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INTEGRATED PNEUMATIC FRACTURING/BIOREMEDIATION FOR THE IN-SITU TREATMENT OF CONTAMINATED SOIL

Uwe Frank
U.S. Environmental Protection Agency
Risk Reduction Engineering Laboratory
2890 Woodbridge Avenue
Edison, New Jersey 08837
(908) 321-6626

John R. Schuring
Hazardous Substance Management Research Center
New Jersey Institute of Technology
Newark, New Jersey 07102
(201) 596-5849

The objective of this project is to demonstrate that for low permeability soils, treatment by pneumatic fracturing to increase permeability will enhance bioremediation. For in-situ bioremediation to be successful in a timely manner, the microbial population must be stimulated by injecting nutrients and an oxygen source to the microbes. Normally, formations with low permeability make it extremely difficult to supply microbes with the necessary subsistence making bioremediation technically and economically infeasible. This project involves pneumatic fracturing of contaminated soils followed by biodegradation using indigenous or cultivated microbes. The soils under investigation are contaminated with benzene, toluene and the xylenes (BTX) in concentrations ranging from 120-1500 mg/kg soil. The end point target of the remediation is a 95% reduction in the BTX concentration in the top five feet of the soil bed.

The pneumatic fracturing process involves the injection of high pressure air at controlled flow rates and pressures in the zone of contaminated soil. In fine-grained, low permeability soils such as clay, this process creates conductive channels in the formation. The vapor movement in the formation becomes convection and diffusion-controlled instead of just diffusion-controlled. This increases the permeability and the exposed surface area of the soil, facilitating the treatment and removal of contaminants.

Pneumatic fracturing is also used to enhance stacked aerobic, denitrifying and methanogenic microbial processes in staggered spatial distribution for maximum effectiveness. Aerobic processes will dominate at the fracture interfaces, and to a limited distance, into the soil away from the fracture. Depletion of oxygen during aerobic biodegradation will allow the formation of a denitrifying zone a short distance away from the fracture. Depletion of nitrate by denitrifying biodegradation processes allows the formation of methanogenic populations at greater distances from the fractures. During methanogenic processes, methane will be generated and diffuse out with the fracture sweep air. Results of pilot-scale testing will be presented.

For more information, contact Uwe Frank, U.S. EPA, RREL, 2890 Woodbridge Ave., Edison, New Jersey 08837. Phone (908) 321-6626, FAX (908) 906-6990.