Designation: F3349 – 18 (Reapproved 2024)

Standard Guide for Use of Herding Agents in Conjunction with In-Situ Burning[1]

This standard is issued under the fixed designation F3349; 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 relates to the use of herding agents in conjunction with in-situ burning of spilled oil.

1.1.1 Although the focus is on the use of herders in conjunction with in-situ burning, herders may also be used to aid in mechanical recovery of spilled oil.

1.2 The purpose of this guide is to provide information that will enable oil-spill responders to select the appropriate techniques and devices to successfully collect and ignite oil spilled on water.

1.3 The focus of this guide is on the in-situ combustion of marine oil spills in drift ice conditions. The use of herding agents on calmer ice-free water is also possible.

1.4 This guide is one of several related to in-situ burning. Other standards cover specifications for fire-containment booms and the environmental and operational considerations for burning.

1.5 The storage, transport, and use of herding agents may be subject to regulations that will vary according to the jurisdiction. While guidance of a general nature is provided in this document, users of this guide should determine regulations that apply to their situation.

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, health, and 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]

D971 Test Method for Interfacial Tension of Insulating Liquids Against Water by the Ring Method

F631 Guide for Collecting Skimmer Performance Data in Controlled Environments

3. Terminology

3.1 *herding agent (*also known as *surface collection agent)*—chemical product that can be applied to the water surface surrounding an oil slick to concentrate the slick and thicken it to enhance countermeasures such as in-situ burning or recovery.

3.2 *ice concentrations*—ice cover expressed as tenths, that is, $^{5}/_{10}$ ^{ths} is equivalent to 50 % ice coverage by area.

4. Significance and Use

4.1 This guide describes the use of herding agents for the purpose of in-situ burning. It is intended to aid decision-makers and spill-responders in contingency planning, spill response, and training, and to aid manufacturers in developing effective herding agents.

4.2 This guide is not intended as a detailed operational manual for the use of herding agents or the burning of spilled oil.

5. Overview of the Use of Herding Agents for Burning Spilled Oil on Water

5.1 The main requirement for the effective use of in-situ burning of a marine oil spill is an adequate slick thickness to support combustion. Slicks of greater than 1 mm are required to allow ignition and sustain combustion. Thicknesses of 2 mm to 3 mm or greater will ensure effective in-situ burning.

5.2 For spills that are not naturally contained against a shoreline, ice edge, or amongst ice pieces, artificial containment will be required to achieve burnable slick thicknesses.

5.3 Collection and containment using fire-resistant boom is possible in open water and drift ice concentration up to 3 to

[1] This test method is under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Response and is the direct responsibility of Subcommittee F20.11 on Control.

Current edition approved March 1, 2024. Published March 2024. Originally approved in 2018. Last previous edition approved in 2018 as F3349 – 18. DOI: 10.1520/F3349–18R24.

[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.

5/10 ths, but is slower than in open water. In drift ice concentrations of 7/10 ths and greater, natural containment may be adequate for in situ burning. Herding agents (also known as herders) may be useful when ice concentrations do not allow the use of booms and when natural containment is not afforded. Herding agents can be used to contain and concentrate oil for the purpose of in-situ burning.

5.4 Herding agents sprayed onto the water surrounding an oil slick result in the formation of a monomolecular layer of surfactants on the water surface (Fig. 1). These surfactants reduce the surface tension of the surrounding water significantly. When the surfactant reaches the edge of a thin oil slick it changes the balance of interfacial forces acting on the slick edge and causes the oil/water and oil/air interfacial tensions to contract the oil into thicker layers.

5.5 Herding agents were initially developed in the 1970s as a method of thickening oil slicks on open water prior to mechanical recovery. Unfortunately, it was discovered during field tests that herded slicks resumed spreading within tens of minutes in all but relatively calm seas and cannot resist winds in excess of 2 m/s (4 knots). Herders have limited effectiveness in breaking waves which rapidly disrupt the herder layer. Recent research has re-examined the use of herding agents in the context of in-situ burning in drift ice conditions, where breaking waves are generally less of an issue and the ice and oil tend to drift downwind at the same velocity.

