

A Comparative Analysis at Low and High pH Activation of Sodium Persulfate in a Fractured Carbonate Aquifer

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Background/Objectives. In situ chemical oxidation (ISCO), the selected remedy, was implemented in overburden and fractured rock with the goal of reducing tetrachloroethene (PCE) groundwater concentrations to 50 ppb or lower at the Crown Cleaners Superfund Site (Site) in Watertown, New York. PCE concentrations in the source area were as high as 40 ppm. Most of the PCE resides in shallow rock and has not significantly migrated. Impacted bedrock is described as interbedded limestone, dolomitic limestone, and dolomitic sandstone to a depth of approximately 140 feet below ground surface (bgs). Four feet of overburden overlays the rock.

EPA selected alkaline activated persulfate (AAP) as the preferred approach to address the contaminated zone. Two rounds of injections were completed between 2016 and 2017, where sodium persulfate (SP) was injected under a lower pH activation and higher pressures in the first event while a combined approach of AAP and Modified Fenton's Reagent (MFR) was completed under higher pH and lower pressure injections; both events were followed with a 6-month monitoring program. MFR was primary utilized for overburden soils and SP for the fractured rock.

Approach/Activities. In 2016, EPA installed via (4) air rotary rigs within 15 days: (43) shallow, (19) nested intermediate and deep, and (4) shallow and intermediate injection wells (IWs). Direct push technology was used to inject AAP and MFR into the overburden. The data collected included CVOCs/persulfate concentrations and other geochemical parameters. AAP forms oxidative radical species, reductants, and nucleophiles. This multi-radical attack allows the treatment of chlorinated ethenes and a variety of hydrocarbons. Practitioners have attempted bench studies for treatment of chlorinated ethenes at lower pH ranges which pose a variety of challenges. There appears to be two schools of thought as to the most efficient pH to activate SP. This presentation will focus on a comparative data analysis of two SP injections under two distinct targeted pH(s) and injection techniques.

Results/Lessons Learned. The presentation will review the data sets and compare the two injection techniques, PCE destruction efficiency and reagent delivery and activation methodologies. Specific lessons learned from both operations include:

- Base buffering capacity (BBC) and standardized protocols for treatability studies
- Optimal pumping rates to avoid refusal or daylighting
- Optimal pH for activation and oxidation of PCE
- Advantages of low pressure or gravity feeding vs. high pressure injections
- Challenges of injecting in fractured rock
- Potential mobilization of contaminants via injections in fractures without adequate activation of SP.