Topic CCB-1

White Paper Topic: Placement of CCBs at Coal Mines - Risk Assessment

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Problem Definition:

The use and disposal of Coal Combustion By-Products (CCBs) (i.e. fly ash, bottom ash, flue gas desulfuratization (FGD) material, and fluidized bed combustion (FBC) material) at coal mines has become an area of intense interest, research, activity, and controversy during the last decade. The Office of Surface Mining has a very specific area of responsibility concerning the use of Coal Combustion By-Products when these materials are placed at a mine regulated under the Surface Coal Mining and Reclamation Act of 1977. Current, beneficial mining related uses include: (1) an alkaline seal or fill material to contain acid forming materials and prevent the formation of acid mine drainage; (2) an agricultural supplement to create productive artificial soils on abandoned mine lands where native soils are not available; (3) a flowable fill that seals and stabilizes abandoned underground mines to prevent subsidence and the production of acid mine drainage; (4) a construction material for dams or other earth like materials where such materials are needed as a compact and durable base; and (5) a non-toxic, earthlike fill material for final pits and within the spoil area to reduce reclamation cost.

The determination of risk to public health and the environment accomplished during permit review for a specific application under SMCRA would typically require: (1) a complete physical and chemical analysis of the CCB materials proposed for placement on the mine, including results of leachate tests for predicting potentially toxic pollutants to the ground water; (2) a detailed plan for how the materials are to be placed in the backfill in order to ensure that the resulting physical stability and ground water hydrology are appropriate for the approved post mining land use; and (3) that the monitoring plan is designed to ensure that post reclamation ground water quality has not been contaminated by potentially toxic pollutants as a result of the CCB placement.

The standard EPA method for testing for potential leachate toxicity from a solid waste is the TCLP method. Numerous researchers have indicated that this test is limited in its applicability when used as a predictor of actual leachate results when CCBs have been placed on a SMCRA mine. The TCLP method was developed to simulate leachate conditions with a mild organic acid in domestic landfills.

The hydrogeologic conditions of SMCRA mines are much more variable than domestic solid waste landfills and range from: (1) the extremely alkaline and arid western U.S.; (2) the mildly alkaline and humid Midwestern U.S., to (3) the neutral to pyretic acid and humid Eastern U.S. In many cases, native ground water supplies within coal mining regions are unusable prior to mining and reclamation due to natural high levels of mineralization or limited quantity.

The DOE National Energy Technology Laboratory (NETL) has conducted several years of column leach tests with various lixiviants solutions that span the range of surface and ground water to which CCBs might be exposed. In general, they found that environmental contamination was usually not a problem, but that certain CCBs should not be placed in certain environments without additional safeguards. However, such leaching tests are very time-consuming. More appropriate leachate test methods need to be developed that would be better predictors of potential toxic pollutants that could be generated by these materials when placed in

contact with typical backfill materials found in the major coal regions of the country. Efforts to develop more appropriate regional mine specific leachate test methods are being attempted by CCB researchers such as: (1) David Hassett at the Energy & Environment Research Center, University of North Dakota to develop the SGLP method for the western U.S.; (2) Paul Ziemkiewicz at the National Mined Land Reclamation Center at the University of the West Virginia to develop the MWLP method for the eastern U.S.; and (3) Barry Scheetz who is proposing the use of the MCC 3S method for the eastern U.S.

In addition, the NETL has initiated an inter-laboratory comparison of leaching methods applicable to granular materials, such as coal utilization by-products. The participating laboratories are NETL; the National Mine Land Reclamation Center at West Virginia University; the Energy and Environmental Research Center, University of North Dakota; the Virginia Tech Dept. of Crop and Soil Environmental Sciences; and the University of the Western Cape Dept. of Chemistry in Cape Town, South Africa. Each participant is applying multiple methods to identical CUB samples, analyzing leachates for a list of metal components, sharing data, and evaluating the methods based on information generated, sensitivity, precision, time required, simplicity, and applicability. The procedures being compared are the Serial Batch Leaching Protocol developed at NETL, the MWLP, the SGLP, and the 3-Tier Leaching Protocol described by D.S. Kosson, H.A. van der Sloot, F. Sanchez, and A.C. Garrabrants, in "An Integrated Framework for Evaluating Leaching in Waste Management and Utilization of Secondary Materials"(Environ. Eng. Sci., Vol. 19, No. 3, pp. 159-204, 2002).

Course of Action:

The OSM CCB steering committee conducted a half day session on "LEACHING PROTOCOLS AND STUDIES SUPPORTING CCB RISK ASSESSMENT AT MINES" at the WOCA conference in Lexington Kentucky in April of 2005. The applicability of new mine specific leachate tests was discussed by their developers. The results of this technology transfer effort were that a consensus emerged that no one test will be applicable to all situations. Specific leachate protocols must be developed for specific CCB types and specific hydrogeologic conditions.

OSM needs to work with ASTM in the development of a decision tree that would guide the choice of the most appropriate leachate test or tests for a given CCB type and hydrogeologic condition.

OSM needs to work with DOE and its Combustion By-Product Recyling Consortium to promote a directed scientific investigation into verifying the use of these new leachate test methods with actual mining operations that would be typical of CCB placement in the various hydrogeologic coal mining regions of the country.

Cost of Project:

$250,000 - $1,250,000 over several years to be funded in part by OSM and in part by DOE.

Literature Survey:

- David J. Hassett
  USING LABORATORY LEACHING METHODS TO EVALUATE CCBs
  University of North Dakota, Energy & Environmental Research Center, Grand Forks, North Dakota
- Ann G. Kim
  LEACHING METHODS APPLIED TO THE CHARACTERIZATION OF COAL UTILIZATION BY-PRODUCTS
  National Energy Technology Laboratory, US Department of Energy, Pittsburgh, Pennsylvania
- David J. Hassett and Debra F. Pflughoeft-Hassett

EVALUATING COAL COMBUSTION BY-PRODUCTS (CCBs) FOR ENVIRONMENTAL PERFORMANCE
University of North Dakota, Energy and Environmental Research Center, Grand Forks, North Dakota

- Paul F. Ziemkiewicz
  THE MINE WATER LEACHING PROCEDURE
  National Mine Land Reclamation Center, West Virginia University. Morgantown, WV
- Paul F. Ziemkiewicz
  PREDICTION OF COAL ASH LEACHING BEHAVIOR IN ACID MINE WATER: COMPARISON OF LABORATORY AND FIELD STUDIES
  West Virginia Water Research Institute, West Virginia University, Morgantown, West Virginia
- Michael J. Menghini, Roger J. Hornberger and Alfred D. Dalberto
  THE USE OF LEACHATE DATA AND OTHER FACTORS IN EVALUATING CCB's FOR PLACEMENT AT COAL MINE SITES IN PENNSYLVANIA
  Pennsylvania Department of Environmental Protection
- Deborah A. Dale
  THE USE OF NEUTRAL LEACHATE TEST DATA IN INDIANA'S COAL COMBUSTION BY-PRODUCT DISPOSAL PROGRAM
  Indiana Department of Natural Resources, Division of Reclamation, Jasonville, Indiana
- Ann G. Kim
  CCB LEACHING SUMMARY: SURVEY OF METHODS AND RESULTS
  National Energy Technology Laboratory, U.S. Department of Energy, Pittsburgh, Pennsylvania
- Ishwar P. Murarka
  ENVIRONMENTAL PERFORMANCE OF CCPs
  Ish Inc., Sunnyvale, California