

Design and Implementation of Full-Scale ISCO of PCE in Soil and Groundwater Using Surfactant-Facilitated Sodium Permanganate at an Urban Location



Karnam Ramanand, PhD (Cherry Hill, NJ) Donald W. Podsen, LSP, PG, CGWP (Andover, MA) Elizabeth W. Wilson (Andover, MA) Marek Ostrowski, PE (Upper Saddle River, NJ) Kevin D. Dyson, PE (Radnor, PA)



Mike Temple (Lawrenceville, NJ)

Acknowledgments: Chuck Myette Carla Oliveira Radhika Patel Sean Wren



Overview

Brown AND Caldwell

- Site background
 - Urban setting
 - PCE impacts
- Pre-Design Investigation
 - Clean water gravity injection test
 - Native oxidant demand
 - Treatability study
- Full-Scale
 - Design
 - Implementation
 - Results
- Summary







Brown AND Caldwell

Site Background: Site and the Surrounding Urban Setting



Brown AND Caldwell Site Background: Historic Soil PCE Contour Map Soil (mg/kg) (DTW 9-11 ft)



Limited unsaturated areas at the northwest and southwest parking lots were also impacted

Site Background: Groundwater Quality (2011)



Brown AND Caldwell Surfactant-Facilitated ISCO

- Up to three injection events are designed to meet cleanup goals.
- This presentation describes first round of injections.

Proposed unsaturated and saturated areas for surfactant and ISCO treatment



ISCO – Oxidant Selection



Brown AND Caldwell

> Is permanganate the right oxidant for our site?

Seríously...

- Proven to degrade PCE
- Longer persistence
- No activator needed
- Serves as a tracer
- No toxic by-products
- Not an vapor intrusion concern (non-exothermic)

Based on your description of the site, yes.

amazon

Brown AND Caldwell

Pre-Design Investigation

- Clean water injection test: Up to 3 gpm/well can be injected.
- PNOD: 1.7 g/kg for the saturated soil and 32 g/kg for the unsaturated soil.
- Treatability study: Test the ability of the surfactant to desorb PCE from the soil.
 - Calfax
 - SDS



Brown AND Full-Scale Design – Oxidant Injection Challenges

Urban setting and the challenges to inject the oxidant safely:

- Densely populated urban community
- Oxidant surfacing concerns
- Active businesses with no interruption
- Buildings/liquor store with basement
- Vapor intrusion concerns
- Complaints from public







Brown AND Caldwell Full-Scale – Marking the Injection Points



Brown AND Full-Scale: Tanks with the oxidant or oxidant + surfactant



Brown AND Caldwell Field Implementation – Geoprobe Injections



Brown AND Caldwell Permanganate and Surfactant Injections

- Injections at the unsaturated soil
- Injections at the saturated soil and groundwater
- 4,462 gallons of 40% NaMnO₄ (= 38,600 gallons of 5 to 20%)
- 220 gallons of 35% surfactant (= 990 gallons of 8.75%)



Brown AND Caldwell Pre- and Post-Injection Groundwater Sampling Activities

- VOCs Sampling:
 - Baseline April 2017 (18 monitoring wells)
 - 7 months after injection January 2018 (18 monitoring wells)
 - 10 months after injection April 2018 (10 monitoring wells)
 - Monitoring in two key wells one month (July 2017) and two months (August 2017) after injections
- Color Monitoring:
 - Averaged once in 2 months
- Process Monitoring During the Injections



PCE Conc. (μ g/L) in the Monitoring Wells Before and After the Oxidant Injections



Brown AND Caldwell PC

PCE Concentrations Before and 7 Months After Oxidant Injections



Brown AND Caldwell

Site Background: Groundwater Quality (2011)



Brown AND Caldwell Summary

- Successfully injected through 108 injection points.
 - 38,600 gallons of 5 to 20% NaMnO₄ (17 totes of 40% strength)
 - 990 gallons of 8.75% surfactant (four 55-gallon drums)
- Site-wide average PCE concentration decreased by >90%.
 - Concentration reduction was observed in 17 of the 18 wells
 - Concentration was <50 µg/L (standard) in 14 of 18 wells
 - Most impacted well revealed concentration reduction from 27,000 µg/L to <20 µg/L in 7 months
- Precautions were taken to deliver the oxidant safely in an urban setting.
 - No surfacing / no public complaints / no business interruptions
 - No vapor intrusion issues based on air monitoring during and postinjections

Brown AND Caldwell





Karnam Ramanand, PhD | Supervising Scientist | <u>kramanand@brwncald.com</u> | 732-581-1116

Engineers | Scientists | Consultants | Constructors 100% Environmental | Employee Owned | <u>BrownandCaldwell.com</u>

MnO4 Concentrations Before and 7 Months After Injections

