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Injection of Emulsified Vegetable Oil for Full-Scale In Situ Treatment of Hexavalent Chromium: Two Years Later

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Background/Objectives. Plating operations at a former manufacturing facility in California resulted in soil and groundwater contaminated with hexavalent chromium. The manufacturing facility was demolished, contaminated soil was excavated, and the site was redeveloped for commercial use. Groundwater at the site is contaminated with hexavalent chromium with concentrations as high as 1,800 micrograms per liter (µg/L) within the past year. The site geology primarily consists of sand with large cobbles; however, a fault exists near the downgradient portion of the site resulting in a 10 foot decrease in groundwater surface elevation and approximately 90 degree change in groundwater flow direction on the downgradient side of the fault. The current State of California drinking water maximum contaminant level (MCL) for hexavalent chromium is 10 µg/L, which is the cleanup goal for the site. Remedial action objectives for the site include reducing hexavalent chromium concentrations in groundwater, limiting off-site migration, and prohibiting the use of site groundwater.

Approach/Activities. A bench test was performed to evaluate the treatment efficiency of different dosages of emulsified vegetable oil (EVO) and ferrous sulfate plus sodium dithionate. Based on the bench test results, the low dosage EVO solution (1 percent by volume) showed the most effective treatment while limiting secondary water quality impacts. A pilot test was then performed in the field and involved injection of low dosage EVO solution (0.5 to 1 percent by volume) into three injection wells followed by 6 months of performance monitoring. Based on post-injection hexavalent chromium concentrations, EVO was effective in creating reducing conditions and facilitating reduction of hexavalent chromium. A data gap investigation was performed in September 2014, to optimize the full-scale design. The full scale design, implemented in 2015, included injection of EVO in the hexavalent chromium source area, and installation of a permeable reactive barrier near the site boundary to limit off-site migration of hexavalent chromium.

Results/Lessons Learned. Performance monitoring results from the pilot study indicated:

- EVO solution was successfully injected into three wells at flow rates averaging 10 gallons per minute.
- Based on post-injection hexavalent chromium concentrations, EVO was effective in creating reducing conditions and facilitating reduction of hexavalent chromium;
- The estimated radius of influence based on these injections was approximately 20 to 25 feet; and
- EVO injection did not negatively impact downgradient water quality.

Pilot study results were incorporated into the full-scale design for hexavalent chromium. Initial post-injection results in the downgradient barrier show a decrease to below the MCL in all five injection wells and the well located approximately 30 feet downgradient of the barrier. The source area injection was performed in late August 2015. Up to 24 months of post-injection data from the downgradient barrier and 20 months of post-injection data from the source area will be available at the time of the conference. An additional injection at the downgradient area may also be performed.