CASE STUDY

TYPE: In Situ Bioremediation (Chlorinated Solvents)
COMPONENTS: ISD Equipment and Amendments

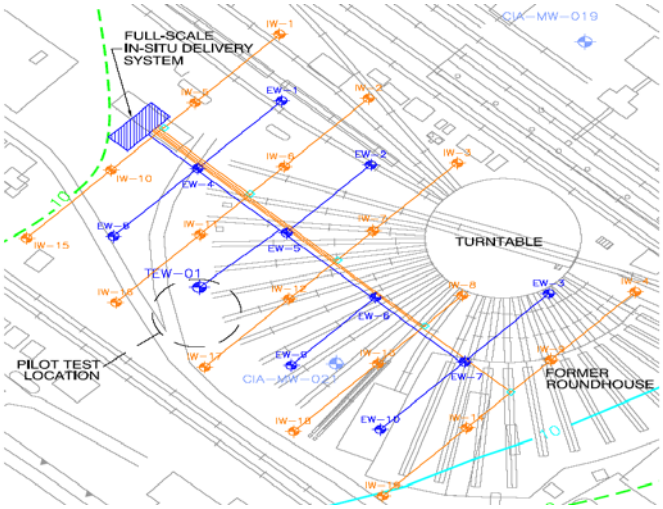
AGGRESSIVE CHLORINATED SOLVENT REMEDIATION USING THE 40-GPM IN SITU DELIVERY (ISD™) SYSTEM
Industrial Facility, Eugene, OR

Type of Project: Full-scale demonstration
Contaminants Treated: PCE, TCE, DCE, VC, TCA, DCA
Concentration: Maximum of 21,000 ppb total chlorinated solvents observed
Technology Applied: Anaerobic Dechlorination
Geology: Silty sand w/ large cobbles, confined on both sides by silt/clay
Treatment Interval: 10 to 29 ft bgs
Average % Reduction: >90% reduction of PCE, TCE, and DCE in full-scale area
Timeframe: 3 months of active GW recirculation w/ 1 year of post monitoring

DESCRIPTION

A skid-mounted 40-gpm In Situ Delivery (ISD™) system was used at an active industrial facility in Eugene, Oregon to treat PCE/TCE-contaminated soil and groundwater that was co-mingled with diesel-range petroleum hydrocarbons and chlorinated ethanes (TCA and DCA). This full-scale action was based on the results obtained from a pilot demonstration that was conducted at the same location, which showed favorable and effective results using a simple nutrient-amended substrate. The full-scale location is the source area and has the dimensions of 400 feet wide by 300 feet long, and a saturated thickness of 20 feet (total volume of 89,000 cubic yards). Saturated zone lithology is silty sand with cobbles.

The ISD™ system was fabricated and installed by ETEC, and was able to re-circulate over 2.3 million gallons of groundwater over a 3 month timeframe (~35 gpm rate) and amend it with 8,200 lbs of CarBstrate™. Groundwater was extracted from 11 extraction wells (blue EWs), automatically amended with CarBstrate™, and distributed into the subsurface via 20 injection wells (orange IWs).



Shallow groundwater was already anoxic due to the presence of diesel fuel that had promoted partial dechlorination of PCE (as indicated by the presence of TCE, DCE, and VC prior to initiating the pilot demonstration). CarBstrate™ was selected as the electron donor due to its high solubility and low cost, as well as the fact that it poses no risk to human health.

ETEC trained the consultant to operate the ISD™ system. We also provided the appropriate substrate feed rate, which was based on the mass of chlorinated solvents, the mass of the terminal electron acceptors, and the total groundwater extraction rate. Extraction wells were used as performance monitoring wells to assess the effectiveness of the approach. Groundwater

