materials Control Research Institute: Silver Spring, MD, pp. 94 103.
Key words: Groundwater, Oil Spills
In this paper, the author describes the types of investigation and cleanup programs that have been successful in solving contamination problems resulting from service station gasoline losses in residential areas. Methods of investigation and treatment are described within the framework of a few of the projects undertaken by Groundwater Technology. The first case history involves the loss and retrieval of an

unleaded gasoline that initially resulted in free product accumulations of greater than 3 ft on the water table and the accumulation of flammable vapors in an adjacent bank. The second case history describes the impact and abatement of dissolved gasoline contamination on ten domestic water supply wells.

Yaniga, Paul M. 1985. Groundwater abatement alternatives for removal of organic contaminants. In: Proceedings of the 1985 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 25 - 28, 1985., pp.253 - 262. Los Angeles, CA.: Washington, DC: American Petroleum Institute.
Keywords - Groundwater, Abatement, Organic, Containments.

Yaniga, P.M., F. Aceto, L. Fournier, and C. Matson. 1989. Comprehensive site remediation CSR sup tm anchored by bioreclamation saves groundwater supply of small mid Atlantic community. 494(p):426-440.
Key Words: Biodegradation field tests, oil spills biodegradation, water reclamation biodegradation, cleaning, dissolution, gasoline service stations, ground water, hydrogen peroxide, nutrients, Pennsylvania, quantity ratio, site characterization, sorption, water supply, water tables, water wells, chemical reactions, commercial sector, decomposition, Federal Region III, hydrogen compounds, marketers, North America, oxygen compounds, retailers, USA.

Yap, K.C.,and O. Maguire. 1990. ,Reassessment necessary to enhance oil spill response preparedness. In: Proceedings of the 8th spe et al offshore south east asia conf (singapore, 12/4-7/90) preprints pp 223-230, dec 1990 (osea-90167)
Key words: accident, administration, asia, business operation, contingency planning, control equipment, environment, environmental impact, eurasia, malaysia, management, planning, safety, strategy

Yapa, P. D., J.T. Shen, S. F. Daly, and S. C. Hung. 1991. Oil spill simulation in rivers. In: Proceedings of the 1991 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 4 - 7, 1991., pp. 593 - 600. San Diego, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Rivers.

Yapa, P. D., H. T. Shen, and K. Angammana. 1993. Modeling oil spills in River-Lake systems. In: Proceedings of the 1993 Oil Spill Conference(Prevention, Preparedness, Response), March 29 - April 1, 1993., Tampa, Florida.: Washington, DC: American Petroleum Institute. pp. 611 - 616.
Keywords - Oil Spills, River-Lake.

Yapa, Poojitha D. and Tamara Chowdhury. 1989. Oil spreading under ice cover. In: Proceedings of the

1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., pp. 161 - 166. . San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Ice.

Yaroch, G.N., and G.A. Reiter. 1989. The tank barge MCN-5: Lessons in salvage and response operations. In: Proceedings of the 1989 API - EPA - USCG Oil Spill Prev. Behavior Control Cleanup Conf., February 13 16 1989, San Antonio, TX, API Publ. N.4479, pp. 87-90.
Key words: Accident, Business Operation, Contingency Plan, Economic Factor, Pollution Control

Yaroch, G. N. 1991. The Nestucca oil spill:A Christmas story. CHEMTECH 21(12:722-730).
It was winter cold on the Pacific Ocean on December 22, 1988, when plowing through the seas came the tug Ocean Service towing the good barge Nestucca. All was well - for a time. Then, as the two came into Grays Harbor, Washington, the monotonous yet peaceful chuga-chuga-chuga of the tug was disturbed by the sudden parting of the heavy towline and the casting adrift of the good barge Nestucca. Then, the Ocean Service was set into the Nestucca's sideshell, putting a hole in the barge's number one starboard cargo tank. And lo, there was a great darkness that appeared over the deep. A major oil spill was in the process of occurring. It was once again time to ante up and make right the offering to the Keepers of the Sorbent.
Key words: oil spills, environmental, impacts, water, pollution, remedial actio, accidents, cleaning, petroleum industry, transport.

