

## Application of Chemical Oxidation Followed by Anaerobic Degradation Remedial Technologies for Trichloroethene in a Multi-System Aquifer

**Andrew J. Applebaum, P.G.** (aapplebaum@envalliance.com) NJ Operations Manager,  
Bill Smith, P.G. (bsmith@envalliance.com) Principal Hydrogeologist  
(Environmental Alliance, Inc., Middlesex, New Jersey and Wilmington Delaware, USA)

Remedial enhancements to an existing Pump & Treat (P&T) system were selected for a Pilot Study to address trichloroethene (TCE) impacted groundwater within a fractured bedrock system extending into a residential neighborhood. The focus for implementing the remedial enhancements was the farthest down gradient area of the dissolved plume not fully responding to P&T system operations due to pumping well distance as predicted by groundwater modeling. This area is hydrogeologically complex due to an upward vertical gradient where TCE impacted bedrock groundwater moves into overlying unconsolidated sediment. To enhance treatment of this area, an aggressive *in-situ* treatment train was implemented to quickly reduce groundwater impact using RegenOx™ and then establish a long-term remedy using NewmanZone® to stimulate microbial growth as part of an Anaerobic Reductive Dechlorination (ARD) bioremediation process. Application of RegenOx™ and NewmanZone® was accomplished via permanent injection points into the bedrock and unconsolidated sediments (alternating points screened within glacial till and fluvial deposits/fill).

RegenOx™, a chemical oxidant consisting of sodium percarbonate and sodium carbonate monohydrate activated by ferrous sulfate (comparable with Fenton's Reagent chemistry), was initially injected via installed points to enhance the oxidation process of chlorinated solvents (tetrachloroethene, TCE, etc.) and break them down into harmless byproducts (CO<sub>2</sub> and H<sub>2</sub>O). NewmanZone®, an electron donor formulation consisting of sodium lactate, soybean oil, food-grade additives, and proprietary surfactants and stabilizing agents that stimulates the ARD process, was injected via a continuous feed to the injection points. ARD is an electron donor/carbon source (substrate) rate driven, microbial mediated, oxidation-reduction reaction capable of degrading chlorinated solvents (i.e. TCE) to final end products, chloride, ethene and ethane.

The RegenOx™ application directly to injection points in the treatment zone resulted in TCE concentration reductions from 16 to 93 percent. After monitoring to determine aquifer conditions were suitable for establishing ARD, Newman Zone® was injected via a continuous feed to the injection points. A former residential well was utilized to providing the necessary injection water for substrate addition, which also exerted hydraulic control and formed an in-situ recirculation loop to establish conditions for naturally occurring anaerobic bacteria growth in the area. Reducing conditions and TCE concentration reductions were observed after two months of initiating Newman Zone® injection indicating this remedial strategy could be appropriate for full-scale application to enhance P&T system effectiveness and achieve remedial goals.