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Standard Guide for Use of Chemical Shoreline Cleaning Agents: Environmental and Operational Considerations[1]

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1. Scope

1.1 This guide covers the use of chemical cleaning agents on oiled shorelines. This guide is not applicable to other chemical agents nor to the use of such products in open waters.

1.2 The purpose of this guide is to provide information that will enable spill responders to decide whether to use chemical shoreline cleaning agents as part of the oil spill cleanup response.

1.3 This is a general guide only. It is assumed that conditions at the spill site have been assessed and that these conditions are suitable for the use of cleaning agents. It is assumed that permission has been obtained to use the chemical agents. Variations in the behavior of different types of oil are not dealt with in this guide and may change some of the parameters noted herein.

1.4 This guide covers two different types of shoreline cleaners: those that disperse oil into the water and those that disperse little oil into the water under low energy levels. The selection criteria for these two types can differ widely. This guide does not cover dispersants.

1.5 *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. Referenced Documents

2.1 *ASTM Standards:*

F 929 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Marine Mammals[2]

F 930 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Rocky Shores[2]

F 931 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Seagrasses[2]

F 932 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Coral Reefs[2]

F 971 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Mangroves[2]

F 972 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Nearshore Subtidal[2]

F 973 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Tidal Flats[2]

F 990 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Sandy Beaches[2]

F 999 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Gravel or Cobble Beaches[2]

F 1008 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-Salt Marshes[2]

F 1012 Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response-the Arctic[2]

F 1209 Guide for Ecological Considerations for the Use of Oilspill Dispersants in Freshwater and Other Inland Environments, Ponds and Sloughs[2]

F 1210 Guide for Ecological Considerations for the Use of Oilspill Dispersants in Freshwater and Other Inland Environments, Lakes and Large Water Bodies[2]

F 1231 Guide for Ecological Considerations for the Use of Oilspill Dispersants in Freshwater and Other Inland Environments, Rivers and Creeks[2]

F 1279 Guide for Ecological Considerations for the Use of Oilspill Dispersants in Freshwater and Other Inland Environments, Permeable Surfaces[2]

F 1280 Guide for Ecological Considerations for the Use of Oilspill Dispersants in Freshwater and Other Inland Environments, Impermeable Surfaces[2]

F 1686 Guide for Surveys to Document and Assess Oiling Conditions on Shorelines[2]

3. Significance and Use

3.1 This guide is primarily intended to assist decision-makers and spill-responders in contingency planning, spill response, and training.

3.2 This guide is not specific to site or type of oil.

4. Background

4.1 Chemical shoreline cleaning agents are compositions designed to be applied to oil and to remove oil from the shoreline above the low water line.

4.2 Chemical shoreline cleaning agents are generally used

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[2] *Annual Book of ASTM Standards*, Vol 11.04.

differently from chemical dispersants, which are used to treat oil spills in offshore waters.

4.3 Chemical shoreline cleaning agents are sometimes known as surface washing agents, shoreline cleaners, or beach cleaners.

4.4 The basic application method for shoreline cleaning agents is to spray the product onto the oil and leave the agent to penetrate the oil and then either flush away the oil or let a rising tide wash it away. The oil may be washed directly into containment areas for recovery **(1)**.[3]

4.5 The fundamental advantage of using a shoreline cleaning agent is that oil can be removed rapidly without using excessive temperatures or pressures, which can be harmful to biota on and in beaches **(2,3)**.

4.6 Laboratory effectiveness tests have been developed and many products have been tested **(4-6)**. Field effectiveness tests are being developed **(7,8)**.

4.7 Laboratory testing shows that effectiveness may differ in saltwater and freshwater **(6,9)**.

4.8 There are differences in action mechanisms between dispersants and shoreline cleaning agents. Composition of the two products differ **(4, 9-13)**.

4.9 Before specialized products were developed, dispersants were used as shoreline cleaning agents with varying results **(14)**.

