Biological selenium removal: The solution to pollution?

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Selenium has been referred to as an "essential toxin" due to the fact that it shows only a marginal line between the nutritious requirement and toxic effects upon exposure. The steep dose response curve due to bioaccumulation effects have lead to the characterization of selenium as a "time bomb" that can be fused by exceeding a narrow threshold concentration in ecosystems through anthropogenic activities.

Ironically, an estimated 0.5 to 1 billion people worldwide suffer from selenium deficiency, whereas areas of toxicity can be separated from selenium deficient areas by only 20 km.

The microbiological treatment of selenium - so called "dissimilatory metal reduction" - could supersede this problem, as selenium-reducing microorganisms are highly selective for selenate, reducing it to insoluble, less-toxic elemental selenium that can potentially be recovered from the process.

A study funded by the European Union, published in the September-October issue of the *Journal of Environmental Quality,* demonstrates that the biological treatment is indeed efficient for selenate reduction, and substantial amounts of selenate are converted to methylated selenium species or nano-sized elemental selenium particles. The emission of nano-sized selenium particles is problematic, as these can become bioavailable by direct assimilation or reoxidize to selenite and selenate.

Dimethlyselenide and dimethyldiselenide, two species with unknown

ecotoxicological long-term effects, contributed substantially to selenium dissolved in the effluent. Their formation was induced by minor temperature changes during biological reduction, thus a careful process control might drastically increase removal success of existing biotreatment systems for selenium and is a prerequisite for successful removal in full scale applications.

Consequently, remediative systems aiming at minimizing ecotoxicological risks on the one hand and selenium recovery and reuse on the other hand should be implemented. Due to the "high volume - low concentration" character, no sustainable solution has been found yet to treat selenium-contaminated drainage waters originating from the San Joachin Valley, one of the agriculturally most productive areas of the US (a comprehensive report by the USGS is available at http://pubs.usgs.gov/pp/p1646/pdf/pp1646.pdf).

Source: Soil Science Society of America