Solubilization of Trace Metals from FGD Gypsum Using a Continuously Stirred Tank Reactor

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Abstract

A continuous, stirred-tank extractor (CSTX) is an effective technique for evaluating the leachability of contaminants from flue gas desulfurization (FGD) products and other materials with low permeability or cementitious properties and allows the chemistry of the leaching process to be studied at a level unachievable through more traditional batch and column techniques. In this study, metal release patterns were examined in detail over a range of pH values extending from the material's natural, slightly alkaline pH to acidic pH conditions. Understanding the fundamental mechanisms operating during the leaching process provides a basis for evaluating the safety of FGD byproducts and ensuring these materials are used and disposed of appropriately. The results indicate that the leaching behavior of individual elements depends on several factors including, but not limited to, the solubility of the mineral phases present, sorption properties of the remaining phases, behavior of the solubilized material in the tank, the type of species in solution and the neutralization capacity of the minerals. Bulk gypsum is moderately soluble; dissolution is controlled by its solubility product and hydration reactions rather than pH. Elution and pH profiles indicate the presence of alkaline material(s) that buffer the system during the initial leaching. Iron and aluminum are not leached until the buffering capacity is exhausted. Any elements bound to these phases can be mobilized during this dissolution. Arsenic, lead and mercury are not released during the leaching of most samples and become concentrated in a minor, insoluble residue remaining at the end of each experiment.