Sulfate Removal in Biochemical Reactors and Scrubbers Treating Neutral Low-Metal Concentration Mine Influenced Water (MIW)[1]

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Abstract: Sulfate and metals are commonly found in mining influenced water (MIW). A biochemical reactor (BCR) is an established technology that can remove sulfate and metals. Three organic mixtures were bench-tested to decrease sulfate concentration in a circumneutral pH MIW containing low metal concentrations. As it was of interest to charge the BCRs with organics that could be sourced regionally, organic mixtures included various proportions of wood pellets, oat straw, and biochar and, as an inoculum, manure. The inorganic fraction of the mixture included limestone-dolomite. The BCRs were operated for a total of 180 days. Additionally, three inorganic materials were evaluated as a means of scrubbing excess hydrogen sulfide/sulfide ion from the BCR effluents. The scrubber reactors or sulfide polishing units (SPUs) were charged with native soil from the site, zero valent iron (ZVI) or magnetite and operated in series to a single BCR. Median MIW influent contained about 3000 mg/L of sulfate and very low concentrations of metals and the flow rate was varied from 144 to 500 mL/day, corresponding to BCR hydraulic retention times of less than 38 days. All BCRs demonstrated similar removal rates of 1.3 to 1.5 mol $SO_{4\text{-}2}/m^3$ day. SPUs were operated to remove dissolved sulfide from the BCR effluent, but they behaved as an extended BCR unit. It appeared that dissolved organic carbon in the BCR effluents continued to promote sulfate-reducing microbial activity in the SPUs where the inorganic materials functioned as a solid support for the microbial community. In fact, somewhat higher rates of reduction were achieved in the scrubber units using non-lignocellulosic support materials: 1.9 and 2.2 mol SO_4^{-2}/ m^3-day in SPU-1 (native soil) and SPU-2 (ZVI), respectively. Magnetite was not an effective media for sulfate removal. Sulfate removal efficiencies in the BCRs varied: 56% (BCR-1), 58% (BCR-2), and 68% (BCR-3). Sulfate percent removal in the SPUs was 35% (SPU-1 paired with BCR-2) and 37% (SPU-2 paired with BCR-1). Novel reactor charging configurations in single units may therefore be much more effective and efficient than approaches exclusively using lignocellulosic or inert supports. It was also noted that sulfate reducing microbial populations were still increasing at reactor termination.

Additional Key Words: BCR; Sulfate; Organic Mixture

Optional Data: Project Location: Lat. *Confidential*, Long. *Confidential*

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