

Remediation of Chlorinated Groundwater Plumes: A Technology Development Project

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Background/Objectives. Groundwater is the primary source of drinking water in Denmark and more than 99% originates from groundwater. The groundwater beneath many of our larger cities is threatened by chlorinated solvents from former dry cleaning and degreasing activities. Remediation of these plumes is often a very expensive and lengthy task involving many years of O&M. There is a need to find and develop new remedial methods that can reduce contaminants to acceptable levels in plumes. With this in mind the Capital Region of Denmark has initiated a technology development project to mitigate contaminated plumes.

The aim of the project is to test and document the effectiveness of a promising technology for in situ remediation of chlorinated solvents in groundwater plumes. The technology chosen is liquid activated carbon™ (PlumeStop®) combined with injections of electron donor and bacteria to create a treatment barrier intercepting the plume. The project is performed in collaboration with the Technical University of Denmark (DTU) and Regenesi.

If successful, it could be a useful addition to the remediation options available to those looking to remediate groundwater plumes.

Approach/Activities. An appropriate test site has been chosen with a saturated zone beginning at 12 m bgl. and hydraulic conductivity at approx. $2\text{-}5 \times 10^{-5}$ m/s. The groundwater plume downgradient from the source area contains chlorinated solvents at around 500 µg/L (primarily TCE). PlumeStop®, donor (HRC®) and bacteria (BDI Plus®) have been injected through 12 fixed screens in the aquifer to create a barrier, where the chlorinated solvents are expected to adsorb and be degraded by stimulated reductive dechlorination. The effect of the injection is followed in groundwater monitoring wells (75 screens) placed upgradient, in the barrier and downgradient.

The project focuses on documentation of the following aspects;

- The overall efficiency of the technology with a focus on documenting the dechlorination of sorbed chlorinated ethenes
- The distribution of injected carbon, electron donor and bacteria in the soil matrix
- Obtaining practical experience with the method and evaluating the potential of the method for treating groundwater plumes

The documentation is obtained from a comprehensive monitoring program (soil and groundwater) from the site supplemented by laboratory test performed at DTU. Besides standard parameters the groundwater monitoring includes analysis of compound specific isotopes (CSIA) and microbial communities (Quant array) to evaluate the degradation. Intact soil cores will be collected in different depths and distances from the injection points to evaluate the distribution of the injected carbon in the soil.

Results/Lessons Learned. The barrier has been established in December 2017 and the results of the baseline monitoring and the first four monitoring rounds covering the first year of

the project are available in December 2018. The presentation will give an overview of results obtained and discuss these results in relation to the abovementioned focus areas, with a special focus on performance monitoring.