Enhanced Anaerobic Biodegradation of Trichloroethene and Hexahydro-1,3,5-trinitro-1,3,5-triazine in a Commingled Source Area Using Permeable Reactive Barriers and Groundwater Recirculation

Shawn Eichelberger, P.G. (seichelberger@hgl.com) (HydroGeoLogic, Inc., Lakewood, CO)
Cindy Crane, Ph.D. (crane@hgl.com) (HydroGeoLogic, Inc., Fremont, NH)

Background/Objectives. Corrective action (CA) for groundwater is being conducted at Solid Waste Management Unit (SWMU) I15 located at Hawthorne Army Depot (HWAD), Hawthorne, Nevada. The objective of this project is to enhance the anaerobic biodegradation of trichloroethene (TCE) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in groundwater within a comingled source area (approximately 2.6 acres in size) by installing transects of injection wells and extraction wells across the source area and distributing two electron donors. Each injection well transect was used to deliver substrate and establish permeable reactive barriers (PRBs), while each row of extraction wells was used to enhance substrate distribution between the PRBs using groundwater recirculation. The impacted aquifer at SWMU I15 is unconfined and encountered from 125 to 150 feet below ground surface. The saturated matrix is heterogeneous and comprised of alternating sequences of fine grained (silts and clays) and coarse grained (fine to coarse sands) deposits.

Approach/Activities. Approximately one year following completion of a successful five-month pilot study, the full-scale remedy was implemented and consisted of installing four PRBs (injection well transects) across the source area and four extraction well transects between the PRBs to enhance substrate distribution. An injection and extraction system (i.e. recirculation system) was constructed and operated to distribute two substrates across the source area. Potassium lactate (Newman Zone QR™) was used to rapidly establish anaerobic conditions, while an emulsified soybean oil (Newman Zone® 190-6730) was used to establish the PRBs. During injection activities at each PRB, groundwater was simultaneously extracted, treated through a granular carbon unit and amended with substrate before re-injection. Once the substrates were distributed, the recirculation system was turned off to allow the microbial communities to metabolize the substrate and degrade the contaminants. A quarterly performance monitoring program, which consists of sampling six wells within the source area, was initiated following full-scale implementation to assess the remedy's effectiveness.

Results/Lessons Learned. Reducing conditions were observed across the majority of the source area within one month following full-scale implementation, the native microbial community was successfully stimulated, and both TCE and RDX daughter products have been consistently observed during performance monitoring. The most recent performance monitoring results (April 2017) indicate that TCE concentrations have been reduced between 95.3% to 99.3% and RDX concentrations have been reduced between 70.0% to 99.9% in four of the six performance monitoring wells. At the remaining two wells, treatment was initiated following full-scale implementation and the October 2016 injection/extraction event, however the substrates have been depleted. As a result, these portions of the source area were targeted during the July 2017 injection/extraction event.