Field Demonstration of a Sequential Electrolytic Permeable Reactive Barrier for Ground Water Treatment

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Abstract.

Plumes of dissolved contaminants may persist in ground water for decades. The persistence of the plumes imparts a challenge to reduce long-term risk for users of the affected aquifer. Strategies to manage dissolved plumes aim to confine their migration by either hydraulically controlling the ground water flow, or by removing the compounds of concern from the aqueous phase using a variety of mechanisms. The latter strategy can be implemented with a permeable reactive barrier (PRB). PRBs consist of a porous reactive medium, which convert target compounds to benign substances as they pass through the barrier under natural hydraulic gradients. A new technology, developed at Colorado State University, utilizes sets of electrodes as the active PRB substrate to treat ground water in situ. The approach has been termed sequential electrolytic barriers, or e-barriers.

Ongoing research into e-barriers includes a field demonstration of the technology at F.E. Warren Air Force Base in Cheyenne, Wyoming. The objectives of the study are to evaluate treatment efficacy on a field scale, develop a framework for reactor operation, and assess construction and implementation costs. The demonstration began in August 2002, when a 20 m² planar barrier was installed within an existing trichloroethene (TCE) plume, and orientated normal to ground water flow. Power was applied to the reactor in January 2003, after installation of ground water collection and data acquisition systems were completed. Monitoring ground water quality and electrical parameters has continued through three reactor settings. Results to date show a significant decline in TCE concentration from upstream values of 300 µg L⁻¹, to less than 10 µg L⁻¹ immediately downstream of the electrode set, at an applied potential difference setting of 6.5 V between the anode and cathode. The demonstration is scheduled for completion during summer 2004. Additional potential settings will be evaluated before the experiment is concluded.

The presentation will review reactor operating principles and design, and provide an overview of reactor performance to date. Specific performance aspects that will be discussed include TCE concentration reduction, inorganic water quality, electrochemical response to reactor potential settings, and reaction by-products.