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Recent Work

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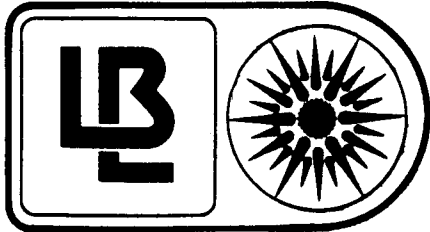
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NEWSLETTER

Lawrence Berkeley Laboratory
Applied Science Division

APRIL 1984

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****RESULTS OF LBL STUDY FEATURED ON ABC-TV****

Recent research by the Building Ventilation and Indoor Air Quality group on the behavior and removal of airborne particles and radon progeny was featured on ABC-TV. This segment - which appeared nationwide on March 28 on "Good Morning America" - focused on the (non)performance of some of the most popular air cleaning devices available in the marketplace, and was based primarily on the results appearing in a recent LBL report (LBL-16659). This work was part of an overall BVIAQ research effort that studies the physics and chemistry of indoor pollutants, characterizes their behavior, and investigates possible mitigation and control techniques. The research is jointly sponsored by DOE (OHER), EPA, and BPA. A partial synopsis of the report outlining the research results and conclusions concerning the effects of portable air cleaners on indoor particle concentrations appears below:

Research Results

Eleven portable air cleaning devices were evaluated for control of indoor concentrations of respirable particles. These devices are representative of four types of air cleaners: 1) simple fan-filter units; 2) extended surface filters; 3) electrostatic precipitators; and 4) negative-ion generators. Oscillating fans were also investigated in order to study the effects of air circulation only on particle concentrations. All these devices are portable, that is, designed to be used as a stand-alone unit within a room and not installed as part of a heating or ventilation duct system.

The experiments were conducted in a room-size chamber that had been tightly weatherized to reduce the infiltration of outside air to a negligible level. Tobacco smoke, selected because it is a common indoor pollutant, was generated for each experiment by smoking one cigarette in a cigarette smoking machine. Instruments to determine the size and concentration of the smoke particles were operated continuously to provide real-time data before and during operation of the air cleaning device.

Two parameters can be used to characterize the performance of air cleaners; the effective cleaning rate (ECR) and the efficiency of the

PUB-432

air cleaner system. The ECR is the difference in particle concentration decay rates observed with and without operation of the air cleaner multiplied by the test chamber volume. Thus the ECR is the effective flow of particle-free air that would produce the observed reduction in particle concentration. It provides a measure of how fast the device cleans the air. For those air cleaners with fans (all but the ionizers had fans), the system efficiency is the ECR divided by the air flow rate through the device. The ECR for each device was determined for each particle size grouping and for the total concentration of particles. Little variation in ECR as a function of particle size was observed for particle diameters between 0.09 and 1.25 μ m.

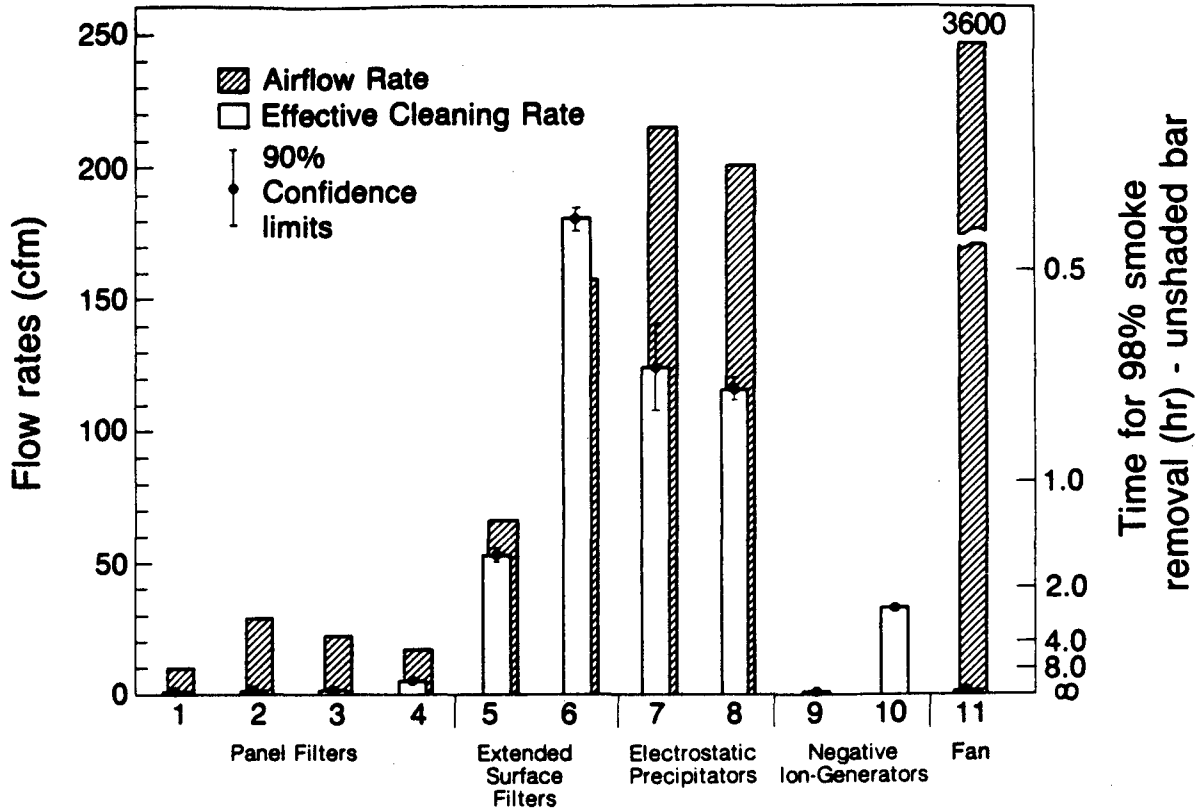
The results of this study are displayed in the attached figure. The small panel filters, devices 1 through 4 in the figure, have low effective cleaning rates, between 0 and 7 cubic feet per minute (cfm), and system efficiencies of 0, 11, 16, and 39 percent respectively. The low particle removal rates appear to be due to the low total air flow rates and the large fraction of the air flow that bypasses the filters in these devices. Similarly, negligible particle removal rates were observed using two oscillating fans as a means of evaluating the effect of increased air circulation on particle removal (device 11).

