Bioenhanced In-Well Vapor Stripping (BEHIVS) to Treat Trichloroethylene

Cleanup
CU-1064

Background:

Solvents such as trichloroethylene (TCE) are by far the most prevalent organic groundwater contaminants. Source areas for these contaminants may exist in the subsurface as dense nonaqueous phase liquids (DNAPL), which are very difficult to remediate. These DNAPLs sink in aquifers because of gravitational pull and act as continuous sources for contaminant plumes that can stretch for miles within an aquifer. Deep (i.e., more than 25 feet below the ground surface), contaminated soils are not amenable to soil excavation, and other conventional methods of remediating solvent contamination source areas are generally ineffective.

Objective:

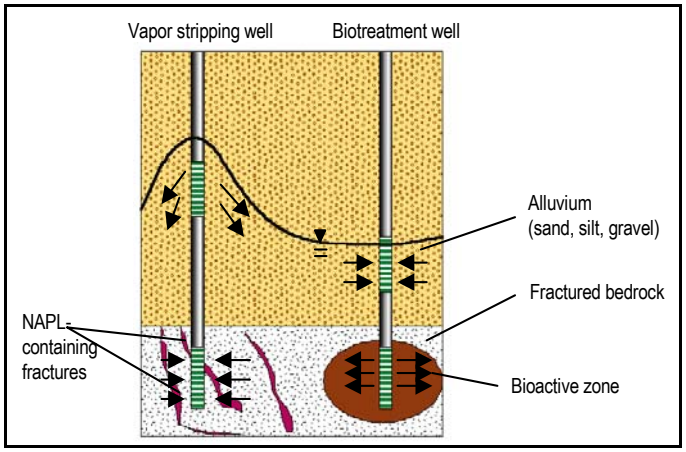
This project's objective was to demonstrate the potential of combining two innovative, recently demonstrated technologies, in-well vapor stripping and in-situ aerobic cometabolic bioremediation, to remediate a contaminant source area. This hybrid treatment system, known as bioenhanced in-well vapor stripping or BEHIVS, was installed and tested at Edwards Air Force Base (AFB), CA.

Summary of Process/Technology:

The treatment system consisted of a single vapor stripping well located near the contamination source and two biotreatment wells located down gradient and on either side of the vapor stripping well in a "conveyor-belt" mode of operation, with the vapor-stripping well removing relatively high concentrations of TCE near the source and the biotreatment wells serving to "polish" the effluent from the vapor stripping well. The system operated by introducing air into the vapor stripping well to pump contaminated water from the lower zone of the aquifer. More than 95 percent of the TCE in the water moving through the stripping well volatilized into the air in the well and was subsequently treated above ground. While the water was pumped downward through the biotreatment wells, nutrients (i.e., toluene and oxygen) were added to stimulate aerobic cometabolic bioremediation by indigenous microorganisms that grew in bioactive zones adjacent to the injection screens of the biotreatment wells. As the water passed through these zones, TCE concentrations were further reduced. Some of this treated water recycled back to the intake screen of the vapor stripping well for further treatment, while some of it moved down gradient through the aquifer.

Benefit:

This combination of technologies has the potential to reduce high concentrations of contamination in a source area to very low levels. Application of the technologies in situ minimizes the risk to human and environmental receptors as well as reduces the costs of pumping contaminated water to the surface for treatment and disposal. BEHIVS can be used at sites with source areas having volatile contaminants that are amenable to bioremediation by aerobic cometabolism [e.g., TCE, dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, dichloromethane, etc.].



BEHIVS System

Accomplishments:

Operation of the BEHIVS system for 4.5 months reduced the TCE concentrations in the lower aquifer zone by 91 percent. Average TCE concentrations in the upper aquifer zone were reduced by 56 percent. The total TCE mass removal was 8.8 kilograms (kg), 7.8 kg of which resulted from in-well vapor stripping and 1.0 kg from biotreatment. Capital and operating costs were estimated at $30 per 1,000 gallons of water treated, which compares extremely well with competing technologies. Overall, this study shows that the BEHIVS technology has the potential to cost-effectively destroy contaminant mass in a DNAPL source area in situ. It was also demonstrated that the complex flow and fate mechanisms occurring in the field could be adequately modeled for use in system design and data analysis. This project was completed in FY 2001.

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