Environmental Solutions

EHC® Reagent
Case Study

EHC® Reagent PRB for Treatment of Chlorinated Ethenes, Ethanes, and Methanes at a Manufacturing Site in North Carolina

Summary

Field scale pilot tests were performed to evaluate the performance of enhanced reductive dechlorination (ERD) of chlorinated aliphatic hydrocarbons (CAHs) at a manufacturing facility in western North Carolina. The key CAHs found in groundwater at the site include 1,1,2,2 tetrachloroethane (TeCA), trichloroethene (TCE), and chloroform (CF), as high as 350, 1,100, and 1,500 ppb respectively. PeroxyChem employed its EHC® in situ integrated biological and chemical reduction (ISCR) reagent yielding safe, rapid, and effective treatment. Eleven weeks after injection, concentrations of TeCA, TCE, and CF in a nearby well reduced by 86%, 98% and 66%, respectively. After approximately 26 months, the key CAHs in the monitoring wells in the silty-clay (saprolite) zone indicated an overall decrease of up to 95%.

Challenge

The site is located in the Appalachian Piedmont physiographic province (mountainous) of North Carolina and consists of saprolite soils overlying a partially weathered rock (PWR) zone. Fractured bedrock underlies the PWR zone. Groundwater concentrations have rebounded since historical treatment, indicating the potential for continuing sources, desorption, or problematic hydrogeology or microbial conditions at the site. Presence of low permeability soils, low groundwater velocities, and a mixture of CAHs presented a unique challenge for remediation.

Solution

EHC is a patented combination of controlled-release carbon and zero valent iron (ZVI) particles used for stimulating reductive dechlorination of otherwise persistent organic compounds in groundwater. Two pilot-scale permeable reactive barriers (PRBs) were installed in January 2005 to evaluate the efficacy of EHC to control and treat the chlorinated solvents plume in two areas of the site. The first injection PRB was installed into the saprolite between 10 and 25 ft below ground surface (bgs) and the second injection PRB was installed into the partially weathered rock (PWR) between approximately 30 and 35 ft bgs. Each PRB measured an estimated 40 ft long x 20 ft wide. Approximately 3,000 pounds of EHC was injected in two Geoprobe boreholes in the saprolite zone and 3,500 pounds of EHC was injected at four drilled locations in the PWR zone.

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The presence of low permeability soils and the PWR zone required hydraulic fracturing to inject EHC at the site. Injection pressures and ground uplift were monitored, and soil boring and monitoring wells were installed to verify fracture propagation and distribution of the EHC. Soil samples collected around the injection points indicated the presence of EHC material. Based on field observations, the influence of EHC injection extended in a zone approximately 10 to 15 feet around the injection point in the saprolite. The injection in the PWR zone was controlled by the fracture orientation.

The presence of high concentrations of total organic carbon and metabolic acids and negative oxidationreduction potential in the nearby monitoring wells indicated that the injected EHC created anaerobic zones favorable for CAH reduction.

Results

Eleven weeks after injection, concentrations of TeCA, TCE, and CF in a nearby well in the PWR zone reduced by 86%, 98% and 66%, respectively. After approximately 26 months, these compounds in the same well reduced over 98%. Potential degradation products of these CAHs such as 1,1,2-trichloroethane, methylene chloride, cis-1,2-dichloroethene, trans-1,2-dichloroethene, vinyl chloride, ethene, ethane and methane were detected in low concentrations, as shown in Figure 3. The concentrations of TeCA, TCE and CF initially increased in one downgradient well in the saprolite zone and gradually decreased. The test results indicated that reductive dechlorination was delayed in the aquifer despite the presence of dechlorinating bacteria such as *Dehalococcoides, Dehalobacter* and *Methanogens*. The likely reasons for the slow treatment response are the slow rate of groundwater flow as well as desorption of CAHs. After approximately 26 months, the key CAHs in the monitoring wells in the saprolite and PWR zone indicated a decrease of up to 99% (see Figures 1, 2, and 3). Despite the reductions in CAH concentrations, organic carbon is still present supporting the reductive dechlorination process in the saprolite and PWR zone.

