Soil, Sediment, Bedrock and Sludge

Soil Flushing

Introduction/Description:

Pure water, or water including an additive to improve contaminant solubility, is applied to the soil or injected into ground water to raise the water table into the contaminated soil zone. Contaminants are leached into the ground water, which is then extracted and treated.

Co-solvent Enhancement:

Co-solvent flushing entails injecting a solvent mixture (e.g. water plus a miscible organic solvent such as alcohol) into the vadose zone, saturated zone, or both to remove organic contaminants. Co-solvent flushing can be used to dissolve either the source of contamination or the contaminant plume stemming from it. The co-solvent mixture is typically injected up gradient of the contaminated area, and the solvent with dissolved contaminants is extracted downgradient and treated above ground.

Extracted ground water could necessitate further treatment in order to meet discharge standards before it's either recycled or released to a publicly owned wastewater treatment works or stream. The separation of surfactants from the recovered flushing fluid is a key factor in the costing of soil flushing. Treatment of the recovered fluids results in process sludges and residual solids, such as spent carbon and spent ion exchange resin, which has to be treated correctly prior to disposal. Air emissions of volatile contaminants from recovered flushing fluids must be collected and treated to meet relevant regulatory standards. The time duration of the soil flushing process is typically short- to medium-term.

Applicability:

The process may be utilised to treat VOCs, SVOCs, fuels, and pesticides, but could be less cost-effective than alternative technologies for these contaminants. The supplement of environmentally compatible surfactants may be used to enhance the solubility of some organic compounds, but the flushing solution may vary the physical/chemical properties of the soil system. This technology offers the ability for recovering metals and can mobilise a number of organic and inorganic contaminants from coarse-grained soils.

Limitations:

- Low permeability or heterogeneous soils are tricky to treat.
- Surfactants can adhere to soil and reduce effective soil porosity.
- The potential of washing the contaminant beyond the capture zone and the introduction of surfactants to the subsurface concern regulators. The technology should be used only where flushed contaminants and soil-flushing fluid can be contained and recaptured.
- Aboveground separation and treatment costs for recovered fluids can drive the economics of the process.

Data Needs:

Treatability tests are needed to establish the viability soil flushing. Physical and chemical soil characterisation parameters that should be known take in soil permeability, soil structure, soil texture, soil porosity, moisture content, total organic carbon (TOC), cation exchange capacity (CEC), pH, and the buffering capacity. Contaminant characteristics include concentration, solubility, partition coefficient and reduction potential.

Performance Data:

Soil flushing is a budding technology that has had limited use in the United States. Preferably, lab and field based treatability studies should be undertaken prior to soil flushing being selected for treatment.

Cost:

Soil permeability is the main cost driver. Soils with a lower permeability are generally more recalcitrant to soil flushing therefore remediation time can be greatly increased which has a knock on effect of increasing costs. Depth to groundwater is a secondary cost driver, with a deeper water table increasing costs.