Co-Application of 3-D Microemulsion® and BDI® Plus Accelerates Enhanced Reductive Dechlorination in Source Area

Combined Remedy Source Treatment Applied at Florida Dry Cleaner

Project Highlights

- PCE and TCE reduced by 92% within one year
- Ethene and Dehalococcoides approaching three orders of magnitude increase 12 months post-injection confirming complete dechlorination
- Vinyl Chloride Reductase, a functional gene measuring dechlorinating activity, increased five orders of magnitude since application

Project Summary

A former dry cleaner in an urban setting in central Florida was contaminated with a PCE plume that extended nearly 1,000 feet downgradient from the source. An extensive treatability test that compared multiple emulsified vegetable oils and other electron donor technologies to 3-D Microemulsion® (3DME) indicated that 3DME would perform best at the site. An aggressive remediation approach was therefore designed that simultaneously applied the 3DME electron donor and bioaugmentation cultures of Dehalococcoides (DHC). This technologically advanced co-application procedure provides a significant increase in the rate of enhanced reductive dechlorination (ERD) compared to the more established two-phase method and is made possible by improvements to the controlled-release electron donor as well as a better understanding of the bioaugmentation process.

The enhanced anaerobic bioremediation treatment was implemented in two areas – the source area near the dry cleaner and an area approximately 500 feet downgradient. A total of 13,900 gallons of 3DME was injected into 30 direct push points in the two areas. In addition, 97 liters of BDI® Plus bioaugmentation culture were injected to accelerate treatment results. The injections were performed near the former dry cleaner to deplete the source mass and expedite a transition into natural attenuation monitoring. A plume treatment was implemented as a permeable reactive barrier approximately 500 feet downgradient to help mitigate the risk of additional downgradient migration. Injections were completed using direct-push technology.

Site Details

Site Type: Dry Cleaner

Contaminant of Concern: PCE

Concentration: PCE 22,000 ug/L

Remediation Approach: Enhanced Reductive Dechlorination

Soil Type: Silt

Treatment Area: 7,600 sq ft

Technology Used:

BDI PLUS BIO-DECHLOR INOCULUM

3-D MICROEMULSION

Technology Description

3-D Microemulsion (3DME) is an engineered electron donor technology that offers a novel three-stage electron donor release profile, pH-neutral chemistry, and unique subsurface distribution properties.

Bio-Dechlor INOCULUM Plus (BDI Plus) is a natural microbial consortium containing species of Dehalococcoides sp. (DHC). This microbial consortium has been enriched to increase its ability to rapidly dechlorinate contaminants during *in situ* bioremediation processes.