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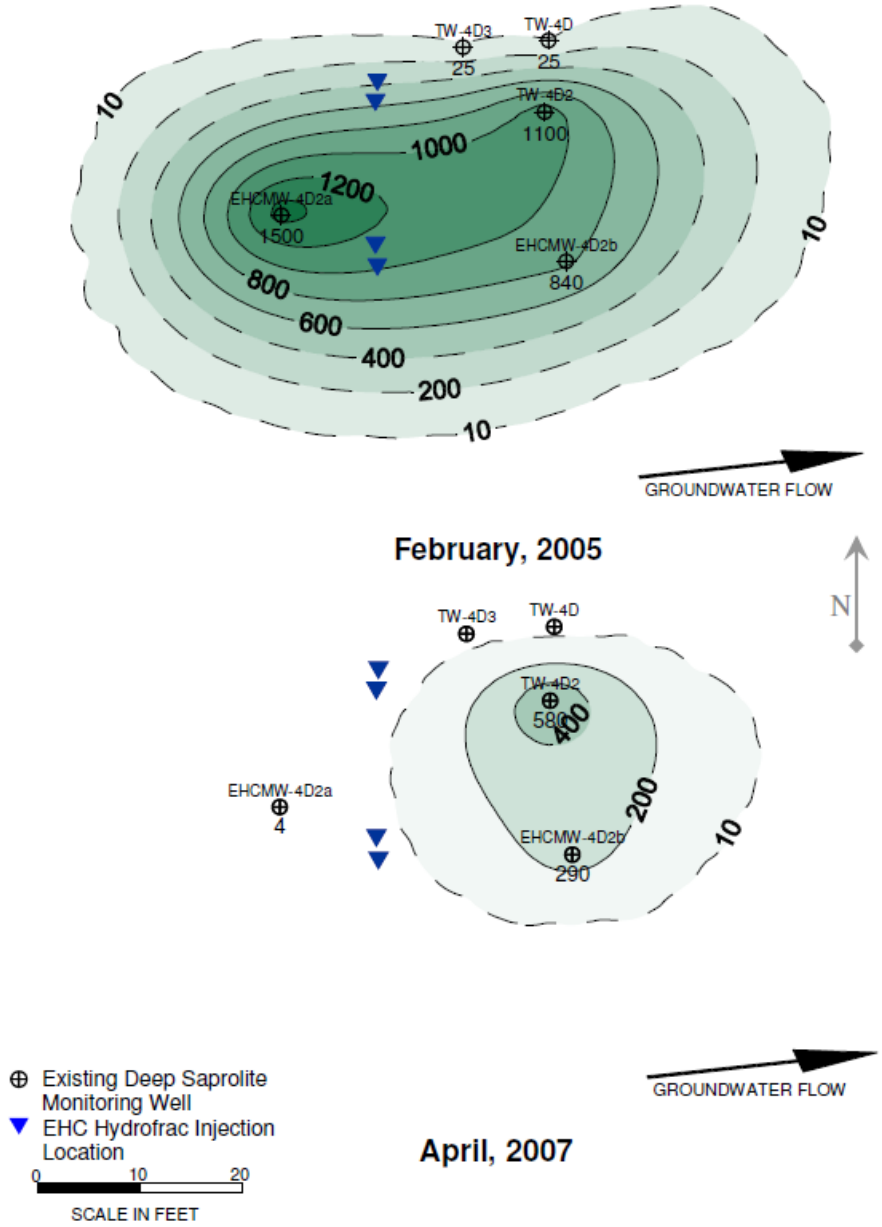

Figure 1: North plume of CF before and two years after EHC injection in the Saprolite and PWR zone (µg/L).

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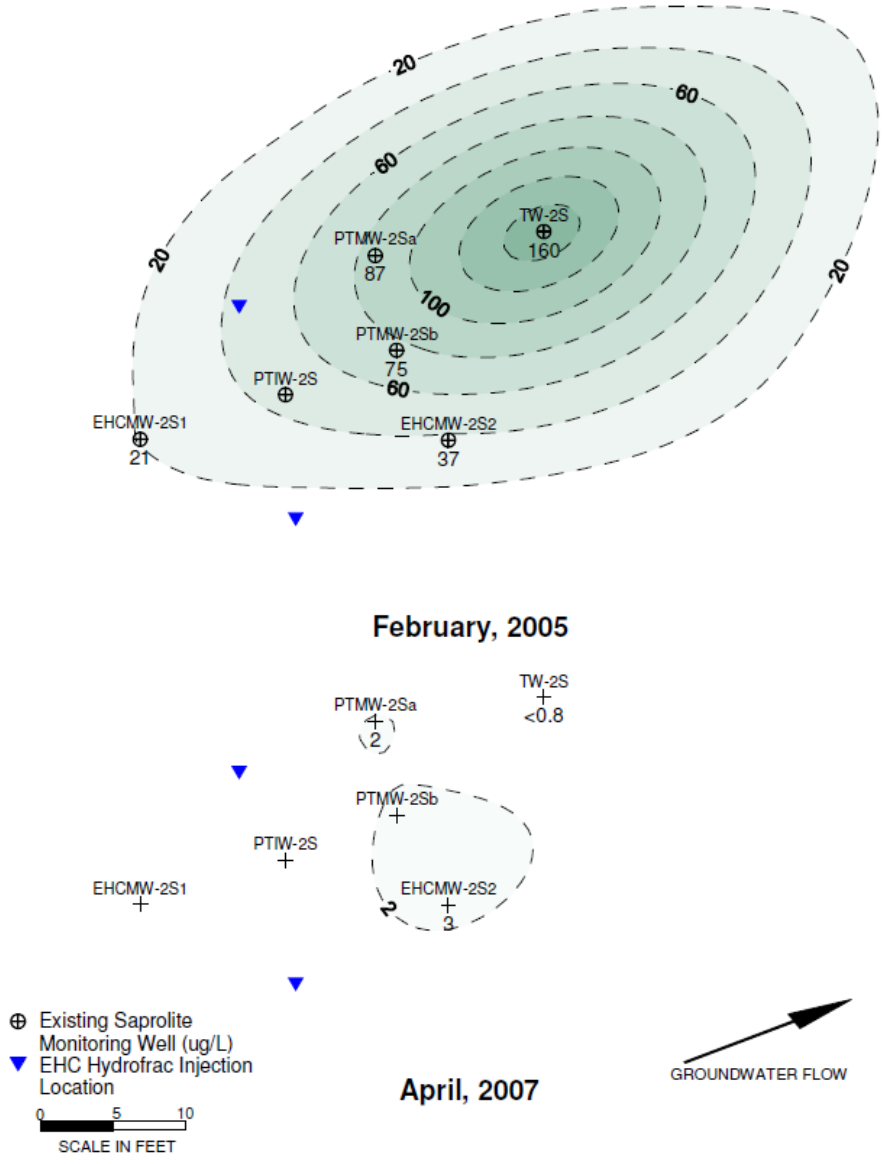

