POLICY AND GUIDELINES FOR USE OF OIL SPILL DISPERANTS (OSD) IN INDIAN WATERS

2009

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PREFACE

This guideline document has been produced as an up-to-date guide on oil spill dispersants and is intended for the use of the resource and response agencies to respond to oil spills at sea and to the general readers who are interested in the marine environment protection issues. The specifications prescribed are arrived at, after undertaking various trials by the National Institute of Oceanography (NIO), Goa. More scientific information, together with supporting references, could be obtained from the NIO on this subject.

Oil spills can cause a lot of distress to the affected communities. It is important that oil spill response actions are explained to everyone involved, including those likely to be worst affected by the oil spill. The use of oil spill dispersants can sometimes be contentious because of misunderstandings about the principle of dispersing oil and the possible side effects that can be caused. A "net environmental benefit" will be achieved if the damage that might be caused to marine life by dispersed oil is less than the damage that would have been caused if the oil had come ashore or drifted near to particularly oil-sensitive resources.

A balanced and correct application requires issue of guidelines on the subject with respect to its use. Accordingly, the Indian Coast Guard being the Central Coordinating Authority for Oil Spill Response, had issued a document " Guidelines and Policy for use of OSD in Indian Waters" in the year 2002. The advancements made in the development of dispersants has necessitated for review of the 2002 document. This document incorporates the specifications for the new generation dispersants and also various other inputs provided by the resource agencies from time to time. The Coast Guard acknowledges the assistance provided by the National Institute of Oceanography for drafting the necessary guidelines and providing the specifications for compliance.

Comments of the Industry, response planners and the environmentalists to improve this document are welcome.

November 2009
New Delhi

Director (Environment)
Coast Guard Headquarters

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CHAPTER - 1

INTRODUCTION

1.1 DISPERSANTS

1.1.1 Dispersants are chemical agents that include surface active agents which are partly oil and water soluble. Dispersants change the fate of oil at sea by facilitating the breakdown of an oil slick into tiny droplets, which are suspended and disseminated in water mass, thus enhancing the penetration of oil into the water column. Dispersed oil will degrade more rapidly than oil in a surface slick and in circumstances will present a lesser threat to the environment than oil. However, the environmental gains ensuring from an increase in the rate of bio- degradation may be offset by the toxicity of dispersants in some cases, making the dispersed oil available to organisms in the whole of water body.

1.1.2 Though mechanical response is the preferred means to combat an oil spill, a total reliance on mechanical response may not be possible in all circumstances where limitations on equipment are imposed due to factors of weather and sea conditions. The area of spill, its sensitivity and the movement of drift, spread and speed could necessitate the use of non-mechanical means like use of Oil Spill Dispersants (OSD) as one of the possible techniques.

1.1.3 The use of OSD is not appropriate for all types of oil. Some oils like diesel, gas oil and other light oil types usually disperse readily and, therefore, do not require any sort of treatment. Sea conditions, tides and a number of other factors are also important in determining whether treatment with OSD is the best response. In addition, there are a wide range of oil treatment products available that have different properties and may be suitable for use only on certain types of oil and under certain sea conditions.

1.1.4 For many oil spills, the best option is to leave the oil to disperse or degrade naturally. While, planning the use of oil treatment products, the conditions and circumstances under which use is considered should be assessed with respect to other response methods, such as mechanical recovery, that may be used instead of, or in addition to, dispersants.

1.2 PRINCIPLE

1.2.1 Dispersants being partly oil and water-soluble, reduce the interfacial tension between oil and seawater which under the influence of wind and wave energy, break up a surface oil slick into small droplets. Reduced interfacial tension increases the rate of droplet formation and inhibits coalescence of droplets. The fine droplets (less than 100 microns in diameter) under the action of mixing energy are rapidly distributed throughout the water column, thus decreasing the concentration of oil in water to background levels. However, dispersion action introduces a large amount of oil into the upper water column, which is generally a disadvantage to spill response through use of dispersants.

1.3 ROLE OF DISPERSANTS

1.3.1 Experience has shown that mechanical response often has distinct limitations, poor recovery rates, and cannot adequately deal with very large spills. In addition, booms and skimmers are of limited use even in moderate seas and are usually effective only at slow current less than 1 knot and low wave heights less than 2 meters. Even for calm conditions, it may not be feasible to use mechanical equipment alone to deal with large spills in which oil may spread rapidly over large areas. For these reasons, use of chemical dispersants is considered a complementary option in responding to an oil spill emergency.

1.3.2 The immediate effects of dispersant are to:

1.3.2.1 Break the oil into tiny droplets to facilitate their dissemination in water column. The dispersed oil is distributed throughout the water column and is more affected by water currents and turbulence compared to surface slick that are prone to drift due to winds and waves.

1.3.2.2 Increase water/oil interface leading to dilution of oil suspension in a larger volume of water, thus improving biodegradation in the marine environment

1.3.2.3 Increase local oil toxicity (until the suspension is sufficiently diluted in the water column).

1.3.2.4 Inhibit formation of water in oil emulsion “chocolate mousse”, to a limited extent.

1.4 TYPES OF DISPERSANTS

1.4.1 Based on solvents used in formulation, dispersants are generally graded into three types:-

1.4.1.1 **Type I - Conventional Hydrocarbon Base:** These are normally used in undiluted (neat) form and are generally applied at a dosage ratio of one part of OSD to between 2-3 parts of oil. These products are generally of low viscosity, similar to that of kerosene, and require additional agitation to mix the OSD into the oil and consequently into the water column.

1.4.1.2 **Type II – Water Dilutable Concentrate:** These dispersants are used after dilution with sea water in the ratio of 1:10. Treatment rates are one part of dispersant to 2-3 parts of oil. (Equivalent to 1 part of concentrate dispersant to 20-30 parts of oil for mainly combating offshore spills, coastline and beaches.) They are generally applied from a small tug or fishing vessel on which spray booms and associated equipment is rigged.

1.4.1.3 **Type III – Concentrate:** Also known as third generation dispersants are alcohol/ glycol solvent-based dispersants containing higher concentrations of surface-active agents. These are primarily used in undiluted form. Diluting such products with water can reduce effectiveness. Third generation Oil Spill Dispersants are designed primarily for use from aircraft - fixed or rotary wing. Their dosage rate is much smaller, one part to 20-30 parts of oil, depending upon slick thickness. In addition, these dispersants can also be used from ships or on beaches, using appropriate spray gear.

