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NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION RESEARCH

Application of the Permeable Reactive Barrier Technology for the Treatment of Arsenic in Ground Water

Background

This project explores passive treatment of arsenic-contaminated ground water using a permeable reactive barrier (PRB). Current concentrations of arsenic in the ground water near a former metal-smelting facility are up to 5,000 times the drinking water standard of 10 parts per billion. PRB technology may make it possible to restore the aquifer to drinking water standards. The advantages of PRB technology are:

- Contaminant remediation occurs in situ
- Remediation is passive; this eliminates the generation of arsenic-laden hazardous waste from conventional treatment processes
- There is no ongoing energy input following installation

Objectives

The objectives of this research are to:

- Test the performance of the PRB technology for the treatment of arsenic contamination in ground water
- Better understand the chemical processes that result in arsenic removal in a PRB
- Evaluate the impact of the PRB on the adjacent aquifer chemistry and hydrology
- Continue to evaluate cost-effective remedial alternatives to pump-and-treat designs for cleaning up ground water that is impacted by inorganic contaminants.

A PRB is an emplacement of reactive materials in the subsurface designed to:

- Intercept a contaminant plume
- Provide a flow path through the reactive media
- Transform the contaminants into environmentally acceptable forms in order to attain remediation concentration goals at some point down-gradient of the reactive barrier

In the case of inorganic species such as arsenic, the design objective of such an installation is to drive adsorption or precipitation reactions that result in the formation of less-soluble and less-mobile forms in the subsurface reactive media.

Approach

This project includes both field and laboratory research components. Field components involve hydrogeological and geochemical studies in order to select an appropriate design configuration, and to evaluate the performance of a pilot-scale subsurface PRB to remediate arsenic-contaminated ground water.

Accomplishments:

Lien, H.-L. and Wilkin, R.T. (2005). High-level arsenite removal from groundwater by zero-valent iron. *Chemosphere*, v. 59, 377-386.

Wilkin, R.T., Jacobson, L., and Coombe, E. (2005). Zero-valent iron PRB application expands to arsenic removal. *Technology News and Trends,* Issue 21, p. 1-2.

Wilkin, R.T., Acree, S.D., Ross, R.R., Beak, D.G., and Lee, T.R. (2009). Performance of a zerovalent iron reactive barrier for the treatment of arsenic in groundwater : Part 1. Hydrogeochemical studies. *Journal of Contaminant Hydrology*, v. 106, p. 1-14.

Beak, D.G. and Wilkin, R.T. (2009). Performance of a zerovalent iron reactive barrier for the treatment of arsenic in groundwater : Part 2. Geochemical modeling and solid phase studies. *Journal of Contaminant Hydrology*, v. 106, p. 15-28.

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