

Dispersed Volcanic Ash in Feed Coal and Its Influence on Coal Combustion Products

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The U. S. Geological Survey and the University of Kentucky Center for Applied Energy Research are collaborating with an Indiana Utility to determine the physical and chemical properties of feed coal and coal combustion products (CCP) from a coal-fired power plant. The plant utilizes a low-sulfur coal (0.23-0.47 weight % S) coal from the Powder River Basin.

SEM and XRD analysis of feed coal samples identified two mineral suites. A primary suite (not authigenic) consisting of quartz (detrital and volcanic beta-form grains), biotite, and minor zircon and a secondary authigenic mineral suite containing calcite, alumino-phosphates (crandallite and gorceixite), kaolinite, quartz, anatase, barite, and pyrite. These minerals are attributed to air-fall and reworked volcanic ash deposited in peat-forming mires. Feed coals contain higher amounts of Ba, Ca, Mg, Na, Sr, and P when compared to other western coals. These elements are associated with alumino-phosphate, biotite, calcite, and clay minerals. The element associations are indicative of coals influenced by volcanic ash.

XRD analysis of CCP revealed a predominance of glass, perovskite, lime, gehlenite, quartz, and phosphates with minor amounts of periclase, anhydrite, hematite, and spinel group minerals in the fly ash and quartz, plagioclase (albite and anorthite), pyroxene (augite and fassaite), rhodonite, and akermanite in the bottom ash. Microprobe and SEM analysis of fly ash samples revealed quartz, zircon, monazite, euhedral laths of corundum with merrillite, hematite, dendritic spinels/ferrites, and rounded grains of wollastonite with periclase. The abundant Ca and Mg mineral phases in the fly ashes are related to the presence of carbonate, clay, and phosphate minerals in the feed coal.

The Ca- and Mg-rich mineral phases in the CCP can be attributed to volcanic minerals deposited in the peat-forming mire. Dissolution and alteration of these minerals occurred either in the peat-forming stage or during coalification/diagenesis contributing to the authigenic mineral suite. Other factors that affected the geochemistry of the feed coal and the resulting CCP are the detrital input and the epigenetic ground-water flow.