Characterizing the Release of Mercury from CUB – Application and Interpretation of Multiple Techniques

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Summary

Coal utilization byproducts (CUB) can contain a variety of major elements, including silicon (Si), aluminum (Al), calcium (Ca), iron (Fe), magnesium (Mg), sulfur (S), and trace elements including arsenic (As), cadmium (Cd), chromium (Cr), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), selenium (Se), and zinc (Zn), that originate from the mineral matter in coal or additives used in pollution control processes. Leaching techniques are frequently used to predict the fate of elements in surface and groundwater environments, soils and sediments, and can indicate potential problems associated with use and/or disposal. Commonly, batch, sequential batch or fixed-bed column techniques have been used to determine the compatibility of CUBs in particular end-use or disposal environments. Individual batch leaching techniques utilize a single, predetermined volume of leaching solution to provide information on metals release at a set pH, rather than a range. Sequential batch leaching procedures involve multiple steps, typically at decreasing (increasing) pH to provide information regarding the effect of increasing acidity (basicity). Parallel batch procedures provide similar information by using a separate aliquot of the solid for leaching at each pH. The fixed-bed column approach employs a continuous flow of leaching solution to the material under investigation. Elution profiles, with changing elution volume and pH, are produced for each element under investigation. In contrast to batch techniques, clogs can form in fixed-bed leaching columns, either because of the cementitious properties of the material, such as is seen for FBC ash, or because of precipitate formation, such as can occur when a high-calcium ash is subjected to sulfate-containing leaching solutions. Coarse-grained materials are more amenable to column leaching compared to fine-grained materials, such as FGD gypsum, because of permeability problems that can arise with decreasing grain size. While batch techniques are commonly designed to give equilibrium values, flow systems may be under kinetic control.

A number of leaching methods have been applied to CUB at NETL. Current efforts to integrate all of the results into one consistent view of the Hg leachability have been only partially successful. Plots of cumulative Hg leached versus pH provide some reasonable comparisons for an alkaline ash. However, the technique fails to be illuminating for an acidic ash. Currently, it is thought that a geochemical model accounting for both thermodynamic and kinetic parameters will be necessary to fully integrate the data.