

REMEDIATION OF TWO LARGE, DILUTE PLUMES USING MULTIPLE CAT 100 PERMEABLE REACTIVE BARRIERS

ABSTRACT

A series of CAT 100 permeable reactive barriers (PRBs) were used to successfully reduce chlorinated solvent mass in two separate plumes - Plume 1 originating from a former plating operation, and Plume 2 from a former firing range. Due to drinking water clean-up criteria, an acidic aquifer, highly permeable soils, and a short remediation timeframe, RPI's CAT 100 product was implemented to bisect the plumes in multiple stages and rapidly reduce plume-wide contaminant concentrations. CAT 100 utilizes an innovative combination of sorption and abiotic/biotic dechlorination treatment mechanisms. RPI Group installers ISOTEC and AST teamed-up on the design and installation.

CHALLENGES & OBJECTIVES

- The project objective was to reduce parent and daughter compounds to meet federal MCLs.
- Plume 1 originated at the solvent handling area of a plating operation and covered approximately 3.5 acres of the property. Plume 2 was associated with the firing range area and spanned approximately 0.7 acres of the range area. While the site is currently vacant, some areas are used for agricultural purposes.
- PCE and TCE concentrations ranged between 2 and 190 ug/L throughout the plumes and included daughter products in some wells, e.g. cis-1,2-dichloroethene (max of 479 ug/l) and vinyl chloride (max of 527 ug/l).
- The acidic aquifer (pH 4 to 5) pilot testing concluded pH buffering was going to be challenging.
- To achieve radial mixing of the CAT 100 slurry within the sandy formation at 2 ft vertical intervals, 60 gal of slurry was injected at 60 gpm through six 5/32-inch ports creating exit velocities of approximately 10,000 feet per min.
- The large injection volume per vertical interval required the preparation of up to 4,500 gal of CAT 100 slurry per day. To achieve this production schedule, a separate mixing trailer was used to prepare slurry batches that were then transferred to the injection trailer for installation.

APPROACH

- Multiple PRBs, each consisting of three rows of injection points spaced 10 ft apart, were chosen for treatment of the plumes. Plume 1 utilized five (5) PRBs and Plume 2 employed three (3) PRBs.
- PRBs were oriented perpendicular to groundwater flow direction and spaced such that groundwater would flow through at least one PRB, and in many cases two PRBs, within a 2-year period.
- CAT 100 was the reactant installed at each PRB location. CAT 100 utilizes an innovative combination of sorption and abiotic/biotic dechlorination treatment mechanisms. Add hyperlink to RPI site
- A total of 31,527 lbs of CAT 100 was used to construct the five PRBs (590 linear feet total) in Plume 1, with final construction depths varying by PRB (14 to 50 ft bgs).
- A total of 3,618 lbs of CAT 100 was constructed in three PRBs (160 linear feet total) in Plume 2, with final construction depths of 18 to 26 ft bgs.

PROJECT SNAPSHOT

Lithology: Highly permeable, poorly sorted fine to coarse sands with little gravel, silt, and clay. At the former firing range area (Plume 2) there is a clay layer at 25 feet below ground surface (ft bgs).

Primary Contaminants: Tetrachloroethene (PCE), Trichloroethylene (TCE), and daughter products

Implementation Method: Direct Push Technology and high energy slurry injections

Injection Unit: Two variable speed positive displacement pumps operating in parallel controlled with variable frequency drives, which can deliver slurries at flow rates ranging from 2 to 70 gallons per minute (gpm) at a maximum pressure of 1,200 pounds per square inch (psi). Slurry batches are prepared in a 400 gallon (gal) tank and continuously mixed throughout injections.

Injection of CAT 100 – Nov. and Dec. 2017

Monitoring period – 2.75 years (to date)

RESULTS

- Reductions in PCE and TCE were immediately realized within weeks of injection, along with degradation markers (e.g. ethene).
- Within 6 months post-injection, PCE and TCE concentrations were reduced over an order of magnitude from baseline concentrations.
- 2.5 years after injection, 15 of 16 wells were below federal MCLs for PCE, TCE, and daughter products.