The In Situ Treatment of Dissolved BTEX and Gasoline Residues Using Micro Activated Carbon

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Background/Objectives. The use of activated carbon to treat dissolved phase benzene, toluene, ethylbenzene, and xylenes along with other gasoline-related volatile and semi-volatile organics has been well demonstrated in ex situ applications. However, reporting and documentation of in situ field testing using activated carbon on BTEX and hydrocarbon plumes is limited, though well applied. The objective of this study was to evaluate if micro activated carbon (Petrofix™) could be injected into a moderate deep sand aquifer to attenuate moderately high concentrations of BTEX and gasoline range compounds over a prolonged period. Secondary objectives of the study were to evaluate the effect of the micro activated carbon on various physical and chemical parameters including general groundwater chemistry, the microbiology of the aquifer system and if heterogeneity impacted the distribution of the reagents within the targeted injection zone.

Approach. Micro activated carbon was injected into a plume hotspot underneath and near a building where other remedial technologies were not effective at addressing the contaminants. These included air sparging, soil vapor extraction and aerobic bioremediation. The micro activated carbon was delivered to the sandy aquifer using direct push technology and injection wells installed within the upper 3 feet of the aquifer at a depth of approximately 70 feet below ground surface (bgs). Concentrations of total BTEX ranged up to 9.5 mg/L whereas the total gasoline range concentrations were measured at a maximum of 16.5 mg/L within the plume. Over a 300 square metre area a total of 4,100 pounds of micro activated carbon was injected at a 5 percent concentration. The injections were targeted to address the upper 3 feet of the saturated aquifer.

To evaluate the performance of the micro activated carbon, groundwater was collected and sampled prior to and post injection over a two-year period for various inorganic and organic parameters as well as microbiological parameters and compound specific isotopes. Additionally cores of the aquifer were collected to evaluate the distribution of the micro activated carbon post injection.

Results. The results from the two-year testing period suggested that the micro activated carbon was effective at reducing the dissolved phase mass within the groundwater. Sampling of the groundwater over a 24-month period indicated that the BTEX was reduced by greater than 99 percent whereas the gasoline range parameter was reduced by greater than 98 percent and maintained over the monitoring period.

Microbiological testing using a variety of techniques including evaluation of the V4 region of the 16S rRNA gene was applied to samples collected outside and within the injection area to determine if the micro activated carbon influenced the microbiological makeup. Results suggest that the microbiology was impacted by the micro activated carbon and its associated carrier fluid resulting in a more anaerobic microbial environment.

Compound specific isotopic analysis of various BTEX compounds suggested that within the area of micro activated carbon injection, biological reactions were dominated by sorptive reactions unlike the areas outside of the injection zone.

Analysis of soil cores collected pre- and post-injection indicated that the distribution of the micro activated carbon was influenced by method of injection (i.e., injection well versus direct push technology) as well as by small scale heterogeneities within the upper aquifer. However, all aquifer samples collected within the targeted injection zone contained TOC at an average increase in concentration of greater than 1,000 percent compared to the pre-injection TOC concentrations.