4.10 The aquatic toxicity of the treating agents varies widely and is a factor in choosing products **(3,9)**.

4.11 The amount of oil dispersed into water primarily depends on energy used to remove the oil from the substrate, especially for dispersing shoreline treating agents. The energy level is difficult to measure, but may be estimated from indicators such as the pressure of the rinse water **(1-3)**.

4.12 The ease of oil removal from a beach depends very much on the type of oil, its degree of weathering and the type of beach. For example, a highly-weathered oil is difficult to remove by any means **(2)**.

5. General Considerations for Using Chemical Shoreline Cleaning Agents

5.1 Two basic types of shoreline cleaners are available: those that disperse oil into the water column, and those that disperse little oil into the water column at low energy levels.

5.2 Considerations for the use of shoreline cleaning agents that disperse are the same as those for using dispersants in the specific habitat. ASTM Guides F 929, F 930, F 931, F 932, F 971, F 972, F 973, F 990, F 999, F 1008, F 1012, F 1209, F 1210, F 1231, F 1279, F 1280, and F 1686 have been prepared for many of these habitats as referenced in Section 2.

5.3 Shoreline cleaning agents that do not disperse, have very little impact on the water column.

5.4 Regulatory authorities may have additional criteria and regulations regarding the acceptability and use of shoreline cleaning agents.

5.5 The decision of whether to use or not to use shoreline cleaning agents always involves tradeoffs. Using a non-dispersing shoreline cleaning agent moves oil out onto the water where it must be recovered. Using a dispersing cleaning agent moves oil into the water column. Therefore, adverse effects on water organisms may be increased in the water column (in the case of a dispersing agent) by removing it from the shoreline.

5.6 Shoreline cleaning agents are used primarily as a cleanup method and not as a spill control method. Since some shorelines are more vulnerable to the longer lasting impacts of spilled oil, an acceptable tradeoff may be to protect these sensitive environments by removing the oil and either recovering it or putting it into a less sensitive environment. When dispersing-type agents are used, the tradeoff that must be evaluated is the long-term impact of the residence time of spilled oil that is stranded on shorelines as opposed to the short-term impact of the presence of dispersed oil in the water column. For non-dispersing agents, the trade-off that must be evaluated is the difficulty of recovering the released oil versus the impact of the long residence time of spilled oil that is stranded on shorelines and the possibility of re-oiling adjacent shoreline.

5.7 It has been found that some shoreline cleaning agents are equally effective in fresh and salt water, while others are not. The salinity of the water involved may therefore be a factor, and the effectiveness of the particular product in that salinity **(9)**.

6. Environments Covered

6.1 *Shorelines Generally*—Shorelines vary extensively in their composition and their retention of oil. Several classification schemes are available for oiled shorelines as well as guides to other cleanup methods **(15,16)**.

6.2 *Seagrasses*—Seagrass-dominated shorelines can be found in shallow marine environments from the tropics to Arctic regions. Seagrass beds form a discreet ecosystem that traps material derived from terrestrial sources and then exports large quantities of organic matter to the open sea. The presence of an extensive network of roots and rhizomes facilitates not only the sediment-binding of the grass beds but also the transport of materials back out to sea. Oil can adhere to the seagrasses and cause damage.

6.3 *Mangroves*—Mangrove ecosystems are intertidal forests dominated by various species of woody halophytes, commonly called mangroves. There are 12 families and more than 54 species of mangroves. Mangrove ecosystems occur in tropical low-energy depositional areas. Mangroves tend to promote the deposition of organic and mineral matter and their extensive root systems are important in stabilizing intertidal sediments. They are important ecologically as they provide the structural basis for many species of animals and plants. Mangroves are particularly prone to damage from oiling as they have respiratory openings on roots that can be clogged **(17)**.

6.4 *Tidal Flats*—Tidal flats are usually broad intertidal areas of unconsolidated sediments that have little slope and are usually protected from direct wave action. They are composed of sediments of varying characteristic grain size depending on the amount of wave and current energy present. Tidal flats may be covered by seagrasses, marsh grass, or mangroves, the environments which are discussed elsewhere in this guide.

