36920 PDF

HYDRAULIC FRACTURES AS ANAEROBIC AND AEROBIC BIOLOGICAL TREATMENT ZONES

Wendy Jo Davis-Hoover, Ph. D., Michael Roulier, Ph.D., L. Taras Bryndzia, Ph. D.
Risk Reduction Engineering Laboratory (RREL), 5595 Center Hill Ave., Cincinnati, Ohio 45224
513-569-7206, 513-569-7796, 513-569-7857; fax 513-569-7879
Jonathan Herrmann,P.E., Leland Vane, Ph.D.
RREL, 26 W. M.L. King Jr. Dr., Cincinnati, Ohio 45268
513-569-7839, 513-569-7799; fax 513-569-7787
Lawrence C. Murdoch, Ph. D., Stephen J. Vesper, Ph.D.
University of Cincinnati, Cincinnati, Ohio
513-556-2568, 513-556-2538

Hydraulic fractures were initially developed to be used in bedrock to enhance oil recovery. We have modified the procedure for use in the environmental field in shallower subsurface soils to increase the permeability of the soils to liquids, gases, and solids. This has allowed us to significantly enhance in situ methods of soil cleaning (pump and treat, steam injection, solvent extraction) (1) and aerobic bioremediation (2) .

We are now concentrating on enhancing movement of contaminants between hydraulic fractures and into hydraulic fractures using electrokinetics and destruction of contaminants within the hydraulic fractures. Bioremediation, very specific to the unusual conditions that electrokinetics presents to the subsurface soil is being developed. This work is being done as a result of the RTDF and in conjunction with researchers at Monsanto, Dupont, General Electric, and DOE.

Hydraulic fracturing allows for the insertion of a pancake-shaped lens of sand. The sand lens increases the soil permeability of the area allowing a 10 fold increase in the area of influence of the well allowing for a 10 fold increase in vapor extraction, and a 10 fold increase in liquid addition (such as solubilized nutrients and hydrogen peroxide), which leads to a 100 fold increase in aerobic bioremediation (1). The process also allows for other solid addition to contaminated subsurface soils such as solid slow-releasing oxygen which increases aerobic bioremediation (2, 3, and 4).

The Lasagna technology uses 2 outer hydraulic fractures as two dimensional electrodes in the electrokinetic process moving contaminants into 3 inner hydraulic fractures designed to be zones of biodegradation (5). Several experiments that the members of the research consortium have performed have indicated that the process of electrokinetics modifies the pH of the soil to a spectrum of 2 to 10 and increases the temperature significantly. Thus as a result of this we decided to naturally select for thermophilic organisms that will degrade contaminants at these high and low pHs .

We have been successful in obtaining thermophilic organisms that will degrade contaminants at high and low pHs (6). These are being tested in lasagna microcosms (6). The next step is to test them in the field.

REFERENCES

1. U. S. Environmental Protection Agency. Hydraulic Fracturing Technology: Applications Analysis and Technology Evaluation Report. EPA/540/R-93/505, U. S. Environmental Protection Agency, Cincinnati, Ohio, 1993. 60 + pp.

2. Vesper, S. J., L. C. Murdoch, S. Hayes, and W. J. Davis-Hoover. Solid Oxygen Source for

Bioremediation in Subsurface Soils. Journal of Hazardous Materials. 36:265-274, 1994.

3. Vesper, S., L. Murdoch, W. Davis-Hoover. Oxygen Pellets Spike Bioremediation. Soils. May 1994. p 14-17, 1994.

4. Davis-Hoover, W. J. , L. C. Murdoch, S. J. Vesper, H. R. Pahren, O. L. Sprockel, C. L. Chang, A. Hussain, W. A. Ritschel. Hydraulic Fracturing to Improve Nutrient and Oxygen Delivery for In situ Bioreclamation.In: R. E. Hinchee and R. F. Olfenbuttel (eds.) In Situ Bioreclamation. Butterworth-Heinemann, Boston.1991. p. 623.

5. Murdoch. L. C., J.-L. Chen, P. Cluxton, and M. Kemper. 1995. Hydraulic Fractures as Subsurface Electrodes: Early work on the Lasagna Process. In: RREL Symposium Proceedings. paper before this.

6. Vesper, S. J., et al. 1995. Advances in TCE-degrading Thermophilic, Mesophilic and Alkaline-Resistant Organisms . In: RREL Symposium Proceedings. paper after this.

FOR MORE INFORMATION: Wendy Jo Davis-Hoover, Ph. D.
RREL, 5595 Center Hill Ave., Cincinnati, Ohio 45224
513-569-7206, fax 513-569-7206