

Source Remediation of Chlorinated Ethenes Using Enhanced Reductive Dechlorination and a Change in Strategy toward Performance-Based Delivery

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Background/Objectives. Environmental investigations at a former industrial plant revealed the presence of chlorinated ethenes (tetrachloroethene and its reductive dechlorination daughter products) in groundwater at concentrations that indicate a potential vapor intrusion (VI) risk. As an interim measure, a permeable reactive barrier (PRB) was installed along the western property boundary to intercept the chlorinated volatile organic compound (CVOC) plume and accelerate off-site plume attenuation to concentrations less than regulatory standard values. Emulsified lecithin substrate (ELS), a microemulsion of food-grade carbon, was injected into 38 injection wells in 2015 and 2016 to promote enhanced reductive dechlorination (ERD) in the shallow and intermediate aquifers. The groundwater monitoring data indicated variable PRB performance due to substrate delivery inconsistency and inadequate residence time through the PRB treatment zone and partial reductive dechlorination was observed at locations upgradient of the PRB indicating natural attenuation is occurring.

Approach/Activities. Considering these groundwater monitoring results and the PRB implementation, a new strategy to better sustain reducing conditions throughout the groundwater plume was developed. This revised strategy focused on a plume-wide carbon substrate injection effort to target areas where the groundwater vinyl chloride (VC) concentrations exceed 100 micrograms per liter ($\mu\text{g/L}$) to promote the biodegradation of the chlorinated ethenes and mitigate VI risks, limit further off-site migration, and protect nearby surface water. To implement this more aggressive strategy, up to 56 new injection wells were installed in the end of 2017/early 2018 using a staged approach to promote complete reductive dechlorination throughout the entire plume rather than just at the plume boundary. The injection wells were fitted with buried conveyance piping leading to two manifolds where mobile injection systems supply the substrate. This setup allows the current property owner to concurrently convert the facility into usable commercial space without disrupting the remediation process. A comprehensive monitoring plan enables detailed data collection and evaluation to optimize the overall injection program. Finally, to incentivize the treatment process, the project was contracted with performance-based milestones over a five-year period of performance.

Results/Lessons Learned. Three years of PRB monitoring data supported the revision of the remediation strategy toward a plume-wide ERD remedy. Rather than just focusing on off-site plume migration, the revised remedy is targeting accelerated attenuation of the entire plume to both protect human health and the environment and facilitate property redevelopment. Further, work under the performance-based contract has been effectively implemented to expedite treatment while incentivizing delivery to reduce costs and ultimately save the client money. The presentation will include the baseline data that supported the basis for the strategy change, a review of the revised remedy implementation, a discussion of the performance-based approach and progress to date, and update on the property redevelopment.