EHC® Reagent Treatment of Groundwater Plume Containing Chlorinated Solvents at a Former Manufacturing Facility in the Southeastern United States

Summary

Groundwater at a former manufacturing facility was impacted by chlorinated solvents, primarily carbon tetrachloride (CT) and trichloroethylene (TCE), as well as organochlorine pesticides (OCPs). EHC® Reagent was used *in situ* yielding safe, rapid, and effective treatment.

After only 3 months after the EHC application, the CT concentration decreased from 260 ppb to 7.8 ppb (97% removal) without the accumulation of catabolic intermediates. Treatment improved further at the 6-month sampling, showing a decrease to 0.8 ppb (99.7% removal). All six monitoring wells met the groundwater clean-up criteria for volatile organic compounds (VOCs).

Site Information:

Site Type: Former Manufacturing Facility

Location: Southeastern United States

Remedial Approach: Three 10ft wide reactive zones perpendicular to groundwater flow installed through direct push technology

Contaminants of Concern: CT, TCE, OCPs

Results: 99.7% Removal of CT, all wells met groundwater clean-up criteria

Remedial Approach

EHC reagent is a proprietary combination of controlled-release carbon and zero valent iron (ZVI) particles used for stimulating reductive dechlorination of otherwise persistent organic compounds in groundwater. The impacted area targeted for remediation measured 110 ft (34 m) wide by approximately 190 ft (58 m) long, from 15 to 40 ft (4.6 to 12 m) below ground surface (bgs).

The approach was to create three, 10 ft (3 m) wide reactive zones: one at the upgradient edge of the plume, and two in the middle of the treatment area (Figure 2). The theory behind this approach is that the volatile fatty acids, hydrogen, and ferrous iron released from EHC would migrate downgradient to treat the plume. Further, groundwater would be abiotically treated as it flows through the reactive zone and contact the ZVI particles that is incorporated in the EHC product.

A total of 45,000 lbs (20,455 kg) of EHC was applied at the site. Within the reactive zones, the application rate was 0.5% by dry soil mass; however, the overall application rate for the total area treated was 0.08% EHC by soil mass. The EHC zone was installed as two lines of direct push injection points.

Figure 1. Application of EHC Reagent slurry using direct injection

Figure 3 shows the approximate extent of the different plume areas prior to treatment relative the EHC treatment zones.

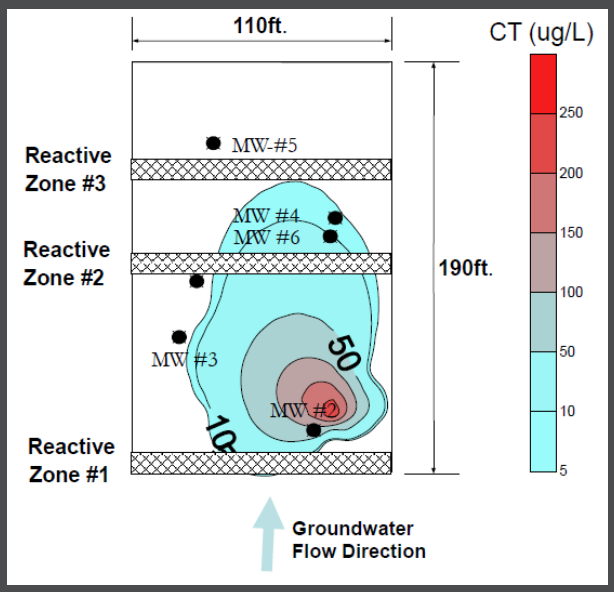

Figure 2. Locations of EHC treatment zones shown on CT plume map (CT concentration data measured 1 year prior to EHC application)

