In Situ Bioremediation of Methylene Chloride Contaminated Groundwater Following Physical Treatment

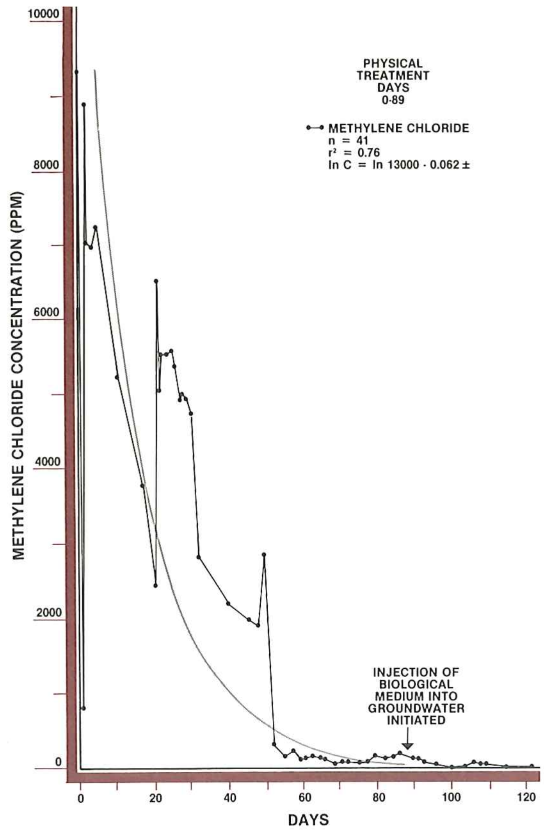
A Groundwater Case Study

OHM Corporation used physical and biological techniques to successfully treat methylene chloride contaminated groundwater following an underground pipeline rupture. Interceptor trenches were constructed initially to contain free-standing product which was staged in vessels for later on-site treatment. Monitoring wells were used to identify the contaminant plume, and pumping techniques were employed to contain the methylene chloride.

Following two months of field operation, pumping and air stripping techniques provided an estimated 97% reduction of methylene chloride in the groundwater (see Figure 1).

OHM Corporation

FIGURE 1



The feasibility of further site matrix remediation by in situ bioremediation techniques was examined.

Laboratory screening studies with representative groundwater samples showed that acclimated bacterial populations at the site could degrade methylene chloride at the average groundwater concentrations of 100 mg/l within 25 hours (see Figure 2). Analytical results also demonstrated that the indigenous bacterial populations became acclimated to methylene chloride within 7 to 20 days.

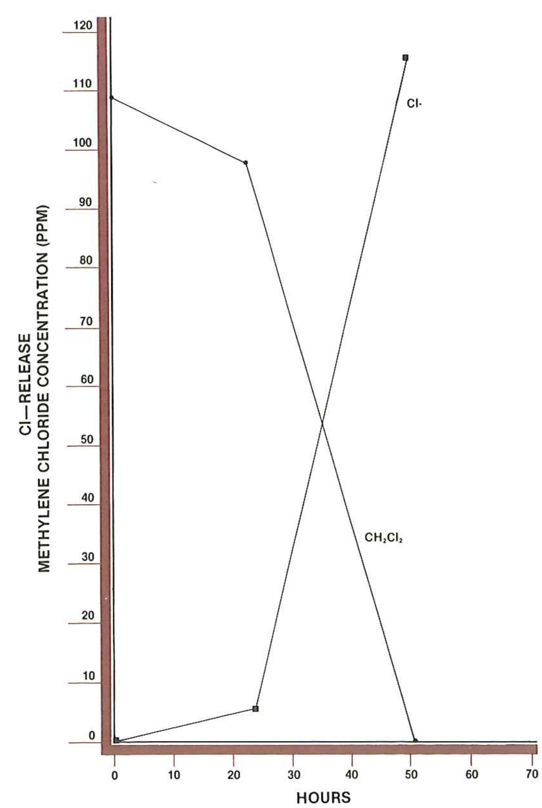
An underground recovery and treatment system was placed into operation on site. Residual methylene chloride in the soil and groundwater was treated using a fixed-film reactor and in situ remediation. Following approximately 240 days of treatment, methylene chloride concentrations ranged from less than 1.0 to 3 ug/l, representing up to a 5 order of magnitude reduction in groundwater concentrations.