The devices with the largest effective cleaning rates, 57 to 180 cfm, were the two extended surface filters; these devices were 86 and 100 percent efficient for removal of cigarette smoke particles. Both of the electrostatic precipitators tested had ECR values of ~120 cfm and system efficiencies of ~56 percent. Two negative-ion generators were evaluated. The unit with the lower ECR had both an emitter operating at -19 kV and a positively-charged collector surface, which appears to limit the range of the ion field and thus reduce the air cleaning effectiveness. The other ionizer operated at -32 kV and had no collector so that particles are removed only by collection on room surfaces.

Conclusions

The evaluation of the air cleaners shows a substantial variation in the abilities of various types of devices to remove particles from indoor air. Based on the results of this study, simple panel-filter devices are not effective in removing particles generated by tobacco combustion. While this type of air cleaner appears to have a large share of the consumer air cleaner market, our studies indicate they provide essentially no air cleaning. The effects of additional air circulation were investigated, and no measurable reduction in particulate concentrations was found, although it was observed that additional air circulation helps dissipate the visible smoke plume. The results for the two negative-ion generators are mixed; the unit which has both an emitter and collector surface does not remove particles unless there is substantial air circulation. Even then, the removal rate is very modest. For the ionizer with a higher negative voltage on the emitter and no integral collector surface, the overall performance is better, although since room surfaces (walls, tables, etc.) become the particle collectors, soiling of these surfaces may be a concern. The electrostatic precipitators and extended surface filters used in this study produced a significant reduction in particle concentrations. However, it

should be emphasized that the experiments measured only the effectiveness with which the particulate phase contaminants of tobacco smoke were removed and should not be construed as evidence for removal of the many gas phase contaminants, some of which are best controlled by ventilation (e.g., carbon monoxide).



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Effective cleaning and air flow rates for several types of air cleaning devices evaluated in this study. The height of the unshaded bar in the figure represents the effective cleaning rate and the shaded bar the measured air flow rates. The ratio of the height of the unshaded bar to that of the shaded bar is the air cleaner system efficiency. The right axis indicates the time required (in hours) for removal of 98 percent of the particles for each device (unshaded bar) in the 1240 cubic foot test chamber.

APPLIED SCIENCE DIVISION/JACKSON STATE UNIVERSITY COLLABORATION

Collaborative research projects have been established between the Applied Science Division and Jackson State University (JSU), and two members of the Division, Rolf Mehlhorn and Rollie Otto, have accepted appointments as Adjunct Faculty members at JSU. The projects date back to the Fall of 1982 when Don Grether and Rollie Otto first met with Jim Perkins, now Dean of the School of Science and Technology at JSU, to explore areas of mutual interest. It was clear that atmospheric science and aerosol science were promising areas for developing projects.

The Bureau of Mines has funded a project at JSU which will study methods for the characterization of respirable coal mine dust. This research involves Ray Dod of the Atmospheric Aerosol Research group and Cass Parker, who is a recent Ph.D. graduate of the University of Pittsburg, new Associate Scientist at JSU, and will be a visiting scientist at LBL for the coming year. Cass had the distinction of using one of the few LAMMA (Laser Microprobe Mass Analyzer) systems available in the U.S. for his thesis work.

