**Past, Present and Future for Treating Selenium-Impacted Water**

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Water quality in selected regions of North America is impaired due to selenium, which typically originates from shale formations that were deposited in a marine environment. In the Western US, these shale formations typically underlie agricultural zones or are associated with hard rock mines. In the Eastern US and Western Canada, the marine shale formations may be associated with coal deposits. Thus, selenium can be a constituent of mining influenced water (MIW) and is often present in circum-neutral waters. Selenium is typically leached from large waste rock piles which can result in multiple, high-flow seleniferous discharges at mine sites. Selenium treatment challenges include stringent regulatory limits as low as 5 µg/L and high flow rates.

In recent years, active and passive biological treatment of selenium have emerged as an effective and relatively inexpensive method compared to physical and chemical methods. Biological treatment relies on microbial reduction of dissolved selenium species (i.e., selenate, selenite) to insoluble, elemental selenium. Bench and pilot results for both active and passive selenium removal were conducted on a variety of mine discharge waters. Active biological treatment systems require continuous nutrient addition, pumping, and water heaters. Examples of active treatment technologies are Envirogen’s Fluidized Bed Reactor, General Electric’s ABMet™, and Golder’s ICB™ technologies. Passive biochemical reactors (BCRs) require neither continuous nutrient feeds nor electricity. BCR media is mixture of limestone and several solid organic materials such as wood chips, sawdust, and hay.

Testing was performed at multiple hydraulic retention times, ranging from hours for active biological systems to days for passive systems. Among the test sites, influent total selenium concentrations ranged from 30 µg/L to 600 µg/L and selenium removal rates ranged from 65% to 98% were achieved. Influent nitrate concentrations ranged from a 2 mg/L to 40 mg/L as N and complete denitrification was achieved in the bioreactors.

Biological treatment, active or passive, is an effective bulk removal process for selenium which can typically reduce selenium concentrations by 70 to 98%. For sites with high selenium concentrations, this removal is insufficient to achieve 5 µg/L in the effluent. In these cases, a polishing treatment such as coagulation and filtration may be necessary to further reduce selenium. For sites with lower selenium concentrations, biological treatment alone can be sufficient to meet a 5 µg/L discharge standard.