NETTS PROJECT/DEMONSTRATION SUMMARY

Title: Extraction of MTBE by a Hollow Fiber Membrane
NCBC-37-99 (Rev. 10/00)

Lead PI/Affiliation: UCSB
Co-PI's/Affiliations: NFESC

Date/Duration:
Initiated - 03/99
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Abstract:
Although MTBE is considered highly volatile, the Henry's Law Constant for MTBE is low due to its extremely high solubility. Once MTBE comes in contact with groundwater, its removal requires proactive measures. An investigation has been designed to determine the feasibility of removing dissolved MTBE from groundwater using an innovative hollow fiber membrane (HFM) technology coupled to an internal combustion unit (ICU) for hydrocarbon vapor treatment.

Water containing volatile and semivolatile organic compounds is passed through the inside of the hollow fibers while a vacuum is applied to the outside of the fibers. The organic compounds are transferred to the gas phase outside of the fiber and then are destroyed using the ICU. The hollow fibers are made of materials that retain the flowing water, yet allow for gaseous exchange. The fibers are bundled in a container, denominated in a membrane module consisting of separate inlet and outlet ports for water and organic vapors. Contaminated groundwater enters the module and comes in contact with clean air. Treated water and organic laden vapor exits the system.

Removal efficiency depends strongly on the vacuum pressure applied to the exterior of the hollow fibers. Typically, higher vacuum pressures result in higher removal efficiency. In addition, removal efficiency also depends on water temperature. Higher water temperature results in more volatilization of the organic compounds, thereby, increasing the removal efficiency. Water flow rate is also a critical factor. Lower flow rates result in higher removal efficiency. The ICU will be used to augment heat and power requirements.

Up stream from the HFM, the system will be equipped with a spray aeration tank that promotes the removal of dissolved volatile organic constituents by transfer to the vapor phase. Within the aeration tanks, contact between contaminated groundwater and air is maximized by a finely atomized sprayer, the temperature is increased, and the pressure is reduced.

Three modes of evaluation will be conducted. The first mode will couple the HFM with the spray aeration tank and ICU. The second mode will bypass the spray aeration tank in the separation and treatment process. A third mode will bypass the HFM component in the process.

The primary objective of the study was to determine the feasibility of using the HFM technology for MTBE remediation under field conditions. A secondary objective included determining the optimal operational parameters for both the HFM separation technique and the treatment portion of the system.

Results/Conclusions: The complete system configuration used during the demonstration consistently achieved MTBE, benzene, and toluene removal efficiencies greater than 99.9% for flow rates between 1 to 9 gpm and temperatures ranging from 321 to 56°C. During the 5-day demonstration effort, approximately 34,200 L of contaminated groundwater was treated while continuously meeting the project's MTBE clean up goal of 5 µg/L (the secondary drinking water standard for California water supplies).

From late 1984 to early 1985, approximately 10,800 gallons of gasoline leaked from two storage tanks and piping under the Naval Exchange (NEX) gas station at the Naval Base Ventura County Port Hueneme Site

(NBVC). Since 1985, the Navy has taken actions to prevent any further damage to the environment from the leaks. The MTBE remediation technologies demonstrated at NBVC Port Hueneme Site are part of the overall strategy in the NEX Plume Management plan for containment and control of the plume to prevent any further damage to the environment.

Publications:

Kram, M., et al., "MTBE Remediation Using Hollow Fiber Membrane and Spray Aeration Vacuum Extraction Technologies," NFESC CR 00-004-ENV, Sept. 2000.