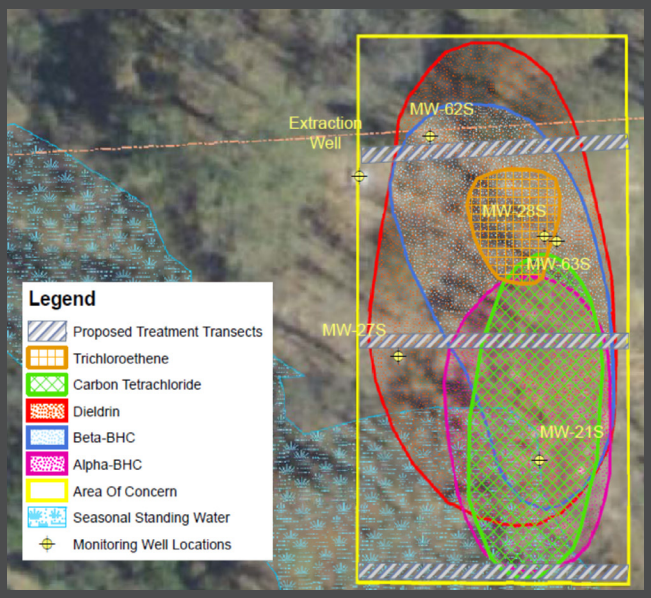

Figure 3. Approximate extent of TCE, CT and OCP groundwater plumes prior to treatment relative proposed locations of EHC treatment zones.

Results

The injections were completed in June of 2005 using direct injection. The first round of monitoring well sampling occurred in September of 2005. The treatment results were attained, as shown in Table 1, where the pre-treatment and 3-month post-treatment results are presented for all wells in the treatment area.

Table 1. Influence of 3 months of EHC treatment on TCE and CT concentrations in groundwater from all wells in the treated area

	MW #1	MW #2	MW #3	MW #4	MW #5	MW #6
TCE Pre-treatment, ppb	<1.0	2.5	1.5	44	<1.0	1.0
TCE Post-treatment, ppb	<1.0	1.1	<1.0	1.3	<1.0	<1.0
CT Pre-treatment, ppb	<1.0	260	<1.0	3.7	0.34 (est.)	4.2
CT Post-treatment, ppb	<1.0	7.8	<1.0	<1.0	<1.0	<1.0

Figure 4 shows the contoured field data for carbon tetrachloride one year prior to injection, and three and six months following the injections. All values were less than 1 ppb at the six-month sampling, and all VOC treatment goals were met.

The full range of analyzed chloroethenes and chloromethanes are shown in Figure 5 for the most highly contaminated well MW-2. All constituents at this well were reduced by significant amounts, with CT being reduced by 99.7%.