ASD scientist Rolf Mehlhorn and Richard Sullivan, Chair of the Chemistry Department at JSU, have begun collaboration on a project to study the process of CO₂ assimilation by a microorganism (cyanobacteria). Their expertise lies in the area of magnetic resonance spectroscopy. Rolf has done much of his current research using ESR (Electron Spin Resonance) and Rich's research has been done using NMR (Nuclear Magnetic Resonance) spectroscopy. The combination of these two techniques will be an effective method for studying this problem which is directly relevant to the current debate on sources and sinks of CO₂.

SCIENTIFIC REVIEW PANEL ON TOXIC AIR CONTAMINANTS

President David P. Gardner of the University of California has nominated Nancy Brown, Tica Novakov, and Tony Nero for appointments to the Scientific Review Panel on Toxic Air Contaminants. The Scientific Review Panel (SRP) will provide an independent review of scientific data used by the State of California Air Resources Board and Department of Food and Agriculture in the program to identify and control toxic air contaminants.

The SRP is a multidisciplinary group consisting of nine members, each appointed to a three-year term. One member will be appointed from each of the following areas: Toxicology; Biochemistry; Biostatistics; Occupational Medicine; Pathology; Oncology; Epidemiology; Atmospheric Science; and Scientific Review Administration.

HONORS

C. Judson King has been elected a Fellow of the American Institute of Chemical Engineers (AIChE), an honor limited to only ten percent of those eligible. Those elected have made significant contributions to their fields. Fellows must have been working professionally for at least 25 years and been AIChE members for ten to be eligible for election.

Charles Wilke was named an Eminent Chemical Engineer (one of thirty singled out) during the AIChE 75th Diamond Jubilee Celebration in November 1983.

LBL/JSU/AGMEF WORKING COMMITTEE

David Shirley has established a LBL/Jackson State University/Ana G. Mendez Educational Foundation Working Committee to be headed by Walter Hartsough. Rollie Otto has been appointed to the committee from the ASD Division, along with Alope Chatterjee, John Colonias, Donald Rondeau, and Harold Wilson from other LBL divisions. This committee is an expansion of the Lawrence Berkeley Laboratory/Jackson State University program of collaboration. The recent addition of the Ana G. Mendez Educational Foundation in Puerto Rico presents many opportunities for the integration of the Hispanic community into the fields of science and high technology.

SABBATICAL VISITOR

Per Eskilson will be at Lawrence Berkeley Laboratory for one year, until December 1984, and he is working with the Building Energy Simulation (DOE-2) group. Per has an M.S. degree in Engineering Physics from the Lund Institute of Technology, Lund, Sweden, and he is currently working on a Licentiate degree. In Sweden he has been working in the Department of Mathematical Physics studying thermal analysis of heat extraction from the ground, and during the past few years his group has interacted extensively with Chin Fu-Tsang from LBL's Earth Sciences Division. While in the DOE-2 group, he will be applying a numerical approach to earth contact problems in building analysis, and he will also be taking graduate courses at U.C. Berkeley on heat conduction and heat convection.

ASD/UNIVERSITY INTERACTIONS

On March 29, David Shirley made a presentation to Alvin Trivelpiece, Director of the Office of Energy Research, and to the other National Laboratory directors. He discussed the interactions between LBL and the university community, a topic recently brought to light by the Energy Research Advisory Board's report to DOE.

To prepare for that meeting, the divisions were asked to compile information about their involvement with various universities. Our Division contributed significantly to the collection of examples of joint research, student exchanges, lectureships, and hosting of visiting faculty, which Dr. Shirley brought before the group of lab directors and DOE managers.

Some of the statistics on the interactions which took place between ASD researchers and universities all over the world during 1983 are listed below. The numbers reflect the responses received to the queries for information, not the total numbers of interactions in the Division, but they give some sense of the scope of our cooperative efforts. Examples of these efforts include: 15 subcontracts which the Electrochemistry Group has with several universities in the country; the Adjunct Professorships of Rollie Otto and Rolf Mehlhorn at Jackson State University, a minority college with which we are collaborating on various research projects; the lectures on energy conservation which Art Rosenfeld has given at universities in China, France, Sweden, and the U.S.; and the research on the physiological effects of lighting which Sam Berman is conducting with UCSF Medical Center and the UCB School of Optometry.

