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Standard Guide for Ecological Considerations for the Use of Oilspill Dispersants in Freshwater and Other Inland Environments, Permeable Surfaces[1]

This standard is issued under the fixed designation F 1279; 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 oilspill dispersants 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 Spill responders have available several means to control or clean up spilled oil. In this guide, the use of dispersants is given equal considerations with other spill countermeasures. It is not considered as a last resort after all other methods have failed.

1.3 This is a general guide only. It assumes the oil to be dispersible and the dispersant to be effective, available, applied correctly, and in compliance with relevant government regulations. In the assessment of environmental sensitivity, it is assumed that the dispersant is nonpersistent in the natural environment. Oil, as used in this guide, includes crude oils and refined petroleum products. Differences between individual dispersants or between different oil products are not considered.

1.4 The guide is organized by habitat type; for example, small ponds and lakes, rivers and streams, and land. It considers the use of dispersants primarily to protect habitats from impact (or to minimize impacts) and to clean them after a spill takes place.

1.5 This guide applies only to freshwater and other inland environments. It does not consider the direct application of dispersants to subsurface waters.

1.6 In making dispersant use decisions, appropriate government authorities should be consulted as required by law.

1.7 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Significance and Use

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

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

3. Environment Covered—Permeable Surfaces

3.1 Permeable ground includes any soil, rock, agricultural land and forest, pasture land, forest, roadside or other surface, that is permeable to water and oil.

4. Background

4.1 The effects of oil and especially that of dispersed oil on terrestrial biota is not well known. In one study, oil spilled on soil decreased the nematode (worm) population by as much as 80 % **(1).**[2] Lai Hoi-Chaw and co-workers show that a littornid gastropod (snail) showed avoidance to oil spilled on the mud of a mangrove swamp **(2).** 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 **(3).**

4.2 Oil has a broad-spectrum herbicidal effect on plants **(3,4).** 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 **(4).** Black spruce, alfalfa and canola have a low tolerance for oil, while willow, dogwood and brome grass have a high tolerance **(5).** Light oils may be toxic to vegetation on contact. Heavy oils have a tendency to smother plants over a longer period of time **(3).** 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 **(3).** In one test, 0.4 to 3.4 L/m^2 of a light crude oil killed most plants in a northern boreal setting **(6).** In another experiment light fuel oil at 0.6 % by weight killed all plants present **(7).** Oil reduces the germination rate of seeds. Weathered oil on the soil forms a crust which can slow revegetation **(3).** Revegetation time varies but has ranged from 1 to 20 years depending on location, condition, and amount of oiling **(1,3).**

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

4.3 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. Studies on marine beaches show that dispersants increase the oil penetration. Dispersants increase the penetration rate and depth **(8,9).** Rowland and co-workers showed that dispersants premixed with oil increased penetration into supratidal sediment **(10).** Dewling and Silva examined the use of dispersants on a beach in Brazil and determined that the average penetration of oil was increased from 5 to 60 cm by the use of hydrocarbon-based dispersants **(11).**

4.4 Oil degradation takes place on soil surfaces under many conditions. Factors that increase degradation rate and amount include high oxygen level, ample but not excessive (saturating) moisture, slightly alkaline pH, high temperature and ample nutrients **(1).** 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). Soil respiration increases after a spill **(1).** Parkinson showed in a test spill on northern boreal soil that soil respiration increased 100 % and the bacterial numbers increased tenfold **(12).**

4.5 Microbial degradation of oil occurs primarily at the soil surface **(1,3,13).** One study showed that below 15 cm there was little degradation **(14).** Degradation occurs primarily at the surface due to oxgyen, low but sufficient moisture, supply of nutrients, and because the highest population of oleoclasts is there **(1).**

4.6 Contamination of 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 **(1,15).** 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 **(15).**

4.7 Several remediation techniques have been demonstrated for oiled soils **(1,3,5).** 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 dispersants have a useful role in these remediation techniques.

5. General Considerations for Making Dispersant Use Decisions

5.1 The dispersant use decision is, in this case as most others, one of tradeoffs. The use of dispersants can reduce the adverse effects of spilled oil on certain biological species at the expense of other components of the ecosystem.

5.2 In most cases the mortality of individual creatures is of less concern than the destruction of habitat. The repopulation of areas after the spill will occur naturally when an area becomes a suitable habitat for a given species.

5.3 Groundwater protection is a high priority for land spills. Groundwater contamination has serious consequences and is difficult to clean up. Groundwater should be protected during land spill cleanup.

6. Recommendations

6.1 Where groundwater contamination is not a concern, the use of dispersants may be considered as a spill countermeasure.

6.2 The use of dispersants on permeable surfaces is not recommended where groundwater can be affected. Consultation with a groundwater specialist is recommended.

6.3 Degradation of oil occurs naturally on many soils and the use of dispersants can move oil downward where it degrades more slowly. The use of dispersants is only recommended when other technologies are ineffective in reducing the potential for oil runoff or animal contact. This is one of the environmental trade-off situations.

7. Keywords

7.1 dispersants; freshwater; inland; oil spill; oilspill dispersants; permeable; soil

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