Metals got you Down? A Look at Effective Mining-Influenced Water Treatments

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Abstract: Background: Historic and present day mining activities continue to adversely impact surface and groundwater quality. But you can also get metal-impacted water from any excavation into sulfur-bearing rock during creation of roadways, especially when deep enough to be below the zone of active weathering. Roadways in regions where pyritic material becomes exposed can also result in a long-term source of metal contamination. Metal-impacted discharges can persist as contaminant sources for many decades. Significant efforts have been undertaken to evaluate reactive amendments for ex situ remediation of metal-contaminated soil and surface water. Reductions in aqueous metal concentrations can be achieved by: (1) oxidation, (2) adsorption, (3) entrapment of metals in crystal lattices and, (4) precipitation/co-precipitation.
Approach/Activities: Manganese (Mn) and Iron (Fe) are common constituents found in net alkaline and net acidic mining discharges. Typically, Fe is removed by adding a chemical that increases pH (e.g., sodium hydroxide, lime, soda ash). Mn removal requires higher pH (e.g., >9.5) to precipitate dissolved Mn which may lead to the creation of treated water that exceeds regulatory discharge pH limits. High pH values may also lead to the resolubilization of aluminum, an element under increasingly close scrutiny. Permanganates have been widely used for decades for Mn and Fe removal in drinking water and wastewater applications. Recent permanganate product innovations have resulted in two technologies for metal treatment: 1) Permanganate Tablets for passive year-round removal of Mn and Fe in net alkaline mine drainages and 2) Alkaline Permanganate for coupled Mn/Fe removal with pH adjustment for net acidic waste streams. Reactive capping technologies have also proven beneficial in reducing the bioavailability of dissolved metal contaminants after road cut activities.
Results: Experimental research and field efforts have proven the benefits of using a variety of adsorbents and reactive amendments for in situ and ex situ capping approaches. For example, environmentally benign resins have been used for ex situ capping for slope stabilization, soil retention, and remediation in road cuts and slag piles. In addition, thin layers of reactive components have been used as part of a reactive capping. By incorporating a thin layer of pH adjusting compound into a reactive capping technology the bioavailability and mobility of metal contaminants is decreased, the required cap thickness is decreased and by the addition of reactive amendments there is reclamation and remediation of soils and runoff. Promising results from field-scale efforts where permanganate tablets, alkaline permanganate and the reactive capping technology PennzSuppress will be presented where Mn and Fe were successfully removed and pH adjusting amendments were incorporated into a reactive cap to meet regulatory discharge limits.

Additional Key Words: Acid Mine Drainage, Reactive Capping, Permanganate

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