

Summary of Information About a Laboratory Study of Bioremediation Using Butane

Site Name: Not provided

Site Location: Not provided

Contaminant: MTBE

Media: Soil and Groundwater

Technology: Bioremediation

Technology Scale: Bench

Period of Operation: Not provided

Vendor:

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Description:

Global BioSciences, Inc. (GBI) has patented a process and method to stimulate biodegradation of MTBE and other contaminants in soil and groundwater. This process, referred to as Butane Biostimulation Technologies™, involves injecting butane into a contaminated area using a specially designed delivery system. According to GBI, the injection system is safe, code compliant, and requires little maintenance and technician oversight. The injection equipment is manufactured by Matheson Tri-Gas, a firm specializing in custom engineering and design applications (<www.mathesongas.com>).

GBI's approach to treating contaminated soil and groundwater relies on the ability of different bacteria to cooxidize chlorinated solvents, BTEX and MTBE, as well as a variety of other environmental pollutants, while growing at the expense of butane. Butane is the most soluble of the gaseous alkanes, having four times the solubility of methane, and more than twice that of propane. Butane injection results in a large radius of influence at injection wellheads and may be used as a barrier technology.

According to GBI, butane's high solubility in water results in increased microbial access, which in turn results in high cell densities in both the soil and groundwater. Increased microbial access also results in microbial oxidation within the saturated zone, capillary fringe and vadose zone by increasing the cell densities in the treatment area. Because Butane Biostimulation Technologies™ are designed to enhance natural attenuation processes, inoculation methods are not employed.

GBI has conducted full-scale technology implementation using Butane Biostimulation Technologies™ for chlorinated solvent contamination in soil and groundwater. The Massachusetts Department of Environmental Protection issued GBI final approval on November 12, 1999 to implement Butane

Biostimulation Technologies™ as an Immediate Response Action (IRA) Plan for chlorinated solvents at a site in Canton, Massachusetts. As of January 2000, no data are available from this application.

To date, data are available only for bench-scale testing of Butane Biostimulation Technologies™ for MTBE; pilot-scale testing in the planning stages. GBI has begun a field demonstration using Butane Biostimulation Technologies™ to remediate an MTBE plume at a Sun Oil Company facility. Preliminary data from this test site will be available within four to six months.

In the bench-scale test, MTBE cometabolism was evaluated using Butane-utilizing Bacteria™ suspended in 45 milliliters (ml) of sterile mineral salts medium. The bacteria consisted of groups of cells from the following genera: *Pseudomonas*, *Variovorax*, *Nocardia*, *Chryseobacterium*, *Comamonas*, and *Micrococcus*. Bacteria used for this study were isolated from gasoline-contaminated soil and groundwater. Growth was monitored in 120 ml serum bottles under a butane, MTBE, and air mixture (approximate butane:MTBE ratio was 28:1). Butane consumption rates between 1.5 and 6.0 mg/hr/L were measured for selected consortia using a gas chromatograph equipped with a photoionization detector (GC-PID). MTBE concentrations in the headspace were reduced from as high as 10 mg/L (arbitrary concentration used in study) to sub-ppb levels within a 48-hour period, as measured using a GC-PID. Byproducts that were measured included carbon dioxide and dissolved oxygen, although concentrations were not provided in the available materials. The vendor reported that these data demonstrated the potential for the bioremediation of MTBE using butane as a cometabolic substrate.

The following additional full-scale technology applications of Butane Biostimulation Technologies™ are planned to be performed in 6 to 18 months, depending on the areal and vertical extent of the contaminant plume, contaminant concentrations, and subsurface lithologies:

- Chlorinated Solvent Site located in Cincinnati, Ohio
- Chlorinated Solvent Site located in Des Moines, Iowa (Meeting with EPA on 2/3/00)
- MTBE Site located in Fall River, Massachusetts
- MTBE Site located in Chelsea, Massachusetts
- MTBE Site located in Taunton, Massachusetts

References:

1. Information about Butane Biostimulation Technologies™. <<http://www.biobutane.com/>>. September 27, 1999.
2. Telephone conversation. Richard Weisman, Tetra Tech EM Inc., and Felix A. Perriello, Global BioSciences, Inc. September 28, 1999.
3. Sixth Symposium on Soil and Groundwater Remediation, Montreal, March 1997; *Trichloroethylene Degradation in a Fixed-film Bioreactor*.
4. 97th General Meeting of the American Society of Microbiology (ASM), Miami, May 1997; *Biotransformation of Trichloroethylene Using Butane-Oxidizing Bacteria*.
5. Massachusetts' Environment, April 1998; *An Innovative and Cost Effective Bioremediation Technology for Chlorinated Solvents*.
6. 98th General Meeting of the ASM, Atlanta, May 1998; *MTBE Biotransformation with Butane Oxidizers*.

7. 14th Annual Conference on Soil Contamination, University of Massachusetts, October 1998; *The Bioremediation of Chlorinated Solvents in Soil and Groundwater*.
8. Journal of Soil Contamination; *Biotransformation of Trichloroethylene Using Butane-Oxidizing Bacteria*, January 1999.
9. Americana 1999, Montreal; *Enhancing Natural Attenuation for Remediation: In-situ Bioremediation of TCE and 1,1,1-TCA Using Butane-Oxidizing Bacteria*, March 25, 1999.
10. HazTECH News, March 11&31, 1999. *Use of Butane Pilot-tested for Cometabolic Biodegradation of Chlorinated Organics*.
11. The Professional Geologist, September 1999. *Enhancing Natural Attenuation: A Cost Effective Bioremediation Technology for Chlorinated Solvents*.
12. Massachusetts' Environment, December 1999; *Chlorinated Solvent Case Study using Butane Biostimulation Technologies*.
13. Soil and Groundwater, February 2000; *Chlorinated Solvent Remediation using Butane*.