REDOX TECH, LLC

"Providing Innovative In Situ Soil and Groundwater Treatment"

A CASE STUDY FOR THE APPLICATION OF ABC-OLE and ZVI TO REMEDIATE TETRACHLOROETHENE AT A FORMER DRYCLEANER

Project Location
Former Drycleaner
Central New Jersey

Contaminants
Tetrachloroethene
Trichloroethene
Dichloroethene Isomers
Vinyl Chloride

Product Used
ABC-Olé plus ZVI

Scope and Media
Full-Scale Biological ERD and Abiotic Reductive Treatment in Groundwater

Results
PCE↓ 99.5%

TCE↓95.6%

Sulfate↓98.5%

↓ORP (-265 mV)

A full-scale application of ABC-Olé plus zero valent iron (ZVI) was performed by Redox Tech in September 2014 to remediate groundwater at a drycleaning facility in Central New Jersey. Groundwater and soil at the site were impacted with tetrachloroethene (PCE), a chlorinated solvent historically used in the drycleaning industry. ABC-Olé, which contains emulsified fatty acid esters and a fast burning carbon substrate, and microscale ZVI were injected to treat groundwater by enhanced reductive dechlorination and abiotic reduction methods.

SITE BACKGROUND

The site is located in central New Jersey within the Upper Coastal Plain physiographic province, near its western terminus at the Piedmont province. Groundwater in this area occurs within a single, unconfined aquifer system consisting of reworked Coastal Plain sedimentary sand, silt and clay deposits that overlay fractured crystalline bedrock of the Piedmont. Depth to groundwater averages four feet below ground surface at the site.

Other chlorinated alkenes that are by-products of PCE dechlorination were also present in groundwater, including trichloroethene (TCE), cis-1,2-dichloroethene (cDCE) and vinyl chloride (VC). Prior to active remediation with ABC+, the maximum groundwater PCE concentration was 57.7 ppb in the treatment zone. Sulfate was also naturally occurring in groundwater at concentrations up to 49 ppm in the treatment area. Natural levels of total organic carbon (TOC) were generally less than 1 ppm in groundwater prior to treatment.

APPLICATION METHODS

A combined total of 65,000 pounds of ABC-Olé and ZVI were injected at 90 locations throughout the dissolved PCE plume in groundwater. The percentage of ZVI varied between 20% and 50%, with higher concentrations of ZVI being used in higher solvent areas. Each location had four injection depth intervals: 7, 10, 13 and 16 feet below ground surface. Each location received approximately 300 gallons of diluted treatment amendment.

RESULTS

Groundwater was sampled at seven wells prior to the injections and on a quarterly basis thereafter for one year. Samples were laboratory analyzed for chlorinated alkenes, sulfate, and total organic carbon (TOC) during each groundwater sampling event. Water quality parameters of dissolved oxygen and oxidation-reduction potential were also field-analyzed to monitor the progress of reducing geochemical conditions required by anaerobic microbes.

PCE concentrations were reduced up to 99.5% during the first year of post-injection monitoring. Daughter products both increased and decreased during this period as they were generated via dechlorination sequences and subsequently biodegraded. TOC concentrations up to 1,800 ppm were measured in groundwater within three months after injection and remained above 70 ppm after one year. Groundwater DO was reduced to below detection levels and ORP readings were negative (-65 to -265 mV) throughout the monitoring period at five of the wells within the injection zone of influence. Sulfate was also reduced at most of these wells within one year.

MW-3: PCE concentrations decreased in this source area well from 44 to 0.643 ppb (98.5%) during the one year monitoring period. TCE also showed an overall decrease of 63.9% compared to baseline (Figure 1).MW-3 showed consistent cDCE production for the first nine months, followed by a 91% decrease from the peak concentration in the final three months. MW-3 was the only well that had detectable baseline VC concentrations that increased throughout the monitoring period. MW-3 showed a temporary increase in PCE, TCE, cDCE, and VC at the 9-month monitoring event. TOC also reached its highest levels during the 9-month monitoring event. Sulfate was reduced from 33.6 ppm (baseline) to < 1 ppm after one year.

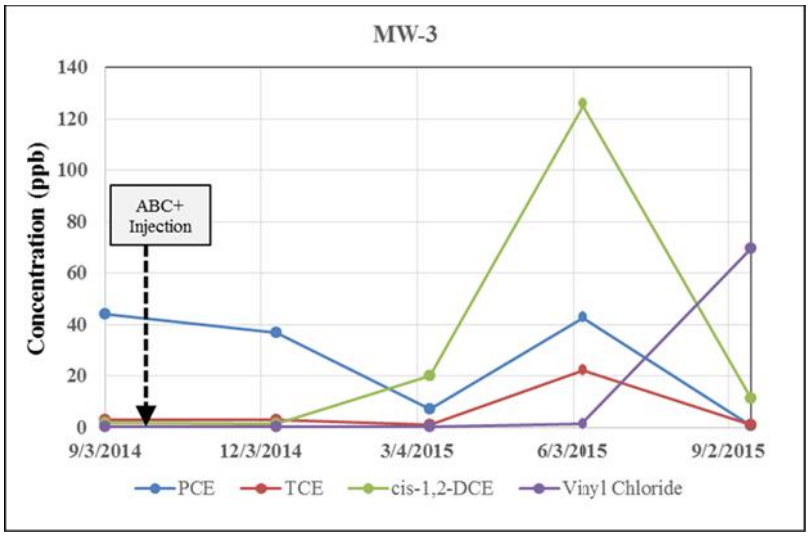

Figure 1. Chlorinated Alkenes at MW-3

MW-4: This mid-plume well had the largest baseline PCE concentrations (57.7 ppb) prior to the ABC+ injections. PCE concentrations decreased steadily following the ABC+ injections, resulting in a 99.5% reduction after one year. TCE was reduced by 95.6% after one year, while cDCE increased by one order of magnitude after nine months and then stabilized for the next three months (Figure 2).

