

HOWTO: Bioremediate Chlorinated Solvents without accumulating Metabolites

By **ADVENTUS GROUP**

Chlorinated volatile organic compounds (CVOCs) such as tetrachloroethylene (PCE) and trichloroethylene (TCE), commonly used as dry cleaning solvents and degreasers, pose an ongoing threat to human health and wildlife when spilled into groundwater. Through the injection of bioremediation products into the impacted groundwater, the chlorine atoms can be removed from these compounds *in situ*. However, depending on the treatment pathway, varying amounts of more harmful by-products can be formed, such as cis-dichloroethylene (cis-DCE) and vinyl chloride (VC). Site owners, C&E firms and regulators are realizing that the ability to effectively treat the original contaminants, while minimizing formation of harmful by-products, is an important aspect of performing permanent and responsible *in situ* bioremediation.

The use of simple carbon substrates such as emulsified oils and lactate-based Hydrogen Releasing Compounds often results in the long-term accumulation of these problematic by-products. One method of chemically treating chlorinated solvents without such accumulations is through the use of zero-valent iron. An oxidation-reduction reaction occurs where electrons are donated from the ZVI to the solvent, which removes the chlorine atoms from the compound, and in a very short contact time drives the contaminant through to easily biodegraded ethene. Although injecting iron into the subsurface can yield significant degradation of CVOCs, achieving uniform injection of the iron is important and can be difficult to accomplish, as with the injection of any solid or highly viscous liquid. EHC® is a patented combination of solid organic carbon with ZVI that has been field proven to generate very low redox conditions that will drive chlorine from the CVOCs, while minimizing the formation of toxic by-products. The compounds are treated not only via biological mechanisms, but by chemical ones as well. Successful treatment is less dependent on distribution than with ZVI alone. This application of *In Situ* Chemical Reduction (ISCR) science is extremely reliable in its ability to treat CVOCs in a short timeframe at sites with minimal to negligible accumulation of by-products. The following case study is representative of hundreds of Adventus sites around the globe.

Through the Oregon DEQ's Dry Cleaner Program, remediation of the "Former Serry's Dry Cleaner" site was conducted through the injection of 10,250 lbs of EHC. The treatment area of 800 ft² required 32 direct injection locations, implemented by using a pressure-activated GeoProbe® injection tip (Exhibit 1). The injections were performed over a vertical depth of 13 to 25 ft below ground surface (bgs), into a silty clay with fine sand interbeds. Four well clusters



Exhibit 1. Pressure-activated injection tip with four side injection ports.

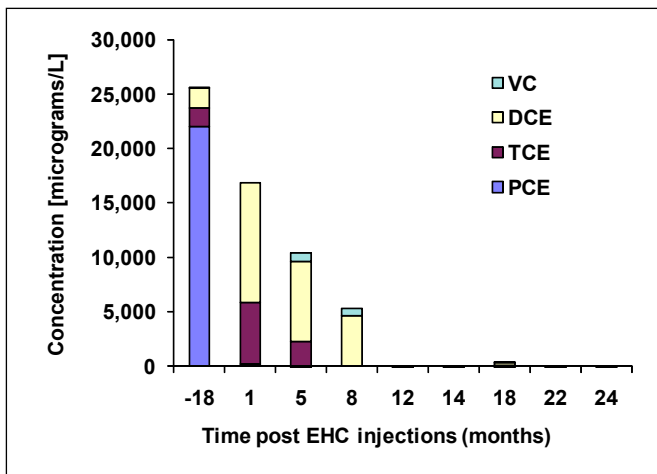


Exhibit 2. Influence of EHC injections on CVOC concentrations over time.

were sampled over time after the injections, which showed very high removal efficiencies. As shown in Exhibit 2, pre-existing impacts, with PCE as high as 22,000 µg/L, were reduced by 99.9% within 12 months of the injections. Over the short-term, some TCE, cis-DCE and VC were formed, followed by near complete removal between 8 and 12 months. After 2 years, the concentrations have remained at or near non-detect, and monitoring is continuing. For further information on this site, please visit the State Coalition for Remediation of Drycleaners at <http://www.deq.state.or.us/wdr/?p=20107>, or contact the helpful professionals at Adventus for more details.

