Quantifying Sulfide Removal Using Solar Powered-Aeration in Passive Treatment of Net Alkaline Mine Waters[1]

Taylor R. Wall* and Robert W. Nairn[2]

Abstract: Although passive treatment systems can improve water quality for mine water discharges, some process units, like vertical flow bioreactors (VFBRs), can produce excess sulfide. Elevated sulfide concentrations are sources of nuisance odors and may lead to direct ecotoxicity. In this study, a novel sulfide removal approach using a custom-designed solar-driven system and activated carbon filter (ACF) was evaluated. The study site, the Southeast Commerce passive treatment system (SECPTS) at the Tar Creek Superfund Site in Oklahoma, addresses 380 L/min of net alkaline lead-zinc mine waters in four process units. VFBR effluent enters a closed odor control structure from which the sulfide-rich atmosphere is pulled into the ACF using a solar-powered exhaust blower. The ACF includes 180 kg of GC Sulfasorb and activated carbon media. VFBR effluent aqueous sulfide concentrations were as high as 0.147 mg/L. ACF gaseous sulfide concentrations were up to 33.8 ppm into the ACF and were consistently below detectable limits out of the ACF. Aqueous sulfide concentrations greater than 0.002 mg/L are considered chronically toxic to aquatic life, and prolonged exposure to gaseous concentrations greater than 20 ppm may lead to fatigue, poor memory, and dizziness. These data were generated during the first year of operation of the SECPTS, during the autumn and winter months. It is anticipated that warmer ambient temperatures will result in greater biological activity and elevated sulfide concentrations, which may impact ACF performance. In addition to the sulfide removal system, solar-powered blowers re-aerate the water column in the post-VFBR final polishing unit (FPU). Aqueous sulfide concentrations exiting the FPU ranged from 0.002 to 0.026 mg/L. Initial evaluation of the off-the-grid renewable energy-powered sulfide-removal and aeration systems indicates that they enhance water quality improvement effectiveness and may be especially attractive for use in remote locations and/or at sites where operation and maintenance budgets are limited.

Additional Key Words: vertical flow bioreactor, sulfate reduction, renewable energy, activated carbon.

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2. Taylor R. Wall, Graduate Research Assistant (student) and Robert W. Nairn, Professor, Center for Restoration of Ecosystems and Watersheds, School of Civil Engineering and Environmental Science, University of Oklahoma, Norman, OK 73019.