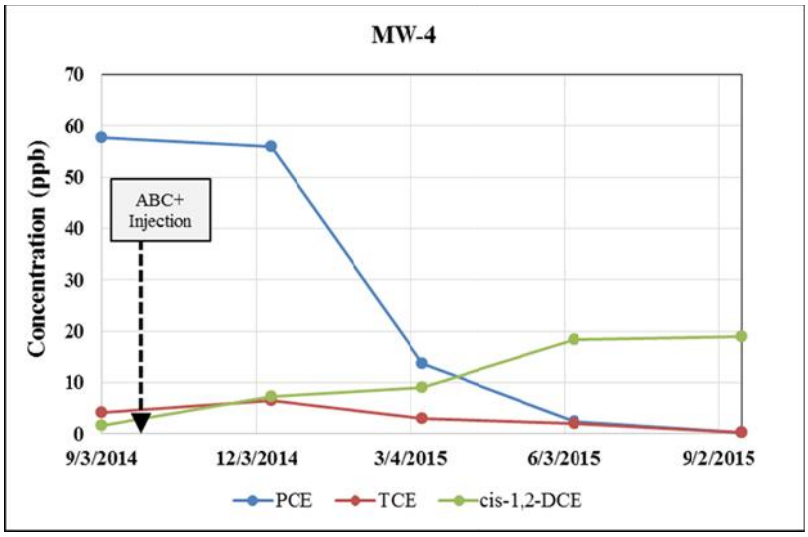

Figure 2. Chlorinated Alkenes at MW-4

Vinyl chloride was not detected at well MW-4 during the one-year monitoring period. This well also experienced the strongest reducing conditions with ORP of -265 mV measured in groundwater, which coincided with the treatment zone where higher ZVI concentrations were used in the ABC+ solution. The treatment zones with higher ZVI concentrations likely minimized VC production and accumulation in these areas. Sulfate was reduced in groundwater from 32.8 ppm to <1 ppm in nine months at MW-4.

MW-5: This monitoring well is located in the down gradient section of the plume where the in-situ treatment barrier was constructed. Following ABC+ injections, PCE in groundwater consistently decreased from 29 ppb to <0.495 ppb within ninemonths at MW-5, with an overall 99.2% reduction observed during the one-year monitoring period. TCE showed a similar reduction efficacy of 91.5% during the same period. A one order of magnitude increase in cDCE occurred within the first nine months, followed by a decrease in this compound (Figure 3).

Sulfate was reduced in groundwater from 32.6 ppm to <1 ppm within nine months following the ABC+ injections.Sulfate depletion in groundwater also coincided with increased reduction of PCE, TCE and cDCEconcentrations. VC was not detected in groundwater at this well. TOC increased to 1,800 ppm within three months of the ABC+ injections and declined to 82 ppm after one year.

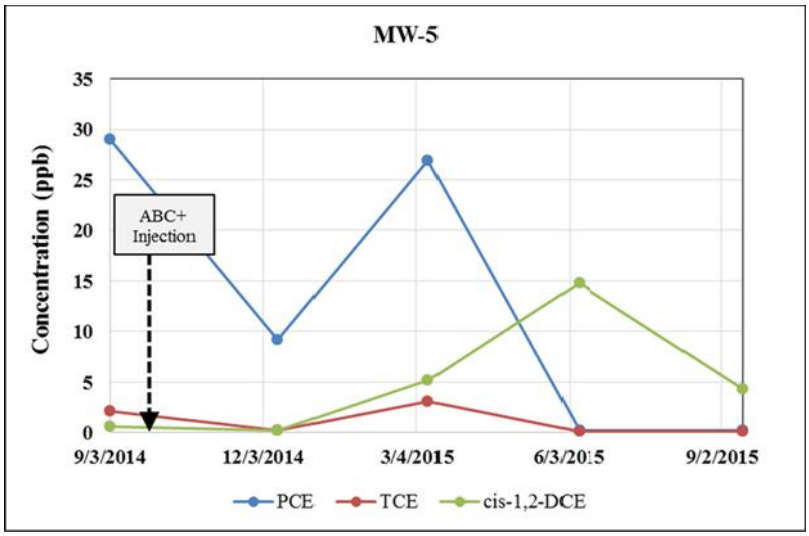

Figure 3. Chlorinated Alkenes at MW-5

Regulatory cleanup levels for all chlorinated alkenes of concern were in achieved in groundwater at four out of seven monitoring wells following ABC+ treatment. PCE cleanup levels were also met in six of the wells. The remaining concentrations of chlorinated alkenes were close to their respective regulatory standards one year after the injections.