

A FIELD DEMONSTRATION OF AN ALTERNATIVE COAL WASTE DISPOSAL TECHNOLOGY – GEOCHEMICAL FINDINGS¹

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Abstract: The objective of this study was to develop alternate management practices for coal refuse disposal which will minimize the release of sulfate (SO_4) and chloride (Cl) into surface water discharge. It was designed to provide confidence to mine operators to develop and implement innovative concepts for engineered waste disposal at coal mines. Field-scale kinetic testing (leaching columns) was employed to investigate whether co-disposal of coarse and fine coal refuse will provide an improved geochemical environment necessary to minimize total dissolved solids (TDS) in refuse area discharge, while maintaining adequate geotechnical stability. The impact of alkaline addition (moderate additions of ground limestone to the coarse and fine coal refuse blend) was also investigated as a means of increasing both the geotechnical stability and the buffering capacity of the simulated co-disposed waste fill. The primary purpose of this paper is to present our geochemical findings. Nineteen months of field testing was conducted at an active Southern Illinois mine site using duplicate 100-gallon leach columns [oval, polycarbonate, stock tanks 113.4 cm (52.5 inches) long by 94 cm (37 inches) wide by 53.3 cm (21 inches) tall] containing three compacted refuse blends. Two columns contained coarse refuse, representing the existing practice (the control), two columns contained a fine and coarse coal refuse blend (simulating co-disposal) and two columns contained blended refuse with 10% (by volume) ground limestone. We found that the mobility of sulfate was significantly lower in leachate derived from columns composed of the compacted blend of coarse and fine refuse as compared to compacted coarse refuse alone. Additional improvements in leachate chemistry were observed in columns simulating blended refuse with limestone addition. In this experiment, Cl was extracted at a considerably higher degree than S. The counter ion Na was also elevated in column leachate, but could have also been derived from cation exchange (with Ca) in abundant clays associated with the run-of-mine (ROM) coal in the region. Kinetic testing revealed a rapid decline in bicarbonate (HCO_3) concentration as compared to sulfate (SO_4) concentrations suggesting that either carbonate weathering rates far exceeded the sulfide rates or that alkalinity-producing minerals were passivated (coated with mineral precipitates), thereby limiting carbonate dissolution. In the course of leach testing higher pH conditions in columns simulating the two co-disposal options may have enhanced precipitation of oxy-sulfate minerals such as K- and Na-jarosite, minerals which can sequester both Fe and S. Both of these sulfate minerals were predicted to form during the late leaching period (> 7 months) in geochemical models. Modeling also indicated that Fe hydroxides will form within the columns at higher pH (> 6) during early leach testing (< 7 months) and may have combined with jarosite to limit the mobility of Fe. This research was conducted partial support from the Illinois Clean Coal Institute.

Additional Key Words: Sulfate, chloride, TDS, co-disposal, coal refuse, alkaline addition.

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