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EHydraulic Pneumatic Fracturing

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The Need

If contaminated sites contain fine-grained soils, such as silts or clays, or dense bedrock, such as shale or siltstone, current in-situ technologies do not provide satisfactory remediation because wastes cannot easily pass through the soil. The presented technology offers an enhanced solution to remediation of sites with such types of soils, increasing the efficiency of remediation technologies like, soil vapor extraction, bioremediation, and thermal enhancement.

The Technology

The technology is an enhancement process designed for integration with primary in-situ treatment technologies such as vapor extraction, bioremediation, thermal treatment, and 'pump and treat'. Fractures in dense soils are created, using hydraulic or pneumatic methods, making existing fractures larger to get at contaminants and allowing a more effective distribution of the extractive air throughout the soil.
Pneumatic Fracturing was jointly developed by Accutech Remedial Systems Inc. and the New Jersey Institute of Technology. It involves the injection of air (or another gas) into a contaminated geologic formation at sufficient pressure and flow rate to create artificial fractures or to extend natural fractures. Once established, the fractures increase the permeability of the formation, which renders the removal or treatment of the contaminant more efficient, particularly by vapor extraction, biodegradation, and thermal treatment. Typically, pneumatic fracturing is used in formations where the fractures will remain open without support (see Figure 1).

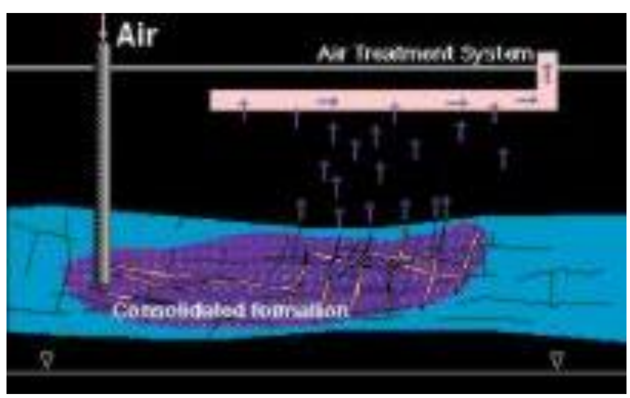

Figure 1 Pneumatic Fracturing

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The technology comprises the following steps: First, the positioning of a proprietary device known as "HQ Injector" (Remediation, Spring 1995) in the fracture well that seals off a discrete one-to-two-foot interval. The next step is the application of pressurized air for approximately 30 seconds. The last step is the repositioning of the HQ Injector to the next elevation and repeating the procedure. A typical cycle takes between 15 to 30 minutes, depending on the amount of time required to move the injector vertically within the same hole, and horizontally from one hole to another. Terra Vac Inc, presents a variation of the pneumatic fracturing using steel probes to create the fractures instead of wells. The probes are inserted using electric jackhammers or a hydraulic device. Hydraulic fracturing is used in formations that require the injection of a solid to support the fractures (see Figure 2).

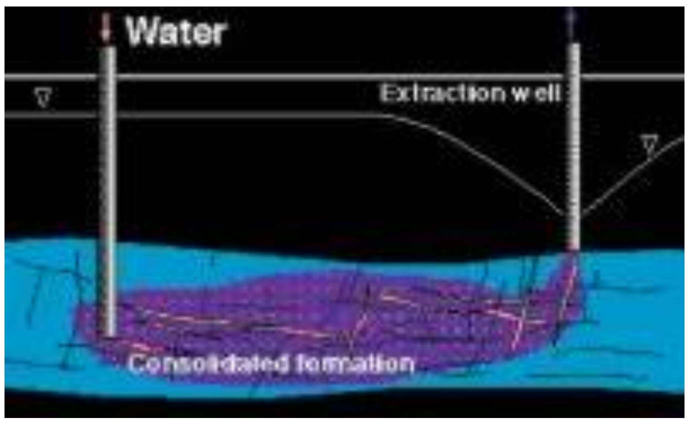

FIGURE 2 HYDRAULIC FRACTURING

It involves the injection of high-pressure water to create sand-filled fractures that will facilitate the permeability and application of the different remediation technologies.

The technique begins with the injection of high-pressure water to start the creation of fractures. A slurry of water, sand, and a thick gel is pumped at high pressure to propagate the fractures. The gel biodegrades resulting in a sand-filled fracture that works as a highly permeable medium for bioremediation, steam or hot air injection, or contaminant recovery and can also improve pumping efficiency and the delivery for other in situ processes.

THE BENEFITS

The benefits of this technology lie in the reduction of the number of remediation wells, and in the treatment duration. The extracted air flow rates are increased by 400 to 700%. This technology has also made in-situ remediation possible in sites where 'excavating and hauling' was the only option. Although it has been estimated that the use of this technology will bring an increase in production cost in excess of that of primary remediation by about $8 to $20 per cubic yard of soil (Remediation, Spring 1995), significant

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overall savings can be realized with this technology. The approximate cost range for pneumatic fracturing is $9 to $13 per metric ton ($8 to $12 per ton).

Status

The Environmental Protection Agency, under the Superfund Innovative Technology Evaluation program (SITE), sponsored several projects where hydraulic and pneumatic fracturing were used and evaluated. The report EPA542-K-94-005 shows a list of several sites where the technologies were applied and where the information regarding their application can be easily obtained. This report can be downloaded from the internet through the following address: http://www.clu-in.com/remed1.htm.

Barriers

Due to the prevailing paradigms in the industry, a higher remediation cost per cubic yard may discourage the industry from adopting hydraulic or pneumatic fracturing. This is because the larger initial cost would seem to overshadow the long-term overall savings or benefits realized from these techniques.

Both technologies are not applicable for treating inorganic or nonvolatile organic compounds or to sites with a high natural permeability. Factors that may limit the applicability and effectiveness of the process include: 1) The technology should not be used in areas of high seismic activity. 2) Fractures will close in non-clayey soils. 3) Investigation of possible underground utilities, structures, or trapped free product is required. 4) The potential exists to open new pathways for the unwanted spread of contaminants (e.g., dense nonaqueous phase liquids).

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Reviewers

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