CAT 100® Applied at Indiana Industrial DNAPL Site

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Background/Objectives. A manufacturing site established in 1912-1913 conducted activities including 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. Soil and 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 degreasers. 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.

Approach/Activities. Enhanced reductive dechlorination was implemented downgradient of one of the degreaser areas and out toward the property boundary in 2012. Although positive results were obtained, activity subsided and reduction essentially stalled at cis-DCE. In source areas, over 100 ppm TCE and/or PCE persists in the saturated zones, with visible DNAPL present. In 2016, the CAT 100 technology was implemented as an interim remedial measure (IRM) to reduce the offsite migration chlorinated solvent mass in one of the two source areas. CAT 100 is a fusion of BOS 100® and biotechnology, to produce a technology capable of achieving results beyond the capabilities of either one alone. The CAT 100 treatment mechanism is reduction-oxidation, however the electrons are sourced from added complex carbohydrates (starches) via degradation using selected bacteria. The electrons are then shuttled within the activated carbon to surface sites where iron is present and take part in the reductive dechlorination reaction. This process takes the electron donor burden off the iron, which in turn allows the same quantity of iron to dechlorinate significantly more mass than abiotic dechlorination by BOS 100® alone. Although, not the primary degradation mechanism, contaminants are degraded by the addition of harvested and native chlorinated compound reducing bacteria and the donor electrons generated from the complex carbohydrates breakdown.

As stated above, this project included both an IRM in 2016 and based on two years of data from the IRM area, full-scale implementation in a second source area 2018 and is an ongoing project. The >16,000 pounds of CAT 100 was injected in the IRM source area to reduce DNALP level concentration of CVOCs. Following 2 years of performance data, a second phase of CAT 100 injections was performed in the second source area. More than 38,000 lbs of CAT 100 was installed in >600 injection points from 10 ft to 32 ft bgs in the saturated zone.

Results/Lessons Learned. Elevated TCE concentration at the IRM source was reduced to non-detect within two months (reducing over three orders of magnitude). Initial rises in cis-DCE and VC topped out within a few months and are now falling. PPM level ethylene and chloride production continues, so complete dechlorination is actively occurring. Steady concentrations of volatile fatty acids including acetate, and formate continue to be observed as CVOC concentrations trend down. As part of part of IRM performance monitoring, pre and >2 years post injection microbial census data was collected. From these data, it can be seen that native DHC and added TCE and VC reductases, DHB, DSM, and DSB have sustained increases by multiple orders of magnitude over the 2.5-year performance monitoring period.