1.4.1.4 **Type II/III Combination**: This is a new type of dispersant manufactured both for undiluted spraying from aircraft and for sea by water dilution prior to spraying using sea going vessels. The advantage of this dispersant is that any organisation need not store type II and type III dispersant separately. When used for Type II application, dilute 1 part dispersant with 10 parts water (fresh or sea), for 'Type III' application, use undiluted and spray 1 part dispersant onto 20 - 30 parts oil. In all cases the product should be sprayed by suitable spraying equipment and then agitated.

1.4.2 An important parameter that a good dispersant need to meet is that it should be highly effective, less toxic by itself and most importantly it should not increase the toxicity of oil it is added to. The OSD should also be free of hydrocarbon solvents and safe for personnel handling the product and should not pose any health hazard.

CHAPTER - 2

OBJECTIVES

2.1 The objective of all oil spill response strategies should be to minimise the damage, both ecological and economic, that could be caused by an oil spill. The most obvious way to do this is to prevent the spilled oil from coming into contact with oil-sensitive resources. Most damage is done by spilled oil when it gets into shallow water or comes ashore. The objective of oil spill response actions at sea should be to prevent oil from reaching the shoreline or particularly sensitive resources at sea, so as to minimize the damage and to prevent the long term effects that may ensue. The objectives of this document are:-

2.1.1 To develop a document to guide OSD usage.

2.1.2 To promulgate specifications of OSD.

2.1.3 To lay down criteria for approval of OSD by Indian Coast Guard.

CHAPTER - 3

POLICY ON USE OF DISPERSANT

3.1 Once oil has spilled, responders use oil spill countermeasures to try to reduce the adverse effects of spilled oil on the environment. Dispersants are one kind of countermeasure. Dispersants which are solvents and agents for reducing surface tension are used to remove oil slicks from surface. The treated oil enters the water column as fine droplets where it is dispersed by currents and eventually subjected to natural degradation such as bio-degradation. But the dispersed oil in the water column may affect certain living resources prior natural degradation. Thus the policy on the use of dispersant is made balancing the resource protection issues on the shore and environment protection issues at sea. The policy on the use of the dispersant arrived at is as follows:

3.1.1 Use of dispersants must be documented in the respective contingency plans and only dispersants that are on the approved list should be used.

3.1.2 As far as practicable, all stake holders, Ports, Oil handling and storage facilities, Shipping companies (Master/owner), Coastal refineries and Oil Exploration and Production organizations, shall recover oil from oil slick (spilled oil) by deploying physical methods / mechanical recovery equipment.

3.1.3 When physical methods or mechanical deployment of recovery equipment are not safe and practical then, approved Oil Spill Dispersant (OSD) with prior permission of Indian Coast Guard shall be used at the earliest. Ships flying foreign flag and foreign oil spill response agencies are to comply with these Oil Spill Dispersant Guidelines.

3.1.4 Stagnated high sea spill shall be left to degrade naturally unless it causes or likely to cause harm /damage to amenities and marine environment of a coastal area.

3.1.5 Dispersant shall be used after thorough weighing of pros and cons through Net Environment Benefit Analysis (NEBA) including socio economic considerations and these shall be properly documented.

3.1.6 No dispersant shall be used in sensitive areas, shallow waters, protected bays and inlets.

CHAPTER – 4

DEFINITIONS

4.1 **Approved Dispersant.** A dispersant which has been tested for toxicity, stability and dispersal efficiency and which, having met acceptable toxicity, stability and efficiency criteria, is suitable for use in Indian waters.

4.2 **Batch**. A quantity of some commodity made in one operation or lot.

4.3 **Chocolate Mousse.** Water –in-oil emulsions.

4.4 **Cloud Point.** The temperature at which solid substances begin to separate from solution.

4.5 **Dispersant.** Chemicals which reduce the surface tension between oil and water, and thereby facilitate the breakup and dispersal of the oil in the form of finely divided droplets throughout the water column.

4.6 **Dispersant Efficiency**. The ratio expressed as a percentage of the volume of oil dispersed to the total volume of oil treated with dispersant.

4.7 **Efficiency Index** : It is percentage by weight of the test oil which has been transferred as small droplets into the water phase under the test conditions assuming complete and even distribution at the time of sampling.

4.8 **Emulsions.** Many oils have a tendency to form water – oil emulsions (mousse) which can increase the volume of the pollutant drastically. These emulsions are often extremely viscous and stable and more difficult to clean up. Emulsions may contain as much as 75 to 90% water – which has implications for total spill volume and response decisions. (Skimming, transfer, storage and disposal)

4.9 **Flash Point**. The temperature at which a liquid gives off sufficient vapor to flash in the presence of a naked flame.

4.10 **Net Environmental Benefit Analysis (NEBA)** Urgent decisions need to be made about the options available for response and clean-up in order that the environmental and socio-

economic impacts are kept to the minimum. Getting the correct balance is always a difficult process and conflicts inevitably arise which need to be resolved in the best practicable manner. The advantages and disadvantages of different response options need to be considered and compared, both with each other and with the advantages and disadvantages of natural recovery. This assessment process is known as Net Environmental Benefit Analysis (NEBA)

4.11 **Surfactant**. A substance which has the effect of altering the interfacial tension between oil and water.

4.12 **Toxicity.** It is the incipient lethal limits with the object of determining 96 hour LC 50 test

4.13 **Viscosity**. Viscosity of oil is its resistance to flow. Viscosities decrease with increasing temperature and hence the seawater temperature and absorption of heat from the sun are important considerations.

4.14 **Weathered oil.** When oil is spreading and moving over the sea surface, a series of natural processes change the physical and chemical properties of the oil. This includes spreading, evaporation, dispersion, emulsification, dissolution, biodegradation, oxidation and sedimentation.

CHAPTER – 5

GUIDELINES ON USE OF OIL SPILL DISPERSANT IN INDIAN WATERS

5.1 Type I Conventional, Hydrocarbon-base dispersant **shall not be used.**

5.2 Type II water dilutable concentrate dispersant shall be used either by spraying from ships or boats in the diluted form (1 part of dispersant to 10 parts of sea water) in the ratio of 1 part of dispersant to 2 - 3 parts of oil (equivalent to 1 part of concentrate dispersant to 20-30 parts of oil for mainly combating offshore spills, coastline and beaches, etc).

5.3 Type III concentrate dispersant shall be used by spraying from aircraft in the ratio of 1 part of dispersant to 20 - 30 parts of oil for mainly combating offshore spill.

