# Selenium, Uranium, and Nitrate: Treatment of Troublesome Contaminants in Mining Wastewaters – EBR Case Studies[1]

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**Abstract:** Selenium (Se), uranium (U), and nitrate ($NO_3$) are widespread in many North American mining environments and other related industrial waters. These contaminants are often particularly difficult to remove using conventional water treatment methods, such as chemical coagulation/precipitation, reverse osmosis filtration, ion exchange, etc. Treatment system capital and operating expenses combined with additional costs of sludge or concentrate stream disposal, are driving research and application of biotreatments methods for removal of these contaminants from mining and industrial wastewaters. This paper discusses application of the Electro-Biochemical Reactor (EBR) technology for Se, U, and $NO_3$ bio-reduction and removal from mining wastewaters. Three case studies are presented, based on laboratory bench- and on-site pilot-scale trials with significantly different mining waters (floatation-influenced based metals mine water, leach solution from a gold mine, and coal mine seepage water), each contaminated with varying concentrations of selenium, uranium, and nitrates. Average concentrations of these contaminants were 2,712 µg $L^{-1}$ Se, 2.0 µg $L^{-1}$ U, and 1.53 mg $L^{-1}$ $NO_3$-N (Site A); 2.9 µg $L^{-1}$ Se, 92.5 µg $L^{-1}$ U, and 189 mg $L^{-1}$ $NO_3$-N (Site B); and 105 µg $L^{-1}$ Se, 18.4 µg $L^{-1}$ U, and 50 mg $L^{-1}$ $NO_3$-N (Site C). The EBR technology was demonstrated on all three sites to treat the waters to <0.5 – 3.2 µg $L^{-1}$ Se, <0.1 – 0.8 µg $L^{-1}$ U, and <0.02 – <2 mg $L^{-1}$ $NO_3$-N. The high combined Se, U, and $NO_3$ removal efficiency achieved with EBR treatment, at both laboratory and field scale, has positive implications for future treatment system design at many sites. The EBR process would be applicable and beneficial at sites facing the challenge of mixed contaminant treatment to low discharge standards, simplifying the treatment train to one primary process, and eliminating the need for sludge or concentrate stream treatment/disposal.

Additional Key Words: bio-treatment, electro-biochemical reactor

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