Yaroschak, P.J. 1983. New directions in Navy spill contingency planning. In: Proceedings of the 8th Bien API, EPA & U.S. Coast Guard Oil Spill (Prev, Behav, Contr, Cleanup) Conf (San Antonio, 2/28/83 3/3/83).
Key words: Navy, planning, disposal, oil, monitoring, offshore

Yates, John J. 1978. Used Oil Recycling in Illinois: Data Book. In Illinois Inst. of Natural Resources, Chicago. 142p. Oct 78.
Key words: survey, inventory, environmental impacts, disposal, recycling, Illinois
This survey information has been organized into four sections: Illinois inventory of industrial used oils; Environmental impacts of oil disposal practices; Organization of recycling and re-refining industry in Illinois; Recycling and re-refining technologies.

Yates, John , J. Rajan, K. Chaudhry, and Harriet P. Croke. 1978. Oil Audit and Reuse Manual for the Industrial Plant. In Illinois Inst. of Natural Resources,

Chicago., 144p. Nov 78. Final rept.
Key words: used oil, recycling, disposal, Illinois
This document is the last of three resulting from a study by the IINR of industrial used oil recycling and disposal in Illinois. A manual to aid the industrial plant in organizing and implementing an oil reuse program is developed. The other two documents covered an assessment of policies to encourage the reuse of industrial oils in Illinois, and a survey report on present practices of industrial used oil disposal and reuse.

Yates, J.R., and F.J. Mondello. 1989. Sequence similarities in the genes encoding polychlorinated biphenyl degradation by pseudomonas strain LB400 and alcaligenes eutrophus H850. Pub. in Jnl. of Bacteriology, Vol. 171, No. 3, 1733-1735 (Mar 1989).
DNA-DNA hybridization was used to compare the Pseudomonas strain LB400 genes for polychlorinated biphenyl (PCB) *degradation* with those from seven other PCB-degrading strains. Significant hybridization was detected to the genome of Alcaligenes eutrophus H850, a strain similar to LB400 in PCB-degrading capability. These two organisms showed a strong conservation of restriction sites in the region of DNA encoding PCB metabolism. No other sequence similarities were detected in the two genomes. DNA from the other PCB-degrading strains showed no hybridization to the probe, which demonstrated the existence of at least two distinct classes of genes encoding PCB degradation.
Key words: genes, DNA hybridization, polychlorinated, biphenyls, biodegradation, pseudomonas, genetics, biochemistry, comparative evaluations, genetic engineering, metabolism, oxidation.

Yates, Lt. Ralph A. 1975. The Making of a local contingency plan. In: Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975.,pp. 307 - 314. San Francisco, CA. : Washington, DC: American Petroleum Institute.
Keywords - Contingency Plan.

Yazaki, Atsuo. 1977. New test facilities for the prevention of oil pollution in Japan. In: Proceedings of the 1977 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), March 8 - 10, 1977., pp.429 - 434. . New Orleans, LA. : Washington, DC: American Petroleum Institute.
Keywords - Prevention, Oil, Pollution, Japan.

Yazaki, Atsuo. 1983. Research and development in the institute of ocean environmental technology. In: Proceedings of the 1983 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 28 - March 3, 1983.,pp. 95 - 104. San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords - Ocean, Environmental, Technology.

Yoshioka, G.A., L. Jonas, and K.E. Armstrong. 1989. Emergency reporting for oil discharges : recent statutory and regulatory changes. In: Proceedings of the API et al Oil Spill (Prev, Behav, Contr, Cleanup) 20th Anniv Conf, Feb 13-16, 1989, San Antonio, TX, pp. 253-256.
Key words: Oil Spill, Regulation, Environmental Impact, Government, Groundwater, Monitoring, Ship

