Soil, Sediment, Bedrock and Sludge

Landfarming

Introduction/Description:

Contaminated soil, sediment, or sludge is dig out, spread over lined beds, and regularly turned over or tilled to aerate the waste. Soil conditions are controlled to optimise the rate of contaminant degradation. They include moisture content (by irrigation or spraying), aeration (by tilling soil with predetermined frequency, the soil is mixed and aerated), pH (buffered near to neutral pH through adding crushed limestone or agricultural lime) and the addition of other amendments such as soil bulking agents, nutrients, etc.

Contaminated media is typically treated in lifts that are up to 40 cm in depth. When the desired level of treatment is accomplished, the lift is removed and a new lift is constructed. It could be advantageous to only remove the top of the remediated lift, then build the new lift by adding more contaminated media to the remaining material and mixing. This helps to inoculate the newly added material with a known actively degrading microbial culture, and can help in reducing the overall treatment times. Land treatment is a full-scale technology in which the soil, climate, and biological activity interact to degrade, transform, and immobilise waste constitutes.

A land treatment site should be managed correctly to prevent both on-site and off-site problems with ground water, surface water, air, or food chain contamination. Sufficient monitoring and environmental protections are required.

Applicability:

Ex situ landfarming has been most successful in treating petroleum hydrocarbons. Due to that fact lighter, more volatile hydrocarbons (such as gasoline) are treated successfully by processes involving their volatility (e.g. soil vapour extraction), the use of aboveground bioremediation is generally restricted to heavier hydrocarbons. As a rule of thumb, the greater the molecular weight (and the more rings with a PAH), the slower the degradation rate. Furthermore, the more chlorinated or nitrated the compound, the more difficult it is to degrade.

Contaminants that have been effectively treated using landfarming include diesel, fuel oils, oily sludge, wood-preserving wastes (PCP and creosote), and some pesticides.

Limitations:

- Large amount of space is required.
- Conditions affecting biological degradation of contaminants (e.g., temperature, rain fall) are mostly uncontrolled, which increases the length of time to complete remediation.
- Inorganic contaminants will not be biodegraded.
- Volatile contaminants, such as solvents, must be pre-treated because they would volatilise into the atmosphere, causing air pollution.
- Dust control is an important consideration, especially during tilling and other material handling operations.
- Runoff collection facilities must be constructed and monitored.
- Topography, erosion, climate, soil stratigraphy, and permeability of the soil at the site must be evaluated to determine the optimum design of facility.
- Waste constitutes may be subject to "Land-ban" regulation and thus may not be applied to soil for treatment by landfarming (e.g., some petroleum sludge's).

Data Needs:

Contaminant considerations that should be focused on prior to execution include types and concentrations of contaminants, depth and distribution of contaminants, presence of VOCs and inorganic contaminants, namely metals.

Surface geological features for instance topography and vegetative cover, subsurface geological and hydrogeological features, temperature, precipitation, wind velocity and direction, water availability, soil type and texture, soil moisture content, soil organic matter, cation exchange capacity, water-holding capacity, nutrient content, pH, permeability, and microorganisms (degradative populations present at site) ought to be addressed.

Performance Data:

Several full-scale operations have been utilised, mostly for sludge's from the petroleum industry. As with other biological treatments, under correct conditions, landfarming can transform contaminants into non-hazardous substances. Removal efficiency, however, is dependant upon a large number of factors.

Cost:

Costs before treatment (thought to be independent of the volume treated) is between £ 12,000 to £ 30,000 for laboratory studies; and under £ 50,000 for pilot assessments or field demonstrations.

The cost of a prepared bed (*ex situ* treatment and placement of soil on a prepared liner) is thought to be less than £ 65 per cubic meter.