5.6 When applied correctly, herding agents do not affect the physical or chemical properties of the oil, and will not affect the ability to subsequently disperse or mechanically recover the oil, beyond any effect related to thickening the oil slick.

5.7 The ultimate fate of herding agents will generally be dispersion and dissolution into the water column due to wave action. Given the low application rate, the concentration of herding agent in the water will generally be very low.

5.8 A more thorough description of herding agent development is contained in Appendix X1.

5.9 Although not the focus of this standard, herders may also be used in other applications, such as: concentrating oil to enhance recovery operations; and clearing thin films of oil from under piers and among wetlands where marine access may be difficult.

6. Guidelines for Use

6.1 The use of specific chemical surface-active agents, sometimes called oil herders or surface oil collection agents, to clear and contain oil slicks on an open-water surface is well known.

6.2 Herding agents are applied to the water surface around the periphery of a slick, not onto the slick itself. Herders can be applied in a low-volume and low-pressure stream, for example, using simple backpack sprayers.

6.3 These agents have the ability to spread rapidly over a water surface into a monomolecular layer, as a result of their high spreading coefficients, or spreading pressures. The most effective herding agents have spreading pressures in the mid-40 mN/m range, whereas most crude oils have spreading pressures in the 10 mN/m to 20 mN/m range.

6.4 Consequently, small quantities of these surfactants (approximately 15 L per kilometre, equivalent to 7 gal per nautical mile, as measured along the perimeter of a slick) will quickly clear thin films of oil from large areas of water surface, contracting the oil into thicker slicks. Additional applications may be required.

6.5 For example, a 10 m^3 (63 barrels, equivalent to 2640 gal) spill with an average thickness of 0.1 mm would have a perimeter of approximately 1100 ml (3600 flt), and would require approximately 16 L (4 gal) of herding agent. In this example the herding agent to oil ratio is 1:600.

6.6 Depending on the scale of the application, herding agent may be applied dropwise or in low volume streams. In either case, care should be taken to avoid mixing the herding agent into the water column or spraying it onto the slick.

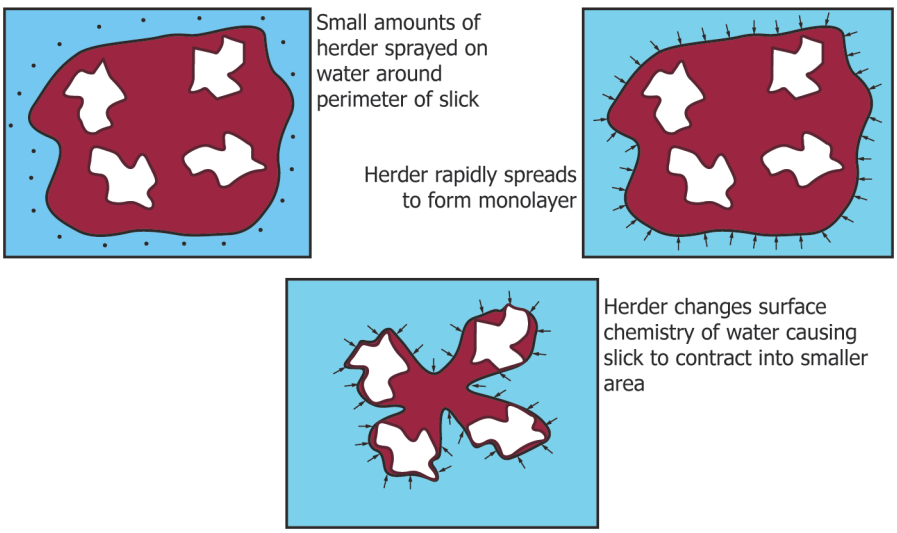

FIG. 1 Depiction of Herding Agent Application