Young, A. 1990. Oil spill information tailored to the shoreline environ of Pukaskwa National Park. Environment Canada, Ottawa, ON (Canada). Water Quality Branch. Report No. EC/WQB-91-05907, 58p.
Key words: oil spills, emergency plans, oil spills, environmental impacts, pollution control
A study was carried out to compile information concerning oil products as it would relate to Pukaskwa National Park in the event of an offshore oil spill. Physical properties of the oils shipped past the park's shoreline (gasoline, diesel fuel oil, light heating oil and Bunker C) are described, and specific gravity, viscosity, pour point, flash point, surface tension, solubility and weathering data are presented. The shoreline sensitivity of the park is discussed with respect to shoreline material and penetration, coastal exposure, wave energy levels, and accessibility. The effects of oils on small water organisms, birds and fish are explained, and oil containment, recovery and treatment are discussed. It was recommended that the park develop a contingency plan specific to oil spill response along the coastline, identifying appropriate protocol, contact agencies and staff training needs. Small spills resulting from staff use of oils could be handled effectively by park staff if the park was prepared ahead of time for such an incident. It was recommended that boom logs be provided to enable protection of sensitive areas in the event of Bunker C or other spills, and that a skimmer should be rented rather than purchased in the event that one is required. Priority shorelines should be more thoroughly identified to enable best use of effort in the event of a spill. 15 refs., 14 figs., 4 tabs.

Young, Jr, Harry N. and Peter F. Olsen. 1989. The Development of an advanced oil spill control chemicals usage course. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989., pp. 575. San Antonio, TX.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Spill, Control, Chemicals, Usage.

Young, L.Y. 1987. Toxic chemicals, anaerobic fate and transformation. In: Proceedings of the American Chemical Society national meeting, August 30, 1987, New Orleans, LA, pp. 37 38.
Key words: biodegradation, microorganisms, bacteria, hydrocarbon

This paper discusses the anaerobic biodegradation of aromatic compounds by certain microorganisms.
Metabolism of toxic chemicals under methanogenic and denitrifying conditions was studied in both
mixed and pure all cell cultures. Many phenolic derivatives were degraded to CO/sub 2/ and CH/sub 4/;
metabolism of substituted aromatics was sometimes incomplete. Degradation under denitrifying
conditions was not always complete. Possible metabolic pathways for degradation of certain aromatics
have been proposed.

Young, L.Y., and M.M. Haeggblom. 1991. Biodegradation of toxic and environmental pollutants. Current
OPinion in Biotechnology. 2(3):429 435.
Key words: polychlorinated biphenyls, hydrocarbons, biodegradation
A review with 44 references focusing on some of the most important recent developments in the
biodegradation of toxic chemicals such as trichloroethylene, chloroform, carbon tetrachloride, toluene,
phenols, chlorinated phenols, polychlorinated biphenyls and polyaromatic hydrocarbons.

Young, A., and J. Sparkes. 1990. Oil spill information tailored to the shoreline environ of Pukaskwa
National Park.
Canadian Parks Service. Natural Resource Conservation, Ottawa (Ontario), 58 pp.
Key words: Oil Spills, Maps
During the shipping season, which generally runs from the beginning of April to the end of December,
Bunker C oil, gasoline, diesel fuel oil and light heating oil are regularly shipped into Thunder Bay past
the park's coastline. This report provides park staff with a quick reference guide to aid in the response to
oil spills off the shore of the park. The guide covers the physical properties of the four oils shipped;
shoreline sensitivity; effects on small water organisms, birds, and fish; the use of containment booms; and
the recovery of the spilled oil by skimmers or sorbents.

Young, L.Y., and Max M. Haggblom. 1989. The anaerobic microbiology and biodegradation of aromatic
compounds. In: Proceedings of the Biotechnology & Biodegradation Int Workshop, Lisbon, Portugal
(Gulf Publishing), pp.3-19.
Key words: Biodegradation, Hydrocarbons, Bacteria
Mechanisms underlying the anaerobic degradation and transformation of substituted aromatic compounds
are reviewed. These reactions are mediated by photosynthetic bacteria, denitrifiers, sulfidogens, and
methanogenic biota. Studies on mixed cultures have demonstrated that side chains and ring substituents
such as hydroxyl radicals and chlorides are removed prior to further metabolism, which generally
involves ring reduction and ring fission. Mechanisms of ring

transformation in pure cultures include
activation of benzoate, partial reduction of the phenolic ring
structure, and anaerobic oxidation of the
methyl ring substituent.

