

Project Summary

1) TITLE: DE-FC26-02NT41590

Speciation and Attenuation of Arsenic and Selenium at Coal Combustion By-Product Management Facilities

2) PROJECT PARTICIPANTS:

Sponsors – DOE-NETL, EPRI

Subcontractors – Natural Resource Technology, Trent University, Purdue University, Ish Inc., Illinois Waste Management and Research Center

3) PROJECT DESCRIPTION:

A. Objective(s)

The overall objective of this project is to evaluate the impact of key constituents captured from power plant air streams (arsenic, selenium and mercury) on the disposal and utilization of coal combustion by-products. Specific objectives of the project are: 1) to develop a comprehensive database of field leachate concentrations at a wide range of CCB management sites (about 25 sites), including speciation of arsenic and selenium, and low-detection limit analyses for mercury; and 2) to perform detailed evaluations of the release and attenuation of arsenic and selenium species at 3 CCB sites.

B. Background/Relevancy

The fundamental or mechanistic data to reliably model many of the inorganics in CCB leachate are lacking. There is a large degree of uncertainty in the initial leachate concentrations, long-term leaching characteristics of CCBs, and the attenuation coefficients typically used in groundwater transport models. As a result, the model simulations are either highly conservative, or they can be manipulated to obtain almost any desired result. This research project will develop a coherent field leachate database and soil attenuation coefficients for improved modeling and evaluation of the potential for groundwater impacts at CCB management facilities. The work is focused on speciation of four key constituents at CCB sites: arsenic, selenium, chromium, and mercury. The proposed work will help to narrow the uncertainties in the range of values of these critical inputs and improve the accuracy of the modeling results.

C. Period of Performance :

October 1, 2002 – September 30, 2005

D. Project Summary

Work will be done in two phases. In the first phase, a comprehensive database of field leachate concentrations at CCB management facilities will be developed. Existing EPRI data will be augmented with field sampling at approximately 25 active or closed CCB facilities to determine concentrations of a range of inorganic constituents in field leachates. Analysis will include speciation of arsenic and selenium, and low level analysis of mercury. Facilities will be chosen to represent a range in coal types, combustion conditions, air emissions controls, and CCB management methods. The data will be used to establish the range in expected leachate concentrations in actual field settings. In Phase II, three coal ash disposal facilities will be selected for detailed field investigations of arsenic and selenium leaching and attenuation. The selected sites will represent different geochemical settings, will have documented concentrations of arsenic and/or selenium in leachate above their respective MCLs, and will have an existing groundwater monitoring network that can be used to define groundwater flow directions and existing groundwater quality. Field investigations will include collection of soil and ash samples from multiple depths for conducting laboratory tests. Ash samples will be

tested to determine the amount of arsenic and selenium present, potential for leaching and release, and the species of arsenic and selenium in the leachate. Soils will undergo physical-chemical characterization, and several equilibration experiments using predetermined concentrations of As (III), As (V), Se (IV), and Se (VI) to: evaluate the potential range of leachate concentrations in developing the adsorption isotherms; determine pH dependence of adsorption of arsenic and selenium species; examine synergism or antagonism due to dissolved sulfate concentrations on the adsorption of arsenic and selenium species; and evaluate leachate matrix effects on adsorption characteristics. Two soil samples from each site will be used in conducting laboratory column studies to obtain adsorption capacity and attenuation coefficients in a flow-through system. Data will be used to model movement of arsenic and selenium at the site, and results will be compared to monitoring well data.

4) PROJECT COSTS:

- A. DOE Costs - \$358,014
- B. Recipient Share - \$358,014
- C. Project Total - \$716,029

5) MAJOR ACCOMPLISHMENTS SINCE THE BEGINNING OF THE PROJECT:

- Field leachate sampling at 22 sites completed
- Approximately 75 % of the leachate analyses for the 22 field sites completed
- Field work for detailed attenuation studies at 3 completed
- All of the laboratory attenuation work for arsenic and selenium completed
- Completed interim report for field leachate sampling:
Characterization of Field Leachates at Coal Combustion Product Management Sites: Methods and First-Year Results, EPRI Report 1005272, Dec. 2004
- Completed interim report for arsenic attenuation:
Chemical Attenuation Coefficients for Arsenic Species Using Soil Samples Collected from Selected Power Plant Sites: Laboratory Studies, EPRI Report 1005505, Dec. 2004
- Prepared and presented several conference papers

6) MAJOR ACCOMPLISHMENT PLANNED DURING THE NEXT 6 MONTHS:

- Field leachate sampling at remaining sites completed by April 2005
- Complete all analyses for field leachate samples by June 2005
- Complete selenium attenuation data analyses and reporting by June 2005
- Complete final project report by December 2005.

7) ISSUES:

The primary difficulty we have encountered to date is obtaining accurate speciation data for arsenic and selenium on the field leachate samples. These analyses are very difficult due to problems with preservation of field samples and matrix interferences with the laboratory analytical techniques. The ability to resolve the speciation is highly dependent on the sample characteristics. We have spent a good deal of time working on these analytical issues and believe we have satisfactorily resolved them.