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New Technology Applied at Indiana Industrial DNAPL Site

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Background/Objectives. The property was developed for manufacturing in 1912-1913 and activities included steel stamping, forming, machining, parts cleaning and degreasing, heat treating, electroplating (brass, copper, nickel, and chromium), painting, and assembly. Past operations resulted in multiple source areas and one of these, a former degreaser on the southwest portion of the property is located nearby a residential area. Groundwater sampling results indicate a potential for off-site migration of groundwater with concentrations of CVOCs that could pose a risk to indoor air. Multiple lines of evidence support the presence of DNAPL at least two locations.

Objectives included reducing the total mass of CVOCs in saturated soil and groundwater around the former degreaser: This will have the effect of reducing the total mass available for dissolution into groundwater as well as reducing the mass of CVOCs migrating off site. Site geology consists of two to several feet of fill material (asphalt, concrete, fill soil, etc.) underlain by a sequence of silt, silty clay, and sandy silt (silt/clay) interspersed with apparently discontinuous lenses of silty sand and sand. A clay unit underlies the more permeable soils across the site.

Approach/Activities. Enhanced reductive dechlorination was implemented in the area of the degreaser and out toward the property boundary in 2012. Although positive results were obtained, activity subsided and reduction essentially stalled at cis-DCE in the test area while over 80 ppm TCE persisted at another soured area. A new product combining features of activated carbon, zero-valent iron, and ERD was selected for testing. This product, RPI's CAT 100™ (patent pending) combines activated carbon impregnated with metallic iron, a complex carbohydrate (time release substrate), a consortia designed to degrade CVOCs and a second consortia designed to breakdown the polymeric carbohydrate to its monomeric fragments. These smaller substrate fragments are then efficiently used by the CVOC degraders. The essence of CAT 100™ is that the carbon shuttles electrons produced by biological assimilation of electron donors to sites where deposits of metallic iron reside. Instead of metallic iron being oxidized, it is essentially electroplated back onto the metallic surface. The metallic iron is now acting as a catalyst, promoting abiotic degradation of the CVOC without being depleted in the process.

Results/Lessons Learned. Elevated TCE concentration at the source was reduced to non-detect within two months. Initial rises in cis-DCE and VC topped out within a few months and are now falling. PPM level ethylene production continues to be observed so complete dechlorination is actively occurring. There is evidence to suggest sulfate may be an effective agent for suppression of methane generation. Groundwater quality at the property boundary and near the residential area has greatly improved. Steady concentrations of volatile fatty acids including acetate, and formate continue to be observed as CVOC concentrations trend down.