Figure 2: South plume of CF before and two years after EHC injection in the Saprolite zone (µg/L).

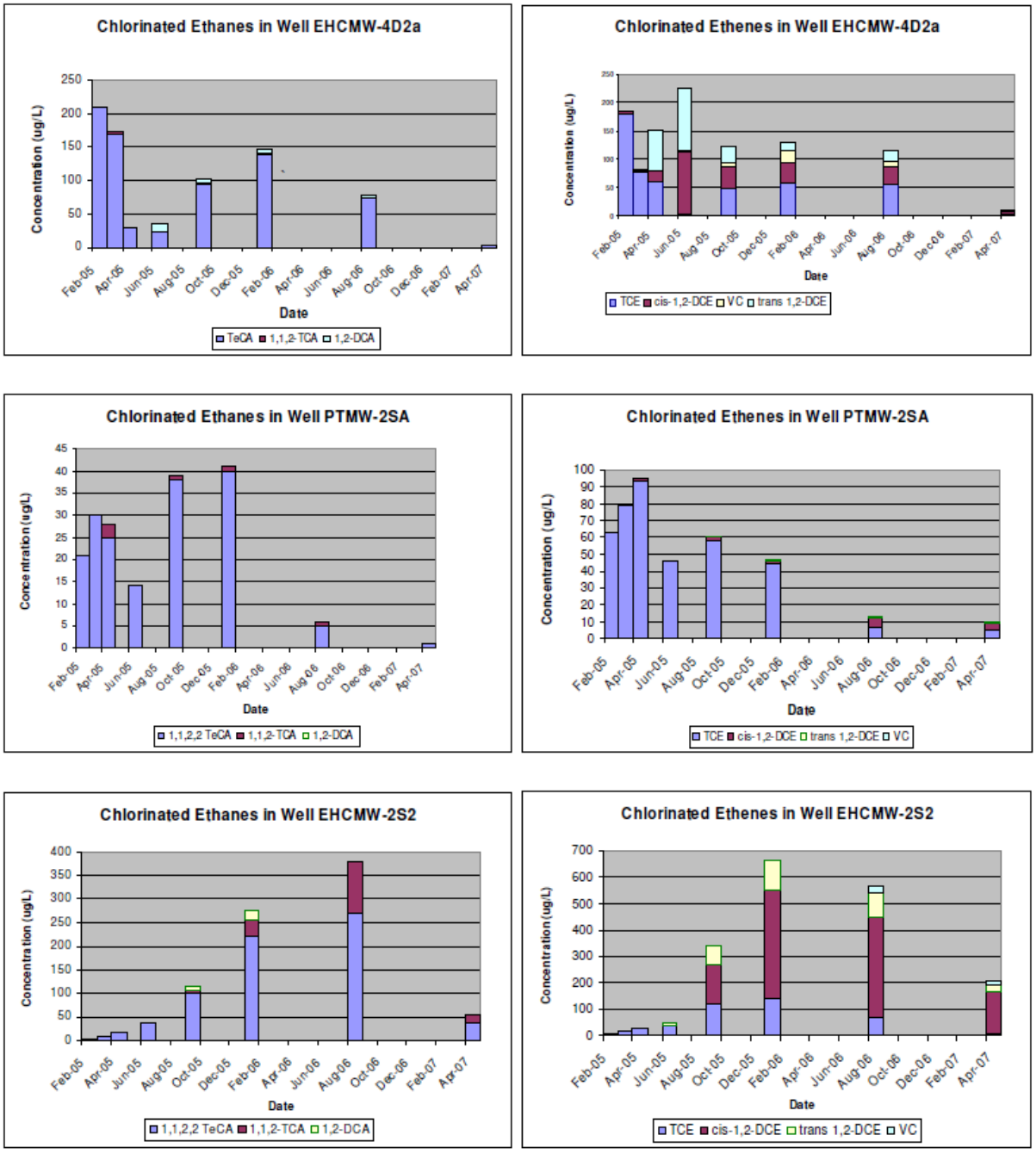

Figure 3: Chlorinated ethanes and ethenes in saprolite (PTMW-2SA, EHC MW2-2S2) and deeper PWR (EHCMW-4D2a) monitoring wells.

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