Effects of Synthetic Soil Containing Fluidized-Bed Combustion Coal Ash on Vadose-Zone Water Chemistry at a Reclaimed Coal-Processing Waste Pile

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KEYWORDS: water chemistry, coal ash, mine reclamation

ABSTRACT

A coal-processing waste deposit (120 acres) in Indiana was reclaimed using a synthetic soil composed of equal volumes of fluidized-bed combustion coal ash from Purdue University and microbiological fermentation byproduct from a drug company. Synthetic soil was substituted for traditional borrow soils and lime to demonstrate the effectiveness of industrial byproducts in reclaiming abandoned coal mines. Synthetic soil was incorporated 8 inches deep at a rate of 150 tons per acre into the refuse. Acid-neutralization potential of the synthetic soil is claimed to be approximately one-third that of agricultural lime.

Pore-water samplers were installed at depths of 1.5 feet, 3 feet, and 9 feet at one location to monitor chemical changes occurring in the vadose zone. Hydrologic conditions were monitored by a neutron soil moisture gauge, rain gauge and well with pressure transducer. Conductivity, pH, redox potential, acidity and alkalinity were determined along with 10 cations, 3 anions and 9 trace elements. Eleven site visits based on storm events or season changes have yielded 29 samples since July of 2001.

The data indicates that acid conditions persist in the shallow (1.5 ft) vadose zone and loss of alkalinity at 3 ft has occurred during the monitoring interval. Component concentrations at 1.5 feet fluctuate more from seasonal soil moisture storage changes than from individual storm events. Concentrations of acid-soluble elements decrease with depth as more neutral conditions are encountered. Chemical modeling generated mineral saturation indices consistent with water chemistry data, suggesting that element concentrations decrease with depth due to precipitation.