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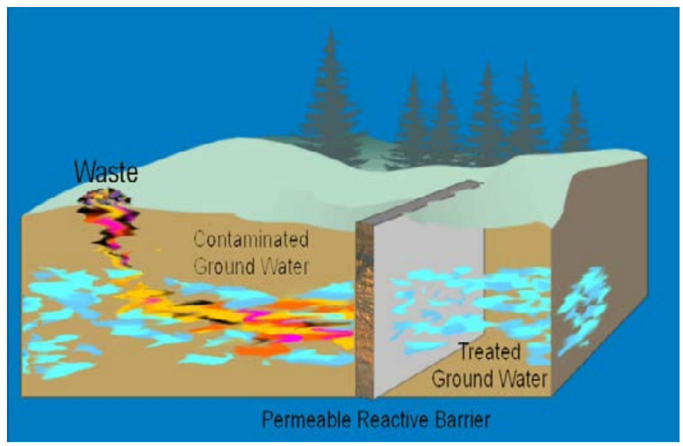
PERFORMANCE ASSESSMENT OF A PERMEABLE REACTIVE BARRIER FOR GROUND WATER REMEDIATION FIFTEEN YEARS AFTER INSTALLATION

ORD research in the Sustainable Healthy Communities program has a focus on sustainable solutions for contaminated sites. Remediating contaminated sites contributes to community sustainability by eliminating risks to receptors and bringing the properties back into commerce. Remediation technology itself can contribute to sustainability by having low cost and operating characteristics which are acceptable to the surrounding community. Research on permeable reactive barriers (PRB) fits these requirements and scientific research on their performance provides the basis for correct application of this technology.



Interest in site-specific evaluations of PRB performance is high, particularly with regard to issues relating to media longevity and hydraulic performance. Compared to the large number of full-scale PRB applications around the world that have been constructed to remediate ground-water contamination, comparatively few long-term data sets are available in the literature that provide detail on performance. Higgins and Olson (2009) recently conducted a life-cycle comparison of PRBs versus pump-and-treat operations for ground-water remediation. Based on their analysis, environmental impacts from PRBs are driven largely by material production requirements and by energy usage during construction, while for pump-and-treat systems environmental impacts are driven by energy demand. Higgins and Olson (2009) conclude that the minimum longevity of granular iron PRBs required to out-compete pump-and-treat systems is 10 years. Consequently, a key aspect of life-cycle analysis and cost/performance assessment is to have predictive tools that reasonably estimate long-term PRB performance using site-specific parameters such as groundwater chemistry and hydrologic conditions. Development of such predictive tools *requires* long-term data sets.

The granular iron PRB installed at the U.S. Coast Support Center located near Elizabeth City, NC (USA) is a well-documented full-scale PRB designed and constructed for removing hexavalent chromium from ground water. Current research provides an update on the contaminant removal efficiency of this PRB after 15 years of operation.

Study Findings:
Results of the long-term performance evaluation (Wilkin et al., 2014) at the Elizabeth City site indicate that the reactive barrier there continues to remove contaminants from ground water after fifteen years of operation. Key results are:

• Removal of contaminants, Cr and TCE, continues after fifteen years of PRB operation. In all cases, chromium concentrations have been reduced to below regulatory thresholds and in the majority of sampling events Cr was undetected in monitoring wells located downgradient from the PRB. Concentrations of volatile organic compounds have been significantly reduced, but TCE concentrations above the MCL have been observed in some downgradient wells.

• After fifteen years, ground water in the PRB is moderately alkaline (pH>9) and moderately reducing (negative E_H values). Time trends in pH suggest quasi-steady-state conditions. Time trends in E_H, however, suggest that the PRB is gradually losing the capacity to produce reducing conditions due to progressive exposure to ground water.

• The Elizabeth City PRB has consistently removed inorganic carbon, sulfate, and calcium from influent ground water. These components have either been precipitated out in the PRB, or have been chemically transformed by biotic or abiotic processes.

REFERENCES:

Higgins, MR and Olson, TM (2009). Life-cycle case study comparison of permeable reactive barrier versus pump-and-treat remediation. *Environmental Science and Technology*, v. 43, p. 9432-9438.

Wilkin, RT, Acree, SA, Ross, RR, Puls, RW, Lee, TR, and Woods, LL (2014). Fifteen-year assessment of a Permeable Reactive Barrier for treatment of chromate and trichloroethylene in groundwater. *Science of the Total Environment*, v. 468/469, p. 186-194.

CONTACTS:

Richard Wilkin, Ph.D., Office of Research and Development, 580-436-8874, wilkin.rick@epa.gov;

Jim Weaver, Ph.D., Office of Research and Development, 580-436-8550, weaver.jim@epa.gov;

David Jewett, Ph.D., Office of Research and Development, 580-436-8560, jewett.david@epa.gov