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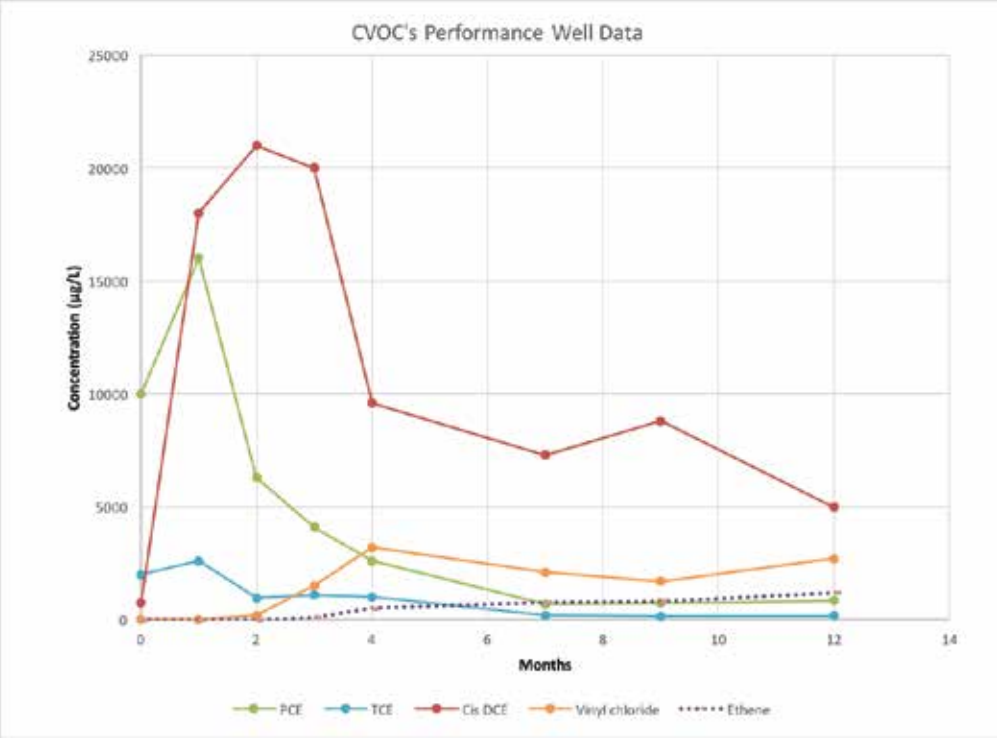
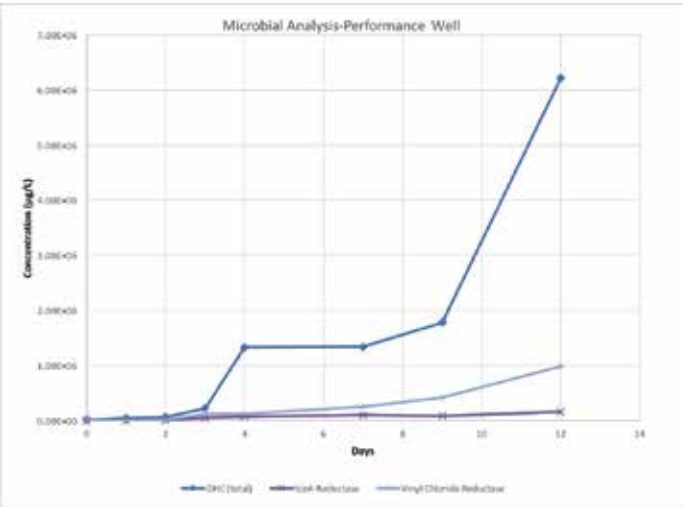
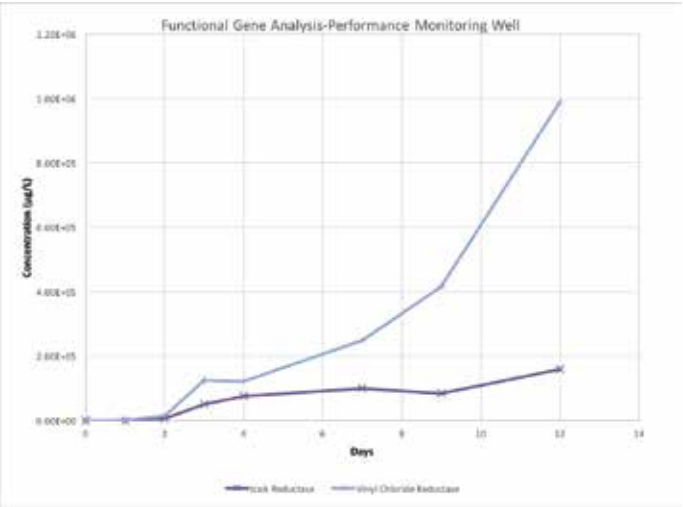
Results

Following two treatment events of 3DME and BDI Plus, PCE and TCE concentrations within the source area were rapidly depleted by over 92% within one year. Within the same period, a temporary increase in the daughter products of dechlorination (dichloroethene and vinyl chloride) was observed, which is consistent with rapid reduction of PCE and TCE supported by ERD. Furthermore, rising ethene concentrations demonstrate complete and sustained dechlorination at the site.



Microbial data show a rapid and sustained enhancement of the dehalococcoides population by nearly three orders of magnitude, as well as a rapid increase in the vinyl chloride reductase population. Together with the slow-release electron donor 3DME, these enhanced microbial populations will continue to sustain complete reductive dechlorination and move the site towards closure.





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