Title

MONTHLY PROGRESS REPORT FOR SEPTEMBER - CONTROL TECHNOLOGY FOR IN-SITU SHALE RETORTS

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October 14, 1980

TO: Charles Grua, Brian Harney, and Art Hartstein

FROM: Peter Persoff, Bill Hall, Mohsen Mehran, and Phyllis Fox

RE: Monthly Progress Report for September
Control Technology for In-Situ Oil Shale Retorts
LBID-304

TASK 3. BARRIER OPTIONS

Grout Permeability Measurements

Permeability measurements of grouts and triaxial compressive strength tests on simulated grouted core samples are continuing. Preliminary results indicate that using 2½% portland cement in the grout mix reduces the permeability by approximately a factor of three.

Evaluation of fly ashes as grout ingredients

Samples of fly ash have been received from four power plants in Wyoming and Colorado. X-ray diffraction analysis showed that one of these, from Gillette, Wyoming, contained C_3A, an active compound of portland cement. To further evaluate this material, it was tested for time of set, free lime, and compressive strength. Results of these tests are summarized in Table 1.

Table 1. Properties of Wyodak Fly Ash

Time of Set (ASTM C266)	
initial set	1 hr.
final set	30 hr.
Compressive Strength (ASTM C109)[a]	
3 day	561 psi
7 day	806 psi
28 day	1358 psi
Free Lime (ASTM C114)	1.5%

[a] 5% gypsum added for this test

The high calcium content of this material suggested that it might be an economic replacement for limestone in the process for producing hydraulic cement from Lurgi spent shale. A mixture of three parts fly ash to one part spent shale was calcined for one hour at 1000°C. However, the resulting product was inferior to the as-received fly ash.

Evaluation of Lignosulfonate Fluidizers

The lowest cost fluidizing admixtures to decrease grout viscosity are lignosulfonates which are by-products of the pulp and paper industry. Samples of such materials have been received and are now being evaluated as grout ingredients. Preliminary investigations suggest that by using a small amount of lignosulfonate fluidizer, it may be possible to prepare a non-bleeding grout from Lurgi spent shale without the use of sand or raw shale fines that is adequately fluid (20 second time of efflux from a Corps of Engineers standard grout flow cone).

Development of a Mathematical Model for Penetration of Non-Newtonian Fluids through Beds of Packed Particles.

Preliminary experiments and theoretical analysis showed that no existing model was satisfactory to describe the flow of non-Newtonian fluids through beds of packed particles. Experimental work has now been initiated to develop and verify a new model.

As the first step in this work, test slurries of type III portland cement are being characterized. These fluids will be injected into various porous media to obtain data for model development.

TASK 5. LEACHING OPTIONS

Leaching of Organics from Spent Oil Shale

A series of leaching experiments of LETC Run S-55 shale was completed in the 11.5-cm columns. Data from these runs are being used to verify the leaching and transport model. Each run in the series was continued until the TOC concentration in the column effluent approached that in the influent. Two columns were left with the leachate quiescent in the pores of the spent shale bed. The increase of TOC concentration with time in the fluid is being monitored. From these measurements the rate of diffusion of TOC within the solid phase will be calculated.

Another series of leaching experiments in the 11.5-cm columns loaded with spent shale from run L-2 of LLL's 6000-kg retort will be started shortly. We will follow the same experimental procedure used to leach the S-55 shale. The purpose of these additional runs is to determine the applicability of the leaching and transport model to a different type of shale.

TASK 6. GEOHYDROLOGIC MODIFICATION

Dewatering and Reinvasion Calculations

Model calculations on tract C-b were extended to include 60 years of dewatering calculations and 60 years of reinvasion calculations. The material properties used in this work are summarized in Table 2.

Table 2. Material properties used for dewatering and reinvasion calculations

Material	Saturated permeability (m^2)	Porosity	Storage Coefficient
Upper aquifer	8×10^{-14}	0.01	a
Lower aquifer	2×10^{-14}	0.01	1×10^{-4}
Confining layer (pre-retorting)	2×10^{-15}	0.01	a
Confining layer (post-retorting)	2×10^{-14}	0.30	a

[a]not used in model calculations.

An expanding retorted area was used, and recharge was applied as described in previous monthly reports. The mine inflow rate (dewatering rate) always increases, but at a decreasing rate as shown in Figure 1. The position of the phreatic surface at various times is shown in Figure 2.

On abandonment (after 60 years of dewatering) water starts to reinvade the desaturated flow region. The flow properties of the retorted area are changed as shown in Table 2 to reflect post-retorting conditions. Based on