Young, G.N. 1991. Guidelines for the application of geophysics to
onshore E&P environmental studies.
In: Proceedings of the 1ST SPE et al Health, Safety & Environ in
Oil & Gas Explor & Prod Int Conf,
November 11-14, 1991, The Hague, Netherlands, 2:427-436.
Key words: Groundwater, Oil Spill, Soil Pollution

Young, J. C. and H. H. Tabak. 1989. Assessing toxicity of organic
chemicals to anaerobic treatments
processes. Environmental Protection Agency, Cincinnati, OH.
Report No. EPA 600/A/169, 14p.
Key words: Biodegradation, Pollutants, Waste Management
A screening protocol has been developed to provide a rapid but
dependable and repeatable assessment of
the effect of toxic organic chemicals on anaerobic treatment
processes. The protocol provides information
on the rate limiting biological reactions and the concentration
of toxic chemicals at which changes in
reaction rate take place. General features of the protocol
include (1) relative ease of use, (2) relatively
short response time days versus months, (3) low labor
requirements, (4) use of conventional techniques,
(5) reproducibility among laboratories, and (6) it builds on
previously developed protocols and
procedures. The screening protocol consists of three steps: STEP
I is a prescreen to identify the range of
toxic impact of a chemical; STEP II is a short-term batch test to
identify the effect of slug doses of
chemical and to show which anaerobic reaction is inhibited first;
STEP III is a semi-continuous culture
test to determine the effect of a gradual a buildup of toxicant
and to identify concentrations at which
specific inhibitory effects take place. The results indicate the
potential for using anaerobic processes for
treating toxic and hazardous organic chemicals and provide a
basis for anticipating toxic impacts of toxic
organic chemicals on anaerobic processes.

Youssef, M., and M. Spaulding. 1993. Drift current under the
action of wind and waves. In: Proceedings
of the Environment Canada 16th Arctic and Marine Oil Spill
Technical Seminar, June 7 9 1993, Calgary,
Alberta, 1:587-615.
Key words: Atmosphere, Deep Water, Oil Waste

Yu, Tsi Shan. 1977. Quantification of Navy oils in detergent
Laden waters. In: Proceedings of the 1977
Oil Spill Conference(Prevention, Behavior, Control, Cleanup),
March 8 - 10, 1977., pp.169 - 172. . New
Orleans, LA.: Washington, DC: American Petroleum Institute.
Keywords - Navy, Oils, Detergent, Waters.

Yvon, J., F. Le Guen, Marc Brussieux, and Rolland Burkhalter. 1987. Realtime processing of oil spill remote sensing data. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp. 71 - 74. Baltimore, MD.: Washington, DC: American Petroleum Institute.
Keywords - Processing, Oil Spill, Remote Sensing.

Zafiriou, O. C. 1973. Oil spill-source correlation by gas chromatography: an experimental evaluation of system performance. In: Proceedings of Joint Conference on Prevention and Control of Oil Spills, March 13 - 15, 1973., pp. 153 - 160. Washington, DC. : Washington, DC: American Petroleum Institute.
Keywords - Oil Spill, Gas, Chromatography, Performance.

Zaidi, B., and N. Mehta. 1992. Effects of alternate substrates on the degradation of toxic chemicals in industrial waste water stream by the inoculated bacteria. In: Proceedings of the 92nd General Meeting of the American Society for Microbiology, May 26 30, 1992, New Orleans, LA, p. 359.
Key words: biodegradation, environmental pollutant, bacteria, disposal, microorganisms

Zalan, P.V., S. Wolff, M.A.M. Astolfi, I.S. Vieira, J.C.J. Concelcao, V.T. Appi, E.V.S. Neto, J.R. Cerqueira, and A. Marques. 1990. The Parana basin, Brazil. Interior Cratonic Basins (AAPG MEM No 51) pp. 681-708.
Key words: Brazil, Basin Devlopment, Hydrocarbon Potential, Sratigraphy, Crude Oil

Zawadski, Capt. David. 1987. Considerations for dispersant use: tank vessel PUERTO RICAN incident. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp. 341 - 348. Baltimore, MD.: Washington, DC: American Petroleum Institute.
Keywords - Dispersant, Tank, Vessel.

