Transition to Monitored Natural Attenuation for a CVOC Plume after 28 Years of Pump and Treat: Lessons Learned

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Background/Objectives. This presentation is a case study that highlights the transition from an active pump and treat system to monitored natural attenuation (MNA) for a chlorinated VOC (CVOC) plume at the Chem-Dyne Superfund Site in Hamilton, Ohio. A groundwater pump and treat system was installed at the site in 1987. The system, consisting of 25 extraction wells, operated from 1987 through June 2015, at which time the system was shut down as part of a pilot test to evaluate the efficacy of MNA as a final remedial action for the remaining CVOC plume. The case study includes analyses used to demonstrate that the active system could be reliably shut down and that MNA is sufficient for continued remediation of the CVOC plume.

Approach/Activities. A key metric in demonstrating natural attenuation is the observation of stable or decreasing trends in contaminant mass. However, in the case of CVOC degradation, increasing trends in breakdown compounds may be observed that oftentimes can be mis-interpreted as “degradation stall”. This phenomenon was encountered at the Chem-Dyne site, and what was initially interpreted as degradation stall by regulatory agencies was in fact shown to be minor accumulation of breakdown compounds with significant net natural biodegradation of total CVOCs.

In lieu of using well-by-well analysis, a more accurate method of assessing CVOC degradation, accumulation, or stall within a plume is using plume-based methods such as the Ricker Method®. Of particular usefulness is the calculated plume mass value in lieu of concentration values from individual monitoring wells. The plume mass for each of the individual CVOC plume constituents can be evaluated in units of moles supporting an evaluation of total CVOC degradation. Plume mass-based methods are more accurate because they allow for an analysis to be conducted within a control volume, thereby allowing for a mass balance approach.

The efficacy of MNA at the site was evaluated using the Ricker Method® for multiple CVOC “families”, including chloroethenes, chloroethanes, and chloromethanes. The case study presented here includes the analysis for individual chloroethene compounds (PCE, TCE, cis-1,2-DCE, and VC), as well as for the total chloroethene plume.

Results/Lessons Learned. Initial interpretations of pilot test data by the regulatory agencies, based on well-by-well analysis, was that “DCE stall” was occurring and that MNA would not be sufficient as a stand-alone remedy. However, by using a plume-based approach for evaluating CVOC plume stability on a molar basis, it was demonstrated that although minor accumulation of daughter compounds was observed, there was a significant decreasing trend in the total chloroethene plume mass. Moreover, plume-wide molar fractions were observed to be decreasing for parent compounds (PCE and TCE) coupled with increasing trends in plume-wide molar fractions of daughter compounds cis1,2-DCE and vinyl chloride. After several additional years of monitoring through 2021, it was determined that MNA would be selected as the final remedy for the site.

The plume-based approach also was used to calculate net attenuation rates for each CVOC compound, which was useful in predicting future behavior of the CVOC plume.