ABSTRACT

The Air Force Center for Engineering and the Environment (AFCEE) has been demonstrating the use of permeable mulch biowalls for enhanced in-situ anaerobic bioremediation of chlorinated solvents in groundwater since 1989. Permeable mulch biowalls and bioreactors have been selected by the Department of Defense (DoD) and industry to remediate shallow groundwater contaminated with chlorinated solvents, perchlorate, and other contaminants. A "Technique for Enhanced Anaerobic Bioremediation of Chlorinated Solvents Using Permeable Mulch Biowalls and Bioreactors" (May 1998, soon to be available for download from the AFCEE Technology Transfer web site) has been developed to assist DoD restoration project managers and their contractors in determining whether the technology is appropriate for their sites, and to identify optimum approach and design.

Biowalls using mulch and compost substrates are intended to provide a long-term source of organic carbon to stimulate and sustain anaerobic degradation processes for periods of 5 to 15 years or more. The use of low-cost substrate materials and the low operational requirements of biowalls are anticipated to result in low life cycle costs for the engineered remedial systems. Biowalls may be replenished with substrate amendments, such as emulsified vegetable oil, to extend the effective life span of the application. Alternative amendments (e.g., iron or sulfur) may also be added to stimulate biogeochemical reduction of chlorinated solvents. Application of the technology is not limited to passive biowalls or bioreactors, but may be used to displace contaminated groundwater or to provide a long-term source of organic carbon to stimulate and sustain anaerobic degradation processes through a permeable mulch bioreactor. The use of mulch in permeable reactive grouting and permeable mulch biowalls for enhanced in-situ anaerobic bioremediation of aquatic sediments over highly engineered remedial systems, however, is not considered to be within the scope of this technology.

The AFCEE Biowall Protocol provides guidance on designing and implementing a biowall application, including 1) remedial objectives and site conditions, 2) selection of biowall technology, 3) site investigation and monitoring, 4) engineering design, 5) construction management plans, 6) remediate management, 7) field sampling plans, 8) data interpretation and reporting, and 9) operations and maintenance plans. Case studies are presented that illustrate the design concepts and engineering principles detailed in the Biowall Protocol. Performance and cost data are also presented for comparison to alternative technologies.

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Protocol for Enhanced Anaerobic Bioremediation of Chlorinated Solvents Using Permeable Mulch Biowalls and Bioreactors

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BIOWALL AND BIOREACTOR APPLICATIONS

Permeable mulch biowalls and bioreactors are being used by the Air Force to remediate shallow groundwater contaminated with dissolved chlorinated solvents, perchlorate, and other contaminants. A biowall is an environmental engineered trench that includes a permeable mulch mixture, which is used to contain groundwater and stimulate biogeochemical transformation (abiotic) processes to degrade contaminants. Bioreactors are biowalls that are designed to provide a long-term source of organic carbon to stimulate and sustain anaerobic degradation processes, particularly in groundwater. Biowalls and bioreactors are installed using low cost, low operational requirements technologies that may range from $30,000 to $60,000 per linear foot to install.