Zehner, Warren B. and James R. Mullins. 1987. Atypical mitigation of an oil spill, Sam Houston National Forest. In: Proceedings of the 1987 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), April 6 - 9, 1987., pp. 81 - 84. Baltimore, MD. : Washington, DC: American Petroleum Institute.
Keywords - Mitigation, Oil Spill, Sam Houston National Forest.

Zellner, G., M. Geveke, H. Diekmann, and R. Conway de Macario. 1991. Population dynamics of biofilm development during start-up of a butyrate-degrading fluidized-bed reactor. Applied Microbiology and Biotechnology (Germany). 36:3:404-409.
Population dynamics during start-up of a fluidized-bed reactor with butyrate or butyrate plus acetate as

sole substrates as well as biofilm development on the sand substratum were studied microbiologically, immunologically and by scanning electron microscopy. An adapted syntrophic consortium consisting of Syntrophospora sp., Methanothrix soehngenii, Methanosarcina mazei and Methanobrevibacter arboriphilus or Methanogenium sp. achieved high-rate butyrate degradation to methane and carbon dioxide. Desulfovibrio sp., Methanocorpusculum sp., and Methanobacterium sp. were also present in lower numbers. Immunological analysis demonstrated methanogens antigenically related to Methanobrevibacter ruminantium M1, Methanosarcina mazei S6, M. thermophila TM1, Methanobrevibacter arboriphilus AZ and Methanothri soehngenii Opfikon in the biofilm. Immunological analysis also showed that the organisms isolated from the butyrate-degrading culture used as a source of inoculum were related to M. soehngenii Opfikon, Methanobacterium formicium MF and Methanospirillum hungatei JF1.
Key words butyric acid, biodegradation, bacteria.

Zeyer, J., P. Eicher, J. Dolfing, and R.P. Schwarzenbach. 1989. Anaerobic degradation of aromatic hydrocarbons. Biotechnology & Biodegradation Int Workshop, Lisbon, Portugal (Gulf Publishing). pp. 33-40.
Key words: Bacteria, Biodegradation, Microorganism, Hydrocarbons
Experiments performed in a denitrifying laboratory aquifer column, operated under continuous-flow conditions in the absence of molecular oxygen, demonstrated the rapid mineralization of toluene and m-xylene. A bacterium isolated from the column was tentatively identified as a Pseudomonas sp. The organism mineralized the aromatic hydrocarbons under pure culture conditions with nitrate or nitrous oxide as the sole electron acceptors. Carbon balance studies, using 14C-labeled toluene showed that over 50% of the radioactivity was evolved as radiolabeled carbon dioxide.

Zhang, Yimin, and R.M. Miller. 1992. Enhanced octadecane dispersion and biodegradation by a Pseudomonas rhamnolipid surfactant (biosurfactant). Applied and environmental microbiology. 58(10):3276-3282.
Key words: Biodegradation, Dispersion, Hydrocarbon, Bacteria
A microbial surfactant (biosurfactant) was investigated for its potential to enhance bioavailability and, hence, the biodegradation of octadecane. The rhamnolipid biosurfactant used in this study was extracted from culture supernatants after growth of Pseudomonas aeuruginosa ATCC 9027 in phosphate-limited proteose peptone-glucose-ammonium salts medium. Dispersion of octadecane in aqueous solutions was dramatically enhanced by 300 mg of the rhamnolipid biosurfactant

per liter, increasing by a factor of
more than 4 orders of magnitude, from 0.009 to >250 mg/liter.

Zheng, Chunmiao, and Deborah L. Hathaway. 1991. MT3D; a new modular three-dimensional transport
model and its application in predicting the persistence and transport of dissolved compounds from a
gasoline spill, with implications for remediation. Ground Water. 29(5):755.
Key Words: Pollution, ground water, reclamation, oil spills, natural resources, three-dimensional models,
MT3D, dissolved materials, hydrocarbons, organic materials.

