Soil, Sediment, Bedrock and Sludge

Slurry Phase Biological Treatment

Introduction:

Mixing soil or sediment with water and additional additives generates an aqueous slurry. The slurry is mixed in order to keep solids suspended and microorganisms in phase with the soil contaminants. On conclusion of the process, the slurry is dewatered and the treated soil is disposed of.

Description:

Slurry phase biological treatment comprises of the treatment of excavated soil in a bioreactor. The soil is initially processed to separate out any stones and rubble that may be present. The soil is then mixed with water to a predetermined concentration depending on the concentration of the contaminants present, the rate of biodegradation, and the physical nature of the soils. Some processes pre-wash the soil to concentrate the contaminants. Clean sand can then be discharged; thus leaving just contaminated fines and washwater that requires treating. Normally, a slurry contains 10 to 30% solids by weight.

The solids are retained in suspension in a reactor vessel and mixed with nutrients and oxygen. If needed, an acid or alkali may be added to control the pH. Microorganisms also can also be added if an appropriate population is not present. When biodegradation is concluded, the soil slurry is dewatered. Dewatering devices used comprise of clarifiers, pressure filters, vacuum filters, sand drying beds, or centrifuges.

Bioreactors are generally short- to medium-term technologies.

Applicability:

Bioremediation techniques have been effectively used to remediate soils, sludges, and sediments that have been impacted by explosives, petroleum hydrocarbons, petrochemicals, pesticides, and other organic chemicals. Bioreactors are preferred over *in situ* biological techniques for low permeability soils - areas where underlying ground water may be hard to capture, or when faster treatment times are essential.

Slurry-phase bioreactors are used mainly to treat non-halogenated SVOCs and VOCs in excavated soils or dredged sediments. Sequential anaerobic/aerobic slurry-phase bioreactors are exploited to treat PCBs, halogenated SVOCs, pesticides, and ordnance compounds.

Limitations:

- Excavation of contaminated media is necessary, except for lagoon implementation.
- Sizing of materials prior to putting them into the reactor can be hard and expensive. Non-homogeneous soils and clayey soils can create serious materials handling problems. In the case of free phase contaminant, precluded removal is mandatory.
- Dewatering soil fines after treatment can be costly.
- An acceptable method for disposing of non-recycled wastewaters is essential.

Data Needs:

Even though an organic substance may have been seen to be agreeable to biodegradation in the laboratory or at other remediation sites, whether it degrades in any specific soil/site condition is reliant upon numerous factors. To determine if bioremediation is appropriate for the contaminated soil at a specific site, it is crucial to characterise the contamination, soil, and site, and to assess the biodegradation prospective of the contaminants. A preliminary treatability study should ideally be undertaken.

Key contaminant characteristics that must to be known in feasibility investigation are their solubility and soil sorption coefficient; volatility; chemical reactivity (e.g., tendency toward non-biological reactions such as hydrolysis, oxidation, and polymerisation); and their ability to be biodegraded.

Performance Data:

Slurry phase bioremediation has shown a removal rate over 99% and with a large amount of mineralisation.

Mobile treatment units that are quickly moved into and out of the site are available. Residence time in the bioslurry reactors will vary depending on the character of the contaminants, their concentrations, and the required level of removal. Residence time is approximately 5 days for PCP-contaminated soil, 14 days for a pesticide-contaminated soil, and 60 days for refinery sludge.

Cost:

Treatment costs using slurry reactors lie in the range of £ 70 to £ 130 per cubic meter. Costs ranging from £ 110 to £ 165 per cubic meter can be incurred when the off-gas has to be further treated due to the presence of volatile compounds.