

Utah Division of Oil, Gas and Mining Guidance Document

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Landfarm Operations Guidance Document (re: Utah Oil & Gas Conservation General Rules R649-9 Waste Management and Disposal)

This document is intended for use in operating or preparing an application for a landfarm disposal facility for bioremediation of oil contaminated soils and solids. Utah Administrative Code R649-9 pertaining to requirements for disposal facilities should be used in conjunction with this guidance.

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Our Mission

The Utah Oil and Gas Program within the Division of Oil, Gas and Mining:

- Promote the exploration, development and conservation of oil and gas resources*
- Foster a fair economic return to the general public for those resources*
- Maintain sound, regulatory oversight to ensure environmentally acceptable activities*

Scope and Applicability

This Guidance Document provides guidelines and standards for activities at facilities conducting bioremediation of hydrocarbon impacted solids and landfarming treatments of exploration and production (E&P) wastes associated with oil and gas activities in the State of Utah.

The Utah Oil and Gas Program Staff (Division) conduct inspections to ensure operations are in compliance with Utah Code Annotated (“UNA”) 40-6-1 et seq. and Utah Administrative Code R649-9 et seq. Inspections ensure landfarming activities are in compliance with conditions of the permit issued by the Division, and are in the best interest of the state and its citizens, that human health, safety and the environment are being protected.

Introduction

Landfarming is a form of bioremediation used to breakdown hydrocarbon compounds from contaminated solids. In its simplest form, landfarming is a technique where hydrocarbon contaminated materials are applied to the soil surface. Materials are mixed with native soil to promote naturally occurring microorganisms to biodegrade hydrocarbon constituents into less innocuous compounds. Bioremediation can be used to decompose petroleum hydrocarbons into other compounds such as carbon dioxide, water, inorganic compounds, and biomass. Optimal use of natural biological activity to render petroleum hydrocarbons harmless requires design and careful implementation of a bioremediation program to capitalize on favorable environmental conditions to aide in decomposition of contaminants.



Knowledge of physical and chemical characteristics of soil, microbial community, and the target pollutants is necessary in determining parameters of a properly functioning landfarm. Measuring progress of a bioremediation process with chemical analysis is essential to assure desired outcome is achieved. Adequate design, planning, management, and control of environmental variables are essential to successfully bioremediate hydrocarbon contaminated materials at landfarming operations. The following environmental parameters produce conditions that are conducive to the promotion of microbial growth and activity:

| Conditions that Promote Microbial Growth | |
|---|---|
| Factor | Optimal Condition |
| Microbial population | Suitable types of organisms that can biodegrade the contaminants of concern |
| Oxygen | Enough to support aerobic biodegradation ($\approx 2\%$ O ₂ in the gas phase or 0.4 mg/L in the soil) |
| Water | Soil moisture should be from 50%-70% of the water holding capacity of the material |
| Nutrients | Nitrogen, phosphorus, sulfur, and other nutrients as determined to support good microbial growth |
| Temperature | Appropriate temperatures for microbial growth (0°C-40°C) |
| pH | Best range is from 6.5 to 7.5 |

Principles

Landfarming hydrocarbons is a bioremediation technique used to degrade hydrocarbon compounds to a predetermined level. Contaminated solids are mixed, spread and treated according to operation design,



than placed over a prepared surface, where they are tilled (R649-9-5.2.4) until target levels for hydrocarbon components are achieved. The basic goal is to stimulate indigenous microbes and facilitate aerobic degradation of hydrocarbon contaminants. To produce optimal results, environmental conditions are managed to produce ideal conditions for microbial activity, accelerating degradation of hydrocarbon compounds.

Materials added to landfarm operations for enhancement of bioremediation are depicted in the operation plan submitted during the permitting process (R649-9-5.1.2). Changes in operations of a landfarm facility require an update to the operations plan and approval by the Division prior to implementation of changes (R649-9-5.1.3).

Application of materials not containing hydrocarbons is an inappropriate use of landfarming techniques. Introduction of high salinity materials or other non-approved E&P wastes, such as drilling mud can be detrimental to growth of microbes, reducing the efficiency of petroleum hydrocarbons remediation. Landfarm operations are designated for bioremediation of hydrocarbon contaminated soils, and should not be utilized for liquids/fluids. Materials accepted at a landfarm facility are to be sufficiently free of liquids to pass a 60-mesh liquid paint filter test (R649-9-5.2.1). Liquids that pool in an area being used for landfarming, including storm water, will require immediate attention (R649-9-5.2.2).

Landfarming is effective for treatment of surficial soils from 4 inches to 12 inches in depth (R649-9-5.2.3). Adequate supplies of oxygen and other nutrients are required for hydrocarbon-eating microbes to fully facilitate the breakdown of hydrocarbon contaminants. Working or tilling of materials applied to a landfarm area is required, a minimum of once monthly. Improperly worked materials become buried in an

oxygen deprived environment, slowing or halting the bioremediation process. Hydrocarbon contaminated materials buried deeper than 12” are considered in noncompliance with R649-9-5.2.4.

Soils on which landfarm cells are constructed should be impermeable to prevent fluids, amendments, hydrocarbons, etc., from passing through upper layers of the soil profile into lower soil layers or migrating off-site out of treated bioremediation cells. Testing of native soils is required to determine where impermeable layers are in the subsurface (R649-9-5.1.1).

Composite sampling of existing materials should be conducted prior to adding additional lifts of hydrocarbon contaminated materials. Sample results are required to demonstrate landfarming activities have remediated hydrocarbon contaminated materials (R649-9-5.2.5). Materials not bioremediated to target levels require continued working until adequate bioremediation can be demonstrated by composition sampling. Materials that have not achieved required bioremediation levels shall not be buried by an additional lift until hydrocarbons have broken down to acceptable levels.

DOGM Clean up levels for Total Petroleum Hydrocarbons (TPH) and Salinity are: TPH <1% or 10,000 ppm & Salinity < 2,560 ppm Total Dissolved Solids (TDS). TPH should be characterized using Total Recoverable Petroleum Hydrocarbon (TRPH) fractions; for specifics on TRPH thresholds see Clean-up Level Guidance Document. Salinity should also be characterized using Electrical Conductivity (EC), Exchangeable Sodium Percentage (ESP), and Sodium Absorption Ration (SAR). Test results, acceptance records for materials received and processes performed on them are necessary to show E&P wastes are being bioremediated properly. Records will be maintained and available for review by DOGM Staff (R649-9-5.2.6).



References

Kensa, V. Mary., *Bioremediation – An Overview*. Journal of Industrial Pollution Control, 27(2), 161-168. 2011.

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Speight, J.G. & Arjoon, K., Bioremediation of Petroleum and Petroleum Products. New Jersey: John Wiley & Sons, 2012.

Utah Administrative Code R649. Natural Resources; Oil, Gas and Mining; Oil & Gas.

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