Comparative Characteristics of FGD Sulfate-Rich and Sulfite-Rich Scrubber Material

V. M. Malhotra[1], P. S. Valimbe[1,2], and F. Botha[3]

[1] Southern Illinois University, Department of Physics, Carbondale, IL 62901-4401
[2] Current Address: Morse Automotive Corporation, 4100 S. Morgan St., Chicago, IL 60609
[3] Illinois Clean Coal Institute, Carterville, IL 62918

Keywords: FGD scrubber sludge, synthetic gypsum, DSC, DTA, thermal, infrared, XRD

ABSTRACT

Massive quantities of flue gas desulfurization scrubber sludge are produced every year in the United States. The wet scrubbers, depending upon the technologies involved, either produce sulfate-rich or sulfite-rich scrubber sludge. The bulk of the FGD sludge produced goes into landfills though some sulfate-rich sludge is co-mixed with plaster to fabricate wallboards. However, the effective and economical utilization of the scrubber sludge necessitates its thorough characterization. Thus, we undertook physical and chemical characterization of a sulfate-rich and a sulfite-rich scrubber sludge produced by two different power plants burning Illinois coal.

The crystallographic behavior of sulfate-rich and sulfite-rich scrubber sludge was probed with the help of X-ray diffraction (XRD) and scanning electron microscopic (SEM) techniques. The thermal stability of the sludge was examined under nitrogen and oxygen environment by undertaking differential scanning calorimetry (DSC) measurements at $25^{o}C < T < 500^{o}C$ and differential thermal analysis (DTA) measurements at $50^{o}C < T < 1100^{o}C$. The thermal signatures were contrasted with various types of gypsum, $CaSO_3$, and $CaCO_3$. In addition, the structural transitions in sulfate-rich and sulfite-rich material, an important parameter in their utilization, were examined under thermal perturbations by conducting in-situ high-temperature diffuse reflectance-Fourier transform infrared (IHTDR-FTIR) measurements at $25^{o}C < T < 800^{o}C$. Both sulfate-rich and sulfite-rich materials contained soot-like particles, which were handpicked under an optical microscope and were examined by FTIR technique. These soot-like particles did not appear to have a structure similar to the parent coal; rather they were a mixture of inorganic and organic phases.