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Standard Guide for Ecological Considerations for the Restriction of the Use of Surface Washing Agents: Permeable Land Surfaces[1]

This standard is issued under the fixed designation F1279; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers the use of surface washing agents to assist in the control of oil spills. The guide is written with the goal of minimizing the environmental impacts of oil spills; this goal is the basis on which the recommendations are made. Aesthetic and socioeconomic factors are not considered although these and other factors are often important in spill response.

1.2 In making surface washing agent use decisions, appropriate government authorities should be consulted as required by law.

1.3 Spill responders have available several means to control or clean up spilled oil. In this guide, the use of chemical surface washing agents is considered.

1.4 This guide applies only to permeable land surfaces. This guide does not apply to shorelines.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate ~~safety~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F1280 Guide for Ecological Considerations for the Use of Surface Washing Agents: Impermeable Surfaces

F1872 Guide for Use of Chemical Shoreline Cleaning Agents: Environmental and Operational Considerations

3. Terminology

3.1 *Definitions:*

3.1.1 *permeability*—the capacity of the surface to conduct or transmit liquids such as water. An impermeable surface would not transmit water in a short time (minutes).

3.1.2 *surface*—the top or cover of the land at the site of interest

3.1.3 *surface washing agents*—a chemical agent used to ~~loosen~~ loosen, mobilize or remove oil from a surface such as land. Surface washing agents are not dispersants and should not be used as dispersants

4. Significance and Use

4.1 This guide is meant to aid local and regional response teams who may use it during spill response planning and spill events.

4.2 This guide should be adapted to site-specific circumstances.

5. Environment Covered—Permeable Surfaces

5.1 Permeable ground includes any soil, rock, agricultural land and forest, pasture land, roadside or other surfaces, that are permeable to water and oil.

[1] This guide is under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Response and is the direct responsibility of Subcommittee F20.13 on Treatment.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

6. Background

6.1 On permeable surfaces, the main concern is the penetration of the oil downwards and the possibility of soil and groundwater contamination (**1**, **2**).[3] Efforts are generally focused on removing liquid oil rapidly and preventing further aerial and downward contamination in the soil and to the groundwater (**3**). (See Guide F1280.)

6.2 The effects of oil and especially that of treated oil on terrestrial biota have been studied. In one study, oil spilled on soil decreased the nematode (worm) population by as much as 80 % (**4**). Lai Hoi-Chaw and co-workers show that a littornid gastropod (snail) showed avoidance to oil spilled on the mud of a mangrove swamp (**5**). This avoidance decreased the mortality of the species to both oil and chemically-dispersed oil. McGill has noted that soil arthropods (insects) are quickly killed after spills (**6**).

6.3 Oil has a broad-spectrum herbicidal effect on plants (**7**, **8**). Effects vary depending on concentration and on species. Oil in low concentrations has been shown to increase growth in some species, whereas slight contact with oil causes death in others (**7**). Black spruce, alfalfa, and canola have a low tolerance for oil, while willow, dogwood, and brome grass have a high tolerance (**8**). Light oils may be toxic to vegetation on contact. Heavy oils have a tendency to smother plants over a longer period of time (**6**). Oiling of the vegetative portions may kill the upper portion of the plant, but the root may still live and proceed to grow new stalks (**6**). In one test, 0.4 to 3.4 L/m^2 of a light crude oil killed most plants in a northern boreal setting (**9**). In another experiment, light fuel oil at 0.6 % by weight killed all plants present (**10**). Oil reduces the germination rate of seeds. Weathered oil on the soil forms a crust which can slow revegetation (**6**). Revegetation time varies but has ranged from 1 to 20 years depending on location and spill conditions (amount, oil type, time of year) (**4**, **6**).

6.4 Oil spilled on ground will penetrate the surface, the rate of penetration depending on soil type, pore size, depth of the water table, and oil type. Surface washing agents increase the penetration rate and depth (**11**, **12**). Dewling and Silva examined the use of surface washing agents in Brazil and determined that the average penetration of oil was increased from 5 to 60 cm by the use of hydrocarbon-based surface washing agents (**13**). Similarly, Calderon et al. examined the use of surfactants on oil through sandy soil and found that penetration downward was increased (**14**).

6.5 Oil degradation takes place on soil surfaces under many conditions. Factors that increase degradation rate and amount include higher-than-normal oxygen level, ample but not excessive (saturating) moisture, slightly alkaline pH, high temperature and ample nutrients (**4**). Initially after a spill, the diversity of soil microorganisms is decreased by the toxicity of the oil, but the total number is increased due to the increase in number of oleoclasts (oil degrading microorganisms). Parkinson showed in a test spill on northern boreal soil that soil respiration increased 100 % and the bacterial numbers increased tenfold (~~14~~15).

6.6 Microbial degradation of oil occurs primarily at the soil surface (**4**, **7**, ~~15~~16). One study showed that below 15 cm there was little degradation (~~15~~16). Degradation occurs primarily at the surface due to oxgyen, low but sufficient moisture, supply of nutrients, and because the occurrence of the great number of oleoclasts (**4**).

6.7 Contamination of surface water and groundwater is of prime concern in land spills. Little oil degradation takes place in groundwater and dilution alone would take many years to allow use of a groundwater supply contaminated by an oil spill (**4**, ~~16~~17). One study estimated that 120 to 750 years of rainfall dilution alone would be required so that the supply could be used for human consumption (~~16~~17). On the other hand, in a karst environment, flow to groundwater could do more significant damage. Movement of contaminated groundwater can result in broad contamination of the subsurface.

6.8 Several biological remediation techniques have been demonstrated for oiled soils (**4**, **6**, **8**, ~~17~~18, ~~18~~19). Most of these techniques involve aeration, addition of fertilizer, and planting of cover crops. These techniques are well-documented and have been effective in restoring agricultural land to full production in as little as five years. No scientific evidence is available to show that surface washing agents have a useful role in these remediation techniques.

6.9 Several spills on permeable land have been dealt with successfully using mechanical removal, in-situ burning and other remediation techniques (**1**, ~~19~~20, ~~20~~21, ~~21~~22).

6.10 Studies of the toxicity of natural products such as d-limonene, from citrus peels, reveals that many of these have high aquatic toxicities, while showing little human toxicity. Such agents are not recommended for use where runoff can effect biota (~~22~~23, ~~23~~24). (See Guide F1872.)

7. Recommendations

7.1 Surface washing agents should not be used on any permeable land surfaces.

8. Keywords

8.1 land; oil spill; oil spill surface washing agents; permeable; soil ; surface washing agents

[3] The boldface numbers in parentheses refer to the list of references at the end of this guide.