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Bioelectrochemically-Enhanced In Situ Biodegradation of Benzene and Other Petroleum Contaminants in Groundwater

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Background/Objectives. This is the first report of full-scale field application of the bioelectrochemical technology (trademarked as "E-Redox") in enhancing biodegradation of benzene and other petroleum contaminants (reflected as TPH) in groundwater.

E-Redox™ stimulates bio-oxidation reactions of various contaminants by establishing a highly efficient electron transfer conduit and expediting the rate of electron transport within the impacted matrix, as well as providing a perpetual and favorable terminal electron acceptor. This technology consumes no energy during its operation, even generating electricity when electrons flow through the circuit. Such generated electricity, though of low power density, can serve as a convenient indicator and remote monitoring parameter of in situ biodegradation. This technology has been successfully field tested at pilot-scale where significantly enhanced biodegradation of benzene in groundwater was observed (up to 5x faster degradation rate). Currently, the E-Redox™ technology has been implemented at full-scale to enhance biodegradation of benzene and other petroleum contaminants in groundwater at two leaking underground storage tank (UST) sites in Colorado. This presentation will address the findings from these two field case studies.

Approach/Activities. Full-scale installations of the E-Redox™ systems in existing and newly established groundwater wells have been completed at two fuel stations with histories of groundwater contamination from leaking USTs. The primary contaminant of concern at both sites is benzene. In addition to routine quarterly groundwater sampling and monitoring events, voltage patterns generated in E-Redox™ systems have been continuously monitored and recorded by using data loggers. The voltage profile will serve as an indicator to evaluate the viability of in situ biodegradation.

Results/Lessons Learned. To date, groundwater monitoring and E-Redox voltage data have indicated enhanced biodegradation of benzene and TPH in general. Quarterly samplings and field monitoring are ongoing, and results will be included in the final abstract when available. Performance data on benzene and TPH degradation and their correlations with the electrical voltage profile within the E-Redox™ systems will be reported and analyzed. Specific challenges for each site and the applied solutions will also be discussed.