Phosphate Sorption by Base Metal Hydroxides Generated in the Neutralization of Acid Mine Drainage

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Excess phosphorus (P) in runoff from animal production facilities can result in nutrification of watersheds with serious consequences for aquatic life and water quality. In this research, the metal hydroxide waste product generated in the neutralization of acid mine drainage (AMD) was tested for adsorption capacity of P as phosphate. Acid mine drainage is caused by the oxidation of sulfide minerals such as pyrite to form sulfuric acid. The acid dissolves metals present in the sulfide minerals and associated rock, such as iron, aluminum, and manganese. Acid mine drainage is widespread in the Appalachian region due to decades of coal-mining activities predating regulation of acid discharge. When AMD is treated by neutralization with alkaline substances such as limestone or lime, a precipitate or floc is formed, consisting mainly of base metal hydroxides and unreacted alkaline material. Disposal costs of the floc can be as much as one half of the total operating cost for a treatment facility. Therefore, the floc would be an economical and widely available source of material for P sequestration should adsorption densities prove adequate. The effects of AMD composition and choice of alkaline neutralizing substances on floc formation and P adsorption were investigated. The test results were consistent with adsorption of P rather than chemical precipitation. Freundlich adsorption isotherms showed loadings of 30 to 50 milligrams (mg) P per gram dry weight of the sludge in equilibrium with solutions containing 0.1 to 1 mg P per liter. These loadings are much greater than for most natural soils. Phosphate adsorption also occurred under anaerobic conditions, such as would be found for wastes submerged in ponds or lagoons. Longer-term soil bag tests are planned to confirm these promising initial results.

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