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

Tidal flats are important to the coastal ecosystem because of the high biological productivity. Oil retention on tidal flats is largely transitory and oil will often be carried to the supra-tidal regions.

6.5 *Sandy Beaches*—Sandy beaches are composed of sediments ranging from 0.06 to 2.0 mm in size. The composition of the sand itself may vary, but it is usually either siliceous or carbonate. The character of the sediment may be a significant factor in oil retention as oil adheres differently to different types of materials. Wave action can change the profile of a sandy beach and can bury or cover oil.

6.6 *Gravel Beaches*—Gravel beaches are composed of sediments ranging in size from 2.0 to 63 mm. The materials are usually a mixture of minerals with a variety of oil retention properties. Gravel beaches are dynamic and sometimes change in profile. They can retain large amounts of oil which may be buried under clean beach material as a result of wave action. The dynamic nature of the gravel beach depends on its exposure. Sheltered gravel beaches are relatively stable, whereas the gravel on exposed beaches may be continuously re-distributed.

6.7 *Cobble Beaches*—Cobble beaches are composed of materials ranging from 64 to 256 mm. Cobble beaches are relatively stable, unless the beach is exposed to high seas. Cobble beaches will retain the most oil of all types of beaches because of the large interstitial spaces.

6.8 *Boulder/Rocky Beaches*—Boulder or rocky beaches are composed of materials larger than 256 mm (boulders) or bedrock. Despite the large interstitial spaces, they do not retain as much oil as cobble beaches, generally because the interstitial spaces are large enough to permit run-off. Retention is much greater, however, than that for several other types of beaches. The slope of the shore can range from vertical rock wall to a gently sloping or nearly flat platform. The nature of the entire intertidal environment is controlled primarily by the wave energy. Similarly, the biological abundance usually corresponds to the energy regime. High-energy shorelines typically have less biota than low-energy shorelines. The retention of oils varies with the energy. High energy shorelines are generally self-cleaning.

6.9 *Coastal Salt Marshes*—Coastal salt marshes are intertidal wetlands, transitional zones between terrestrial and aquatic ecosystems. Salt marshes are generally formed when plants invade shallow, protected tidal flats on low coastal lands. Typically, soil immersion occurs during about half of the tidal cycle. Salt marshes are low-energy environments in which oil is generally trapped and retained. Salt marshes are very important ecologically and generally are very fragile environments.

6.10 *Freshwater Marshes*—Freshwater marshes are the equivalent of saltwater marshes and are generally found at the fringe of a lake or river. Retention of oil is again high and due to the low energy, self-cleaning is minimal.

6.11 *Ponds and Sloughs*—Ponds and sloughs are freshwater bodies that have little or no water circulation. These water bodies are characterized by high oil retentivity as often there is dense vegetation that can retain oil.

6.12 *Lake Shores*—Lakes are freshwater bodies that can have shorelines very similar to sea shores.

6.13 *River Shores*—River shores may be similar to their sea shore counterparts. Specific types should be compared to that of sea shores.

6.14 *Man-Made Structures*—Man-made structures include piers, docks, breakwaters, boat ramps, dykes, etc. The retentivity and porosity of such structures vary with the type of construction material.

7. General Operational and Environmental Considerations for Use of Shoreline Cleaning Agents

7.1 The tradeoff between leaving the oil on the shoreline or removing it by perhaps more intrusive means, and the use of the treating agent is the primary consideration. The use of dispersing shoreline cleaning agents involves the additional consideration of the fate and effects of the oil in the aquatic environment.

7.2 The aquatic toxicity of the treating agent and the oil is of concern for dispersing shoreline cleaning agents. These types of shoreline cleaning agents require the same considerations as noted for dispersants in the referenced documents.

7.3 The effectiveness of a shoreline cleaning agent may not be the same in fresh water as in salt water.

7.4 Non-dispersing shoreline cleaning agents are usually used to remove oil from the shoreline and the oil is then recovered. The oil spill recovery potential off a given shoreline must then be considered.

7.5 An agent is most effective when it has ample time to penetrate into the oil. Thirty minutes or more of soaking or penetration time are recommended **(1)**.

