Innovative Combination of ISCR and ERD for a VOC-impacted Aquifer

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A bench-scale treatability study was conducted to determine the effectiveness of *in situ* chemical reduction (ISCR) using zero valent iron and enhanced reductive dechlorination (ERD) using a carbon source on volatile organic compounds (VOCs) in groundwater. The VOCs included chlorinated ethenes and ethanes (approximately 4,600 µg/L) as well as dichlorodifluoromethane (CFC 12) and trichlorofluoromethane (CFC 11). EHC™, a proprietary remediation substrate consisting of controlled release of food-grade organic carbon and zero valent iron, was chosen as the substrate due to its unique combination of the two processes. Its effectiveness was compared to results from an *in situ* chemical oxidation (ISCO) field pilot study utilizing heat-activated sodium persulfate as the oxidant. Each of these remedial technologies and a combination of them were evaluated for groundwater treatment in order to replace the existing perimeter groundwater extraction and treatment system.

The objectives of the bench-scale study were to:

1) Determine the amount and dose of substrate required to effectively reduce the individual VOCs by an order of magnitude in the relatively higher concentration area such that natural attenuation would be feasible in the downgradient, on-site plume afterwards;

2) Determine the amount and dose of substrate required to effectively reduce all VOCs rapidly to below remediation goals for a potential treatment zone along the property boundary (mitigating off-site migration);

3) Obtain biogeochemical data required for a full-scale remedial design; and

4) Assess subsurface delivery options for EHC™ into the tight subsurface formation.

EHC™ application rates (10%, 5%, and 2%) and two EHC™ products (EHC™ and EHC-L™, a liquid formation of EHC™) were tested on site soil and groundwater. Four performance monitoring events were conducted over a period of 84 days to assess the effectiveness of the treatments. The 10% system exhibited complete removal of chlorinated solvents and CFCs, and partial removal of cis-1,2-dichloroethene and vinyl chloride. The 10% and 5% EHC columns exhibited only a brief period (< 20 days) of reducing conditions at <-400 mV for ISCR, after which the ORP stabilized at about -100 mV for ERD. Representative data from EHC™ field applications showing similar trends will be presented and discussed with respect to their usefulness in developing a conceptual remedial design for this site.

While ISCO results were also favorable in terms of effectiveness on VOCs, the high oxidant demand (partially due to existing reducing conditions) rendered this approach more costly than an ISCR/ERD application. The conceptual phased approach for full-scale application to meet the primary site objective of replacing the existing pump and treat system includes: 1) a treatment zone using primarily ISCR with a high ZVI content substrate along the property boundary to mitigate off-site migration, and 2) source treatment in the relative higher concentration area injecting a substrate in a grid pattern for ERD to achieve VOC levels amenable for NA downgradient.