Title
MONTHLY PROGRESS REPORT FOR OCTOBER, OIL SHALE WASTE CO-DISPOSAL: AIR/WATER EFFECTS AND CONTROL STRATEGIES

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Authors
Jones, Bonnie M.
Persoff, Peter
Sakaji, Richard H.
et al.

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Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA
ENERGY & ENVIRONMENT DIVISION

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5 November 1981

TO: Charles Grua and Art Hartstein

FROM: Bonnie M. Jones, Peter Persoff, Richard H. Sakaji, and Jerome F. Thomas
Christian G. Daughton (SEEHRL) Lawrence Berkeley Laboratory, Univ. of
California, Berkeley, CA 94720.

RE: Monthly Progress Report for October
Oil Shale Waste Co-Disposal:
Air/Water Effects and Control Strategies
LBID-452

TASK 2. UNCONTROLLED AIR EMISSIONS OF VOLATILES

Problem Definition

We have begun to review and summarize development plans and environmental impact statements of several oil shale operations pursuant to the problem definition task of our work proposal. These plans and environmental impact statements are the primary sources of information on the proposed disposal scenarios. Other sources of information, including patents, journal articles, and government reports are also being reviewed. This overview will enable us to design experiments that can accurately model the proposed codisposal options for spent shale and process waters.

TASK 4. WASTEWATER TREATMENT

Analytical Methodology

Accuracy of the inorganic carbon apparatus was further investigated this month. Successive analyses of a 10,000-ppm inorganic carbon standard prepared from sodium carbonate yielded values within 1% of the theoretical value. The upper limit of inorganic carbon that the instrument can measure has not yet been determined, but it is in excess of 2 mg per sample. A reproducibility study using undiluted filtered Oxy-6 gas condensate yielded a relative standard deviation of 0.2% (n = 10).

We are planning to investigate the determination of total carbon by low-temperature UV-persulfate oxidation as a replacement for high-temperature combustion. Low-temperature oxidation would eliminate equipment down time due

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to combustion tube replacement and conditioning. The carbon dioxide that is generated from the low temperature oxidation of organic compounds and conversion of inorganic carbon will be determined by automatic coulometric titration.

**Physicochemical Treatment**

Fabrication of the steam stripper is continuing. The plumbing connecting the steam generation system to the packed column was completed this month. This has allowed us to begin pressure testing the major components of the steam stripper. Pressure testing was accomplished by flooding the steam stripper with water. Since it is not anticipated that the actual operating pressure of the steam stripper will exceed 50 psi, we decided that the city line pressure of 70-74 psi should be adequate for testing the structural integrity of the column. The results of four pressure tests revealed several minor leaks, a major flaw in a tee flange, and inadequate thread sealant capacity. We remedied the leaks, replaced the sealant, and have ordered a replacement flange. The system has now been successfully pressure-tested.

We are still retrieving and reviewing steam stripper literature. This information will enable us to prepare a manual on operation and theory of the steam stripper.

**Integration of Treatment Units**

Experiments using ozonation/UV irradiation as a pretreatment to biological oxidation demonstrated that the applied dosages of ozone and UV radiation did not reduce the dissolved organic carbon (DOC) concentration or enhance biooxidation of raw or spent Oxy-6 retort water. To the contrary, these experiments showed that ozonation/UV irradiation transformed a large portion of the easily biodegradable compounds into recalcitrant organic species.

In the first experiment, filtered raw Oxy-6 retort water was sequentially subjected to ozonation (20 min), ozonation in conjunction with UV irradiation (40 min), and finally to UV irradiation alone (60 min). Ozone was supplied at the rate of 0.55 g/L/h, and the 450W medium pressure mercury-vapor quartz lamp was immersed in one liter of wastewater. The DOC concentration of the samples from this time-course study remained constant when compared with the time zero control; this indicated that ozonation and UV irradiation together or separately were ineffective for mineralization of organic compounds. Each of these time-course samples was then inoculated with microorganisms acclimated
for growth on Oxy-6 retort water and incubated for 65 h. Microbial mineralization of carbon decreased slightly with increasing time of ozone exposure. The extent of diminished biooxidation greatly increased when UV irradiation was begun; the microbially mediated DOC reduction decreased from 54% for the control to 11%. Ozonation and UV irradiation appeared to alter the polar biologically available organic constituents in retort water; biooxidation of raw retort water that had been ozonated and irradiated was severely hindered when compared with raw retort water. In contrast, subsequent UV exposure in the absence of ozone reversed this trend; the degree of biological removal of DOC from these samples approached that of the control cultures.

In the second experiment, a sample of biologically spent Oxy-6 retort water was exposed to a combination of ozonation and UV irradiation. This sample was sequentially subjected to ozonation (60 min), ozonation and UV irradiation (60 min), UV irradiation (30 min), and finally UV irradiation with addition of a photosensitizer (3 mg/L riboflavin; 30 min). The samples from this time-course study were analyzed for DOC content. The DOC concentration was not significantly reduced by any of these treatments when compared with the control concentration. There was, however, a noticeable reduction in color. Biological oxidation was negligible in all but the last sample, where we observed a 6% decrease in DOC concentration because of microbial activity. It appeared that both ozonation and UV irradiation are incapable of significantly altering the nonpolar organic compounds in retort water. After 3.5 hours of combined treatment, followed by biological treatment, DOC was reduced by only 10%.

**TASK 5. RETORT ABANDONMENT FINAL REPORT**

The numerical groundwater flow model, TRUST, which was used last year to determine water table drawdowns due to dewatering, will be used to determine the course of groundwater reinvasion under various retort abandonment scenarios. It is first necessary to repeat the dewatering calculation to establish the initial condition for reinvasion. Input data are now being prepared for this step. Triaxial compressive strength test data and permeability test data are now being reviewed to determine the most appropriate range of grouted retort permeability values to use as model input data.
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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