

Mechanisms Controlling the Leaching Kinetics of Fixated Flue Gas Desulfurization Material

Min C. Cheng and Harold W. Walker

The Ohio State University, Department of Civil and Environmental Engineering and Geodetic Science, 470 Hitchcock Hall, 2070 Neil Ave., Columbus, OH 43210

KEYWORDS: Fixated FGD material, leaching kinetics, rotating disk, pH effect, hydrodynamic.

ABSTRACT

The primary objectives of this work were to (1) elucidate important mineral phases controlling leaching of flue gas desulfurization (FGD) by-product in aqueous environments, (2) reveal the effect of pH on the kinetics of the leaching process, and (3) determine whether the leaching processes of specific elements from FGD by-product are transport or surface-reaction controlled. To carry out these objectives, leaching kinetics of FGD by-product were examined using a continuous-flow-rotating-disk system. Effluent samples were collected and then analyzed by ICP and IC. XRD, SEM, EDS, and BET were applied to observe the changes of mineral phases and morphology on the surface during leaching. Depletion of hannebachite, portlandite, and a secondary mineral, ettringite, on the leaching surface resulted in high concentrations of Ca and S. Mullite, quartz, hematite, maghemite, magnetite, and magnesioferrite may control the release of minor elements, i.e., Al, Si, Mg, and Fe. No significant increase in leaching rates was found by changing the leaching conditions from pH 6.8 to 3.7. However, at pH 2, the leaching rates of both major and minor elements increased dramatically and the presence of trace elements, i.e., Ba, Mn, Sr, and Ti, was also observed. Preliminary results show that hydrodynamic conditions do not affect the leaching rates for major and minor elements (with the exception of potassium) at pH 5 suggesting a reaction-controlled mechanism. The results presented here provide a foundation for the development of mechanistic models of leaching of fixated FGD material in natural and engineered systems.