5.4 Type III concentrate dispersant can also be used from ships and boats after proper authorisation and advice.

5.5 Type II/III* (combination) concentrate type dispersant shall be used from aircraft (fixed or rotary wing) in the ratio of 1 part to 20 – 30 parts of oil.

5.6 Type II/III* (Combination) Concentrate dispersant can also be used from ships or boats using appropriate spray gear in the diluted form similar to Type II for combating mainly offshore, coastline and beaches spill.

5.7 **No Oil Spill Dispersant shall be used** in case of light distillate fuels are spilled.

5.8 Type II, III and Type II/III combination dispersant can be used on high spreading rate light crude oil spill.

5.9 Type III and Type II/III combination (in concentrate) dispersants can be used on low spreading rate high viscous crude, residues, emulsions, waxy crudes and water in emulsions.

5.10 **No dispersant shall be used on weathered viscous emulsions** (chocolate mousse) at sea.

5.11 Type III and Type II/III combination can be used for final shoreline cleanup after physical removal on persistent leftover hydro carbon products.

5.12 Before applying oil spill dispersant on spilt oil, application rate shall be calculated for effective results. For calculation refer **Annexure-I.**

ENVIRONMENTAL CONSIDERATIONS

5.13 Use of dispersants has to be determined by a comparison of potential damages to the marine environment from both treated and untreated oil with consideration of both long-term and short-term effects. Though, not all aspects of the impact of dispersants on the marine environment are fully understood, however, generalisations can be made with regard to areas where dispersants can be applied. While, application in areas of a high dilution capacity and a high flushing capability i.e open waters is preferred, areas where the dispersant/oil mixture may be concentrated or have a high residency period viz. confined waters such as small bays, bottled harbours and marshes should be avoided.

5.14 An important consideration for application of OSD has to be the sensitivity factor. This is the degree to which the environment will react in response to dispersants and the dispersants/ oil mixture. Some environments or components thereof are so sensitive that, despite ideal dilution and flushing systems, they will be adversely affected by the toxicity of dispersants and of dispersed oil. However, in reality it is often observed that the short-term effects are much less damaging than if the environment was left exposed to untreated oil. Therefore, it is very important to identify specific sensitive resources, both subsurface and surface in the area being considered for dispersant use.

5.15 In addition, due consideration should also be given to the prevailing wind which directly influence untreated oil and current which would more directly influence dispersed oil.

5.16 The use of dispersants is largely dependent upon balancing the consequences of response options and choosing the one that will best preserve the most highly valued resource.

5.17 The effects of dispersants on marine life depend on the conditions in which they are applied and also the type of organisms present. In shallow inshore areas and foreshore areas where scope for rapid dilution of dispersed oil is less and where more sensitive resources may be at risk, the use of dispersants may increase the damage already caused by oil. A number of

factors that need to be taken into account w.r.t toxicity prior application of OSD are:-

5.17.1 The area should generally have adequate depth of water for dispersion of the oil to occur successfully.

5.17.2 The area should generally have an active water exchange rate.

5.17.3 The spilt oil must be of a type, which is appropriate for, or amenable to, dispersion.

5.17.4 No decided or pre-established methodology to calculate dispersant application relative to depth of water or proximity to coastline is available.

5.17.5 The guiding principle is that of Net Environmental Benefit which should decide a case-by-case application.

CHAPTER – 6

GENERAL RULES

6.1 The following are some general rules of thumb for consideration for when to use dispersants and when not to use dispersants:

6.1.1 **When to use dispersants.**

6.1.1.1 When oil is moving towards shore and all available response methods are ineffective. Refer Oil Spill Response Matrix placed at **Annexure-II**.

6.1.1.2 When mechanical removal method alone are not adequate.

6.1.1.3 When weather/ sea conditions preclude use of mechanical recovery.

6.1.1.4 When natural dispersion is not sufficiently rapid.

6.1.1.5 When there are large numbers of birds at risk.

6.1.1.6 When the slick is moving towards areas of important oil-sensitive resources including harbours, mangroves, corals, areas of wildlife aggregation(e.g. birds at sea or on shore, dugong concentration areas, active turtle nesting beaches, etc)

6.1.2 **When not to use dispersant**

6.1.2.1 In very shallow water with poor circulation such as protected bays and inlets.

6.1.2.2 Near seawater intakes for cooling water, desalination and processing plants.

6.1.2.3 On heavy oils that are not dispersible or oils that have emulsified so badly they are no longer dispersible.

6.1.2.4 Directly above coral reef.

6.1.2.5 Near salt marshes, shellfish beds and fish hatcheries

6.1.2.6 On oil sheen.

6.1.3 When in doubt whether to use dispersant in a particular area or not, contact the nearest Coast Guard Regional Headquarters or District Headquarters for advice and approval.

CHAPTER - 7

ADVANTAGES/ DISADVANTAGES/ LIMITATIONS

7.1 In considering the use of dispersants, it is important to be aware of their specific advantages, disadvantages and limitations.

7.1.1 **Advantages.**

7.1.1.1 Dispersants can be used under a wide range of weather and sea conditions.

7.1.1.2 The use of dispersants is often the quickest response for combating large oil spillage.

7.1.1.3 Sea-dispersion of floating oil reduces or removes risk of shoreline contamination and potential fire hazard.

7.1.1.4 Dispersion of floating oil reduces the possible oil contamination of birds and sea-mammals.

7.1.1.5 Dispersion potentially improves biodegradation by increasing oil droplet surface area.

7.1.1.6 The timely use of dispersants may inhibit formation of “chocolate mousse”.

7.1.1.7 In general, costs of treatment at sea are lower than costs of dealing with oil on the shoreline.

7.1.2 **Disadvantages.**

7.1.2.1 Dispersed oil may adversely affect marine ecology especially sedentary species, fish forms, salt marshes and areas of low water exchange.

7.1.2.2 Oil is not removed but dispersed into the water column.

7.1.2.3 Dispersed oil goes to areas where it would normally not go.

7.1.2.4 Oil viscosity is a limiting factor to the efficiency of dispersants. The oils with a viscosity above 2000 centistokes are not amicable to dispersants. Refer **Annexure-III**.

CHAPTER - 8

FUNCTIONAL AUTHORITY FOR APPROVAL

8.1 Indian Coast Guard (ICG) is the Central Coordinating Authority for oil spill response and hence exercises its functional authority for use of spill dispersant (OSD) and approval.

