Remediation of Deep Trichloroethene Plume Using Enhanced In-Situ Bioremediation Technology

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Background/Objectives. Remediation of a deep groundwater plume heavily impacted by chlorinated volatile organic compounds (CVOCs), primarily trichloroethene (TCE), is being conducted at an aerospace manufacturing facility located in Southern California. The depth to the impacted aquifer is approximately 90 feet below ground surface (bgs). The overall size of the TCE plume measures approximately ½ mile long (downgradient) by ¼ wide (cross-gradient), the majority of which extends offsite. The project is complicated by the fact that significant offsite sources of contaminants (including CVOCs) by others are potentially contributing to the downgradient portion of the TCE plume. Previous pilot testing activities conducted onsite demonstrated that enhanced in situ bioremediation (EISB) technology was cost-effective and feasible solution for remediation of CVOCs in groundwater. Following approval of the Groundwater Remedial Action Plan (GWRAP), remediation of the core of the TCE plume onsite was implemented.

Approach/Activities. EISB, or engineered bioremediation, is the acceleration of microbial activities using technology to enhance the degradation or detoxification of environmental pollutants in an anaerobic environment. The purpose of EISB is to increase the rate of microbial activity so the rate of reductive dechlorination is increased. As proposed in the GWRAP, Alta Environmental 75 dual-cased injection wells, screened at 88-98 and 103-113 feet bgs. The wells were located within the core of the onsite TCE plume area on an approximately 30-foot by 60-foot staggered grid pattern. The wells were then injected with a solution of bio-amendment products manufactured by Regenesis Remediation Services, consisting of 3-D MicroEmulsion® (3DMe, an injectable highly-distributable electron donor), Chemical Reducing Solution® (CRS, in situ chemical reduction agent consisting of carbon and soluble iron), and Bio-Dechlor Inoculum® Plus (BDI, consisting of a natural microbial consortium containing species of dehalococcoides [DHC]). One application of 287,194 lbs of 3DMe, 114,418 lbs of CRS, and 1,964 liters of BDI (DHC) were injected into the 75 dual-nested injection wells. A total of 701,616 total gallons of the mixed 3DMe/CRS/DHC solution were injected.

Results/Lessons Learned. Baseline and post-injection groundwater monitoring and sampling at selected groundwater monitoring wells, located within the injection area, was conducted. Results received to date show significant reductions of TCE and tetrachloroethene (PCE) in the primary groundwater monitoring well located in close proximity to the injections performed during the pilot tests and during the recent full-scale injections. TCE decreased from 25,000 µg/l (before full-scale injection) to 290 µg/L (approximately 5 months after injection). Degradation products cis-1,2-dichloroethene (DCE) and vinyl chloride, and significant increases of DHC, carbon dioxide, methane, dissolved iron, and total organic carbon have also been detected in the primary observation well. Marginal reductions of PCE and TCE have been observed in other wells located throughout the injection area. cis-1,2-DCE and vinyl chloride have not been detected yet in these other wells. The effects of the full-scale injections are continually being evaluated, the wells are sampled on a quarterly basis. Additional time is needed for the injected remedial reagent (3DMe/CRS/DHC) to develop and acclimate in other areas of the aquifer.