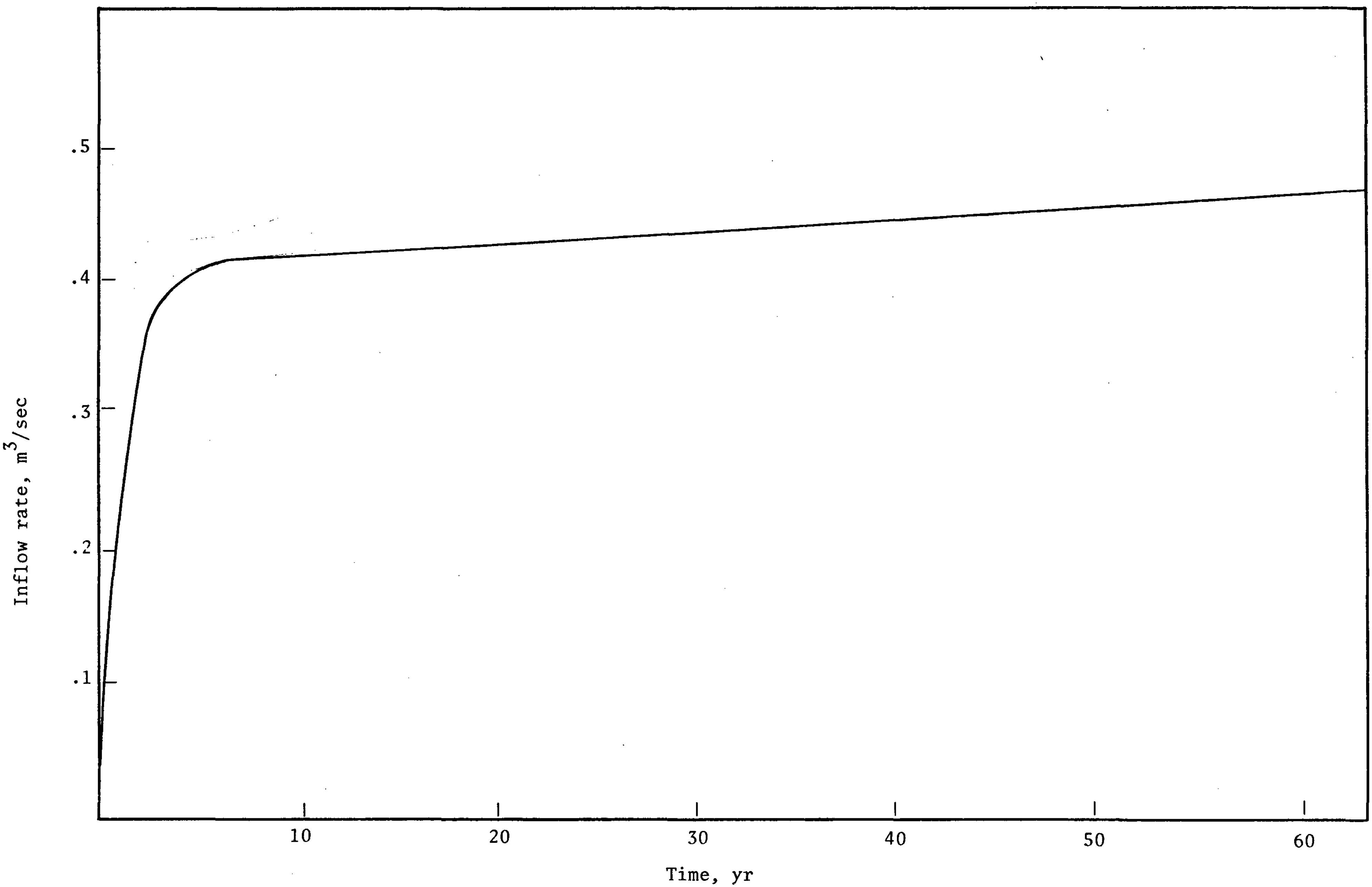

Figure 1. 60-year projection of mine inflow rate for an expanding retorted area in tract C-b.

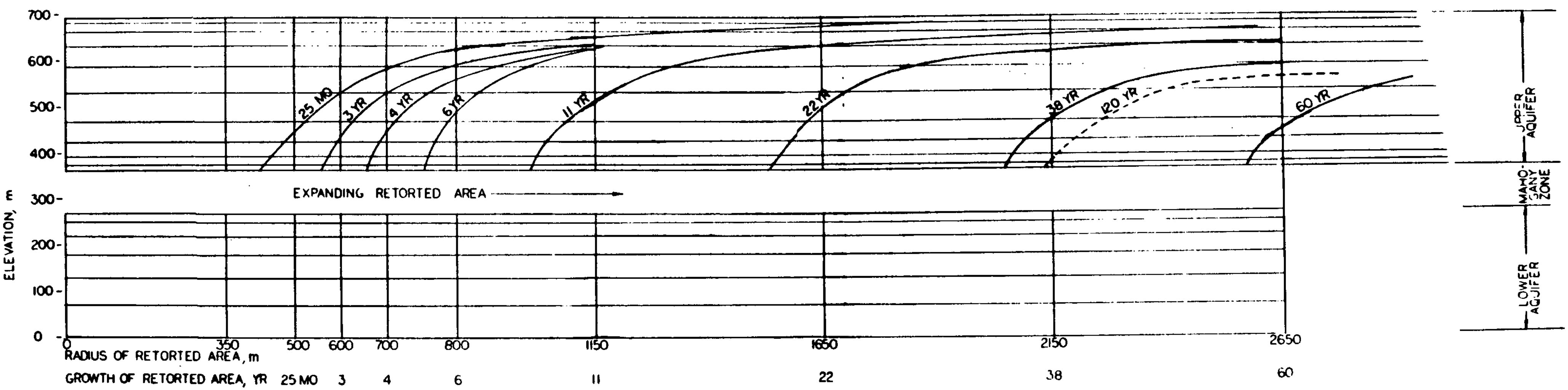

Figure 2. Location of phreatic surface during 60 years of dewatering (———) followed by reinvasion (------)

these assumed values, after 120 years (60 years of dewatering followed by 60 years of reinvasion) the water table recovery is as shown by the dashed line in Figure 2. Note that the recovery proceeds much more slowly than the drawdown. This is due to increased porosity and decreased hydraulic conductivity. The greater porosity requires that more water flow into the retorted region before water pressure can increase; hydraulic conductivity is lower because the media are desaturated.

In future work, sensitivity analyses will be done on the post-retorting material properties, and calculations will be refined by including anisotrophy.

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