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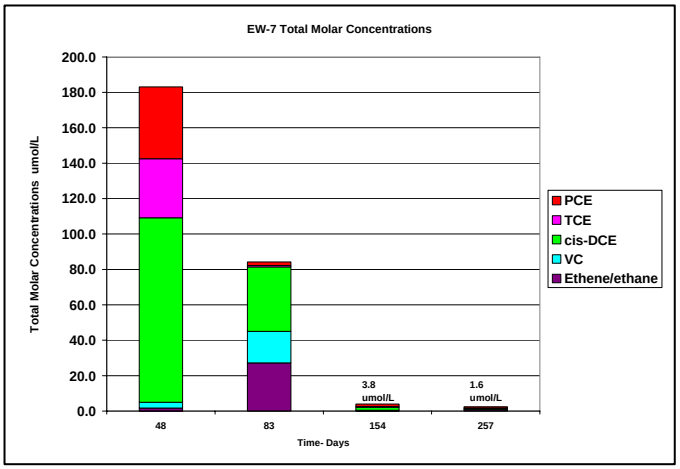
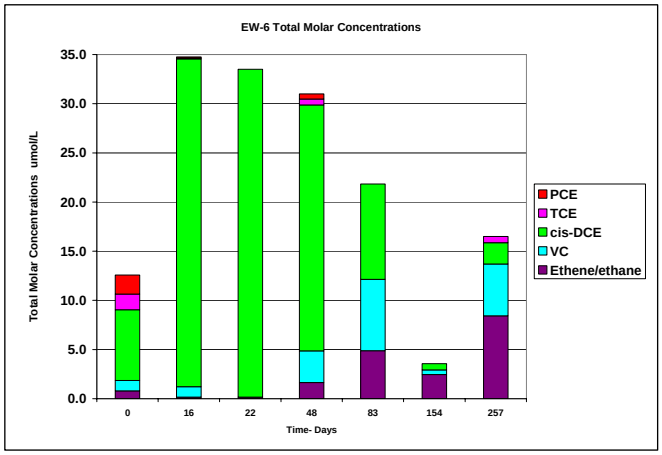
samples were analyzed for VOCs, terminal electron acceptors (iron, manganese, nitrate, and sulfate), methane/ethane/ethene, TOC, organic acids, chloride, and water quality parameters (pH, DO, ORP, and conductivity) prior, during, and after the 2-month recirculation event.

RESULTS & DISCUSSION

Results and observations from the full-scale implementation include the following:

- EW-7 concentrations as high as 21 ppm, with rapid transformation after 83 days, and no rebound after 257 days.
- EW-6 showed a rapid decrease in the parent compounds (PCE and TCE) and significant generation of cis-DCE during recirculation. Bioactivity still occurring 6 months after shutdown that is addressing minor rebounding.

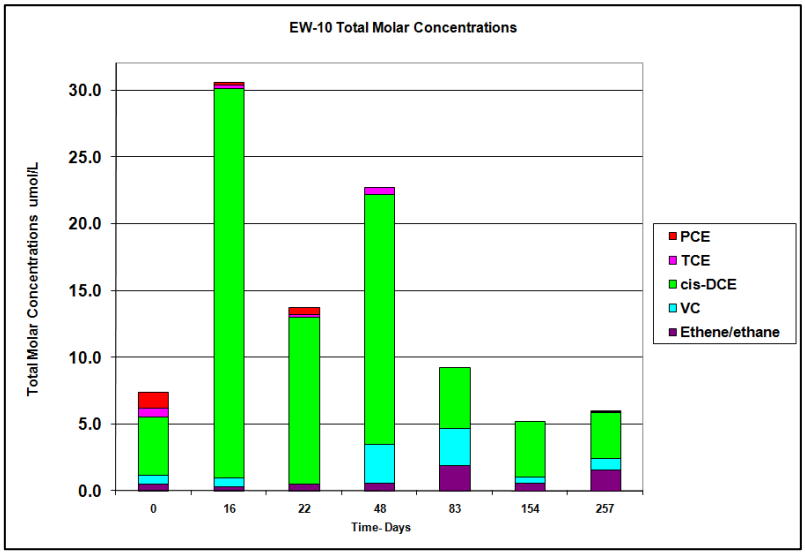




- All monitoring locations showed a significant 3-6 fold increase in total molar concentrations immediately after recirculation/substrate addition began. Once recirculation ceased, the total molar concentrations decreased, and the molar fraction of VC and ethene/ethane increased.

The results demonstrate that aggressive short-term groundwater recirculation can achieve effective electron donor delivery that promotes complete PCE/TCE dechlorination within months, and the generated biomass will continue to sustain dechlorination for months/years.

Sustained dechlorination occurred for months after the recirculation event due to utilization of soluble fermentation byproducts & degradation of generated biomass.



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