Biological and Geochemical Groundwater Treatment Using Recirculation for Distribution to Prevent Excavation

Robert E. Mayer, Jr. (robert.mayer@aptim.com) (APTIM, Knoxville, Tennessee, USA)
Chris Johnson (APTIM, Irvine, California, USA)
James Perkins (APTIM, Concord, California, USA)

Background/Objectives. At the former Naval Air Station Moffett Field California Traffic Island Area past dry-cleaning operations and the discharging of chemicals into a compromised sanitary sewer line led to elevated levels of tetrachloroethene (PCE) in the subsurface. Groundwater investigations at this site have determined that DNAPL levels of chlorinated ethenes may be present on the south side of the Traffic Circle, and in 2020 PCE was detected at 140,000 µg/L. Previous treatability studies evaluated the effectiveness of anaerobic and abiotic technologies to reduce contamination. In 2015 a combined biotic and abiotic approach using a solid phase iron was implemented. Reductions in chlorinated ethenes were observed where amendments were in place. However, during the implementation, high pressure injections were conducted in which surfacing and distribution issues were observed. Also, the tight spacing required for this type of injection was difficult in areas where multiple utilities were present. To reduce the contaminant levels in the groundwater at the Traffic Island Area excavations of the vadose zone and soils in the shallow groundwater have been considered. However, due to the challenges created by utilities, depth of impact, concentrations of COC present, and the need to limit the impact to traffic, a recirculation application of enhanced anaerobic bioremediation / in situ chemical reduction using dissolved ferrous iron as the source removal action was conducted in lieu of shallow soil excavation.

Approach/Activities. The groundwater treatment included the injection of EAB and ISCR amendments into the Upper (0-40 ft) and Lower A-Aquifers (40-70 ft). To distribute the amendments across the treatment area and to decrease the time required to pull through the site, groundwater was recirculated to depress the water table on the downgradient side and increase (mounding) groundwater on the upgradient side. The injection consisted of emulsified vegetable oil, a bioaugmentation culture, and dissolved iron in the form of ferrous sulfate hepta-hydrate. The injection and recirculation activities were conducted in two phases from late January to early April 2021. The first phase included the wells farther from the extraction wells, including the temporary DPT points, to distribute the amendments across the site and recirculate approximately 88,774 gallons. During the second phase of the injection, wells closest to the extraction wells and not used during the first phase, were injected into and the amendments were distributed by pulling the groundwater to the extraction wells and included approximately 43,692 gallons.

Results/Lessons Learned. Decreases in COCs were observed in most wells within the treatment zone which provides evidence that the amendments were distributed. In the Upper-A Aquifer a reduction in TCE was observed with a corresponding increase in cis-1,2-DCE from 4,900 to 1,200,000 µg/L, VC from 650 to 4,300 µg/L and in ethene from 200 to 410 µg/L, indicating that reductive dechlorination is occurring. Also, the bioaugmentation culture was co-injected and DHC levels have increased at the same well from 1.2 cells per milliliter to 3.86E+05 cells per milliliter. In the area if the highest concentrations in the Lower-A Aquifer cis-1,2-DCE levels have decreased from 190,000 µg/L to 9,600 µg/L and VC decreased from 460,000 µg/L to 6,700 µg/L between October 2020 and July 2021, indicating abiotic processes are reducing concentrations. The first post-injection data suggest that both abiotic and biological degradation

is occurring. Upcoming post-injection sampling data will be presented to determine the continued effectiveness of the groundwater treatment.