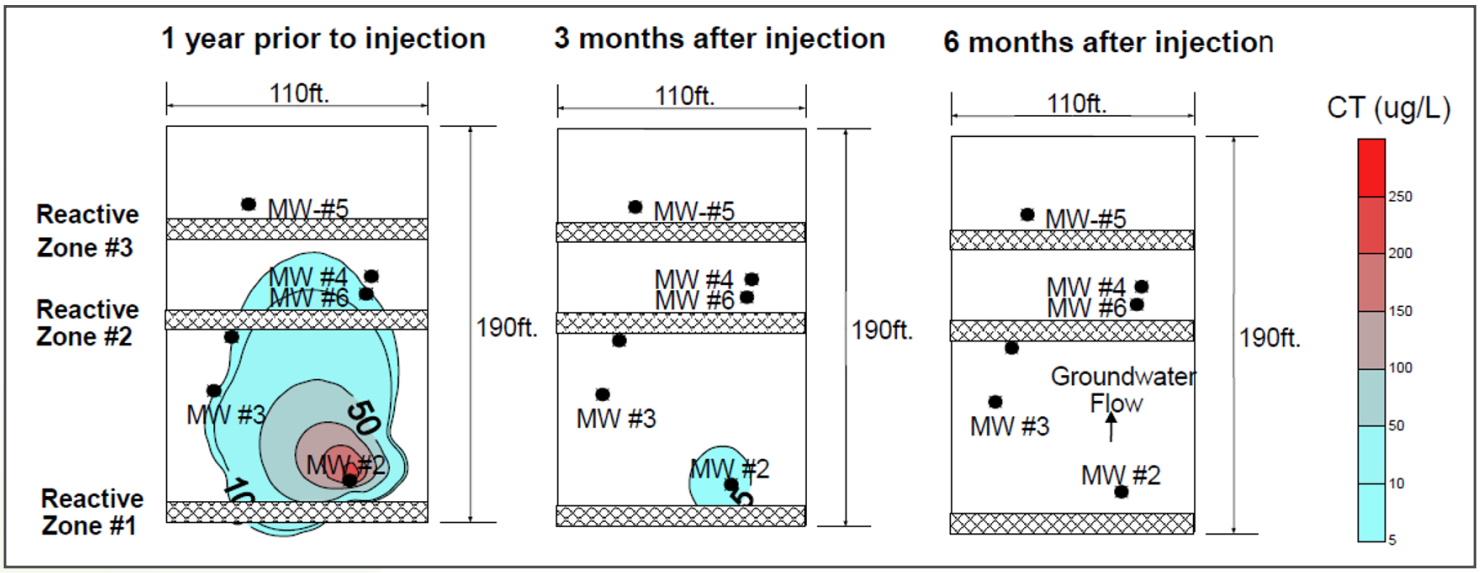

Figure 4. Influence of EHC treatment on contoured carbon tetrachloride data

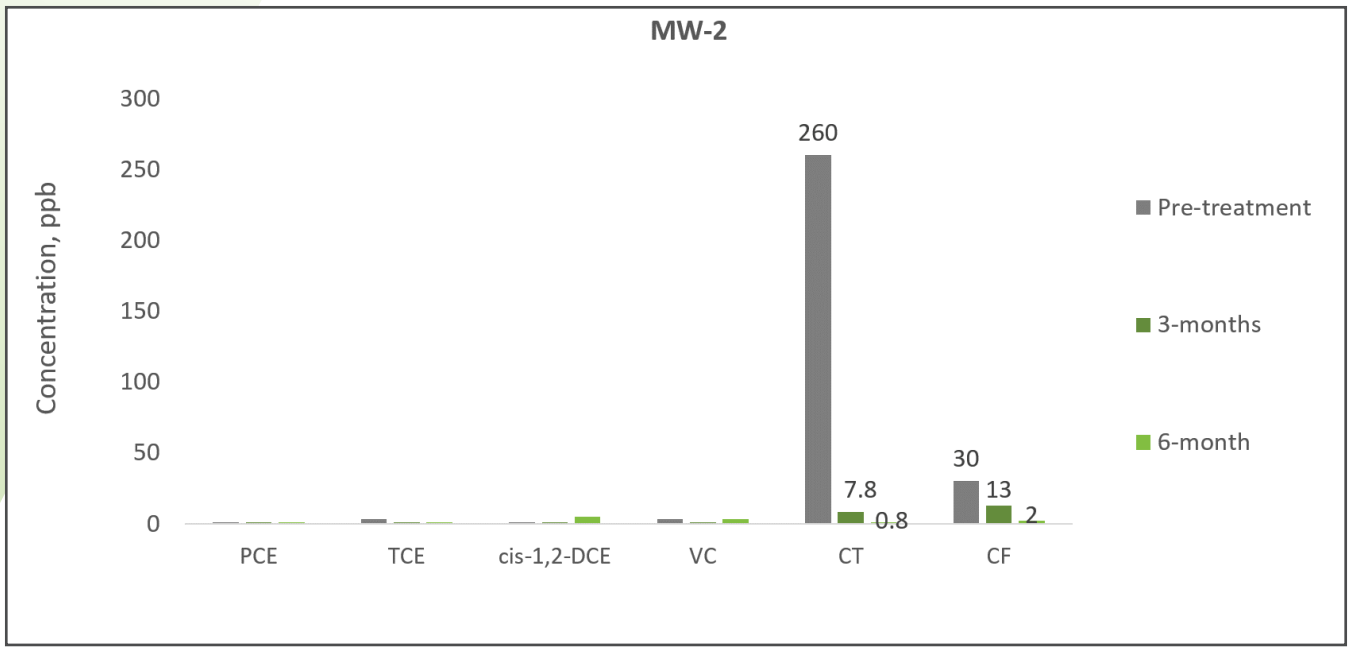

Figure 5. Influence of EHC treatment on chloroethene and chloromethane concentrations at the most highly contaminated well (MW #2)

Figure 6 shows the degradation of OCPs over time due to EHC application (includes the sum of BHC, dieldrin and endrin). Table 2 shows the results for individual compounds (mean of all wells).

