Field implementation challenges to establish In Situ Biogeochemical conditions for the Treatment of Chlorinated Organics in into a fractured bedrock aquifer.

GEOFORM is a Biogeochemical Reagents engineered to deliver the building blocks needed to promote in situ biogeochemical reactions. It provides a source of sulfate, ferrous iron, electron donors, pH buffer, and nutrients to promote mechanisms for dehalogenation via enhanced anaerobic bioremediation, abiotic degradation, and the formation of reactive minerals.

During treatment with GEOFORM, highly reducing conditions are generated which are favorable to the reduction of ferric iron (Fe3+) to ferrous (Fe2+) and sulfate (SO4) to sulfide (S-). If present, the ferrous and sulfide rapidly combine to produce iron-sulfide minerals such as mackinawite (FeS), and pyrite (FeS2). These biologically generated minerals have been demonstrated to abiotically degrade CVOCs on contact by the β elimination pathway. This pathway minimizes the generation of toxic degradation products thereby substantially reducing the clean-up time. In addition to forming reactive minerals, the sulfide will precipitate on zero valent iron (ZVI) if present. This sulfidation of ZVI has been demonstrated to substantially enhance ZVI reactivity.

Approach

The site under study, is located in the Maritimes region of Canada, and previously operated as a dry-cleaning business. It is a vacant and has undergone multiple phases of delineation and monitoring to assess the extent of the chlorinated volatile organic compound (cVOC) plume. The client has already completed remedial excavation to address soil contamination and aims to address the residual groundwater impacts within the bedrock and prevent further migration.

Given the complexity of remediating a cVOC plume in a fractured bedrock and the challenges associated with injecting amendments, a fully soluble solution was applied to facilitate the effective emplacement of the selected amendment into the fractured bedrock.

Bench tests, field pilot studies and full-scale treatment have been conducted to evaluate the effectiveness of the GeoformTM Soluble (BGCR enhancing reagents) for treatment of CVOCs. This reagent has been applied at sites with distinct hydrogeologic and geochemical conditions, and contaminant concentrations.

Results

The pilot field tests demonstrated that the establishment of the BGCR conditions significantly increased the reactivity on the contaminant of concern. The combination of these technologies resulted in the rapid destruction of CVOCs.

This presentation will describe the biogeochemical parameters changes which enables enhanced ERD and ISCR for treatment of CVOCs.

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Jean Pare, P.Eng., has a degree in Chemical Engineering from Laval University. He has been involved for the last 30 years in the evaluation, development, design, and promotion of both conventional and innovative environmental technologies. As Vice President with Chemco Inc., his responsibilities include the remediation design, technico-economical analysis and technology supply for chemical oxidation and reduction, soil washing, and enhanced bioremediation. Last year, he worked with over 400 sites applying his expertise to various types of organic and inorganic contaminants in soil and groundwater. He is also involved with many environmental organizations such as CLRA, CBN, ESAA, BCEIA and Reseau-Environnement where he is an active technical committee member and regular technical speaker.