Project No. WRI-84:

Project Title: Chloride Sorption to Acid Mine Drainage Solids

Recipient: West Virginia University

Principal Investigator: Louis McDonald

Funding:
USGS: 46,462
Cost-Share: 92,905

Total Project Value 139,367

Abstract

There have been reports to suggest that chloride concentrations are increasing in mine water and surface waters affected by mining operations. Chloride concentrations above the in-stream limit of 250 ml L-1 would require treatment, but chloride is a particularly difficult ion to remove from aqueous solution. Although chloride would not be expected to sorb strongly to AMD solid surfaces, there is evidence to suggest that chloride may sorb to iron and aluminum AMD precipitates generated in the laboratory, and chloride has been found in natural AMD precipitates. The anion most likely to compete for sorption sites larger than chloride concentrations. This may explain why chloride sorption was observed in the laboratory studies (approximately equimolar concentrations) but does not explain why chloride has been found in naturally occurring AMD solids. AMD solids (flocs) tend to be loose, porous agglomerations of smaller particles, consisting of three components: suspended solids, hydrolyzed poly-metal ions, and water trapped within the floc during agglomeration. Chloride could be dissolved in the occluded water. This process would be favored with rapid precipitation (neutralization), as would occur if the AMD had high flow and/or high iron concentration. These particles combine to produce larger flocs with more incorporated internal water. Our objectives are 1) to quantify chloride sorption to AMD solids as a Mn2+. Aluminum will be included because it often occurs in AMD, and 2) determine the extent to which chloride is part of the occluded water in AMD precipitates. These results will provide guidance as to what conditions, if any, are most favorable for chloride and sulfate removal and AMD. For Objective 1: Competitive chloride/sulfate sorption isotherm experiments will be conducted by varying the sulfate-to-chloride ratio at constant total salt concentration as a function of pH and ionic strength with and without added Mn or Al. Considering two ionic strengths, 3 pH levels (5, 6, and 7), the Mn or Al treatments and two replications, 48 isotherms will be prepared. A sufficient range of sulfate-to-chloride ratios will be tested to be sure that potentially relevant situations are addressed. The oxidation of Mn2+ on iron oxides will be accounted for. For Objective 2: Methods will need to be developed to address this objective as there do not appear to be adequate methods available in the literature. Methods to be tested may include rinsing solids with distilled water and then ethanol, a common soil test procedure to remove salts from entrained solutions;

manipulating the coagulation rate of the primary AMD precipitates and the resulting aggregate size; kinetic leaching with and without a dispersant; stop-and go leaching experiments, and chloride specific microelectrodes.