Biological Treatment

The first component of the field biological treatment system was an 8,500-gallon equalization pool which received water from the vacuum recovery unit. The pool was used for nutrient addition, mixing and flow equalization. A 500-gallon nutrient feed tank provided a nutrient supply to the system. Nutrient requirements were based on the amount of elemental carbon available to achieve a C:N:P ratio of 100:10:1.

A fixed-film bioreactor packed with corrugated PVC media with a surface area of approximately 30 ft^2/ft^3 was used to treat the methylene chloride contaminated groundwater. Blowers and submerged fine bubble diffusers supplied approximately 30 to 50 scfm of air as an oxygen source for the bacteria and for vertical mixing. The bioreactor overflowed into a 1,000-gallon holding tank, which provided water to the injection line. The pH was automatically controlled in the reactor because excess hydrogen ions were produced from the degradation of methylene chloride.

FIGURE 2



Sampling and Monitoring Program

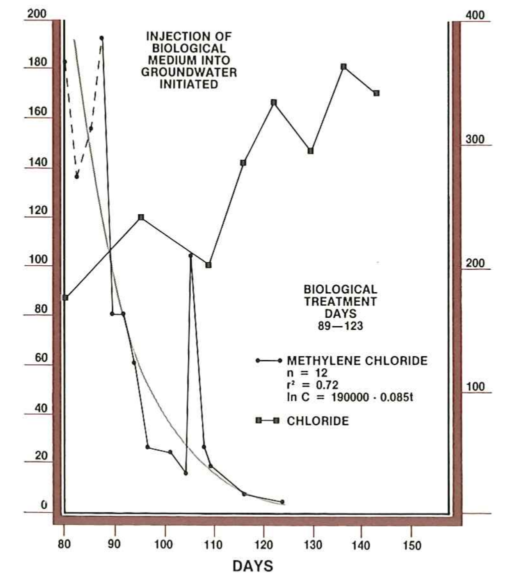
A sampling and monitoring program was developed to measure the effectiveness of biological treatment in reducing methylene chloride concentrations in the groundwater. Six monitoring wells and four locations within the aboveground treatment system were treated on a routine basis. Parameters tested in the field included ammonia-N, orthophosphate-P, pH, chloride and dissolved oxygen.

Samples were analyzed biweekly at the bioremediation laboratory at OHM's corporate headquarters in Findlay, Ohio, for QA/QC. Total heterotrophic bacteria plate counts were performed to monitor biological growth. Injection flow rates and monitoring well water levels were recorded.

Results

Initial methylene chloride concentrations in seven monitoring wells were determined prior to starting the recovery/injection system. These concentrations ranged from < 2 ppm to 5,200 ppm. Methylene chloride rapidly disappeared in these monitoring wells following enhancement of the biological activity. Analyses of on-site monitoring well samples indicated 10^3 to 10^5 reductions in groundwater concentrations of methylene chloride within the soil/groundwater environment undergoing biological remediation since the onset of the project (see Figure 3).

FIGURE 3



Methylene chloride was further reduced to 1ug/l after 240 days of operation (see Figure 4). The groundwater recovery/injection system was removed from the site one month later.

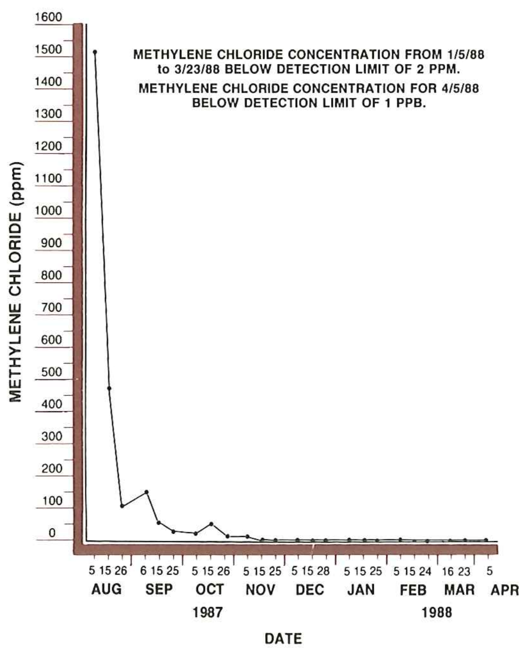
Conclusions

These data demonstrate that the cleanup of spilled contaminants in the environment to less than 1 ug/l can be achieved through bioremediation.

