Chlorinated Solvent Daughter Product Management and Expedited Remediation

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Purpose. Chlorinated solvent degradation products, also known as daughter products, are generated at most remediation sites where an electron donor is introduced or where sufficient natural organic carbon is present in the aquifer. For sites where either perchloroethylene (PCE) or trichloroethylene (TCE) is the parent compound, the degradation products are primarily cis-1,2-dichloroethylene (DCE) and/or vinyl chloride (VC). Where source areas exist (e.g. mg/L concentrations of parent compounds), significant daughter product concentrations can be generated and can persist for extended periods of time, even decades.

Methodology. This presentation will review project sites where activated carbon impregnated with metallic iron, a complex carbohydrate, a facultative microbial consortium designed to degrade chlorinated solvents, and a second microbial consortia designed to break down the polymeric carbohydrate to monomeric fragments were mixed and applied via in situ injection.

Summary of Findings.

Site 1. A combined remedial strategy was implemented to treat elevated levels of TCE in a shallow fine-grained aquifer at a former large industrial facility. This remediation effort was comprised of 1) in situ chemical oxidation to treat the shallow, mostly unsaturated soil mass, 2) a metallic iron-impregnated activated carbon PRB was installed downgradient of the source to manage the flux of dissolved mass off site, and 3) the source area was treated with the above-mentioned combination of technologies and microbial consortia. Within the source area, total chlorinated ethylene (TCE+DCE+VC) concentrations in the source area have been reduced by 99.9% in less than three years. The initial TCE concentration was 47,800 ppb and is currently 2 ppb. DCE and VC concentrations peaked approximately six months post application and have since declined to 21 ppb and 9.4 ppb, respectively.

Site 2. A multi-year phased approach was utilized to remediate a comingled plume at a former chemical plant that stored, repackaged, and distributed a multitude of chemicals, including hydrogen peroxide, methylisobutyl carbinol (MIBC), PCE, acetone, ethanol, and diesel fuel. The first phase was a combination of ex situ and in situ remediation methods that were selected to achieve the site clean-up goals in specific plume areas of immediate concern. The initial total chlorinated ethylene (PCE+TCE+DCE+VC) concentrations were over 213,000 ppb with much of the mass as DCE (72%). After one-and-a-half years of source area treatment, the total concentration was 354 ppb with 25% being DCE and the balance as VC. After demonstrating over nine years of mass flux control with a PRB, and significant groundwater mass reductions in the source area, managed closure status has been requested by the consultant and is pending approval from the regulatory agency.

Conclusions/Significance. This synergistic combination of technologies has been shown to generate significantly less daughter products and to degrade parent and daughter products completely to ethylene in an expedited timeframe compared to traditional enhanced reductive dechlorination (ERD) approaches.

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Mike has been involved with in-situ remediation for over twenty-five years and has worked in the remediation technology and environmental consulting communities his entire professional career. His role as Senior Engineer at AST involves project assessment and design, field implementation oversight, and post project data analysis for sites in the Western US, Canada, Europe, and Australia.