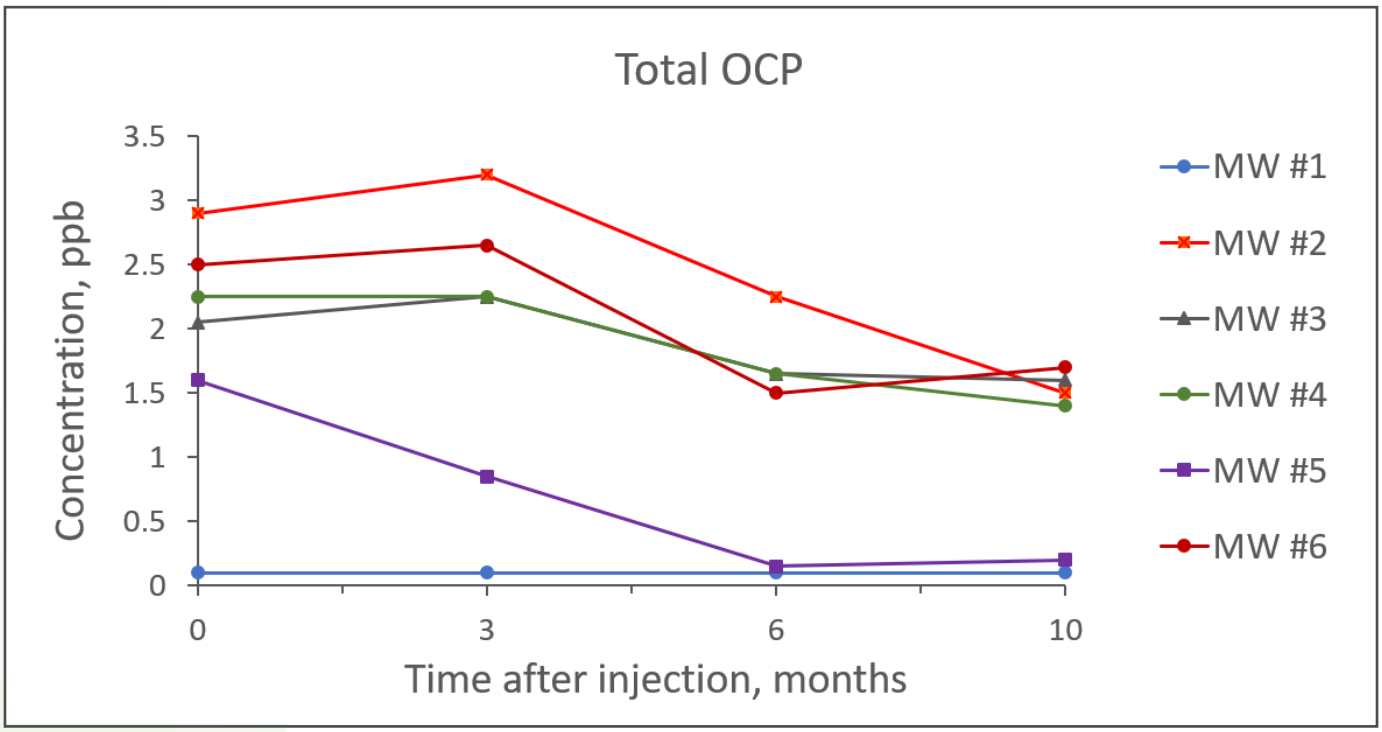

Figure 6. Influence of EHC treatment on total organochlorine pesticides

Table 2. Influence of EHC treatment on BHC, endrin and dieldrin in groundwater

Compound	Mean Concentration (ppb)		% Reduction	Time point
	Baseline	Post Treatment		
Total BHCs [ug/L]	1.1	0.51	54%	6 months
Dieldrin [ug/L]	0.60	0.19	68%	
Endrin [ug/L]	0.58	0.36	38%	
Total BHCs+ Dieldrin+Endrin [ug/L]	2.3	1.1	52%	10 months

The remedial goal was met for CVOCs, BHC and endrin at all sampling locations; only dieldrin remained above the cleanup criteria of 0.1 ppb.