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Use of Anaerobic Reductive Dechlorination and Cement/Ferrous Iron System for the Remediation of Chlorinated VOCs

Michael Scalzi (mikescalz@iet-inc.net) and Antonis Karachalios (akaracha@iet-inc.net)
(Innovative Environmental Technology, Inc., Pipersville, PA, USA)
Brad Gentry (bgentry@iwmconsult.com) (IWM Consulting, Indianapolis, IN, USA)

Background/Objectives. Researchers have observed decreases in chlorinated volatile organic compound (CVOC) concentrations related with the simultaneous existence of cement and iron in the groundwater. PCE (tetrachloroethylene) degradation by Fe(II) in the presence of cement hydration products has been observed in batch slurry reactors. Cement was found to catalyze or participate in CVOC degradation reactions over a pH range of 10.5-13.8 and the degradation kinetics can be described by a pseudo-first-order rate.

Approach/Activities. This study relates to the use of anaerobic reductive dechlorination and the presence of a cement/ferrous iron system to address soil and groundwater contamination at a site in Indianapolis, IN that was identified as having impacted soils and groundwater by chlorinated solvents. An excavation was initially performed at the aforementioned site, which was followed by backfilling of the subsurface with crushed brick and cement from a demolished building. A monitoring well was afterwards installed in the middle of the area and that is where the remedial event was performed. The objective of the remedial design was to promote the conditions in situ necessary for accelerated dechlorination via both abiotic and microbial processes. The remedial program was designed to mitigate off-site migration, treat sorbed and dissolved contamination, and create subsurface conditions that are ideal for biological reductive dechlorination through pH control, addition of organic hydrogen donors, and vitamin and nutrient supplements.

Results/Lessons Learned. The injected remedial mixture was very effective in decreasing the CVOC concentrations, with PCE (tetrachloroethylene) and vinyl chloride concentrations decreasing below their respective laboratory detection limits, the concentrations of TCE (trichloroethylene) and cis-1,2-DCE (1,2-dichloroethylene) have decreased by 99% and 99.5% respectively. However based on the groundwater field parameters, most notably pH values of approximately 11.38 pH units, biologically-based reductive dechlorination conditions do not appear to be favorable. Therefore, it is assumed that the decreases in CVOC concentrations were significantly affected by the presence of cement in the area combined with the iron source that was injected during the treatment process.