

ISCR Remediation on a Shallow and Extremely Variated Geological Conditions: Chlorinated Compounds Contamination in Brazil

Sidney Aluani (saluani@sgw.com.br), Cristina Spilborghs, Eduardo Pujol, Fabiola Tomiatti, and Natália Nascimento (SGW Services, São Paulo, SP, Brazil)
Jim Mueller, Troy Lizer, and Will Moody (Provectus Environmental Products, Freeport, IL, USA)
Mike Skalzi and Wade Meese (IET, Pipersville, PA, USA)

Background/Objectives. A former industrial plant located in the south of Brazil, which manufactured tractors and diesel engines for over 50 years, was contaminated with chlorinated solvents. The site investigation indicated that groundwater was impacted by TCE on an average concentration of 150,000 ppb, main plume area of 100 m² and 8 m depth, originating from a degreasing machine operation. With a shallow groundwater table (~1 m) the site shows very complex geology consisting of consolidated and unconsolidated sediments with a predominance of silty texture, with great variation in compaction and confining characteristics in some portions of the site, bringing a wide range of variation between MWs in short distance, with high variation in water level and conductivity. COV results indicated high concentrations in soil, mainly in the silty layers and unsaturated zones, suggesting the next remediation phase would be challenging. First, a bench test was performed to compare the performance of ISCO and ISCR techniques to reduce TCE concentrations. Based on the bench-scale results, an ISCR pilot/injection test was carried out, which gathered all of the necessary parameters and product dosage for full-scale application. After 2 months of the pilot test injections, a vapor extraction system was installed to minimize the potential of vapor intrusion due to the upcoming remediation process.

Approach/Activities. The bench test indicated that in situ chemical reduction is the most appropriate technique for the hydrogeochemical conditions of the area. In the pilot test 2 tons of Provect-IR were injected in four injection points between 1 and 4 m deep. Since the pilot test results demonstrated excellent performance, the full scale was performed in 2022 with an injection of 13.2 tons of Provect-IR through 16 injection points between 1 and 8 m deep.

Results/Lessons Learned. Regardless of the geological variation in short distances and a wide range of permeability standards in short distances, the use of Provect-IR, forming a reactive zone instead of just contact dichlorination, allowed us to be successful. It was observed in the months following the pilot test injections that the concentration of TCE in groundwater was significantly reduced (around 99%). Regarding the subsurface vapor results, a clear effect of the remediation actions was observed through the increase of the chlorinated compounds concentrations (TCE and daughter products) in the vapor phase in the first month after the injections. Despite the existence of these concentrations above the reference, the potential risks to human health were controlled by the action of the SVE system, whose preliminary results after 6 months of operation indicated a significant reduction in vapor concentrations, besides the fact that the SVE operation itself prevents the vapor intrusion. Regarding the full-scale Provect-IR injection, the biggest challenges were to overcome the daylighting due to the shallow aquifer and inject the product into the compact silty layers, controlling the subtle and constant changes in the geology and compactness.