Soil, Sediment, Bedrock and Sludge

Fracturing

Introduction:

Cracks are generated by fracturing beneath the surface in low permeability and over-consolidated sediments, to produce new passageways that could assist in enhancing the extraction efficiencies of treatment technologies.

Description:

Fracturing is designed to increase the efficiency of other *in situ* technologies in difficult soil conditions. The fracturing increases and extends existing fissures and brings about new ones, typically in a horizontal direction. When fracturing is completed, the formation is subjected to vapour extraction through application of a vacuum to wells or by extracting from selected wells, whilst others are capped or used for passive air inlet or forced air injection. Technologies employed in soil fracturing include blast-enhanced fracturing, Lasagna™ process and pneumatic fracturing.

Blast-enhanced Fracturing

Blast-enhanced fracturing is used at sites with fractured bedrock formations. The enhanced well yields, hydraulic conductivity and capture zones occur due to the highly fractured area created by explosives detonated in boreholes.

Lasagna™ Process

Lasagna™ is an integrated, *in situ* technology, which combines electroosmosis with treatment zones installed directly into the contaminated soil. During the process, hydraulic fracturing is utilised to generate sorption/degradation zones horizontally within the subsurface of the soil.

Pneumatic Fracturing

In this process, fracture wells are installed in the contaminated vadose zone and left uncased for most of their depth. A packer system then isolates small (0.5 m) intervals so that short bursts (around 18 seconds) of compressed air can be injected into the interval in order to fracture the formation. The process is repeated for each interval within depth of the well.

Applicability:

The process of fracturing is suitable for a variety of contaminants and is exploited principally to fracture silts, clays, shale, and bedrock.

Limitations:

- Technology should not be used in areas of high seismic activity.
- Fractures tend to close in non-clayey soils.
- Investigation of potential underground utilities, structures, or trapped free product is needed.
- Potential exists to open new pathways for the unwanted spread of contaminants particularly for dense non-aqueous phase liquids.

Data Needs:

Soil characteristics that must be established are the depth and extent of contamination, concentration of contaminants, and soil type and properties namely structure, organic content, texture, permeability, water-holding capacity, and moisture content.

Performance Data:

The technology is currently available from only a limited number of vendors, but has been demonstrated in the field. Additionally, several bench-scale and theoretical studies have been published.

Standard operation typically requires a two-person crew, generating between 15 to 25 fractures a day with radius's of 4 to 6 meters to a depth of 15 to 30 meters. For longer remediation programs, refracturing may be needed at intervals of 6 to 12 months.

Cost:

The estimated cost for pneumatic fracturing is £ 6 to £ 9 per tonne and for the Lasagna™ process around £ 120 to £ 150 per tonne for remediation in 1 year and £ 70 to £ 95 per tonne if the duration of remediation is 3 years.