

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Environmental & Water
Resources

07/2005



SPECIATION AND ATTENUATION OF ARSENIC AND SELENIUM AT COAL COMBUSTION BY-PRODUCT MANAGEMENT FACILITIES

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Description

Objective

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 Coal Utilization By-Product (CUB) 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 CUB sites.

Background

The fundamental or mechanistic data to reliably model many of the inorganics in CUB leachate are lacking. There is a large degree of uncertainty in the initial leachate concentrations, long-term leaching characteristics of CUBs, 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 CUB management facilities. The work is focused on speciation of four key constituents at CUB 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.

Summary

Work will be done in two phases. In the first phase, a comprehensive database of field leachate concentrations at CUB management facilities will be developed. Existing EPRI data will be augmented with field sampling data from approximately 25 active or closed CUB facilities to determine concentrations of a range of inorganic constituents in field leachates. Analysis will include speciation of arsenic represent a range in coal types, combustion conditions, air emissions controls, and CUB 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

COST

Total Project Value
\$716,029

DOE/Non-DOE Share
\$358,014 / \$358,014

PERIOD OF PERFORMANCE

October 2002 to
September 2005

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different geochemical settings, will have documented concentrations of arsenic and/or selenium in leachate above their respective maximum containment levels, 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.

Accomplishments

- Field leachate sampling at 22 sites was completed
- Approximately 75 % of the leachate analyses for the 22 field sites was completed
- Field work for detailed attenuation studies at 3 sites was completed
- All of the laboratory attenuation work for arsenic and selenium was 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

Planned Activities

- Complete field leachate sampling at remaining sites
- Complete all analyses for field leachate samples
- Complete selenium attenuation data analyses and reporting
- Complete final project report

Issues

The primary difficulty 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. Considerable time has been spent working on these analytical issues and it is believed that they have satisfactorily been resolved.