Geochemical Properties and Long-term Contaminant Release Patterns from CCPs in Acid-Forming Coal Refuse Materials

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ABSTRACT

Research on the beneficial utilization of CCPs in mining environments has focused upon bulk acid-base balances and heavy metal (Cu, Zn, Fe, Al, Mn, etc.) mobility to local ground- and surface waters. Currently, the public and the regulatory community are placing greater focus on the potential mobility of As, B, Se and other oxyanions from CCP utilization in coal mining environments. Five CCPs were selected for a leaching column trial from a set of 28 CCPs produced in Virginia and surrounding states following complete chemical characterization. Strongly acid-forming coal refuse was amended at 0, 10, and 20% (v:v) with the CCPs to simulate scenarios where CCPs are utilized to offset acid drainage evolution. A set of control columns were limed at the rate equivalent to 34.5 Mg CCE per 1000 Mg refuse. Columns were leached twice per week with the equivalent of 2.5 cm rainfall per event. Leachate properties over the 4 month study period reinforce the importance of using an appropriate acid-base accounting approach to maintain the pH of the CCP/refuse blends within an acceptable range of pH 5.5 to 9.0. Leachates from the limed control columns equilibrated at pH 7.2 versus pH 2.1 for the non-limed and otherwise unamended columns. Amending coal refuse with CCPs with adequate calcium carbonate equivalence was very effective in preventing high concentrations and leaching losses of As, Cu, Ni, Zn, Cr, S, Se, and Fe. However, the solubility of metallic elements like Cr, Zn, Pb, and Cu increases at pH >9.0. Of all elements studied, leaching losses of Mo were most strongly related to CCP addition. Amending acid-forming coal refuse also reduced overall bulk soluble salt evolution. Release of Se and Cr from CCPs added to refuse was observed, but was strongly pH dependent and increased significantly only if the pH level dropped to < 3.5 for Cr, and < 3.0 for Se. It is important to note that these results represent worse case leaching potentials that might occur within CCP:refuse utilization zones within refuse fills and do not account for attenuation or dilution that would occur before discharge to local waters.