

Bioremediation of a High-Concentration Chlorinated Solvents Mixture: Bioremediation with ISCO Polishing

Brendan V. Brown (brownbv@cdmsmith.com) and Andrew Ryan (ryanaj@cdmsmith.com)
(CDM Smith, Maitland, FL, USA)

S. Shawn Turner, P.G. (CDM Smith, Houston, TX, USA)

David L. Anderson, P.G., CHMM (CDM Smith, Louisville, KY, USA)

Kent S. Sorenson, Jr., Ph.D., P.E. (CDM Smith, Denver, CO, USA)

Background/Objectives. CDM Smith designed and constructed an enhanced anaerobic bioremediation (EAB) system at a former industrial manufacturing facility in Orlando, Florida. The site was characterized by high concentrations (>100,000 µg/L) of a mixture of chlorinated solvents (1,1-DCE, vinyl chloride, 1,1,1-TCA, 1,1-DCA, and methylene chloride) in the surficial aquifer with concentrations of methylene chloride observed at 2,000,000 µg/L in one monitoring well. Source zone contamination was remediated using EAB with potassium lactate and groundwater circulation to biostimulate indigenous *Dehalococcoides* spp. bacteria. The EAB system was later expanded to treat additional source areas underneath the former manufacturing building which were not part of the initial system. As concentrations of chlorinated solvents began to approach groundwater cleanup target levels (GCTLs), CDM Smith used a process of in-situ chemical oxidation (ISCO) via sodium persulfate injections to polish zones of contamination outside the EAB treatment area.

Approach/Activities. The full-scale EAB system consisted of three 100-foot horizontal extraction wells, a vertical injection well network, and a groundwater treatment plant. Groundwater was circulated between horizontal well segments and injection well networks, with lactate being metered into the injection lines. To address contamination under the building, the system was expanded by installing additional injection wells to inject potassium lactate and establish conditions favorable for reductive dechlorination. Once concentrations had been reduced to near GCTL levels, the active EAB system was shut down. The polishing ISCO treatment consisted of sodium persulfate injections, activated by sodium hydroxide, into 168 individual borings in areas outside the EAB treatment area where chlorinated solvent concentrations were above applicable GCTLs.

Results/Lessons Learned. This project had the highest concentrations of chlorinated solvents to be approved in Florida for treatment by bioremediation. The full scale system with groundwater recirculation was highly successful in reducing chlorinated solvent concentrations to levels at or below GCTLs. Within the first 33 months operation, total VOC mass was reduced from an estimated 2,800 pounds (lbs) to less than 30 lbs with molar concentrations of all VOCs decreasing steadily. Several years of field monitoring displayed a downward trend in all contaminants of concern. Concentrations in the source area decreased from >100,000 µg/L in multiple wells for key contaminants to <10 µg/L. Generation of high concentrations of ethane and ethene throughout the site indicated complete reductive dechlorination of parent and daughter products. ISCO injections further reduced concentrations in areas outside the EAB treatment area. Post-active remediation monitoring (PARM) has shown concentrations at or below applicable GCTLs. Currently, a No Further Action proposal has been provided to the Florida Department of Environmental Project to close the site with institutional controls.