BOD and Phosphate Removal Rates of Wastewater Cotreated with Acid-Mine Drainage[1]

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Abstract: Acid-mine drainage (AMD) is a persistent source of water pollution throughout the United States. Numerous treatment technologies exist but are often decentralized and expensive. An alternative to conventional AMD treatment is utilizing existing wastewater treatment plants (WWTPs) to intake AMD discharges. The benefit of combining these waste streams is that wastewater typically has high pH buffering capacity, and the metals present in AMD will adsorb phosphate and precipitate out of solution. However, there are concerns about how adding AMD to a WWTP may impact the treatment performance. The purpose of this study is to determine the rate at which organic matter (i.e., BOD) is removed from wastewater when mixed with AMD. The kinetic rates of BOD removal were examined for raw municipal wastewater (pH = 8.33) mixed with 10% or 40% additions of AMD from various sources in Central Pennsylvania or distilled water (DI; controls). The AMD or DI and wastewater were gently mixed in 2 L Phipps & Bird jars for 2 min and allowed to settle for 2 hr. (simulating primary clarification in WWTPs), after which pH was recorded, and samples were taken from the supernatant to be used for analysis. The kinetic rate of BOD removal in the supernatant was also determined using BODTrak II respirometers that were seeded with return activated sludge collected from the local WWTP and held at 20ºC for 7 days. Phosphate concentrations were determined using the ascorbic acid method. For both mixing ratios, the kinetic rate of BOD removal was roughly 20% greater in the samples mixed with AMD compared to DI. This increase in BOD removal is likely due to kinetic rates being greatest between pH 6-8, which could be a benefit to treatment performance of alkaline wastewaters. In addition, the pH of the AMD mixed solutions remained circumneutral (8.02 for 10% AMD and 7.10 for 40% AMD), exhibiting the strong pH buffering capacity of wastewater. Phosphate removal in the 10% AMD solution was 15-40% greater than 10% DI, and 60-100% greater in the 40% mixed solutions, illustrating the capability of phosphate adsorption and precipitation with metals in AMD.

Additional Key Words: Sustainable design in reclamation, novel mine water treatment.

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