SERDP
Strategic Environmental Research and Development Program

Multi-Scale Experiments to Evaluate Mobility Control Methods for Enhancing the Sweep Efficiency of Injected Subsurface Remediation Amendments

Environmental Restoration
ER-1486

Background:

The efficiency of in situ remediation technologies that involve injecting remediation agents into the subsurface is often limited by the ability to obtain an efficient sweep of these amendments within the target zone of contamination. Poor amendment sweep efficiencies are typically the result of injected amendments seeking preferential flow paths within zones of higher permeability. This leads to bypassing lower permeability strata and, if sufficient contamination exists within these lower permeability strata, rebounding contaminant concentrations within a groundwater aquifer following treatment. Methods designed to mitigate the potential for preferential flow and bypassing effects would therefore be highly desirable to the Department of Defense (DoD) and would increase remediation efficiencies and reduce costs of environmental restoration efforts.

Objective:

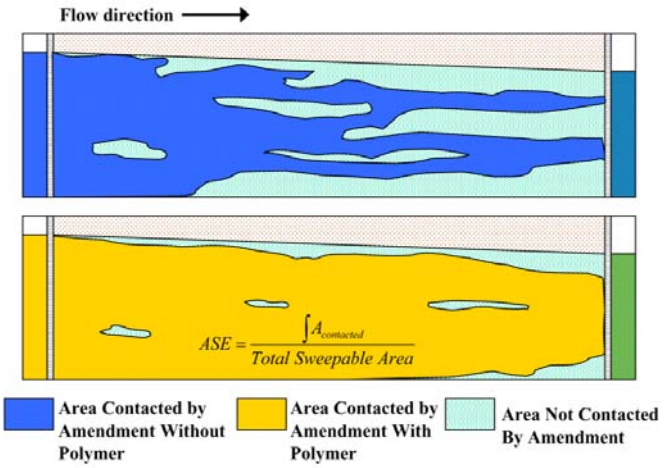
The objectives of this project are to (1) investigate and elucidate the processes that control the subsurface distribution of injected remediation amendments within geologic heterogeneities; (2) test the applicability of water-soluble polymers in minimizing the effects of geologic heterogeneities to improve remediation amendment delivery and distribution; and (3) investigate the impact of emplaced remediation amendments and polymer solutions on the groundwater flow regime.

Process/Technology Description:

Methods that will be utilized to meet the project objectives include batch studies, column studies, two-dimensional (2-D) vertical tank experiments, and three-dimensional (3-D) numerical simulations. The 3-D multicomponent, multiphase, compositional simulator, UTCHEM, will be used in testing experimental conditions to optimize the experimental design of the 2-D tank experiments. UTCHEM also will be used to analyze experimental data and as a tool to identify and further elucidate important mechanisms of amendment emplacement, with and without polymer addition, within heterogeneous aquifer systems. UTCHEM has the unique capability of simulating the subsurface transport of numerous amendment types, including polymer-amended fluids.

Expected Benefits:

Outcomes from this project are expected to contribute to more efficient and cost-effective use of remediation amendments by DoD. Benefits will include: (1) an improved understanding of the distribution of injected remediation amendments in heterogeneous aquifer systems during and after emplacement; (2) an improved understanding of the benefits and limitations of using mobility and heterogeneity control methods for environmental applications; (3) screening rules for assessing the appropriateness of mobility and/or heterogeneity control on a site-by-site basis; (4) protocols for optimizing amendment formulations based on site-specific knowledge of spatial permeability structure; and (5) an improved understanding of injection strategies that optimize the delivery and distribution of remediation amendments. (Anticipated Project Completion - 2009)



Polymer fluid enhances the areal sweep efficiency (ASE) of injected remediation amendments.

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