Influence of Groundwater Constituents on Longevity of Iron-Based Permeable Barriers

Cleanup
CU-1125

Background:

This project investigates factors that may limit the longevity of iron-based permeable barriers used for in-situ treatment of organic- or metal-contaminated groundwaters. This will be accomplished by the following: (1) examining the long-term performance of laboratory columns packed with a porous medium containing zero-valent metal solids through which simulated groundwater of differing compositions is passed; (2) examining the influence of effluent composition and time on the evolving composition of the solid surfaces; and (3) monitoring the electrochemical characterization of the surfaces after varying times of exposure. Particular emphasis is placed on developing new approaches for "real-time" monitoring of changes in system performance through a novel electrochemical probe that can be installed in-situ in pilot- or full-scale applications.

Objective:

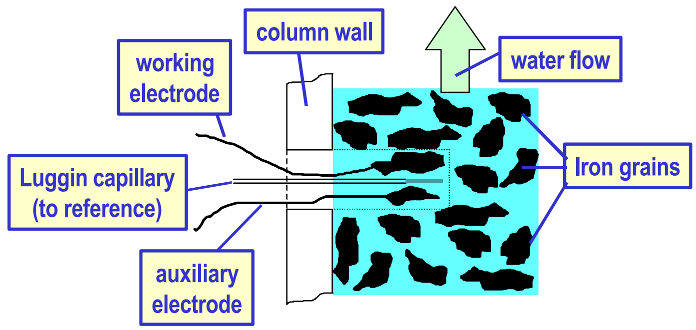
The principal technical objectives of this project are to evaluate the impact of groundwater composition on the long-term performance of zero-valent iron barriers and to develop a prototypic electrochemical probe for monitoring reactivity changes at either the field or laboratory scale.

Summary of Process/Technology:

This project intends to conduct an integrated research program to meet the following specific objectives: (1) to understand the effects of groundwater chemistry on long-term barrier performance, including delineation of the impacts of chemical reactivity changes and alterations in transport properties; (2) to develop an electrochemical probe that can be used to assess the ongoing performance of a reactive barrier continuously, either in laboratory columns or in-situ in the field; (3) to develop a fundamental understanding of the causes of alterations in reactivity through studying its relationship to the changing composition of the iron surface; and (4) to incorporate the results of these studies into a set of guidelines that can be used to predict the impact of the above factors on reactive barrier performance.

Benefit:

This research will provide an improved understanding of the impact of aqueous chemistry on the longevity of iron, both from the perspective of "aging" and also from clogging. This project should provide a fundamental understanding of important issues dictating barrier longevity, providing an improved assessment of life-cycle costs. The project team will use the research results to design guidelines that outline reasonable "safety factors" concerning assumed permeable reactive barrier residence times as a function of the design life of the barrier. Overall, the results of this work will allow better evaluation of the tradeoff between construction costs (e.g., barrier thickness) and system longevity.



A diagram of the electrochemical probe studies conducted under this project

Accomplishments:

In FY99 this project accomplished the following: (1) new plexiglas columns were machined and equipped with sampling ports; (2) researchers investigated the use of SF6 as a nonreactive but volatile tracer to help quantify the volume of the gas phase in the columns; (3) a number of silver/silver chloride reference electrodes were assembled and subjected to various tests; and (4) virgin iron particles that were characterized by Auger Electron Spectroscopy showed indicatation that significant amounts of carbon are located in "patches" on the particle surface.

Contact Information:

Dr. A. Lynn Roberts
Johns Hopkins University
Department of Geography and Environmental Engineering
3400 North Charles Street
313 Ames Hall
Baltimore, MD 21218
Phone: (410) 516-4387
Fax: (410) 516-8996
E-mail: lroberts@jhu.edu

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