



NATIONAL DISPERSANTS USE POLICY

prepared for the

Federal Republic of Nigeria

by

**NATIONAL OIL SPILL DETECTION AND RESPONSE AGENCY
(NOSDRA)**

March 2011

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FOREWORD

FOREWORD

Although dispersants are used and there exists a list of approved dispersants (approved and adopted through individual testing), there has not actually been documented processes or policies to guide the use of dispersants as oil spill response strategy in Nigeria. Dispersant use and application has largely been guided by the discretion of operators; usage of which is determined by individual incidences. However, this practice is unacceptable in view of the environmental concerns.

As part of the Nigerian Action Plan for the biennium 2010 – 2011 under the Global Initiative for West, Central and Southern Africa (GI-WACAF) Project, the National Oil Spill Detection and Response Agency (NOSDRA) in collaboration with the International Maritime Organization (IMO) and the International Petroleum Industry Environmental Conservation Association (IPIECA) organized the National Workshop on Oil Spill Trajectory Modelling and National Dispersant Use Policy in December, 2010 at Lagos. At the conclusion of this Workshop it was agreed that NOSDRA should prepare a draft National Policy on the Use of Dispersants in Nigeria.

This National Policy has therefore been prepared for the purpose of providing a standard framework for the use of dispersants as an oil spill response strategy in Nigeria. It identifies use of dispersants as a response option in the country; enlists the dispersants that are approved for use in Nigeria as well as the approval procedures; outlines the geographical limitations for its use and identifies the appropriate authority responsible for approval of the use of dispersants.

ACKNOWLEDGEMENT

The Agency acknowledges the contributions and commitment of well-meaning individuals towards the development of this National Dispersant Use Policy for Nigeria. First of all, our appreciation goes to the United Nations Development Programme (UNDP) for supporting the Agency immensely in accomplishing this document. Secondly, the elaborate and brilliant input made by the Management and Staff of Mostead Integrated Investment Limited, the Consulting firm that developed the Policy is highly commendable. The Agency also recognises the commitment and effort of its In-House Committee who reviewed the document before it was presented to the stakeholders for final review and validation.

Finally, the partnership between the Agency and international partners which informed the decision to develop this document has been fruitful and highly commendable. Amongst them are International Maritime Organisation (IMO) and International Petroleum Industry Environmental Conservation Association (IPIECA) under the Global Initiative for West, Central and Southern Africa (GI-WACAF) as well as oil operators and other collaborating MDAs such as Nigeria Maritime Administration and Safety Agency (NIMASA), Nigeria Ports Authority etc.

ABBREVIATIONS/ACRONYMS

1. **GI WACAF** Global Initiative Project for West and Central Africa
2. **NOSDRA** National Oil Spill Detection and Response Agency
3. **IMO** International Maritime Organization
4. **IPIECA** International Petroleum Industry Environmental Conservation Association
5. **OSRSWG** Oil Spill Response Stakeholders' Working Group
6. **FEC** Federal Executive Council
7. **NOSCP** National Oil Spill Contingency Plan
8. **OSCP** Oil Spill Contingency Plan
9. **NEBA** Net Environmental Benefit Analysis

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PART I
INTRODUCTION

1 Preamble

1.1 Background

Chemical dispersion is one of the response options used to combat oil spillages. The technique is designed for offshore not for shoreline situations. Although, this technique has clear operational advantages, it requires some precautions.

The objective of this document is to provide relevant up-to-date information on dispersants and their use in oil spill response strategy. This document is to be used in conjunction with the National Oil Spill Contingency Plan (NOSCP).

This document is divided into 4 parts, namely:

Part I Introduction

Part I covers the scope and the general principles that form the basis of the National Dispersant Use Policy in Nigeria.

Part II Use of Dispersants as Oil Spill Response Strategy

This section contains basic information on dispersants and their use. It is included for the benefit of persons who may have limited knowledge on the subject.

Part III Dispersant Use in Nigeria

This is the main section of the document and provides guidelines and procedures for the use of dispersants in the Federal Republic of Nigeria.

Part IV Appendices and Bibliography

1.2 Scope

- i. This Policy shall serve as a regulatory guide in the use of dispersants in Nigeria and shall be applied in conjunction with other existing environmental legislations in the Petroleum Sector.
- ii. This Policy does not in any way override other existing national environmental laws and regulations in the Nigerian Petroleum Sector unless explicitly stated.