By successfully decontaminating the soil and allowing it to remain on site, a two-fold cost savings was achieved and future liability was reduced substantially. This savings estimate is conservative since removal of soil from an area increases void volume for transportation and disposal often by a factor of 1.2 to 1.3.

Moreover, hazardous materials cannot be shipped off site in bulk, but must be packaged in drums. Additional chemical analyses generally are required to characterize the waste prior to off-site transportation and disposal. Inclusion of these additional factors that must be considered for off-site disposal results in recognition of an even greater cost benefit for in situ cleanup.

FIGURE 4



METHYLENE CHLORIDE CONCENTRATIONS IN MONITORING WELL B-17 DURING BIOLOGICAL TREATMENT

OHM's Integrated Bioremediation Services

- Engineering design, fabrication and testing of full-scale systems
- System installation and operation through project completion
- Permitting
- Establishment of data base to estimate cleanup levels achievable, time required for cleanup, and costs for full-scale remediation

Advantages of OHM's Bioremediation Program

- Ten years of demonstrated experience
- On-site, maximized contaminant destruction
- End products of water and carbon dioxide are typically achieved

Classes of Contaminants Treated

- Petroleum hydrocarbons *(e.g., gasoline, fuel oil, crude oil)*
- Aromatics *(e.g., benzene, toluene, xylene)*
- Polynuclear Aromatic Hydrocarbons *(e.g., napthalene)*
- Alcohols *(e.g., isopropanol, ethanol)*
- Carbohydrates *(e.g., glucose)*
- Detergents
- Ketones *(e.g., methyl ethyl ketone)*
- Phenols *(e.g., chlorophenol)*
- Phthalates *(e.g., o-phthalate)*
- Solvents *(e.g., methylene chloride, acetone)*

Compounds Biodegraded

- Acrylonitrile
- Butyl Cellosolve
- Ethylacrylate
- Ethylbenzene
- Ethylene Glycol
- Methylmethacrylate
- n-Butylacrylate
- Styrene
- t-Butanol
- Tetrahydrofuran

TECHNOLOGIES APPLIED

TECHNOLOGY	MATRIX: GROUNDWATER	PROCESS WATER	SURFACE IMPOUNDMENTS	SOIL	SLUDGE
In Situ Bioremediation					
Landfarming				■	■
Injection/Recovery	■			■	
Composting				■	
Contained Bioreactors					
Activated Sludge	■	■	■		
Sequential Batch	■	■			■
Static Bed	■	■			
Fluidized Bed	■	■			
Liquid Solids Contact			■	■	■

Find Out More

For more information call 800-537-9540.
Or write:

OHM Corporation
Client Services
16404 U.S. Route 224 East
Findlay, OH 45840

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OHM CORPORATION GROUNDWATER SERVICES

OHM Corporation has the hands-on experience developing and operating engineered systems to cost effectively treat contaminated soil and groundwater.

- ***COST SAVINGS:*** *Practical, cost-effective solutions readily implemented under field conditions*
- ***SAFETY:*** *Safe completion of nearly 10,000 environmental projects, many involving extremely hazardous materials*
- ***EXPERIENCE:*** *20 years in environmental services, successful completion of more than 1,000 groundwater remediation projects*
- ***RELIABILITY:*** *Complete design, installation, and operation of systems for treating groundwater containing organics, solvents, metals, and nuclear materials*

OHM Corporation provides:

INVESTIGATION AND ASSESSMENT

- Local offices supported by national resources
- Full-time engineering and field sampling staff
- Drilling equipment owned and operated by OHM
- Network of analytical chemical laboratories

SYSTEM DESIGN

- Experienced groundwater remediation professionals and engineers
- Treatability laboratories (bioremediation, thermal and conventional)
- Computerized design systems

REMEDIAL SYSTEM IMPLEMENTATION

- Mobile fleet of process units for physical, chemical, and biological treatment
- Fully staffed fabrication facilities
- Experienced system operations crew
- Experienced staff of equipment and electronic system maintenance personnel
- Materials handling expertise

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