Project Summary

CAT 100 AND BOS 100® ADDRESS DNAPL SOURCE AREA AND REDUCE MASS FLUX VIA PERMEABLE REACTIVE BARRIER

CHALLENGES & OBJECTIVES

The subject site is a manufacturing facility established in 1912 with historic industry that included steel stamping, forming, machining, parts cleaning, and degreasing, heat treating, electroplating (brass, copper, nickel, and chromium), painting, and assembly. These activities created multiple source areas. Soil and groundwater sampling results indicated a potential for offsite migration of groundwater with concentrations of chlorinated volatile organic compounds (CVOCs) that could pose a risk to indoor air (vapor intrusion). In addition, multiple lines of evidence supported the presence of dense non-aqueous phase liquid (DNAPL) in at least two source area locations. Shallow soil was a heterogeneous mix of silt and sand and the depth to groundwater ranged from 5 to 8 ft below grade, with the impacted zone extended to 30 ft below grade.

Project objectives included two stages: Stage 1 was the implementation of an interim remedial measure (IRM) to reduce the total mass of DNAPL level CVOCs in the saturated soil and groundwater around multiple former degreasers; Stage 2 was the installation of a downgradient permeable reactive barrier (PRB) to reduce offsite CVOC mass flux.

APPROACH

A previous remedial effort using enhanced reductive dechlorination (ERD) was implemented across a plume downgradient from one of the former degreasers and at the property boundary in 2012. Although tetrachloroethylene (PCE) and trichloroethylene (TCE) reductions were achieved, concentrations of daughter products (cis-1,2-dichloroethylene (DCE) and vinyl chloride (VC)) stalled and remained persistent. In the source areas, groundwater concentrations over 100 mg/L TCE and/or PCE existed in the saturated zones, with visible DNAPL present in the Remedial Design Characterization soil samples. In 2016, CAT 100 was implemented as an IRM to reduce the offsite migration of CVOC mass. Finally, a PRB was implemented along the site boundary using BOS 100 (activated carbon impregnated with metallic iron). The β-elimination reaction produces a small percentage of daughter products and limits the potential for offsite vapor intrusion. All reagent injections were performed using direct push technology (DPT).

CAT 100 is a proprietary technology that consists of activated carbon impregnated with metallic iron (BOS 100), to which a complex carbohydrate, yeast, a facultative microbial consortium that degrades chlorinated solvents, and a second microbial consortium that breaks down the polymeric carbohydrate to monomeric fragments are combined. This synergistic combination has been shown to generate significantly less daughter products and to concomitantly degrade parent and daughter products completely to ethylene in an expedited timeframe compared to conventional ERD approaches. The persistence of CAT 100 also exceeds that of conventional ERD applications because the ERD technology is combined with the activated carbon component.

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RESULTS

Performance monitoring data demonstrated that no CVOCs were present above residential vapor intrusion standards in the perimeter and off-property wells post-injection. Within the source areas, CVOCs have been reduced by 90 to 100%, with the only exception being VC in one well, which is still elevated but is trending downward. Increased ethylene and dissolved chloride concentrations support lines of evidence for complete dechlorination of the CVOCs. In addition, the client performed microbial diagnostics regularly throughout the monitoring period. The resulting data indicates that elevated bacterial counts (e.g., Dehalococcoides) and functional genes (e.g., VC reductase) are present and have sustained optimal levels since the original injection in 2016. The site is currently in long term monitoring.

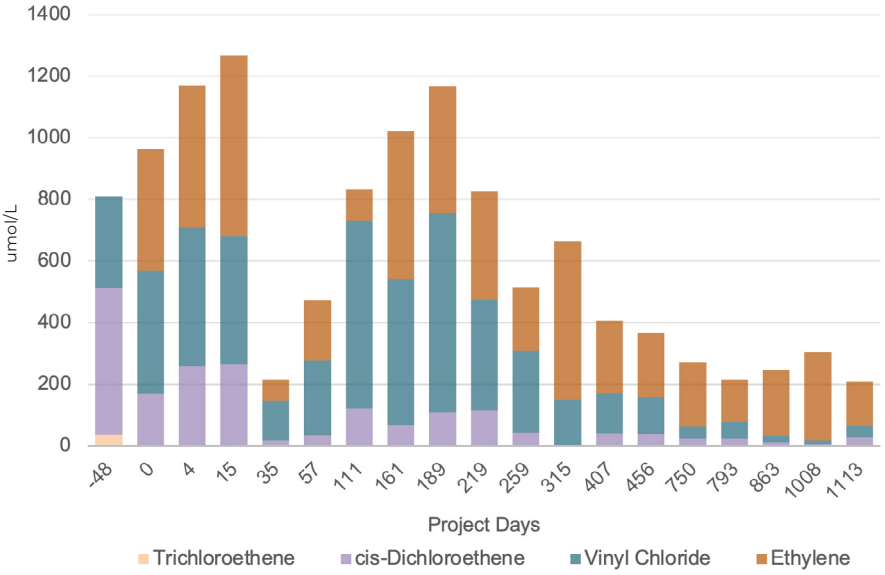

Figure 1.
Groundwater Data from CAT 100 Source Area Injection

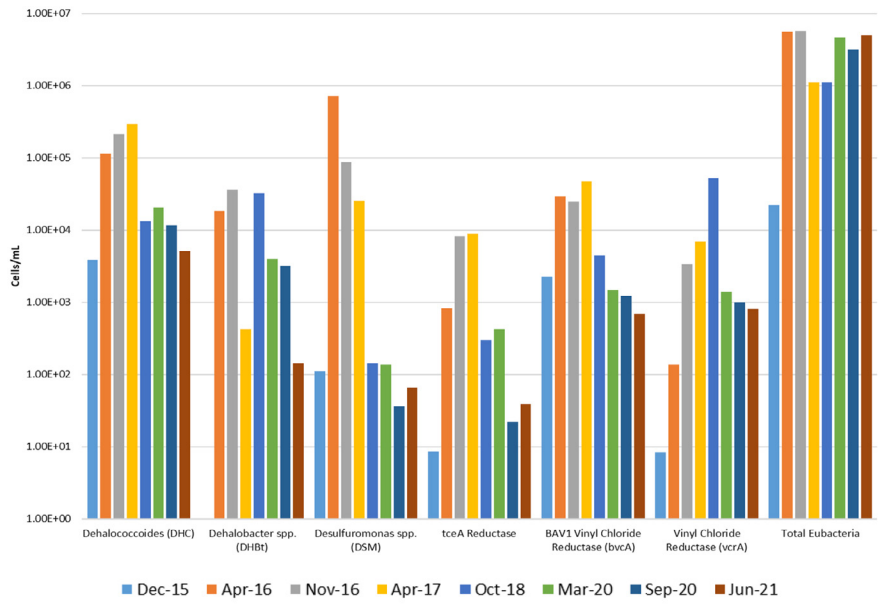

Figure 2.
Microbiological Data from CAT 100 Source Area Injection