Injection of pH-Adjusted Calcium Polysulfide to Treat Groundwater Plume Commingled with Cr(VI) and TCE

Jim Leu (Jim.Leu@parsons.com) (Parsons Corporation, Walnut Creek, CA)
Mehdi Bettahar, Jim Goepel, and Shala Craig (Parsons Corporation, Pasadena, CA)
Tedd Yargeau (Department of Toxic Substances Control, Chatsworth, CA)

Background/Objective: The site is impacted with Cr(VI) concentrations up to 250 mg/L and TCE concentrations up to 1,000 µg/L in groundwater. Since high Cr(VI) impedes the biodegradation of TCE, the proposed remedy includes using calcium polysulfide (CPS) to reduce Cr(VI) concentration to levels below 5 mg/L in the area comingled with TCE then use enhanced anaerobic bioaugmentation (EAB) to effectively treat the entire TCE plume. Stoichiometrically, high Cr(VI) concentration requires high concentrations of CPS. Previous experience with injecting high concentration CPS created precipitation issues resulting in difficulties in operating injection equipment, clogging of injection well screen, difficulties in injecting the solution, decreased aquifer permeability, and substantial decrease of radius of influence (ROI). To prevent calcium precipitation, a CPS solution needs to have a pH higher than 10.9. Since CPS concentrations will drop in the saturated zone after the injection, this study investigated an innovative approach involving a high-pH CPS injectant solution aimed at preventing precipitation issues and used to treat Cr(VI) in the commingled plume for the subsequent EAB application.

Approach/Activities: A bench test was conducted to observe the behavior of a high pH, lower concentration (below 10%) CPS solution. Two 5% CPS solutions were diluted from a 29% CPS solution using water with and without pH adjustment. Precipitation was observed for the solution without pH adjustment, but not for the solution adjusted at pH of approximately 11.5. To stabilize the high pH of the 5% CPS solution in the subsurface, the new pH-adjusted CPS solution was buffered with a 10% sodium carbonate solution before the injection. Three injection wells were installed at select locations, determined based on GW level contour and Cr(VI) contour to maximize Cr(VI) removal. Each injection well depth is 175 ft with screen interval from 155 to 175 ft bgs. During the injection, precipitation was not observed on above-ground equipment and no back pressure was observed from each injection well indicating no significant precipitation. A total of approximately 78,000 gallons of pH-adjusted 5% CPS solution was successfully injected within a week resulting in a 25 ft ROI of each injection well.

Results/Lessons Learned: After the CPS injection, most Cr(VI) concentrations within the ROI were non-detected (ND) or below 1 mg/L. The Cr(VI) concentration rebound was not observed 1.5 months after the CPS injection. In addition, TCE concentrations in some monitoring wells within the ROI decreased to ND. Most elevated pH during the injection had reverted to neutral range within about a week. In addition, DO was less than 1 mg/l and ORP was negative indicating geochemical conditions were rendered favorable for EAB application. The subsequent EAB for treatment of TCE was able to start two months after the CPS injection. Buffered and pH-adjusted CPS solution prevent precipitation of calcium and leads to improved in-situ delivery of CPS, increased Cr(VI) removal, and attenuation time of impacted geochemical conditions. Further updated monitoring results and lessons learned will be shared in the presentation.