Application of Redox Mediators to Accelerate Removal of Selenium from Agricultural Drainage Water

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The redox mediator, AQDS, accelerates the conversion of Se(IV) to elemental selenium thereby increasing the removal rate of total soluble Se from agricultural drainage water.

Effective and economical removal of selenium (Se) in agricultural drainage water is very important in Se bioremediation. Zero valent iron (ZVI) and a redox mediator [anthraquinone-2,6-disulfonate (AQDS)] were assessed for their ability to enhance the removal of Se(VI) or Se(IV) (500 µg/L) in synthetic drainage water by *Enterobacter taylorae*. The results showed that *E. taylorae* was capable of using inexpensive sucrose to remove Se from the drainage water. During a 7-day experiment, Se(VI) was almost entirely reduced to Se(0) and transformed to organic Se in the drainage water with a sucrose level of 500 to 1000 mg/L. Addition of ZVI to the drainage water increased the removal of total soluble Se to 94.5-96.5% and limited the production of organic Se. Addition of AQDS to the drainage water with or without ZVI decreased Se(VI) removal, but enhanced the removal of Se(IV), suggesting that *E. taylorae* only can use anthra-hydroquinone-2,6-disulfonate (AHQDS, a reduced form of AQDS) to respire Se(IV), and not Se(VI). These results show that ZVI has promising application potential in the bioremediation of Se in Se-contaminated water. Recently, we found that *Bacillus* sp. RS1 was capable of using AHQDS to reduce Se(VI) (data not shown in this report), accelerating Se removal from agricultural drainage water.

Publications

Zhang, Y.Q. C. Amrhein, A. Chang, and W.T. Frankenberger, Jr. 2008. Effect of zero-valent iron and a redox mediator on removal of selenium in agricultural drainage water. Sci. Total Environ. 407:89-96.

Professional Presentations

Bioavailability, sorption, and soil redox chemistry of tungsten and tungsten metal-alloys in two California soils. M.H. Davis, A. Dellantonio, C. Amrhein, and D.R. Parker. Soil Science Society of America Annual Meeting, Houston, TX. Oct. 6-10, 2008.

Biogeochemistry of tungsten alloys in soils. A. Dellantonio, M. Davis, and C. Amrhein. Goldschmidt Conference, Davos, Switzerland. June 21-26, 2009.

Collaborative Efforts

This project has helped us get additional funding from the California Department of Water Resources to study the fate of selenium and nutrients in shallow ponds at the Salton Sea. Collaborators on this project are Professors Michael Anderson and Daniel Schlenk (UCR). This work has expanded into other redox-sensitive elements found in soils including molybdenum and tungsten, for which we have received additional funding.

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