Destruction of a Source Area through Establishment of Biobarriers and Optimized Delivery of Emulsified Vegetable Oil

Michael D. Colvin, CPG (mdcolvin@ftch.com), Michael S. Apgar (msapgar@ftch.com), and Peter A. Lepczyk, CPG (palepczyk@ftch.com) (FTCH, Grand Rapids, MI, USA)
Ken Chiang (kchiang@sspa.com) (S.S. Papadopulos & Associates, San Francisco USA)

Background/Objectives. Pump-and-treat groundwater remediation was conducted at the Former Teledyne Semiconductor/Spectra-Physics Superfund Site in Mountain View, California, for nearly 30 years to capture and control a chlorinated volatile organic compound (CVOC) groundwater plume. In 2005, a limited 3-year pilot test was completed to evaluate enhanced reductive dechlorination (ERD) as an alternate treatment technology within the source area. The results of the pilot test indicated ERD was effective and a work plan was prepared to implement a full-scale treatability study. The objectives of the study were to (1) destroy sufficient CVOC mass in the source area to where monitored natural attenuation (MNA) could be used for the offsite plume area, and (2) provide a basis to change the site remedy from pump-and-treat to combined ERD/MNA.

Approach/Activities. The original biobarrier design consisted of six rows of injection wells oriented perpendicular to groundwater flow. The row spacing (60 feet) was based on the groundwater flow velocity and a target travel time of 100 days between rows. Permanent injection well clusters were installed to allow treatment of three specific stratigraphic zones between 20 and 72 feet below ground surface. The injection well rows were located in a parking area; 24 additional injection wells were installed inside the building where a row configuration was not possible. Delivery of emulsified vegetable oil (EVO) and other amendments was done through establishment of simultaneous injection/extraction loops between well pairs; i.e., while groundwater was pumped from one well, EVO was added to the groundwater, mixed, and injected into the adjacent well(s). Injection of EVO typically lasted 2 to 4 hours followed by 24 hours of continued recirculation of groundwater. After this period, the injection/extraction pattern was reversed, and the process repeated. This delivery is considered a best practice for distributing the carbon substrate between the wells and constructing biobarriers.

Results/Lessons Learned. (1) Detailed characterization of the soil column at each cluster provided valuable information on the thickness of injectable strata and caused a 30% reduction to the original design dose of EVO. (2) The site had not been adequately characterized. Collection of a baseline/pre-injection round of groundwater samples, combined with collection of high-density photoionization readings from the soil during well drilling, identified a second, substantive source area that had gone undetected through previous investigations. (3) Installation of permanent injection wells and recirculation of groundwater optimized the distribution of the EVO within the target zones. Marked reductions in CVOCs were rapidly recorded throughout the source area, which destroyed over 90% of the CVOC mass through two injections. (4) Permanent injection wells provided a means to repeat the baseline sampling event 2 years after full-scale implementation to identify areas requiring additional carbon substrate to sustain robust ERD conditions. (5) The in-place well infrastructure made subsequent injections easier and less intrusive to site occupants. (6) Bio-fouling and degradation of well hydraulics was encountered during the second injection event, but these problems were not widespread. (7) In May 2018, the USEPA issued a fact sheet for public comment to change the site remedy. The agency indicated the preferred alternative is Source Area ERD and MNA with Vapor Mitigation Controls. The pump-and-treat system has been decommissioned.