8.1.1 The Indian Coast Guard is the designated national authority under the National Oil Spill Disaster Contingency plan (NOS-DCP) for co-ordination of all types of oil pollution response which includes containment, mechanical recovery and dispersion of oil spills by application of oil spill dispersants.

8.1.2 The maritime zone of India is divided into four Coast Guard regions: North West, West, East and Andaman & Nicobar. These regions are further divided into 11 Coast Guard Districts.

8.1.3 The Regional Commanders are responsible for combating oil spills in their respective areas of responsibility and have the Regional Oil Spill Disaster Contingency Plan (ROS-DCP) in place. There are three pollution response team located at Chennai, Mumbai and Port Blair - with qualified response personnel and well-stocked inventory of response equipment.

8.1.4 In terms of NOS-DCP, specific approval of Coast Guard must be obtained prior to using any oil treatment product i.e. dispersants and surface cleaners or any such product that would perform the same function as these, in Indian waters including any use in tidal docks and locks, on beaches, shorelines or structures such as piers and breakwaters.

8.1.5 In a situation of force majeure, oil spill treatment products approved by Indian Coast Guard can be used without prior consultation. Any such use should, however, be restricted to a situation where there is a genuine risk to human life or to the safety of an installation or vessel or where there is a serious danger from fire or explosion.

8.1.6 Since, use of oil treatment products in deeper waters is less likely to cause damage; the approval will not be subject to restrictions as applicable for inshore use. Any request for use should be submitted to nearest ICG Spill Notification Centre as described in **Annex - IV** along with information as per **Annex -V**.

8.1.7 Though, mechanical response to an oil spill is the favoured option of Coast Guard, in circumstances where there is a threat to sensitive areas, it is advisable to use dispersants and CG will authorize the application. However, such approval will be restricted to such areas and quantities of dispersants as would be mentioned in the approval.

8.1.8 The reports on oil spill dispersants tested by National Institute of Oceanography (NIO), Goa are held by CG and evaluated w.r.t chemical and physical properties. For an OSD to be used in Indian waters, it is imperative that the product should have been tested by NIO, Goa (or any other laboratory authorized by appropriate authority of GOI to carry out test on OSD). Based on the test reports, NIO recommends the use of dispersants and further approval for use is given by the Coast Guard.

8.1.9 Any request by manufacturers or any vendor for evaluation of their product for assessment w.r.t suitability for use in Indian waters and mention in these guidelines may be forwarded to CG along with test report and information as per **Annex - VI** to this document.

8.1.10 CG approval must be obtained on each occasion before any oil treatment product is used in Indian waters, unless that use is covered by the terms of a standing approval. Approval will also be required to be obtained if a larger quantity of product is to be used than the standing approval specifies, or to use the product in a sea area not covered by the standing approval.

8.1.11 On completion of response to the oil spill, CG will require a report to be submitted on any use of oil treatment products that has taken place, whether under the terms of a standing approval or otherwise.

8.1.12 Only approved dispersants by NIO shall be used in those cases where results of NEBA indicate that failure to use dispersants will cause more severe impact on biological resources and economic facilities. The limitation of dispersant must be understood and carefully evaluated before any application.

8.2 **Standing Approval** Based on risk evaluation and sensitivity of the area (CG) would grant a standing approval for the area. Standing approval will, however, be specific to area and quantity of OSD allowed to be used.

CHAPTER - 9

OSD SPECIFICATIONS FOR USE IN INDIAN WATERS

9.1 Approval for use of a particular OSD will be granted after taking into consideration a number of factors such as: toxicity, effectiveness, stability, health hazards, the physical and chemical properties of OSD and also the properties of oil to be dispersed.

9.2 As a general consideration, the dispersant should comply with specification given in succeeding paragraphs.

9.3 **Phase**. The dispersant must be in liquid form and contain no solid material, suspended matter, or additional liquid phases.

9.4 **Prohibited Ingredients**. The dispersant must not contain: benzene, carbon tetrachloride or other chlorinated hydrocarbons, phenol, cresol, caustic alkali, or free mineral acid.

9.5 **Aromatic Hydrocarbons.** The dispersant, must have an upper limit of 3% total aromatic hydrocarbons as determined by gas chromatography/ flame ionization detection, infrared spectroscopy, or fluorescence detection.

9.6 **Stability.** The surfactants must be wholly soluble in the solvent and must remain uniformly distributed at all temperatures from – 0° to 50° C

9.7 **Shelf Life.** The dispersant when stored according to the manufacturer's recommendations, in the original sealed containers, with ambient temperatures ranging between –0°C and +50°C, should have a storage life of minimum five (5) years. Beyond five years, the use of dispersant is subject to fulfilling all specifications after testing on yearly basis.

9.8 **Flashpoint.** The dispersants will have flash point of minimum 60°C as determined by the Pensky Marten closed cup method – D.

9.9 **Cloud Point.** The dispersant will have cloud point of 0°C (minimum). The dispersant must not separate into layers at temperatures over 0°C.

9.10 **Viscosity**. The dispersant viscosity at 0° C must be 250 Cst at a shear rate of 103/s.

9.11 **Toxicity.** Each dispersant must be tested for toxicity with the object of determining 96-hour LC 50 and to establish incipient lethal limits. (The testing will be carried out at NIO).

9.12 **Toxicity Limit**. The toxicity criterion to be adopted for evaluation will be :-

9.12.1 Non toxic: > 10,000

9.12.2 Slightly toxic: 1,000-10,000

9.12.3 Moderate toxic: 100-1000

9.12.4 Toxic: < 100

9.12.5 Dispersant alone should be moderately to slightly toxic

9.12.6 Dispersant should not significantly increase the toxicity of the oil it is added to. However, a margin of 15-20% will be allowed.

9.13 **Biodegradability.** The surfactant preferably be biologically degradable.

9.14 **Efficiency Index.** Percentage by weight of the test oil which has been transferred as small droplets into the water phase under the test conditions assuming complete and even distribution at the time of sampling. The efficiency criteria will be:-

9.14.1 Type II – 50% (minimum)

9.14.2 Type III – 60% (minimum)

9.14.3 Type II/III - 60% (minimum for both)

9.15 **Stability Index.** The dispersant/oil emulsion should be stable/fairly stable (> 50 %).

9.16 The OSD should also be free of hydrocarbon solvents and safe for personnel handling the product and should not pose any health hazard.

