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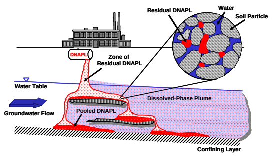
Is Bioremediation Feasible Following Physical-Chemical Treatment at Chloroethene-Contaminated Sites?

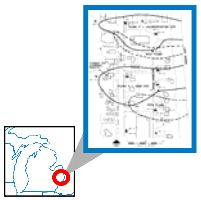
Overview

Environmental Issue

•Chloroethenes (e.g., PCE and TCE) are
- •Toxic and potentially carcinogenic
- •Ubiquitous groundwater contaminants
- •Form dense nonaqueous phase liquids (DNAPLs) that contaminate drinking water sources for decades

•Current physical-chemical treatment technologies are insufficient → Concentrations often above regulatory goals after treatment





Bachman Road Site
Oscoda, Michigan

Promising Field Observations

•Surfactant flushing, a physical-chemical treatment, was performed, but PCE levels were still above regulatory limits

•Post-treatment monitoring showed PCE transformation

•Did the surfactant treatment stimulate native microbial activity responsible for PCE transformation?

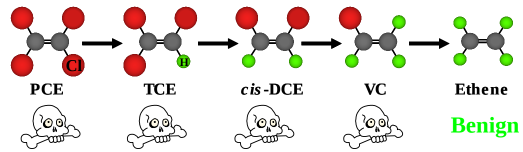
Scientific Approach

Promising Solution

Bioremediation can be used as a "polishing" step to reduce contaminant concentrations to acceptable levels following physical-chemical treatment (e.g., surfactant flushing)

Bioremediation Basics

•Some microbes like to "eat" or "breath" certain toxic compounds, transforming them into benign products



•Scientists have "fished" to identify microbes that can transform harmful compounds, and bioremediation takes advantage of these natural, biological transformations

•Engineers, microbiologists, and site managers work together to provide proper conditions and/or add more microbes so that the microorganisms can "bioremediate" contaminated soil and groundwater

Research Objective

Determine the feasibility of using bioremediation as a polishing step following surfactant flushing

Methods

•Pure and mixed culture batch experiments

•Evaluate microbial activity in the presence of DNAPL

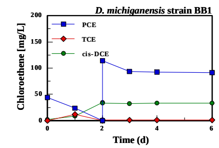
•Evaluate microbial activity in the presence of Tween 80, a biodegradable, food-grade surfactant commonly employed in surfactant flushing

Desulfuromonas michiganensis strain BB1, *Desulfitobacterium*, *Sulfurospirillum*, *Geobacter*

Highly enriched mixed cultures containing *Dehalococcoides* spp.

Research Highlights

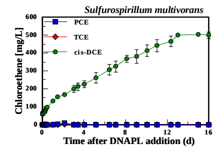
Dechlorination at High PCE Concentrations



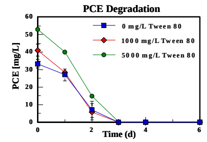
Dechlorination ceased or was severely hindered at high PCE concentrations for all four pure cultures tested

Dechlorination in the Presence of DNAPL

Sustained dechlorination in the presence of DNAPL observed, even with organisms that cannot tolerate high PCE concentrations



Surfactant Effect on Dechlorination



Dechlorination proceeds normally in the presence of Tween 80 for most microbes tested, although complete conversion to (benign) ethene has not been observed
→ Further research needed

Impact

This research shows that a combination of technologies, bioremediation and surfactant flushing, holds great promise to reduce contaminant concentrations to acceptable levels, allowing a reduction in both remediation costs and time

Acknowledgements

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•For more information visit the Löffler Lab at www.ce.gatech.edu/research/loefflerlab