Aquifer Restoration by Enhanced Source Removal

Cleanup
CU-368

Background:

Chlorinated solvents have migrated through the subsurface and entered groundwater at more than 1,000 Department of Defense sites. Conventional cleanup approaches entail pumping groundwater out of the contaminated soils and treating the groundwater aboveground. Because of the low solubility of the contaminants in water, they tend to remain in the soils regardless of the amount of groundwater that is pumped from the site. Improved removal technologies are needed to effectively clean up soil and groundwater contamination resulting from the release of chlorinated solvents.

Objective:

This project evaluated Enhanced Source Removal (ESR) technologies for their effectiveness at removing non-aqueous phase contaminants from the source zone. The technologies were tested in controlled release test cells at the Groundwater Remediation Field Laboratory (GRFL) at Dover Air Force Base, Delaware. The highly instrumented test cells allowed researchers to inject common contaminants into an undisturbed geologic setting without contaminating the surrounding environment.

Process/Technology Description:

Five different ESR technologies were tested. Each technology was applied to an isolated block of soil contaminated with up to 100 liters of tetrachloroethene (PCE). The five technologies included the following:

- **Cosolvent Solubilization** flushes the contaminated soils with a cosolvent such as ethanol. The cosolvent dissolves the contaminants as it is flushed through the soil and then is pumped and treated aboveground.
- **Cosolvent Mobilization** flushes the contaminated soils with a cosolvent such as tert-butyl alcohol enabling the contaminant to flow through the soil at which point it then is pumped aboveground and treated.
- **Macromolecular Solubilization** is similar to surfactant solubilization, only sugars are used in place of surfactants.
- **Surfactant Solubilization** combines the effects of a cosolvent and a surfactant to solubilize PCE which then is flushed out of the test cell.
- **Air Sparging/Soil Vapor Extraction** uses air as the remedial fluid. Air is forced into the contaminated zone to volatilize the PCE. The vapors then are withdrawn and treated at the surface.

Results:

Results from this project demonstrated that ESR technologies can be used to rapidly remove dense non-aqueous phase liquid (DNAPL) from unconsolidated porous media. However, none of the technologies removed all DNAPL mass under the conditions of this test. Technology effectiveness ranged from approximately 45% to 90% removal of the total DNAPL mass. A statistically based Lagragian model has been developed and used to forecast performance of source remediation technologies. The model projections are being compared to measured field performance. Data suggests that partial DNAPL removal can result in substantial decreases in contaminant concentrations in groundwater emitted from a treated source zone. Additional research is required to determine the extent to which contaminant mass discharge from source zones is influenced by DNAPL mass depletion. The Final Report for this project is available in the SERDP and ESTCP Online Library at http://docs.serdp-estcp.org/.

Field Technician Obtains Samples During ESR Experiment

Benefits and Implications:

Development of effective in-situ approaches to remove source zone chlorinated solvent contamination will reduce greatly the length of time needed to treat the associated dissolved phase plumes. (Project Completed - 2004)

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REVISED 4/18/05