

(The) Successful In-Situ Treatment of a TCE Plume Using a Combination of Reduction, Sorption, and Anaerobic Bioremediation

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A former industrial facility was impacted by trichloroethene (TCE), cis 1,2 dichloroethene (cis 1,2 DCE) and vinyl chloride. The plumes extended onto neighbouring properties creating both a potential human health and liability risk to the site owners. As part of the risk mitigation program a permeable reactive zone (PRZ) was installed on the down gradient portion of the site to treat the dissolved phase ethenes of concern. The presence of infrastructure and location to sensitive receptors deemed the use of a trenched PRZ for the shallow highly heterogeneous aquifer to be unacceptable. Therefore an injected PRZ was designed and implemented.

The PRZ used a combination of chemical reduction, sorption and anaerobic bioremediation approaches to address the dissolved phase ethenes. Concentrations of TCE ranged up to 2,560 µ/L whereas cis 1,2 DCE ranged by to 4,300 µg/L and vinyl chloride ranged up to 460 µg/L within the groundwater flowing into the PRZ. Using a dense vertical and lateral injection grid consisting of 69 locations along a 90 metre (m) long PRZ a total of 2,700 kg of colloidal activated carbon (CAC) and 1,130 kg of micro sulphidated zero-valent iron was injected to form a PRZ. The activated carbon and zero-valent iron used for the PRZ are new innovative forms which provide smaller particles allowing for easier injection and better distribution compared to larger particle formats while increasing the reactivity of the reagents themselves.

The results from monitoring indicated that the groundwater exiting the PRZ met the regulatory objectives within three months of the PRZ installation and has met the objectives for over 24 months post injection. Detailed geochemical and microbiological sampling of the groundwater indicated that strong reductive dechlorination conditions were maintained within the impacted aquifer while key microorganisms increased by three to four orders of magnitude. Detailed sampling of the aquifer solids pre- and post-injection revealed that the horizontal hydraulic conductivity of the aquifer was unaffected by the injection of the remedial reagents with no meaningful change being measured in the hydraulic conductivity. Sampling and analyses of the aquifer solids for iron and activated carbon suggested that the two remedial reagents were present within greater than 99 percent of the samples collected at concentrations greater than 700 percent their pre-injection levels.

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Rick McGregor is the President of InSitu Remediation Services Ltd and has over 26 years' experience in groundwater and soil assessment and remediation. Rick has worked in over 30 countries and has authored numerous papers on groundwater assessment and remediation. Rick holds a M.Sc. from the University of Waterloo in hydrogeology and geochemistry and is a Certified Ground Water Professional in Canada and the United States.