Performance, Cost, and Emissions Optimization Using Solar-Powered ISB System

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Background/Objectives. A plume of chlorinated solvents is present in groundwater beneath a former industrial facility located in a remote area with no access to on-site water or electricity. A solar-powered groundwater extraction system (GWES) had operated at the site since 2010 to mitigate groundwater impacts. Extracted groundwater was transported 10 miles to the local water treatment plant; at least four 5,000-gallon tankers per day while operating. Aerobic in situ bioremediation and in situ chemical oxidation injection events were also performed to enhance remedial efforts. The primary goal of remediation is to maintain concentrations below maximum contaminant levels (MCLs) at the downgradient property line. In late 2015, Trihydro was retained by the project owner to evaluate current conditions and potential modifications to the remediation strategy. This review documented that: 1) natural attenuation processes are robust at the site; and 2) chlorinated solvent attenuation rates in the source area could be enhanced by retrofitting the existing solar-powered GWES to perform as an anaerobic in situ bioremediation (ISB) injection system. This presentation will detail how existing infrastructure was used to work with and enhance naturally-occurring processes to optimize treatment effectiveness and reduce costs.

Approach/Activities. The first step in the optimization process was a detailed evaluation of current conditions, including fate and transport, attenuation rates, geochemistry, and the performance results attained by previously-implemented remediation technologies. This evaluation determined that anaerobic reductive dechlorination processes were already robust, and that these processes could be further enhanced by ISB as evidenced by the results of a 2008 ISB pilot test. Both of these considerations suggested that ISB would be an effective remediation technology.

Once ISB was selected for source zone treatment, the next phase of work focused on development of an effective yet efficient delivery process. Because the project owner had already invested in extraction wells and solar-powered pumping equipment, this equipment was leveraged for ISB. Injection wells were installed at a wide spacing based on delivery of a relatively large volume of fluids allowed by continuous operation and also movement of ISB amendment with natural groundwater flow.

Results/Lessons Learned. The solar powered ISB system was installed in late summer 2016, with construction consisting of injection well installation and retrofitting of solar pumping infrastructure and piping. The system was configured to inject into eight wells simultaneously. Emulsified vegetable oil (EVO) bioamendment was metered into the makeup water with a proportional mixer. Though makeup water extraction rates were only up to 5 gpm and averaged 3 gpm, approximately 360,000 gallons of mixed EVO was delivered during the course of the injection event.

This project has been successful in several respects. Concentrations of target compounds in groundwater have been reduced by up to 90% beyond the GWES endpoint during the initial operations phase. Additional concentration reductions are expected as ISB treatment continues. The costs associated with construction and operation of the solar-powered ISB system were lower than the GWES in 2016, and during 2017, costs were reduced by more than half. Use of ISB has eliminated 7,500 miles of truck traffic and 4M gallon load to local wastewater treatment works associated with GWES operations.