1983 Data Based on Responses

UCB Faculty Scientists at LBL	31
Guest/Visiting Faculty Scientists	19
LBL Staff Serving as Adjunct Professors or Lecturers	15
Seminars or Lectures Presented by LBL Scientists at Universities	15
Students Doing Graduate Research at LBL (GSRA's)	90
Students in Coop/Summer Programs	14
Students as Employees (clerical, lab assistants, etc.)	4
Ph.D. Dissertations Completed during 1983	7
Masters' Theses Completed during 1983	7
Projects Performed in Collaboration with Universities	21
Subcontracts to Universities	15

RECENT REFEREED JOURNAL ARTICLES

E. Blumwald, R.J. Mehlhorn, L. Packer, "Ionic Osmoregulation During Salt Adaptation of the Cyanobacterium synechococcus 6311," Plant Physiology, 73, 377-380 (1983).

R.J. Mehlhorn and L. Packer, "Bioenergetic Studies of Cells with Spin Probes," Ann. N.Y. Acad. Sci., 414, 180-189 (1983).

R.J. Mehlhorn and L. Packer, "Electron Spin Resonance Spin Destruction Methods for Radical Detection," Meth. Enzym., 105, 215-220 (1984).

P. Berdahl and M. Martin, "Emissivity of Clear Skies," Solar Energy, Vol. 32, No. 5, 663-664 (1984).

H. Rosen and T. Novakov, "Combustion-generated Carbon Particles in the Arctic Atmosphere," Nature, Vol. 306, No. 5945, 768-770 (Dec. 1983).

L.A. Gundel and T. Novakov, "Characterization of Particles from Several Sources and Three Urban Areas by Solvent Extraction," Atmospheric Environment, Vol. 18, No. 2, 273-276 (1984).

R.H. Fish and J.J. Komlenic, "Molecular Characterization and Profile Identifications of Vanadyl Compounds in Heavy Crude Petroleums by Liquid Chromatography/Graphite Furnace Atomic Absorption Spectrometry," Analytical Chemistry, 56, 510-516 (1984).

P. Berdahl, "Radiative Cooling with MgO and/or LiF Layers," Applied Optics, 23, 370-372 (1984).

P.G. Hull and A.J. Hunt, "A Reciprocating Solar-Heated Engine Utilizing Direct Absorption by Small Particles," Journal of Solar Energy Engineering, 106, 29-34 (1984).

H. Moholy-Nagy, F. Asaro, and F.H. Stross, "Tikal Obsidian: Sources and Typology," American Antiquity, 49(1), 104-117 (1984).

A. Montanari, R. Hay, W. Alvarez, F. Asaro, H. Michel, L. Alvarez, and J. Smit, "Spheroids at the Cretaceous-Tertiary Boundary are Altered Impact Droplets of Basaltic Composition," Geology, 11, 668-671 (1983).

CONGRATULATIONS!

To Erica Atkin and Ken Orvis on the birth of their son, Thomas Ira Atkin-Orvis (9 lbs. 1 oz.), on March 13 at 3:00AM. He was born in the Alternative Birth Center at Alta Bates Hospital in Berkeley, and has a 3-year old sister, Miranda.

INVITED TALKS AND FOREIGN TRAVEL

March

- Tony Hansen was invited to present a paper at the American Physical Society meeting held in Detroit. The paper was entitled "The Aethalometer - An Instrument for the Real Time Detection of Aerosol Graphitic Carbon". While in Detroit, he also visited the research laboratories of General Motors and Ford Motor Company.
- Max Sherman attended the Wind Pressure Workshop at the Air Infiltration Center in Brussels, Belgium, and then travelled to Cambridge, England for research discussions.
- Art Rosenfeld was an invited speaker at the 5th Annual California Public Utilities Commission Symposium held in Palo Alto. The theme for the Symposium was the impact that new and changing technologies will have on utilities, regulators and consumers, and Art's presentation dealt with his work on conservation technologies and how these advances affect the market structure of utilities.

VISITORS

Donna Fitzpatrick, Principal Deputy Assistant Secretary for Conservation and Renewable Energy, DOE, visited LBL on March 27. An introduction to LBL was given by Earl Hyde, Elton Cairns, and Tom McEvilly. Paul Witherspoon presented the geothermal energy work in the Earth Sciences Division, and the ASD building and appliance energy analysis work was presented by Mike Rothkopf. She then toured the lab facilities for Indoor Air Quality, Window Materials, Solar Thermal Conversion to Chemicals, Lighting Systems, and Electrochemical Energy Storage.

Patrick Collins, Undersecretary and Acting Assistant Secretary for Conservation and Renewable Energy, DOE, visited LBL on April 13. He was given an introduction to LBL by Earl Hyde, and Elton Cairns presented an overview of the Applied Science Division. He toured the ASD laboratory facilities in Building 70 - Electrochemical Energy Storage, Indoor Air Quality, Window Materials, and Solar Thermal Conversion to Chemicals.