Bench-Scale Biodegradation of 1,2,3-Trichloropropane from a Dilute Aquifer Using a *Dehalogenimonas*-Containing Bioaugmentation Culture

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Background/Objectives. A Midwestern-US project site contains 1,2,3-trichloropropane (TCP), a chlorinated volatile organic compound (cVOC), in a weathered bedrock aquifer present in a lateral extent of over 3 acres and a maximum concentration of approximately 4 micrograms per liter (µg/L). This emerging contaminant is highly mobile in groundwater and often forms long groundwater plumes as observed at this site. While remediation is typically not selected for dilute plumes of this size, this site was selected for evaluation to address contamination above the state-specific action level of 0.5 µg/L.

TCP has shown to be resistant to many chemical and biological remediation methods including bioaugmentation cultures containing *Dehalococcoides* (Dhc). A bioaugmentation consortium containing *Dehalogenimonas* (Dhg), as well as Dhc, has shown promise in addressing TCP in recent case studies. A bench-scale biotreatability study was conducted to evaluate biodegradation of TCP in a laboratory setting.

Approach/Activities. Geologic material and groundwater were collected from the target interval of the highest TCP concentration area of the project site. A series of anaerobic microcosms were constructed, each containing 60 grams of geologic material, 200 milliliters (mL) of groundwater, and a nominal volume of head space. Testing parameters included Dhg and Dhc by Gene-trac® analysis, TCP, volatile fatty acids (VFAs), pH, and anions. An emulsified vegetable oil electron donor (EDS-ER) and a Dhg-containing bioaugmentation consortia (KB-1 Plus®) were added to treatment microcosms once reducing conditions were achieved.

During the initial weeks of the study and prior to bioaugmentation, TCP concentrations fluctuated, and the microcosms were spiked to match the collected field concentration. This resulted in an increased concentration of 10 µg/L, potentially representing desorption from the geologic material. Following bioaugmentation at Day 76, the treatment microcosms then indicated only a minor reduction to 9.1 µg/L, suggesting that the low initial concentration of 10 µg/L (as compared to other case studies) may not be sufficient to support growth of Dhg microbes.

The team decided to rebioaugment the treatment microcosms at a higher dose of five times the original inoculum in order to increase the microbial populations. A significant reduction in TCP was then observed at Day 147 (1.8 µg/L) and further reduction was reported at Day 181 (0.59 µg/L). A final sampling result on Day 232 indicated no change (0.59 µg/L), suggesting that no further biodegradation had occurred.

Results/Lessons Learned. Biodegradation of TCP in treatment microcosms from the maximum concentration observed to the latest reported concentration indicated nearly a 95% reduction. Most case studies to date have reported positive biodegradation of TCP using Dhg for starting concentrations of 100 µg/L or more. A significantly higher bioaugmentation dose of the amendment may be required to address lower concentrations; however, this indicates a prospect of treating more dilute plumes previously considered infeasible for in situ enhanced bioremediation.