



## Project Highlights

- Green Sustainable Remediation
- Proven Remedial Strategy to destroy dissolved solute, recalcitrant sorbed, and residual chlorinated hydrocarbons.
- Pilot Study demonstrated efficacy of **ERDENHANCED™** as a residual cVOC source control.
- Unanticipated and unusually high baseline concentrations of cVOCs >2,000 mg/L.
- Achieved performance goals using original loading estimates despite increased baseline concentrations.
- Project completed under Site conditions typical of Saudi Arabia to include high humidity, temperature, and site pH.
- Full-scale remedial design approved and currently in development with an anticipated 2012 start-up.
- **ERDENHANCED™** Pilot Study expedited contaminant destruction, site compliance, and reduced future monitoring.
- **ERDENHANCED™** significantly reduced project expenditures.

## Source Area Remediation Pilot Study Case History

### Major Petrochemical Facility

### Kingdom of Saudi Arabia

Plant Products Co. Ltd. (PPCL) manufactures and distributes the BioStryke® line of innovative, cost-effective, and green remedial products designed to biostimulate existing site conditions. BioStryke® **ERDENHANCED™** is an *in-situ* formulation proven to passive-aggressively destroy chlorinated volatile organic compounds (cVOC) by leveraging Mother Nature's momentum. The following documents the cost-effective use of **ERDENHANCED™** and our formulations ability to remediate dissolved, sorbed, and residual source mass cVOC's.

In 2008, a Kingdom company specializing in the manufacture of Vinyl Chloride (VC) and allied cVOCs retained a US firm to provide a hydrogeologic site investigation of the facility. Results documented a large cVOC solute plume; to include, a residual source zone with total [cVOC] in groundwater > 100 milligrams per Liter (mg/L). Plume constituents include chlorinated alkanes, alkenes, and other organohalides, each exceeding regulatory threshold concentrations. A remedial strategy was established which required the identification of 1) an alternative measure to provide contaminant source control, 2) an MNA program to address plume migration, and 3) a cost-effective *in-situ* strategy to replace proposed pump-and-treat strategies.

In 2008, baseline groundwater samples were collected, followed by an **ERDENHANCED™** injection program. Results of baseline sample testing documented [cVOC] significantly greater than originally believed. Specifically, total [cVOCs] approached ≈2,000 mg/L (>0.2% cVOCs) in wells sampled indicating significant residual product in the source area. The injection program, based on baseline [cVOC] ≈100 mg/L, included 5,500 pounds of **ERDENHANCED™** via source area injection wells located upgradient from a network of downgradient monitoring wells. Performance monitoring was carried out over the 6-month evaluation period. Laboratory analysis of performance samples demonstrated a 70% percent reduction in 1,2-dichloroethane mass, along with a 54% - 91% reduction in chlorinated alkanes, and between 72% - >99% reduction in chlorinated alkenes (e.g., vinyl chloride, *trans*- and *cis*-1,2-dichloroethene). Reduction in other organohalides (e.g., dichloromethane, chloroform) ranged from 53% to 60%. The table below summarizes the range of contaminant reduction.

Compound	Baseline (µg/L)	Post-Injection µg/L	Reduction
1,2-Dichloroethane	2,000,430	1,091,500	45%
1,1-Dichloroethane	20,685	1,840	91%
<i>cis</i> -1,2-Dichloroethene	12,875	<100	>99%
Vinyl Chloride	40,824	11,430	72%
Chloroform	214,538	85,660	60%