7.6 After treatment, the oil may be removed using low-pressure water hoses **(1,2)**.

8. Considerations for Specific Types of Environment

8.1 *Shorelines Generally*—Since shorelines vary extensively in sensitivity, oil retentivity, and environmental importance, a general recommendation cannot be made. Each specific environment should be considered separately. An important consideration is the net environmental benefit of using the chemical beach cleaner versus leaving the oil on the shoreline or using other cleanup methods.

8.2 *Seagrasses*—Seagrasses can be treated with shoreline cleaning agents to remove oil. The agent's toxicity to the seagrass should be assessed before usage. Testing of some types of treating agents have shown relatively good success. Care must be taken to avoid physically disturbing the sea grasses during the cleanup operations, which can do more damage than the oil **(18,19)**.

8.3 *Mangroves*—Oil can be removed from the extensive root system using shoreline treating agents, which may save the mangroves or significantly reduce damage to them. Access to perform the operations may be difficult. Experimental data shows that up to 50 % of the mangroves can be saved if treated within 7 days **(17)**.

8.4 *Tidal Flats*—Tidal flats do not often require cleaning, because the oil does not usually retain to the substrate. If oil is retained, it can be treated with shoreline cleaning agents, although access is often difficult and can be damaging to the tidal flats.

8.5 *Sandy Beaches*—Sandy beaches are readily amenable to treatment using shoreline cleaning agents. Low energy washing is required to avoid disturbing the sand.

8.6 *Gravel Beaches*—Gravel beaches can be treated with shoreline treating agents of the non-dispersing type. The dispersing type of agents will cause oil and agent to penetrate to the subsurface. Low energy washing is required to avoid disturbing the shoreline material and damaging biota on the beach.

8.7 *Cobble Beaches*—Shoreline cleaning agents of the non-dispersing type can be used on cobble beaches. Dispersing cleaning agents will cause the oil and surface agent to penetrate to the subsurface.

8.8 *Rocky/Boulder Shores*—The necessity of removing oil varies with exposure. High-energy shorelines will generally self-cleanse. Rocky shorelines are the easiest to clean and generally do not have high levels of biota that can be affected by the cleaning operation. They can, however, be difficult to access. The amount of spray pressure required to remove oil is less than for other types of beaches.

8.9 *Coastal Salt Marshes*—Coastal salt marshes can be cleaned using shoreline cleaning agents. Care must be taken to avoid physically disturbing the marshes. Marshes are particularly vulnerable to physical damage that could be caused by vehicles or the use of tools. High-pressure cleaning should be avoided for the same reason **(18,19)**.

8.10 *Fresh Water Marshes*—Fresh water marshes can be cleaned using shoreline cleaning agents. Care must be taken to avoid physically disturbing the marshes. Marshes are particularly vulnerable to physical damage that could be caused by vehicles or the use of tools. High-pressure cleaning should be avoided for the same reason **(18,19)**.

8.11 *Ponds and Sloughs*—Ponds and sloughs can be cleaned using shoreline cleaning agents. Non-dispersing agents should be used whenever possible to avoid hydrocarbon loading in these water bodies.

8.12 *Lakes Shores*—Lakes shores can be cleaned using shoreline cleaning agents. Care must be taken to avoid physically disturbing the lake shore. Non-dispersing agents should be used whenever possible to avoid hydrocarbon loading in these water bodies. Furthermore, as most lakes are used for drinking water, hydrocarbons should be minimized in the water column.

8.13 *River Shores*—River shores can be cleaned using shoreline cleaning agents. Non-dispersing agents should be used whenever possible to avoid hydrocarbon loading in these water bodies. Furthermore, as most rivers are used for drinking water, hydrocarbons should be kept from dispersing into the water column.

8.14 *Man-Made Structures*—Man-made structures can be cleaned using shoreline cleaning agents. Man-made structures are generally not sensitive to water pressure.

9. Keywords

9.1 chemical treating agent; oiled shorelines; oil-spill cleanup; shoreline cleanup; surface washing agent

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