CHAPTER - 10

STORAGE

10.1 Dispersant that are stored **unopened** should last for many years. However once opened, the dispersant should be tested periodically for its effectiveness. If physical parameters have significantly changed or the expiry date has been reached, a dispersant effectiveness test should be conducted.

10.2 Dispersant should not be stored after they have been diluted with seawater.

CHAPTER - 11

PACKAGING

11.1 **Corrosion Resistance.** The containers used for packing the OSD shall be suitable for use in a marine environment and should not be degraded by exposure to temperatures in the range of – 30°C to + 50°C, humidity up to 100% and high levels of UV radiation.

11.2 **Corrosiveness / Human Toxicity.** The dispersant must be non-corrosive to storage containers and contain no substances that are normally considered to be toxic to humans.

11.3 **Batch Numbers.** The dispersant's batch number and year of manufacture shall be clearly marked on the side of each container.

CHAPTER - 12

DISPOSAL

12.1 Disposal of unusable dispersants is the responsibility of the dispersant owner.

12.2 The dispersant must be disposed off in an environmentally acceptable norms akin to any chemical substances which are disposed in accordance to the environment regulation that are in force. The most common method of disposal is incineration.

CHAPTER - 13

STOCKING CRITERIA

13.1 **Stocking Criteria.** Minimum quantity of OSD to be stocked shall be commensurate with oil spill risk as per approved contingency plan. The general criteria is that the NIO approved oil spill dispersants shall be stocked to a minimum of tier-I size spill for ports and oil handling agencies. {e.g. Ports/Oil handling companies having a risk exposure of 700 tons should ideally stock 25-35 tons of OSD . ie. (1: 20-30 parts of oil)}

13.2 The Coast Guard units shall at all times stock the minimum quantity of OSD as per the policy and orders in force.

Annexure-I

(Refer Para 5.12 of Ch.5)

APPLICATION OF OIL SPILL DISPERSANTS

1. **Important Factors.**

(a) To achieve best results, dispersant application should start as soon as possible and has to be planned in the first stage of a response strategy. Choice of dispersant, method and rate of application is also important for good results.

(b) Many oils form stable water-oil in emulsions (chocolate mousse) the viscosity of which is higher than that of the original oil. Since, chocolate mousse is very difficult to disperse; treatment with dispersants should start before the mousse formation.

(c) Dispersant application is a specialized operation that requires preparation and trained manpower.

(d) Good organization on the ground is also needed to enable spraying operation to continue for the maximum available time during day light hours. Stock piles of dispersants (as mentioned in the contingency plan) should be stocked and conveniently located in order to supply vessels and aircraft with the minimum delay.

(e) The window of opportunity can be calculated by ADIOS package/ oil spill modeling studies The package requires certain data inputs including the life of oil and various other factors associated with weathering such as wind current, tidal range and wave height.

(f) DMP2 package of NOAA, USA software can also be used.

2. Application Methods.

(a) Dispersants can be applied to spilled oil on open waters by boats or aircrafts. Whichever method of application is used, the key to a successful response is the ability to target the thickest part of the oil slick within a short time and before weathering.

(b) **Vessel Spraying.** Dispersants are usually applied from boats equipped with spray arms. Spray units can be portable or permanently installed on a vessel and systems are available that deliver the dispersant either undiluted or diluted with sea water. Vessels offer certain advantages for dispersant spraying because they are usually readily available,

easy to load and deploy, have cost advantages over aircraft and can apply dispersant fairly accurately to specific areas of a slick. Nevertheless, they also have serious limitations, particularly for larger spills, because of the low treatment rate which they offer and the added difficulty of locating the heaviest concentrations of oil from the bridge of a vessel. These problems can be partially overcome by controlling the operations from a spotter aircraft.

(c) **Aerial Spraying.** Aerial spraying of dispersant offers the advantage of rapid response, high treatment rates and optimum dispersant use. The aircraft should be capable of operating safely at a low altitude (typically 50 to 100 feet for larger aircraft) and at relatively low speeds (50 to 150 knots). Only concentrate dispersants are suitable for aerial spraying as they require no mixing.

3. **Application Rate.**

(a) One of the main challenges of dispersants lies in the estimation of the volume of oil to be treated and, hence, the calculation of the appropriate application rate. To achieve this, assumptions must be made concerning the average thickness and volume of an oil slick. The ratio of dispersant to oil required for effective dispersion varies between 1:3 to 1:50 depending on the type of dispersant, the type of oil and prevailing conditions. For planning purpose, the application rate can be calculated (as per the Charts 1 & 2) as follows :

(i) Estimation of the volume of oil (in litres/hectare)

(ii) Calculation of the quantity of dispersant needed to achieve the dose required (litres) and the application rate (litres/hectare)

(b) As a general rule, most fresh oil on the sea surface will spread within a few hours to reach an average thickness of 0.1mm (10^{-4} m). at this thickness the volume of oil in one hectare (10,000m^2) would be:

$10^{-4}m \times 10^4 m^2 = 1m^3$ or 1,000 litres.

(c) For a dosage of 1:20, the quantity of dispersant required would be: 1000 liters / 20 = 50 litres, and the application rate would be 50 litres/hectare (10 Imp. gal/acre). The discharge rate can then be calculated by multiplying the application rate (litres/ m^2) by the swath width of the spraying arm (m) and the speed of the aircraft (m/s). An illustration for 8Mtr spray arms is shown in Charts 1 & 2.

Chart 1 : Neat (concentrated) Type III, (type II/III) Dispersant Application

8 mm spray arms

Vessel Speed (knots)	Neat Application Rate (Black Nozzles) Litres/Hectare	Neat Application Rate (Yellow Nozzles) Litres/Hectare	Area Treatment Rate Km^2/hr
4	430	287	0.13
6	287	191	0.20
8	215	143	0.27
10	172	115	0.33
12	143	96	0.40

