

## **Abiotic and Biotic Treatment underneath an Active Shopping Center**

**Stewart Abrams** (sabrams@langan.com), Lingke Zeng (lzeng@langan.com), and Matthew Wenrick (Langan, Lawrenceville, NJ)  
Ken Tyson (Langan, Parsippany, NJ)

**Background/Objectives.** Permanganate injection via hydraulic fracturing was conducted at a strip mall in northern New Jersey. This previous injection did not reduce the chlorinated volatile compounds (CVOCs) concentration but posed inherent challenges for a supplemental remediation. The permanganate injection converted TCE to cis-1,2-DCE and VC, but the total molar concentration of CVOCs increased. The injection formed preferential pathways for the shallower-impacted interval while the majority mass is situated in the deeper-impacted interval with low permeability. Permanganate formed manganese dioxide, which can inhibit the biodegradation of cis-1,2-DCE. The supplemental remediation will deliver emulsified zero-valent iron (EZVI) into the subsurface to remediate the CVOCs impact underneath the shopping center. The EZVI injection is designed to overcome the aforementioned challenges.

**Approach/Activities.** EZVI along with bioaugmentation culture will be delivered via pneumatic fracturing directly within the building footprint.

- EZVI enhances biotic and abiotic pathways synergically to allow complete degradations of daughter products.
- ZVI is expected to overcome the interference from manganese dioxide.
- The pneumatic fracturing can distribute the substrate mixture in the heterogeneous subsurface. To ensure the building integrity during the injection, a structural evaluation was conducted to provide guidance to protect the building.
- EZVI approach will also generate less desirable by-products, including methane.

The injection is expected to start at the end of September 2018 and two quarterly performance events will be completed before April 2019.

**Results/Lessons Learned.** The previous remediation did not apply sufficient oxidant and did not target the whole contaminant vertical impact. Thus, the supplemental injection will need to avoid the previous mistakes. The upcoming EZVI remediation will provide more insights for:

- The effectiveness of EZVI following oxidation;
- ZVI's ability to overcome manganese impact; and
- Comparison between hydraulic and pneumatic fracturing.