Zhu, J. L., J.C. Parker, A.K. Katyal, V.J. Kremesec, E.L. Hockman, M.N. Gallagher. 1991. Effects of
delays in recovery system startup on product recovery at hydrocarbon spill sites. Ground Water
Management. 8:157-171.
Key Words: Pollution, ground water, soils, hydrocarbons, effects, tertiary recovery, enhanced recovery,
organic materials, oil spills, models, time factor, infiltration, dynamic properties, properties, unconfined
aquifers.

Zhung, Ping, and S.G. Pavlostathis. 1990. Degradation of trichloroethylene in simulated anaerobic
subsurface environments. 20. American Chemical Society (ACS) northeast regional meeting. 40:64.
Degradation of trichloroethene (TCE) took place under denitrification, sulfate reduction and
methanogenic conditions, Microcosms were inoculated with subsurface soil from a hazardous waste
disposal site in upstate New York and incubation was carried out at 20 C. The major intermediate was
cir-1,2-dichloroethene and ethene were also detected in some microcosms confirming sequential reductive
dechlorination. However, methylene chloride and chloromethane found in some microcosms suggest
possible cleavage of the double carbon bond before complete dechlorination. It is believed that
dechlorination of TCE is via cometabolism which requires active cultures. Cultures started with pregrown
inoculum resulted in enhanced degradation of TCE. The microcosms used in this study simulated in-situ
groundwater conditions that can be amended with electron acceptors, such as NO{sub 3}{sup {minus}},
SO{sub 4}{sup 2{minus}}, and nutrients to in-situ remediate TCE contaminated soil and groundwater.|
Key words: chlorinated aliphatic hydrocarbons, biodegradation.

Ziegler, Robert C. and Thomas J. Lyons. 1975. Oil-debris removal boat Samual Wilkeson. In:
Proceedings of the 1975 Conference on Prevention and Control of Oil Pollution, March 25 ª 27, 1975.,
pp. 449 - 454. San Francisco, CA.: Washington, DC: American Petroleum Institute.
Keywords - Oil, Debris, Removal Boat, Samual Wilkeson.

Zimmerle, Jerome. 1989. Development of a small inland oil skimmer for the Navy. In: Proceedings of the 1989 Oil Spill Conference(Prevention, Behavior, Control, Cleanup), February 13 - 16, 1989. San Antonio, TX.: Washington, DC: American Petroleum Institute. Keywords - Inland, Oil, Skimmer, Navy.

Zinder, S.H. 1988. Microbial ecology of thermophilic anaerobic digestion: (Progress report, year 3). 4. The goal of this project is to gain a more complete understanding of the microorganisms converting a lignocellulose waste to methane in a thermophilic (58/degree/C) anaerobic bioreactor. We have directly examined microbial populations in the bioreactor and have examined the properties of microorganisms isolated from the bioreactor. The primary focus has been on anaerobic thermophiles involved in the formation and degradation of acetic acid, the precursor of two-thirds of the methane produced in the bioreactor. Also, novel organisms of fundamental and practical significance have been isolated and characterized.
Key words: acetates, oxidation, bioreactors, lignin, biodegradation, methane, biosynthesis, bacteria, substrates, sulfates, alcohols, alkanes, carbohydrates, carboxylic acid salts, chemical reaction, decomposition, document types, biosynthesis.

Zinder, S.H., 1990. Conversion of acetic acid to methane by thermophiles. Cornell Univ., Ithaca, NY (USA). Dept. of Microbiology. 9. The goal of this project is to gain a more complete understanding of the microorganisms converting a lignocellulose waste to methane in a thermophilic (58{degree}C) anaerobic bioreactor. To accomplish this, we have directly examined microbial populations in the bioreactor and have examined the properties of microorganisms isolated from the bioreactor. The primary focus has been on anaerobic thermophiles involved in the formation and degradation of acetic acid, the precursor of two thirds of the methane produced in the bioreactor. Also, novel organisms of fundamental and practical significance have been isolated and characterized. As the project has progressed there has been greater emphasis on the physiology of pure cultures. 7 refs.
Key words: acetates, oxidation, lignin, biodegradation, methane, biosynthesis.

