Soil, Sediment, Bedrock, and Sludge

Composting

Introduction:

Contaminant impacted soil is excavated and combined with bulking agents such as wood chips, hay, manure, and vegetative wastes. Careful selection of the bulking material will help ensure am adequate porosity and provide a balance of carbon and nitrogen to stimulate thermophilic, microbial activity.

Description:

Composting is a controlled biological process by which organic contaminants such as PAHs are broken down by microorganisms (under both aerobic and anaerobic conditions) to innocuous by-products. Thermophilic conditions (54 to 65 °C) must be maintained in order to effectively compost soil that is contaminated with hazardous organic contaminants. Commonly an increase in temperature will be seen as a consequence of heat produced by microorganisms during the degradation of the contaminant. This is typically achieved through the use of indigenous microorganisms. Maximum degradation efficiency is achieved through maintaining oxygenation (e.g., daily windrow turning), irrigation as necessary, and monitoring moisture content and temperature appropriately.

Three process designs are utilised in composting: aerated static pile composting where compost is formed into piles and aerated with blowers. Mechanically agitated composting where compost is put into a reactor vessel where it is mixed and aerated, and finally windrow composting. Here compost is heaped in long piles known as windrows and periodically mixed with mobile equipment such as a digger. Windrow composting is the most cost-effective composting alternative; however it may also yield the greatest fugitive emissions. If VOC or SVOC contaminants are present in soils, there may be the requirement for off-gas control.

Applicability:

The process has been applied to soils and sediments that are contaminated with biodegradable organic compounds. Pilot and full-scale experiments have effectively shown that aerobic composting is capable of reducing the concentration of explosives (TNT, RDX, and HMX) and associated toxicity to acceptable levels. The process is also applicable to PAH-contaminated soil. Equipment used for composting is commercially available.

Limitations:

- Considerable space is needed for composting.
- Excavation of contaminated soils may cause the uncontrolled release of VOCs.
- Due to the use of bulking agents, there is a volumetric increase in material.
- Although levels of metals may be reduced via dilution, heavy metals not treatable by this method. Additionally, high levels of heavy metals can be toxic to the microorganisms, therefore negatively impacting the biodegradation process.

Data Needs:

Data required to assess the compost process are contaminant concentration, excavation requirements, availability and cost of amendments required for compost mixture, space available for the treatment and pile formation, soil type, and the suitability of contaminants to the process of composting composting.

Performance Data:

Windrow composting has been effectively demonstrated for treating explosives-contaminated soil. TNT reductions as high as 99.7% in 40 days of operation, with the majority of removal occurring in the first 20 days of operation have been seen. The equipment requirements are basic and combined with such positive performance results, show windrow composting to be an economically and technically attractive choice for remediation.

Cost:

Costs differ depending on the amount of soil that requires treating. The soil fraction in the compost, availability of bulking agents, type of contaminant, and the process design employed also impact on costs. The cost of a treatment area and a leachate collection system must be considered.

Soils with a greater density such as fine-grained sands and gravels have lower composting costs, whilst higher TOC soils incur higher costs. Density influences the mass of soil that has to be treated, while the TOC percentage indicates the level of contamination. Contaminant type is also a primary driver.