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Program: Trace Element Contamination Potential of Coal-Fired Power Plant Scrubber Wastes

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On November 9, 1979 a meeting was held in Chicago under the auspices of the Office of Health and Environmental Research (OHER). The purpose of this meeting was to coordinate various projects dealing with potential environmental problems associated with the disposal of coal ash and flue gas desulfurization (FGD) sludges. Those in attendance were Marc Anderson - University of Wisconsin, Herb Allen - Illinois Institute of Technology, David Evans - Savannah River Ecology Laboratory, Florence Harrison - Lawrence Livermore Laboratory, Thomas Theis - University of Notre Dame, and Lawrence Wangen - Los Alamos Scientific Laboratory. The latter four individuals are principal investigators for projects under the technical direction of DOE's OHER. Two of these projects, those of Evans and Wangen, are funded through the Interagency Energy-Environment program managed by EPA's Energy Effects Division, the other two are funded through OHER.

It was agreed that these projects would coordinate around a pollutant groundwater transport model being developed at Notre Dame. LASL's principal contribution is to experimentally investigate the transport of selected contaminants through soils using laboratory column techniques. The following is an outline of the experimental studies LASL will undertake as part of its contribution to this coordination effort. It is noted that this work can stand alone apart from any groundwater transport model even though it will produce data of importance to such a model.

Based on previous studies, As, B, Cd, and Ni were chosen as candidate contaminants. These elements have been shown to be among the elements often found at relatively high concentrations in coal ash and FGD sludge leachates (See our letter report for April-Sept. 1979). Two of these - Cd and Ni - are assumed present as plus two cations and the other two are assumed present as the plus five and plus three oxyanions-arsenate and borate. These assumptions are in accord with the anticipated

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environmental forms of the contaminants. That is, we expect contaminants originating from an oxygen rich combustion process to be present, at least initially, in the highest valence state consistent with environmentally stable states. We will follow the migration of these contaminants through two model soils - kaolin (hydrated aluminum silicate) and amorphous ferric oxide (FeOOH) and up to four real soils - an acidic weathered soil high in amorphous ferric oxide, a high kaolonite clay soil, a calcareous soil, a dunal sand and a laboratory grade silicate sand. The contaminants will be mixed at concentrations between 10 and 100 mg/ℓ. Although these are generally higher than concentrations in real systems, such high concentrations are felt necessary to provide measurable contaminant levels in column effluent and to complete the experiments in a reasonable time. The effect of slightly acidic and alkaline leachates will be investigating by adjustment of column influent to pH of 5 and 10. Nitric acid or potassium hydroxide will be used for pH control. The experiments will be repeated using a $CaSO_4$ leachate matrix (∿10000 mg/ℓ) to better simulate coal ash and FGD sludge leachates for the purpose of investigating the effect of sulfate on contaminant transport. Transport of a real ash or FGD sludge leachate will also be studied.

Thus, the tentative leachates to be studied are the following:

1. Mixture of Cd^{+2}, Ni^{+2}, AsO_4^{-3}, BO_3^{-3} at pH5
2. " pH10
3. Mixture of Cd^{+2}, Ni^{+2}, AsO_4^{-3}, BO_3^{-3} in $CaSO_4$ at pH5
4. " pH10
5. Coal ash and/or FGD sludge leachate.

The movement of these leachates through the six soils and silicate sand will be followed as a function of leachate volume. Two replicates of each soil/leachate combination are planned in addition to one control leachate of distilled water for each soil. (Replicates will not be performed using the laboratory grade silica sand.) Thus, we are anticipating a total of 72 columns. It is further planned to have four sampling ports in each soil column to allow collection of leachate samples from within the soil matrix itself as well as at column inlet and outlet positions.

Efforts since November 9, 1979, which are related to these integrated studies, have included planning the details of these experiments, acquisition of materials and chemicals, and design and construction of laboratory apparatus and columns. We hope to commence initial column studies by 1 February 1980 using soils previously collected by LASL under another program. Quantities of these soils will be provided to LLL for use in their studies on transport of organic contaminants and to Notre Dame for batch studies. Methods for coating sand grains with kaolin or amorphous ferric oxide are presently being investigated. Sand coating is generally required with clays to provide substances with permeabilities high enough to allow a reasonable flow of water. When satisfactory sand-coating or mixing procedures have been developed, column studies with the model soils can be started. Present plans call for testing leachates 1 and 3 with all six soils by the end of FY1980. We presently do not have a high kaolinite soil or the Michigan City dunal sand and are not certain of the amorphous iron oxide content of our acid soil. These issues are being addressed. Their resolution will enable column studies with these materials to proceed. We probably will not know how realistic is our time frame before April or May, by which time we should have encountered most of the pitfalls.