Zinner, R.E., E.A. Hodder, W.E. Carroll, and C.A. Peck. 1991. Utilizing groundwater reinjection in the design of a liquid hydrocarbon recovery system. In: Proceedings of the Nat Water Well Ass & API Petrol Hydrocarbons & Org Chem in Ground Water : Prev, Detection, & Restoration Conf, November 20-22, 1991, Houston, TX, pp. 469-483.

Key words: Groundwater, Oil Spill, Water Pollution, Recovery

Zitomer, D.H., and R.E. Speece. 1993. Sequential environments for enhanced biotransformation of
aqueous contaminants. Environ. Sci. Technol. 27(2):226 244.
Key words: wastewater, microorganisms
Traditionally, wastewater treatment systems removed biochemical oxygen demands (BODs). Then they
also began to remove nutrients such as nitrogen and phosphorus. More recently, treatment systems have
begun to remove toxic organic chemicals from wastewater. Pollution control engineers and scientists have
found that exposure of microorganisms to sequential environments enhances the removal of pollutants
and at the same time produces sludge with good settling characteristics. The authors describe the
sequential exposure of microorganisms and the biological transformations that occur in aerobic
environments, anoxic environments, and anaerobic environments. Now, it is possible to design a
single-sludge process that relies on these sequential environments. Also, anaerobic processes are feasible
for treatment of high-strength industrial wastewaters.

ZoBell, C. E. 1969. Microbial modification of crude oil in the sea. In: Proceedings of Joint Conference on
Prevention and Control of Oil Spills, December 15 - 17, 1969., pp. 317 - 326. New York, NY.:
Washington, DC: American Petroleum Institute.
Keywords - Microbial, Oil, Sea.

ZoBell, Claude E. Sources and biodegradation of carcinogenic hydrocarbons. In: Proceedings of Joint
Conference on Prevention and Control of Oil Spills, June 15 - 17, 1971., pp.441 - 452. Washington, DC.:
Washington, DC: American Petroleum Institute.
Keywords - Biodegradation, Hydrocarbons.

Zoch, Jr., R.M. 1991. NKD (Nukem Dvelopment) process for extractive treatment of refinery oily wastes.
In : Proceedings of the Pennwell Conf & Exhibit Co Petro-safe 91 Conf (Houston, 2/6 8/91).
Key words: Disposal, oil, cleanup

Zongcheng, Zhou, Ni Chunzhi, Cai Ziping, and Zeng Huoshui. 1991. Oil pollution experiment in
marine-enclosed experimental ecosystem. I. Ecological distribution of hydrocarbon-degradation bacteria.
Acta Oceanologica Sinica. 10(2):297-302.
Key words: Oil, China, Water Pollution
Results provide a scientific basis for the evaluation of microbial purification ability on oil pollutants in
Xiamen Bay. -from Authors.

Zoric, J. P. 1989. Oil spill prevention, control and countermeasures plan.Unpublished final report
prepared for the U.S. Department of Energy. Richland, WA:

Westinghouse Hanford Co. 49 pp.
Key words: Oil Spill, Biodegradation, Water Pollution
Environmental Protection Agency regulations 40 CFR Part 112, Oil Pollution Prevention include
requirements for a written Oil Spill Prevention, Control, and Countermeasures (SPCC) Plan. This
document provides such an SPCC Plan for facilities at 100-N Area managed by Westinghouse Hanford
Co. Should an oil spill occur at 100-N Area, the following actions should be followed: stop the flow of
oil, contain the oil spill in order to prevent it from reaching the river, and notify Environmental
Protection. Environmental Protection will assess the oil spill and determine if remedial action is
necessary. If needed, an oil spill response team will deploy oil spill control and clean-up equipment at the
river shoreline to remove any oil that enters the river.

Zumberge, J.E. 1987. Prediction of source rock characteristics based on terpane biomarkers in crude oils:
a multivariate statistical approach. Geochim. Cosmochim. Acta(United States). 51:6:1625-1637.
The distributions of eight tricyclic and eight pentacyclic terpanes were determined for 216 crude oils
located worldwide with subsequent simultaneous RQ-mode factor analysis and stepwise discriminate
analysis for the purpose of predicting source rock features or depositional environments. Five categories
of source rock beds are evident: nearshore marine; deeper-water marine; lacustrine; phosphatic-rich
source beds; and Ordovician age source rocks. The first two factors of the RQ-mode factor analysis
describe 45 percent of the variation in the data set;e precision to which source rock depositional
environments are determined might be increased with the addition of other biomarker and stable isotope
data using multivariate statistical techniques.
Key words: petroleum, biological markers, petroleum, geochemistry, source rocks, hydrocarbons, isotope
ratio, geologic history, chemical compostion, hydrocarbons.

