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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 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]

F1686 Guide for Surveys to Document and Assess Oiling Conditions

F2532 Guide for Determining Net Environmental Benefit of Dispersant Use

[1] This guide is under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Responseand 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.

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 formulations 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 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. Containment areas should be provided before flushing. The oil should 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 shorelines (**1-3**).

4.6 Laboratory effectiveness tests have been developed and many products have been tested (**1, 4, 5, 6**). Field effectiveness tests have been developed (**1**). Removal tests of weathered bitumen showed that a surface washing agent was only effective up to 7 days after oiling because of weathering and up to 5 days after oiling if in full sunlight (**7**).

4.7 Laboratory testing shows that effectiveness may differ in saltwater and freshwater (**1**). Further factors affecting effectiveness included temperature and water quality (**8**).

4.8 There are differences in action mechanisms between dispersants and shoreline cleaning agents. Composition of the two products differ (**1, 6**).

4.9 Before specialized products were developed, dispersants were used as shoreline cleaning agents with varying results (~~7~~10).

4.10 The aquatic toxicity of the ~~treating~~cleaning agents varies widely and is a factor in choosing products (**1, 8**11, **9**12, 13).

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~~cleaning agents. The energy level is difficult to measure, but may be estimated from indicators such as the pressure of the rinse water (**1**).

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 (**1, 2**).

5. General Considerations for Using Chemical Shoreline Cleaning Agents

5.1 Two basic types of shoreline cleaners are available: those that disperse little oil into the water column at low energy levels (most common) and those that disperse oil into the water column (these agents are not common).

5.2 Considerations for the use of shoreline cleaning agents that disperse are the same as those for using dispersants in the specific habitat. (See Guide F2532.)

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

5.3 Shoreline cleaning agents that disperse little oil 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 Shoreline ~~treating~~cleaning agents should be used in accordance with manufacturer's recommendations.

5.6 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. (See Guide F2532.)

5.7 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.

5.8 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 saline ~~environment.~~environment (**1**).

5.9 The safety data sheet (SDS) for the product should be consulted for advice on application and applicability.

6. Environments Covered and Considerations for Shoreline Cleaning Agent Use

6.1 *Shorelines Generally*—Shorelines vary extensively in their composition and their retention of oil (Guide F1686). Several classification schemes are available for oiled shorelines as well as guides to other cleanup methods (**~~10~~14, ~~11~~15**). 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.

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. 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~~cleaning 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 (**~~12~~-16-~~15~~19**).

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 (**~~11~~15**). Oil can be removed from the extensive root system using shoreline ~~treating~~cleaning 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 of initial contamination. (**~~13~~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. 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. 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.

6.5 *Sandy Shorelines*—Sandy shorelines 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. Sandy shorelines are readily amenable to treatment using shoreline cleaning agents. Low energy washing is required to avoid disturbing the sand.

6.6 *Gravel Shorelines*—Gravel shorelines 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 shorelines 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 shorelines are relatively stable, whereas the gravel on exposed shorelines may be continuously re-distributed. Gravel shorelines can be treated with shoreline ~~treating~~cleaning 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.

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

6.8 *Boulder/Rocky Shorelines*—Boulder or rocky shorelines 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 shorelines, generally because the interstitial spaces are large enough to permit run-off. Retention is much greater, however, than that for several other types of shorelines. 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. 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 an abundance 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 shorelines.

6.9 *Coastal Saltwater Marshes*—Coastal saltwater marshes are intertidal wetlands, transitional zones between terrestrial and aquatic ecosystems. Saltwater 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. Saltwater marshes are low-energy environments in which oil is generally trapped and retained. Saltwater marshes are very important ecologically and generally are very fragile environments. Coastal saltwater 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, foot traffic or the use of tools. High-pressure cleaning should be avoided for the same reason (**~~13~~17, ~~14~~18**).

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. Freshwater 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. ~~Highpressure~~ High pressure cleaning should be avoided for the same reason (**~~13~~17, ~~14~~18**).

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. ~~.~~Shorelines of 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.

6.12 *Lake Shores*—Lakes are freshwater bodies that can have shorelines very similar to sea shores. Lakes shores can be cleaned using shoreline cleaning agents. Care must be taken to avoid physically disturbing the lake shore. ~~Nondispersing~~Non-dispersing