Bioremediation of Chromium-Contaminated Groundwater in Complex and Large Plumes

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Background/Objectives. The site is located in Ector County, Texas, just outside the city limits of Odessa. The Superfund site consists of three abandoned metal plating facilities located within one mile of each other. Previous electroplating activities at these facilities released chromium (Cr) to the groundwater and resulted in three separate large groundwater plumes. The Cr plumes cover an area of approximately 47 acres in the Trinity Aquifer, which is the sole-source drinking water supply for many area residents with private water wells. The groundwater remedy at the site consists of more than 100 extraction and injection wells, an infiltration gallery, two groundwater collection facilities, and one central treatment system. Currently, a weak base anion resin is used to reduce hexavalent Cr to trivalent Cr in the ion exchange system. The pump-and-treat system has been upgraded over the years to improve plume capture and treatment effectiveness, which had been a challenge due to the size of the plumes and private wells that have been pulling plumes away from extraction wells, therefore reducing the system capture zones. Additional remedial alternatives were evaluated, and a groundwater model was used to evaluate plume capture and determine a long-term remedial strategy to manage and prevent plume migration. In situ bioremediation (ISB) was incorporated into the remedial strategy to treat the source areas while the pump-and-treat system captures and controls the plumes.

Approach/Activities. An ISB pilot study was conducted from 2010 to 2014 to test several different amendments. Based on the results, Terra Systems SRS-M10®, which is an emulsified vegetable oil (EVO), was selected for full-scale implementation. In 2020, 92 new injection wells were installed in rows perpendicular to the groundwater flow direction in the source areas. In September 2020, SRS-M10® solution was injected followed by sodium bicarbonate and chase water. Injection depths ranged from 70 feet below ground surface (ft bgs) to 125 ft bgs with flow rates from 3 gallon per minute (gpm) to 15 gpm depending on location and formation. Difficulties were encountered during the injection at one of the facilities because of the tight formation different from the other two plume areas. Overall, approximately 170,000 gallons of SRS-M10® solution and 104,000 gallons of sodium bicarbonate solution were injected.

Results/Lessons Learned. Groundwater samples were collected prior to and two and four months after the injection. Cr concentration (Conc.) decreased up to approximately 99% in two facilities, while it had little change in the other facility. In the two facilities, significant Cr reduction was observed with increase in total organic carbon, iron, and manganese Conc. and decrease in nitrate, which indicated anaerobic microbial activities that may be stimulated by the EVO injected. Hydrogeological conditions and Cr Conc. played significant roles in ISB performance. High Cr. Conc. may limit microbial activities, resulting in low Cr reduction. Additionally, tight subsurface formation with small porous space and low injection capacity resulted in challenges to delivery of the designed amount of EVO, causing lower Cr reduction than expected in one of the facilities. This presentation will provide a discussion of future activities to optimize the remedy.