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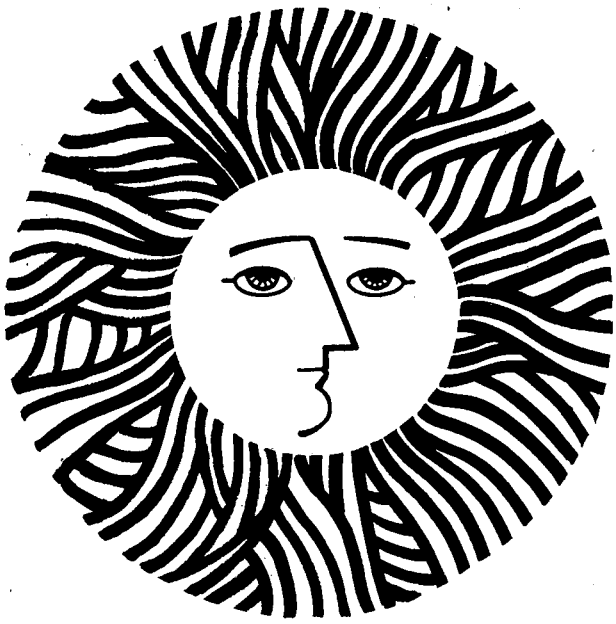

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LAWRENCE BERKELEY LABORATORY
Room: 128 Bldg.: 70 Ext.: 5931

April 6, 1981

TO: Charles Grua, Brian Harney, and Art Hartstein

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

RE: Monthly Progress Report for March
Control Technology for In-Situ Oil Shale Retorts
LBID-383

PRESENTATIONS AND PUBLICATIONS

The paper "Analysis of Subsidence in Modified In-Situ Retorts" by J. L. Ratigan was presented at the Oil Shale Conversion Symposium, Denver, Colorado, March 25, 1981.

The paper "On the Formulation of Saturated-Unsaturated Flow in Deformable Porous Media" by J. Noorishad, M. Mehran, and T. N. Narasimhan has been accepted for publication in Advances in Water Resources.

TASK 3. BARRIER OPTIONS

Penetration of Non-Newtonian Grout through Rubble

A series of tests has been completed in which a non-Newtonian fluid (a bentonite-water slurry) was characterized and pumped into straight horizontal or vertical circular tubes under constant head until no further penetration occurred. Results from these tests are now being analyzed. Additional penetration tests through non-circular (rectangular, triangular and star-shaped) tubes are now in progress.

TASK 5. LEACHING OPTIONS

Leaching of Organics from Spent Oil Shale

Work continues on fitting experimental column and batch data to mathematical models. As stated in the February 1981 monthly progress report, we are using both numerical and analytical techniques to solve the mass transport equation:

$$\frac{\partial C}{\partial t} + \frac{\partial C}{\partial Z} + \frac{\rho_B}{\varepsilon}\frac{\partial q}{\partial t} = 0$$

In this equation:

C = Concentration of TOC in the leachate

t = time

Z = Length along column

q = Concentration of TOC in the shale

ρ_B = Bulk density

ε = Porosity

Some difficulties have been encountered in quantifying the term 'q' for use in the above equation. Previously, we had found that the total amount of TOC contained in S-55 spent shale is about 1.7 weight percent and also that the quantity of readily leachable TOC is about 0.25 weight percent. The total amount was determined by wet oxidation of the shale by strong acids. The 0.25 percent value was determined by leaching the 'readily available' TOC from powdered shale in successive batches of distilled water. The actual quantity of TOC in the shale available for leaching most probably lies between these two values. The 1.7 percent value probably contains some refractory organics that are insoluble in water and the 0.25 percent value could be increased if longer leaching times were used.

If we examine the distribution of TOC in a unit volume in a typical column we note that there is about 150 to 1000 times as much TOC in the solid as in the liquid. For example, a cubic centimeter of material in the column contains 0.6 cm^3 of water and 0.88 grams of shale. If leachate containing 25 mg/l TOC is in contact with shale containing 17 mg TOC per gram of shale, there is about 1000 times more TOC in the solid phase than in the liquid. This great difference in phase concentrations is one of the causes of the difficulties we are having in fitting the experimental data to the mathematical models. The numerical solution involves an iterative calculation of rates of change of the TOC concentrations in two phases. A small change in liquid concentration at a point results in an almost insignificant change in the solid phase and the rate of change in the solid approaches zero. At the present time, we are examining a method for separating the solid phase TOC concentration into two parts, one which would contribute to short-term leaching, and one which contributes to long-term leaching. This method appears to have some merit.

TASK 6. GEOHYDROLOGIC MODIFICATIONS

The computer code ROCMAS is being refined to exclude portions of the code dealing with deformation and stress computation. This will increase the efficiency of the code for our specific needs, fluid, heat, and solute transport. Unsaturated flow will be implemented in the code as described in the paper "On the Formulation of Saturated-Unsaturated Flow in Deformable Porous Media," a copy of which is enclosed.

Previous work in this task has shown the need for improved field data on aquifer parameters. Mr. Jim Taylor of USGS has contacted us for input to a field pump test program to be carried out in the Piceance Creek Basin during the next few months. Our recommendations for these tests have been sent to Mr. Taylor.

This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.

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