Federal Integrated Biotreatment Research Consortium (FIBRC): Flask to Field Initiative

Cleanup
CU-720

RESEARCH CATEGORY: 6.2 Applied Research

LEAD AGENCY: U.S. Army

LAB: Waterways Experiment Station - Vicksburg, MS

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FY 1999 FUNDS: $2,250K

OBJECTIVE: The objective of this project is to develop a set of "realistic" biotreatment processes for the cleanup of several classes of contaminants at Department of Defense (DoD) sites. A single, panacea technology for each contaminant group that can be used at all DoD sites will not be obtained. All treatment processes have technical and economic limitations, and part of the experimental process of this program will be to define these limitations.

BENEFIT: The primary benefit of this study is reduced remediation costs associated with development of "realistic" biotreatment processes for the cleanup of contaminated DoD sites. Secondary benefits include: expanded implementation potential of existing and developing biotreatment processes, biotreatment technologies that result in the on-site destruction of contaminants, and increased regulatory and user acceptance.

TECHNICAL APPROACH AND RISKS: The technical approach of this project will be to continue to investigate a variety of promising biotreatment processes at the bench and intermediate scale. The experiments in this program will be directed toward four major research areas: 1) biological treatment of explosives, 2) chlorinated solvents, 3) polychlorinated biphenyls (PCB), and 4) polycyclic aromatic hydrocarbons (PAH). The planned experiments represent up-to-date techniques with the potential for reducing treatment costs at DoD sites. In some cases, the concepts under investigation have been developed by members of this consortium. In other cases, other concepts that indicate promise were taken from current literature and professional affiliation. Considerable efforts have been made and will continue to be made to ensure that the approach is always up-to-date. The technical approach and processes under development have the potential to be fielded within a reasonable amount of time. This approach will ensure that the DoD will have more cost-effective remediation technology within time frame required for DoD site remediation activities.

Biotreatment processes will be evaluated for the following four major contaminant groups:

EXPLOSIVES CONTAMINATED SOILS AND GROUNDWATERS - A variety of promising biotreatment techniques will be investigated for remediation of soil and groundwater contaminated with explosives compounds. Explosives contamination represents one of the most prevalent types of organic contamination within the DoD. The following biotreatment mechanisms will be investigated for explosives: 1) Discovery of Novel Enzymatic Reactions and Determination of Biodegradation Mechanisms and Pathways, 2) Phytoremediation of Explosives Contaminated Groundwater using Wetlands and Aquatic Plants,

3) Phytoremediation of Munitions Contaminated Soils, Enhanced TNT Biodegradation Through Genetic Manipulation.

PAH CONTAMINATED SOILS - This group of contaminants represents the most regulated of PAH compounds due to their carcinogenic properties. Also, because of their large and complex molecular structure, they also represent the most difficult of all the PAHs to biologically degrade. Key research issues are: 1) Heavy Molecular Weight PAH Biodegradation, 2) Mass Transfer and Bioavailability Enhancement for In-Situ Intermittent Slurry Reactor Treatment of Dense Non-Aqueous Phase Liquid (DNAPL)-Contaminated Soils.

CHLORINATED SOLVENT CONTAMINATED SOILS AND GROUNDWATERS - Chlorinated solvents represent a class of contaminants that is detected at more DoD sites than any other contaminant group. Issues under investigation for chlorinated solvents within this program include: 1) Electrically Activated Reductive Dechlorination of Chlorinated Solvents, 2) Distinguishing the Microbial Communities Active in the Enhanced Aerobic Treatment of Chlorinated Ethenes, 3) Phytoremediation of Shallow Chlorinated Solvent Plumes: Engineered Tree Planation and Transgenic Trees to Secrete Dehalogense Enzymes.

PCB CONTAMINATED SOILS - Soils contaminated with PCBs represent one of the most challenging compound groups under investigation in this project. PCBs are found at many DoD installations due to improper disposal of hydraulic fluids and waste lubricating oils. Primary issues under investigation are: Enhancing PCB Biodegradation.

ACCOMPLISHMENTS: In FY98, the fluidized-bed technology for biodegradation of mixtures of 2,4- and 2,6-dinitrotoluenes in contaminated groundwater was field-tested. The VAAP fluidized bed reactor became operational. The project studied the bed reactor for 9 months to allow for a complete evaluation of scale-up issues at this scale of operation. Throughout the year the consortium has been actively progressing towards the completion of the year's milestones. Many of these accomplishments are ongoing and will proceed into FY99. The consortium has been continually working with the Technical Advisory Committee to ensure that this initiative progresses in a timely manner.

TRANSITION: This project has a transition plan that plans to develop for the DoD community a biotreatment "toolbox" that can be drawn upon to offer the right process for each site. The technology produced by this project is intended to serve remediation project managers want options and well defined limitations of each option made available to them during their remediation efforts. Each process, whether it is traditional or innovative, has technical limitations and risks associated with its fielding. The knowledge of these process limitations will be required to reduce the risks accepted by the installation and regulatory agencies to an acceptable level.