BioStryke Remediation

Project Highlights

- Remediation of cVOC source area baseline [TCE] of ~ 100,000 µg/L
- TCE concentrations decreased to less < 10 µg/L (99.99 %) with no evidence of rebound
- Multiple year Sustainability after single deployment event.
- Minimize Site, Monitoring, and Overall Remediation Costs, saving Client dollars.

DNAPL Source Zone Green Remediation
Optics Manufacturing Facility
Lebanon, New Hampshire

Plant Products Co. Ltd. (PPCL) manufactures-distributes BioStryke® remediation products designed to cost-effectively expedite contaminant destruction. BioStryke® **ERD**ENHANCED™ is an *in-situ* formulation proven to passive-aggressively destroy chlorinated volatile organic compounds (cVOC) by leveraging existing *anaerobic* conditions, working with Mother Nature, not against. The following case study details the cost-effective use of the beta-version of **ERD**ENHANCED™ at remediating cVOC parent contaminants in groundwater and saturated soils.

Source zone contamination was generated via poor site housekeeping to include the direct disposal of spent trichloroethene (TCE) into an on-site dry well. Baseline TCE concentrations ([TCE]) in the source area approximated 97,400 micrograms per liter (µg/L); roughly 9% solubility, indicating residual non-aqueous phase liquid (NAPL). In 2001, the beta-version of **ERD**ENHANCED™ was deployed via direct injection, and 8-1/2 years later, [TCE] had decreased by 99.99% to < 10 µg/L. As of 2010, the amendment remains in effective providing a sustainable Green solution.

The site subsurface consists of ≈ 35 feet of silty clay, with two sand/silt lenses located between ≈ 18 and 25 feet below ground surface (bgs) and ≈ 30 to 33 feet bgs, respectively; both lenses are laterally continuous, and more hydraulically conductive than the silty clay. Both lenses were chosen to represent remediation target zones. Source area groundwater baseline concentrations of the parent products TCE and tetrachloroethene (PCE) approximated 100,000 µg/L; with total concentrations of the daughter products cis- and trans-1,2-dichloroethene (DCE), 1,1-DCE, and vinyl chloride approximating 400 µg/L. On a molar basis baseline parent product contaminants represented 99.6% of the total cVOC signature.

Using BioStryke® **ERD**ENHANCED™ the project attained study objectives, passive-aggressively decreasing source area [TCE] to < 1,000 µg/L within 5-years, allowing monitored natural attenuation (MNA) to manage the contracting solute plume. In summary, **ERD**ENHANCED™ cost-effectively biostimulated the anaerobic treatment zone enhancing the creation of preferential microbial conditions and expedited degradation of dissolved, sorbed phase, and residual source mass contaminants.

To accomplish Site objectives, approximately 2,600 pounds of **ERD**ENHANCED™ was injected over a 25-point grid pattern using direct push technology (DPT). Estimate rates approached 100 pounds amendment per injection point, to include vertical and angle borings to facilitate amendment deployment under the site building.

Analytical testing of performance groundwater samples collected and analyzed shortly (< 3 months) after the *single* injection event documented an approximate 83% reduction in baseline [TCE] from 97,400 µg/L to 16,100 µg/L. During the next four years post the *single* deployment, source area [TCE] ranged between 11,600 µg/L to 29,800 µg/L. This increase in [TCE] indicated the continued flux overtime (contaminant transfer) of sorbed phase and residual source mass into the dissolved phase. During this same period, concentrations of *cis*-1,2-DCE also increased, indicating a similar flux of sorbed and residual daughter contaminant mass and enhanced parent contaminant biotransformation. Given that during growth coupled dehalorespiration native microflora tend to preferentially dechlorinated the more oxidized parent cVOCs (*e.g.* TCE) than the less oxidized daughter products (*e.g. cis*-1,2-DCE), it is expected that significant dechlorination of *cis*-1,2-DCE would be delayed until the bulk of sorbed phase and residual TCE source mass was dechlorinated.

BioStryke® **ERD**ENHANCED™ stimulates the ability of the native microflora to scavenge competing terminal electron acceptors (TEAs) such as oxygen, nitrate, oxidized iron/manganese, and sulfate which can limit cVOC dechlorination. **ERD**ENHANCED™ leverages the momentum provided by Mother Nature, working with Her not against, by enhancing the chemically reducing environment which effectively increases site rates of reductive dechlorination. In summary, the process provides expedited destruction of site contaminants while realizing lower costs to the client. **ERD**ENHANCED™ is a proprietary blend of micro-macro nutrients and superior sources of terminal electron donors to include complex carbohydrates and unique sources of organic carbon. **ERD**ENHANCED™ is proven to facilitate native microflora fermentation, the yielding of volatile fatty acids, molecular hydrocarbon, and expedited dechlorination.

- **ERD**ENHANCED™ expedites the degradation of dissolved contaminants, creating large concentration gradients between groundwater and sorbed/residual source mass, effectively expediting contaminant flux and increasing contaminant bioavailability.

- **ERD**ENHANCED™ expedites desorption of source mass contaminants by transforming parent cVOCs (TCE/PCE) to less-chlorinated daughter products (DCE, VC, and ethene), each with significantly lower sorption coefficients and greater degradation rates under aerobic conditions found outside the anaerobic treatment zone, supporting MNA for long-term plume management.

- **ERD**ENHANCED™ expedites contaminant dissolution by enhancing microbial generation of fatty acids which serve as a co-solvent, increasing contaminant bioavailability and increasing rates of dechlorination.

The **ERD** remediation program was designed to address TCE source mass DNAPL, and did so by achieving a greater than 99% decrease in [TCE] in 5 years, and *no* indication of rebound over 10 years. Our products demonstrate that by enhancing existing conditions, working with Mother Nature not against, one can expedite site compliance, redevelopment, and reuse with less impact to the environment, and less cost to the client.