Zylstra, G.J., W.R. McCombie, D.T. Gibson, and B.A. Finette. 1988. Toluene degradation by
Pseudomonas putida F1: genetic organization of the tod operon. Appl. Environ. Microbiol.(United
States). 54:6:1498-1503.
Pseudomonas putida PpF1 degrades toluene through cis-toluene dihydrodiol to 3-methylcatechol. The
latter compound is metabolized through the well-established meta pathway for catechol degradation. The
first four steps in the pathway involve the sequential action of toluene dioxygenase (todABC1C2),
cis-toluene, dihydrodiol dehydrogenase (todD), 3-methylcatechol 2,3-dioxygenase (todE), and
2-hydroxy-6-oxo-2,4-heptadienoate hydrolase (todF). The genes for these enzymes form part of the tod
operon which is responsible for the degradation of toluene by

this organism. A combination of transposon mutagenesis of the PpF1 chromosome, was well as the analysis of cloned chromosomal fragments, was used to determine the physical order of the genes in the tod operon. The genes were determined to be transcribed in the order todF, todC1, todC2, todB, todA, todD, todE.
Key words: hydrolases, genes, oxidoreductases, pseudomonas, gene regulation, biodegradation, gene operons, bacteria, chemical reactions, decomposition, enzymes, hydrocarbons, mapping, microorganism, organic compounds.

Zylstra, G.J., and D.T. Gibson. 1991. Aromatic hydrocarbon degradation: A molecular approach. Pub. in Genetic Engineering, Vol. 13, 183-203.
Aromatic hydrocarbons have a ubiquitous distribution in nature. The majority of these compounds are formed through the pyrolysis of organic matter. Pyrolysis at high temperatures leads to the formation of unsubstituted polycyclic aromatic hydrocarbons. Pyrolysis at low temperatures, such as those at which crude petroleum is formed, leads to the formation of alkyl-substituted aromatic hydrocarbons. Many of these compounds are suspected carcinogens. Increased use of petrochemicals by modern society has increased the amount of aromatic hydrocarbons found in air and soil samples. It is not surprising then that due to the ubiquitous nature and increasing concentrations of aromatic hydrocarbons microorganisms can be found that have the ability to degrade these compounds. The varied mechanisms by which microorganisms utilize aromatic hydrocarbons as carbon and energy sources have been the focus of several reviews.
Key words: aromatics, biodegradation, bacteria, biochemistry, biological, pathways, carbon, carcinogens, chemical reactions, cloning, combustion, genetics, hydrocarbons, pyrolysis, sampling, soils, temperature dependence, toluene.

Zylstra, G.J., and D.T. Gibson. 1989. Trichloroethylene degradation by Escherichia coli containing the cloned Pseudomonas putida F1 toluene dioxygenase genes. Applied and Environmental Microbiology (USA). 55:12:0099-2240.
Toluene dioxygenase from Pseudomonas putida F1 has been implicated as an enzyme capable of degrading trichloroethylene. This has now been confirmed with Escherichia coli JM109(pDTG601) that contains the structural genes (todC1C2BA) of toluene dioxygenase under the control of the tac promoter.
The extent of trichloroethylene degradation by the recombinant organism depended on the cell concentration and the concentration of trichloroethylene. A linear rate of trichloroethylene degradation was observed with the E. coli recombinant strain. In contrast, P.

putida F39/D, a mutant strain of P. putida
F1 that does not contain cis-toluene dihydrodiol dehydrogenase,
showed a much faster initial rate of
trichloroethylene degradation which decreased over time.
Key words: chlorinated aliphatic hydrocarbons, biodegradation,
genetic engineering, nucleic acids,
organic compounds.