BIOTREATMENT OF SOILS IN SUPPORT OF FORT STEWART ARMY FACILITY

ENVIRONMENTAL SCIENCES DIVISION
"SCIENCE TO SUSTAIN OUR ENVIRONMENT"

Pros and Cons

Pros

- **Relatively simple to design**
- **Short treatment times: usually 6 mo to 2 yr under optimal conditions**
- **Cost competitive**
- **Effective on organic constituents with slow biodegradation rates**
- **Requires less land area than landfarms**
- **Can be designed as a closed system to control vapor emissions**
- **Can be engineered to be potentially effective for any combination of site conditions and petroleum products**

Cons

- **Concentration reductions >95% and constituent concentrations <0.1 ppm are difficult to achieve**
- **May not be effective for high constituent concentrations (>50,000 ppm total petroleum hydrocarbons**
- **Presence of significant heavy metal concentrations (>2,500 ppm) may inhibit microbial growth**
- **Volatile constituents tend to evaporate rather than biodegrade during treatment**
- **Requires a large land area for treatment, although less than landfarming**
- **Vapor generation during aeration may require treatment prior to discharge**
- **May require bottom liner if leaching from biocell is a concern.**

1Adapted from EPA (2004).

Bioremediation Basics Soils contaminated with toxic substances are most frequently treated by removing and transporting the soil to an off-site landfill. While this removes the problem at the contaminated site, it does not remediate the soils and only shifts the problem to another location. Not only is such treatment costly, it increases the risk of human and environmental exposures.

Alternatively, soils contaminated with many types of toxic substances can be effectively treated with bioremediation techniques. Bioremediation uses microorganisms (primarily naturally occurring bacteria and fungi) to degrade and detoxify organic substances to harmless compounds, such as carbon dioxide and water, in a confined and controlled environment, and it is particularly suitable for treating soils contaminated with petroleum hydrocarbons.

Soils can be bioremediated using either in situ or ex situ techniques. In situ techniques (e.g., bioventing, bioaugmentation, biostimulation) treat contaminated soils without removing them. Ex situ techniques (e.g., landfarming, soil biopiles or biocells, composting) involve removal and relocation of the contaminated soil where treatment can be more carefully controlled. The ability to better control the treatment conditions with ex situ techniques reduces the time required for treatment, but because these techniques require excavation and treatment at another location they are often less cost-effective than in situ techniques.

The Problem It is projected that approximately 1,250 and 1,500 tons of soils contaminated with petroleum, oil, and lubricants will be generated annually at Fort Stewart. The sources of these contaminated soils include wash racks where fleet vehicles are cleaned, spills of fuels such as diesel and JP-8, and areas where underground storage tanks have been removed. To limit or stop release of contaminants from these soils, Fort Stewart must remediate existing contaminated sites (e.g., underground storage tanks) and stop and contain new releases (e.g., soils from wash racks) of these contaminants into the environment.

The Solution Oak Ridge National Laboratory, through the Environmental Sciences Division (ESD), is using their expertise in environmental management and remediation to assist Fort Stewart in their efforts to identify and implement suitable means of treating soils that are currently contaminated or that may become contaminated in the future. Factoring in the extent and nature of the problem, the desire to limit use of landfill space, and the need and desire to further limit release of pollutants into the environment, a biotreatment facility that uses biocell technology was designed and is being constructed. This will involve the accumulation of piles of contaminated soils in windrows and stimulating aerobic microbial activity through the aeration and addition of minerals, nutrients, and moisture. Through periodic mixing of soil piles (with a windrow machine) and measurement of key soil characteristics (i.e., pH, moisture, microbial population density, temperature, nutrient and contaminant concentrations), the progress in contaminant reduction can be followed. Once target concentrations of contaminants have been reached (6 months to 2 years depending upon contaminant concentrations and weather conditions), the treated soils will be stockpiled for re-use. The biotreatment facility has been designed so that any contaminated water running off piles during rain events can be collected for treatment prior to discharge.