NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

ORGANIC SORBENTS FOR THE REMEDIATION OF OIL-CONTAMINATED SOILS

(No.)

CODE 772

DEFINITION

Use of organic sorbents to contain spilled petroleum products and provide conditions that are conducive for natural attenuation (i.e. microorganism activity) to occur when sorbent materials are left in place.

PURPOSE

To prevent or mitigate effects of spilled petroleum products on soil, water, and plant quality; eliminate unsightly residues; reduce erosion; protect wildlife, and wetland functions and restore areas to beneficial use.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to locations where large volume oil spills (e.g., from offshore spills) occur, and petroleum products are degrading or threatening to degrade soil quality, water quality, and the environment. This practice can be used in combination with additional remediation methodology or alone when alternate remediation methods are ineffective or excessively invasive.

CRITERIA

General Criteria for All Purposes

Laws, Rules, and Regulations. The landowner/operator is responsible for following all necessary local, state, and federal laws with regards to application, removal, and recycling or disposal of organic sorbents.

The work shall be performed in compliance with all federal, state, and local laws, rules, and regulations with regards to worker training and safety when working with petroleum-based hazardous waste.

Choice of Product. To function as a successful remediation agent, material must have the capacity to absorb oil. Organic sorbents incorporate hydrocarbons into their complex structural matrix primarily composed of cellulose, exposing a significantly higher oil surface to microbial attack. Most organic sorbents, unlike inorganic sorbents, also have a high affinity for water, and serve as supplemental substrates to stimulate microbial growth. The combination of moisture, oxygen, supplemental substrate and high surface area provide an environment for microbial degradation and sequestration of hydrocarbons.

Suitable organic absorbent materials include, but are not limited to, bagasse (rinds of sugarcane), cotton lint and gin wastes, the core and bast of kenaf (a fiber plant), rice hulls, sphagnum peat, wood pulp and wood fiber, grass hays and grain straw. Above materials should be free of noxious weed seed. Suppliers of sorbents are responsible for ensuring that sorbent materials comply with local, state, and federal pesticide and noxious weed seed laws.

The decision to use any given organic absorbent material must be based on documentation from state universities or other independent research entity acceptable to NRCS. Documentation should include information on rate, timing, application method, and any known potential adverse impacts to plants and animals in the ecosystem from the use of a specific organic sorbent.

If a commercially produced product is to be used, the label or accompanying instructions should at a minimum include:

- Active ingredient(s) and their percentage of the whole. Proprietary terminology may be used as long as the actual chemical and/or biological name is included.
    - The purpose(s) for which the product is intended.
    - Recommended application rate(s) to achieve the intended purpose(s).
    - Application timing and methodology to optimize effectiveness of the organic sorbent.
    - Special handling and storage requirements for the organic sorbent.
    - Any safety concerns relating to the use of the organic sorbent and recommended measures to overcome safety concerns.

Timing and Placement. Timing and placement of sorbents will vary between organic and mineral soils. Organic soils generally relate to marshes while sandy soils and mineral soils pertain to beaches and intertidal areas respectively.

Organic sorbents shall be surface applied as soon as possible after deposition of oil or in anticipation of an eminent impact to prevent or retard leaching into soils and runoff.

On organic soils, it is essential that organic sorbents remain in place for several months after application to allow sufficient time for oil disappearance.

On mineral soils, cellulosic materials should be removed as soon as possible after absorption of oil has occurred.

Amount to Apply. Material shall be applied in a quantity which achieves the desired result of preventing or retarding the leaching of oil into soils or runoff.

Criteria for Nutrient Application

Petroleum contains very low amounts of nitrogen and phosphorus, and supplemental amounts of nitrogen and phosphorous can enhance microbial degradation. Optimal C:N and C:P ratios are 15:1 and 200:1, respectively. Nitrogen-rich organic materials can supply most if not all of these nutrient requirements. Water-soluble forms of fertilizer should be avoided where leaching and runoff are likely to occur. Supplemental nutrients need not be applied where mechanical recovery of sorbed oil is planned.

Criteria for Sites Subject to High Levels of Wind or Water Movement

If the material is to be applied in situations where water currents, wave action, tides or high wind speeds could be expected to move the material from the application site, material should be placed or anchored to ensure it cannot wash or blow out for several months after application.

CONSIDERATIONS

Consider availability of supply, quality, biodegradability, and known capabilities for absorbing hydrocarbons of specific organic sorbents when deciding on which product to apply.

Characteristics shown below can interact with organic sorbents and affect amount and rate of biodegradation.

- **Bulk Density -** The mass of absorbent per unit volume of soil determines the amount of exposed surface available for the incorporation of hydrocarbons and thus subjected to microbial attack.
- **Particle size distribution -** Particle size determines amount of surface area available for chemical exchange. Particle size also affects the tendency of organic absorbents to disperse in response to wind and water movement. Ideally, absorbents should remain in place once applied.
- **Aeration** - Degradation of petroleum hydrocarbons is primarily an aerobic process. Saturated soils will have slower degradation rates.
- **Reaction (pH) -** Neutral or slightly alkaline pH values promotes optimum microbial activity and biodegradation.

Adjusting the pH may be required for optimum degradation.

- **Moisture -** Although aerated environments are necessary for rapid crude oil degradation, research indicates the biodegradation of simple or complex organic material in soil is commonly greatest at 50 to 70% of the soil water holding capacity.
- **Temperature -** The highest rates of petroleum hydrocarbon degradation occur above 68^{o} F.

When conditions are not optimal for biodegradation and modification is not possible, consider using higher rates of sorbent or sorbent with slower decomposition rates.

Where organic sorbent material will be subject to water currents, wave action, tides or high wind speeds, consider using materials with higher bulk density, longer fiber length, or can be more easily secured in the environment.

PLANS AND SPECIFICATIONS

Plans and specifications for remediation of petroleum contaminated soils shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. As a minimum, the following shall be included:

- Layout of the planned treatment system showing location of all practices.
- Specific sorbent agent to be used.
- Type and amount of nutrients to be applied.
- Type of equipment used for distribution.
- Thickness of sorbent layer to be applied.
- Details for handling, disposal/utilization of absorbed materials.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and reviewed with the owner/operator prior to implementation of the remediation process.

A monitoring plan shall be developed to assess the efficiency and performance of the treatment system. It is recommended that soil samples be taken monthly for one year after the treatment is applied.

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