Black nozzle : 90 LPM ; Yellow nozzle : 48 LPM

Chart 2 : Diluted (Type II), (type II/III) Dispersant Application

8 mm spray arms

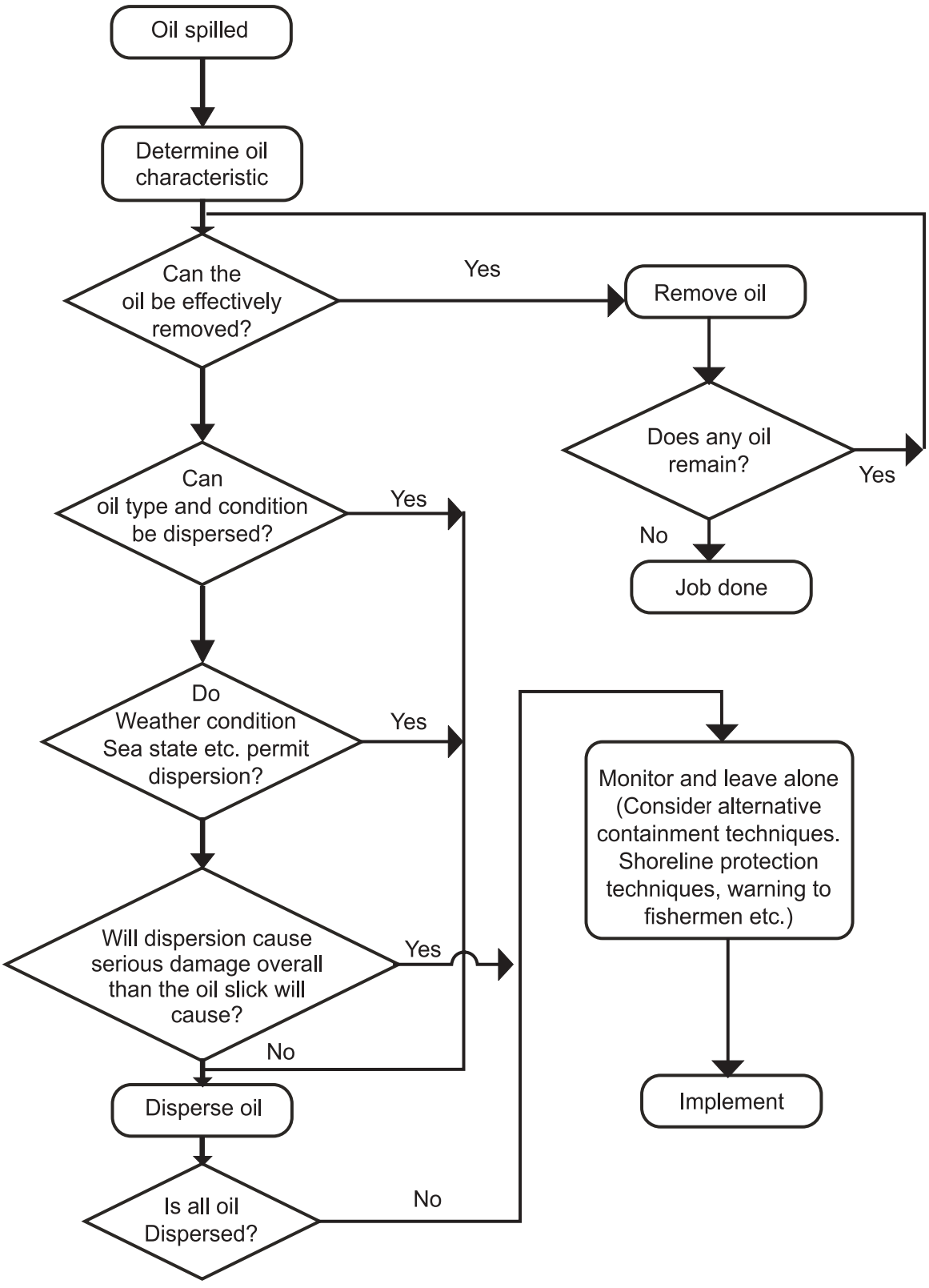
Vessel Speed (knots)	App. Rate Litres/ Hectare (10 LPM)	App. Rate Litres/ Hectare (15 LPM)	App. Rate Litres/ Hectare (20 LPM)	App. Rate Litres/Hectare (25 LPM)	App. Rate Litres/ Hectare (30 LPM)	Area Treatment Rate Km/hr
4	43	65	86	108	129	0.13
6	29	44	58	73	86	0.20
8	22	33	44	55	65	0.27
10	17	26	34	43	52	0.33
12	14	21	28	35	43	0.40

(10 LPM : 10 litres of dispersant diluted with 90 litres of sea water)

Annexure-II

(Refer Para 6.1.1.1 of Ch.6)

OIL SPILL RESPONSE MATRIX



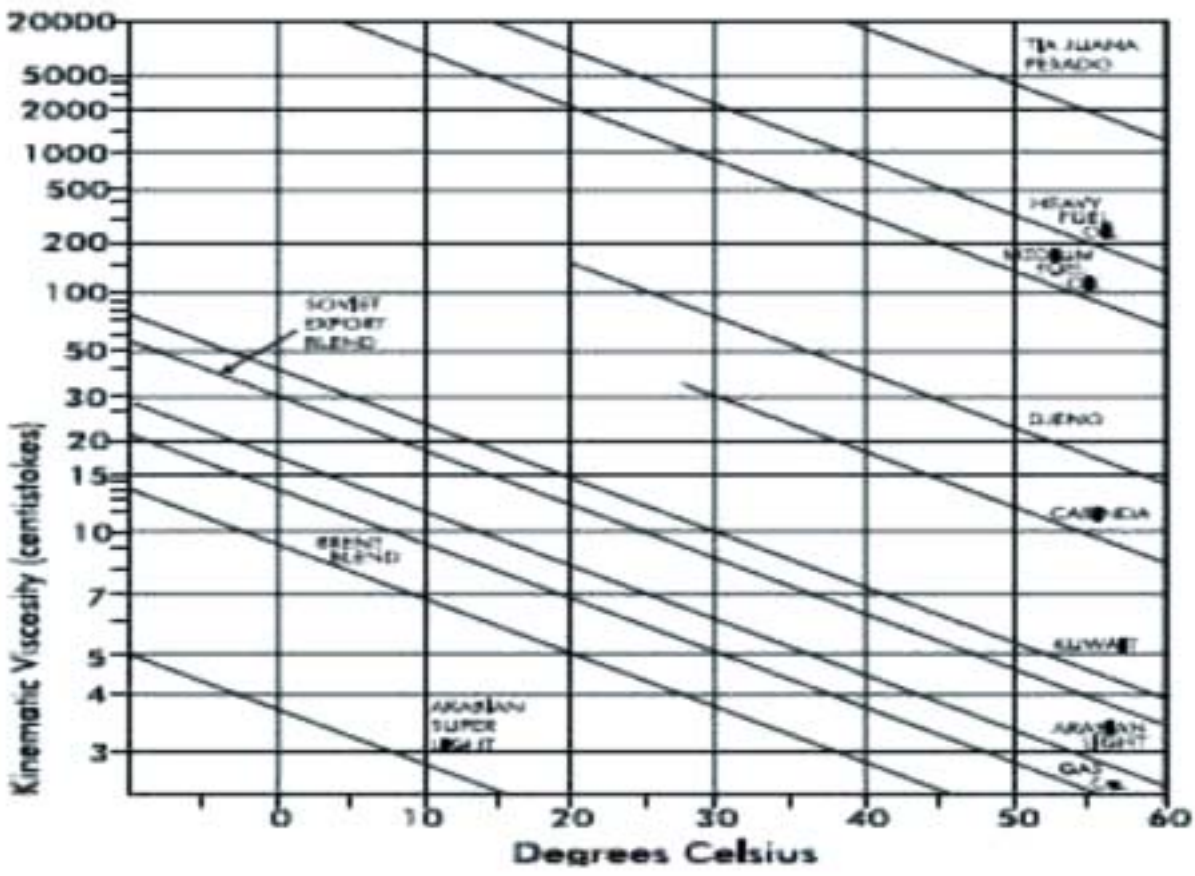
Annexure-III

(Refer Para 7.1.2.4 of Ch.7)

EFFECTIVENESS OF OSD

1. Relationship between Temperature and Viscosity/Pour Point.

(a) The effectiveness of dispersant, will depend on the viscosity of oil and/or oil pour point along with factors like weather, sea temperature and salinity. As a general rule, dispersants are capable of dispersing most liquid oils and liquid water-in-oil emulsions with viscosities less than about 2000 centistokes (cSt), equivalent to a medium fuel oil at 10-20 deg C. Once viscosity exceeds 2000 cSt., dispersants applied at sea become less effective and as viscosities reach the region of 5,000-10,000 cSt., they are ineffective. The relation between viscosity values for different oils at various temperatures as shown in graph below:-



Approximate relationship between temperature and oil viscosity for representative crude and fuel oils

(b) Dispersants are not suitable for weathered viscous emulsions (chocolate mousse) or oils which have a pour point near to or above that of the ambient temperature. Heavy fuel oil is seldom dispersible. Table below lists some crude oils, which may not be amenable to dispersants due to their viscosity or pour point. Even those oils, which are dispersible when spilled, become resistant because of increased viscosity due to weathering.

Crude Name	Loading Port	Country	Gravity ^{0}API	Viscosity CST 100^0 F 37.8^0 C	Pour Point	
					^{0} C	^{0} F
Amna	Ras Lanuf	Libya	36.1	13	18	65
Ardjuna	SBM	Indonesia, E. Kalimantan	37.7	3	27	80
Bachequero	La Salina	Venezueta	16.8	275	-23	-10
Bahia	Salvador	Barazil	35.2	17	38	100
Bakr	Ras Gharib	Egypt	20.0	152	7	45
Bass Strait		Australia	46.0	2	15	60
Belayim	Wadi Feiran	Egypt	27.5	18	6	43
Boscen	Bajo Grande	Venezuelai	10.3	>20,000	15	60
Bu Attifel	Zueitina	Libya	40.6	-	39	102
Bunju	Balikpapan	Indonesia, E.Kalimantan	32.2	3	17.5	63
Cabinda	SPMB-Landana	Angola	32.9	20	27	80
Cinta	SBM	Indonesia, Sumatra	32.0	-	43	110
Duri	Dumai	Sumatra	20.6	100	14	57
El Morgan	Shaukeer	Egypt	32.3	9.5	7	45
Es Sider	Es Sider	Libya	37.0	5.7	9	48
Gamba	Spmb-Gamba	Gabon	31.8	38	23	73

Crude Name	Loading Port	Country	Gravity ^{0}API	Viscosity CST 100^0 F 37.8^0 C	Pour Point	
					^{0} C	^{0} F
Gippstand Mix	Western Port Bay	Australia	44.4	2	15	60
Handil	SBM	Indonesia. E.Kalimantan	33.0	4.2	29	85
Heavy Lake Mix	La Salina	Venezuela	17.4	600	-12	10
Iranian Nowruz	Bahrgan	Iran	18.3	270	-26	-15
Jatibarang	SBM	Indonesia, Java	28.9	-	43	110
Jobo/ Morichal (Monagas)	Puerto Ordaz	Venezuela	12.2	3780	-1	30
Lagunillas	La Salina	Venezuela	17.7	500	-20	-5
Mandji	Cap Lopez	Gabon	29.0	17	9	48
Merey	Puerta La Cruz	Venezuela	17.2	520	-23	-10
Minas	Dumai	Indonesia, Sumatra	35.2	-	32	90
Panuco	Tampico	Mexico	12.8	4700	2	35
Pilon	Carpito	Venezuela	13.8	1900	-4	25
Qua Lboe	SBM	Nigeria	35.8	3.4	10	50
Quiriquire	Carpito	Venezuela	16.1	160	-29	-20
Ras Lanuf	Ras Lanuf	Libya	36.9	4	7	45
Rio Zulia	Santa Maria	Colombia	40.8	4	27	80
San Joachim	Puerto La Cruz	Venezuela	41.5	2	24	75

Crude Name	Loading Port	Country	Gravity ^{0}API	Viscosity CST 100^0 F 37.8^0 C	Pour Point	
					^{0} C	^{0} F
Santa Rosa	Puerto La Cruz	Venezuela	49.4	2	10	50
Seria	Lutong	Brunei	36.9	2	2	35
Shengli	Qingdao	P.R China	24.2	-	21	70
Taching	Darien	P.R China	33.0	138	35	95
Tie Juana Pesada	Puerto Miranda	Venezuela	13.2	>10,000	-1	30
Crude Name Port	Loading	Country ^{0}API	Gravity CST 100^0 F	Viscosity ^{0} C 37.8^0 C	Pour ^{0} F	Point
Wafra Eocene	Mina Saud/ Mina Abdulla	Neutral Zone/Kuwait	18.6	270	-29	-20
Zaire	SBM	Zaire	34.0	20	27	80
Zeta North	Puerto La Cruz	Venezuela	35.0	3	21	70

Source: ITOPF

Annexure-IV

(Refer to Para 8.1.6 of Ch. 8)

SPILL NOTIFICATION POINTS

Information of a spill should be conveyed to nearest point of contact as below:

	Telephone + 91	Fax + 91	Other
National Center			
The Director General Indian Coast Guard Coast Guard Headquarters, National stadium Complex, New Delhi – 110 001,India	01123384934 01123386700	01123383196 01123073529	E-Mail : vprotect@bol.net.in Inmarsat C : 873441907610 Mini M : 762882346
West Coast and East Arabian Sea			
The Commander Indian Coast Guard Region (North West) Sector – 10A Gandhinagar - 382010	079-23241717	23243305	
The Commander Coast Guard Distt HQ-01 Near RGT College Porbandar 360 575 Gujarat	02862247148	02862210559	E-Mail : comdis1_ad1@ sancharnet.in Inmarsat C : 873441908210 Inmarsat M : 873691900510
The Commander Indian Coast Guard Region (West) Golfadevi Temple Road Prabhadevi PO, Worli Mumbai – 400 025 Maharashtra, India	02224376133 02224379201 02224371932	02224933727 02224379201	E-Mail : cgwest@mtnl.net.in Inmarsat C : 873441907210 Mini M : 762882349

	Telephone + 91	Fax + 91	Other
The Commander Coast Guard Distt HQ-11 Admin Bluding III Floor, Marmagoa Harbour Goa 403 801	08322520734 08322520584		E-Mail : comdis11@ dataone.in Inmarsat C : 873441907410 Mini M : 7624484095
The Commander Coast Guard Distt HQ-03 Panambur New Mangalore 575 010	08242405260 08242405262	08242405267	E-Mail : Icgdhq3@sancharnet.in Inmarsat C : 873441908310 Mini M : 764443569
The Commander Coast Guard Distt HQ-04 C/o Fleet Mail Office Kochi - 682 004	04842218121 04842218969	04842218460	E-Mail : comdis4@dataone.in Inmarsat C : 873441907310
East Coast and Bay of Bengal			
The Commander Indian Coast Guard Region (East), Coovam River Complex, Chennai 600 009 Tamil Nadu, India	04425395011 04423460403 04425395016 04423460404	04423460423	E-Mail : icgrhqeast@dataone.in Inmarsat C : 873441907510
The Commander Coast Guard Distt HQ-06 C/o Fleet Mail Office Visakhapatnam 530 014 Andhra Pradesh	08912568878 08912724742 08912741140	08912741130	E-Mail : dhqvsp@sify.com Inmarsat C : 873441907010 Mini M : 762882360

	Telephone + 91	Fax + 91	Other
The Commander Coast Guard Distt HQ-07 Paradip Port Sector NO. 21 Paradip 754 142 Orissa	06722222712 06722223359	06722220174	E-Mail : ctk.cgdhqpdp@ sancharnet.in Inmarsat C : 873441907710 Mini M : 762882363
The Commander Coast Guard Distt HQ-08 Anchorage Camp Haldia Port Haldia 721 605 West Bengal	03224263404 03224263217	03224264541	E-Mail : dhq8@dataone.in Inmarsat C : 873441907110 Mini M : 762484198
Andaman & Nicobar Islands, Andaman Sea and East Bay of Bengal			
The Commander Indian Coast Guard Region (A&N), Post Box No. 716 Port Blair 744 102 A&N Islands	03192232584 03192232798 03192232681 03192231870	03192232424 03192245942	E-Mail : comcgan@dataone.in Inmarsat C : 873441908010 Mini M : 762483765
The Commander Coast Guard Distt HQ-09 Diglipur A&N Islands 744 202	03192272250	03192272315	E-Mail : Icgdhq9sancharnet.in Inmarsat C : 873441908110 Mini M : 762483768
The Commander Coast Guard Distt HQ-10 Campbell Bay A&N 744 202	03192264205	03192264205	Inmarsat C : 873441907910 Mini M : 762483771

Annexure –V

(Refer Para 8.1.6 of Ch. 8)

INFORMATION TO ACCOMPANY APPLICATION WHEN APPLYING FOR CG APPROVAL BY USER

1. Details of spill scenario (quantity, particulars of oil along with chemical properties)
2. Location, (latitude and longitude, depth of water).
3. Location as per land mark.
4. Oil Type.
5. Quantities of oil spilled and source.
6. Description of slick – including dimensions and colour.
7. Other methods of response being applied or considered.
8. Met conditions. Tide/ Wind weather/ Sea State.
9. Sensitive areas in proximity and types.
10. Particulars of OSD (as per enclosures).
    - (I) Toxicity (LC 50 value for 96 hrs).
    - (II) Efficiency.
    - (III) Solubility.
11. Standing approval for use (if held).
12. Criteria for monitoring OSD use
13. Test report and stocks.

Annexure-VI

(Refer to Para 8.1.9 of Ch. 8)

OSD DATA SHEET

Product Information

Chemical Name:

Chemical Formula:

Chemical Family:

Description:

Hazardous Ingredients Information

Health Information And Protection

Nature Of Hazard

Eye Contact:

Skin Contact:

Inhalation:

Ingestion:

First Aid

Eye Contact:

Skin Contact:

Inhalation:

Ingestion:

Workplace Exposure Limits

Permissible Exposure Limits:

Limit Values:

Precautions

Personal Protection:

Ventilation:

Chronic Effects:

Fire & Explosion Hazard

General Hazard

Fire Fighting

Decomposition Products Under Fire Conditions

Spill Control Procedure

Land Spill

Water Spill

Typical Physical & Chemical Properties

Specific Gravity (@ F):

Vapour Pressure (mmHg @ F):

Density:

Solubility in Water:

Viscosity (cST @ F)

Specific Gravity of Vapour (@ 1 atm Air + 1)

Freezing/Melting Point/Range (F):

Evaporation Rate (n-Bu Acetate =1):

Boiling Point/Range (F):

Shelf Life:

Reactivity Data

Conditions to avoid instability:

Conditions to avoid hazardous polymerisation:

Materials & conditions to avoid incompatibility:

Hazardous decomposition products:

Storing And Handling

Electrostatic Accumulation Hazard:

Storage Temperature (F)

Storage Pressure (mmHg)

Loading Temperature (F)

Loading Viscosity (cST @ F)

References

(a) A Specification for Oil Spill Dispersants, Appendix A to WSL Report LR448 (revised 1090)-Warren Spring laboratory.

(b) The Approval and use of Oil Dispersants in the UK, Ministry of Agriculture, Fisheries and Food, 1997.

(c) New Zealand National Marine Oil Spill Contingency Plan, Table-1.

(d) Manual on oil Pollution, Section IV, Combating Oil Spill, IMO, Table-1.