- iii. This Policy shall be administered by the National Oil Spill Detection and Response Agency (NOSDRA) in line with its schedule as stated in the NOSDRA Act Section 19 (1) h & j.
- iv. This Policy shall apply to the conditions and the limit of the use of dispersants in combating oil spill in the inland and territorial waters of the Federal Republic of Nigeria.
- v. The Policy shall cover the following issues:
 - a. Requirement for the use of dispersants
 - b. Restriction on the use of dispersants
 - c. Conditions for the use of dispersants

1.3 Definitions

For the purpose of this document:

- i. **Dispersant** shall mean ‘a mixture of surface active ingredients in one or more solvents, for the purpose of enhancing dispersion of oil into the sea water column by reducing interfacial tension between water and oil’
- ii. **National Commander** shall mean the Director General/ Chief Executive Officer (NOSDRA)
- iii. **Operator** shall mean any individual or company that is involved on oil and gas exploration and exploitation in Nigeria
- iv. **Toxicity** means the degree to which something is poisonous
- v. **Biodegradable** refers to any substance that can be broken down, or can decompose back into the natural environment without causing harm
- vi. **Dispersible** refers to any substance that can be scattered or spread in different directions
- vii. **Non-dispersible** refers to any substance that cannot be scattered or spread
- viii. **Emulsion** means a fine dispersion of minute droplets of one liquid in another in which it is not soluble or miscible

1.4 General Principles

- i. Each operator shall ensure that all national policies and regulations regarding the use of dispersants are reflected in its OSCP

- ii. Each operator shall adapt its own dispersant use procedures in line with its operational peculiarities based on the guidelines in the National Dispersant Use Policy and ensure that these procedures/practices are made available to all personnel and other organizations for oil spill response
- iii. Each operator's dispersant use procedures shall include the following information: types and characteristic of oil which might be chemically dispersible, recommended treatment rate of dispersant, recommended techniques for application of dispersants, the limit of weather/sea conditions during the use of such product, and any other information that it may deem necessary to enhance the response operation.
- iv. Each operator shall ensure the appropriate use and application of dispersants as prescribed by the applicable legislations and policies; and with a view to minimizing the environmental impact of its use
- v. Each operator may restrict the use of dispersants on designated portions of its operational areas based on the principle of Net Environmental Benefit Analysis (NEBA)
- vi. Each operator must follow the dispersant use approval procedure as issued by the National Commander, or in his absence, whomsoever he delegates, taking into consideration the applicable national laws, regulations and conditions for use of dispersants
- vii. Only dispersants that have received prior approval shall be eligible for authorization for use for oil spill response
- viii. Approval for use of dispersants may be granted by NOSDRA only if the dispersant has been subjected to and satisfactorily passed the efficiency, toxicity and bio-degradability tests
- ix. A dispersant may be adopted from the Dispersant List of another Sovereign State, taking into consideration the compatibility of the standards for the efficiency, toxicity and bio-degradability tests conducted by the State concerned
- x. Such dispersant shall still be subject to the standard approval procedure prior to use in the Nigerian environment
- xi. In granting approval for the use of dispersant, consideration shall be given to the changes in the original properties of the dispersant that may occur
- xii. Approval for the use of dispersants shall only be the period stipulated on the approval form

- xiii. Dispersants that have expired or have undergone changes in its physical properties shall not be accepted for use and shall be disposed or destroyed
- xiv. The use and application of dispersant shall be conducted in such a manner as to take into consideration any bilateral, multi-lateral or regional co-operation agreements concerning trans-boundary oil pollution incidents
- xv. In the event of a trans-boundary oil pollution incident, information and guidance for use of dispersant for response shall be provided by the National Dispersant Use Policy
- xvi. Geographical limits where dispersants may be allowed, restricted or prohibited shall be clearly defined taking into consideration environmentally sensitive ecosystems and distance from shoreline
- xvii. Maps of the geographical limits shall be included in the NOSCP and all OSCPs

1.5 Implementing Authority

The National Oil Spill Detection and Response Agency (NOSDRA) in line with its schedule as stated in the NOSDRA Act Section 19 (1) h & j, shall be responsible for the following:

- i. Authorize or prohibit the use of dispersants in the Nigerian inland and territorial waters
- ii. Provide information on delineation of geographical limits for the use, restriction and prohibition of dispersants
- iii. Provide information on efficiency, toxicity and bio-degradability tests on new dispersants
- iv. Publish the list of laboratories authorized, where applicable, to test dispersants, as well as the testing procedures
- v. Conduct research on the process of aging of stored dispersants and related developments
- vi. Provide information on new products, application techniques and other technologies in the field of dispersant use for oil spill response
- vii. Provide advice and technical assistance, and up-to-date information concerning all aspects of the National Dispersant Use Policy

- viii. Periodically co-ordinate, in collaboration with relevant stakeholders, drills and training activities targeted at personnel involved in planning and response
- ix. Periodically update and publish the list of approved dispersants in the Federal Republic of Nigeria

PART II

USE OF DISPERSANTS AS OIL SPILL RESPONSE STRATEGY

2 Objectives of Chemical Dispersants

- 2.1 Dispersants are chemicals (liquid mixtures of solvents and surfactants) used to accelerate the break up oil into small droplets that are dispersed into the water column.

- 2.2 Chemical dispersion aims at minimizing the impact of oil pollution. The use of dispersants at sea aims at reducing the amount of oil which could reach the coast or environmentally or economically sensitive areas. The use of dispersants generates the scattering of the oil in a dispersed form into the marine environment which is favourable to degradation processes (particularly biodegradation).

3 The Chemical Dispersion Process

- 3.1 Dispersants promote the formation of numerous tiny oil droplets, and retard the re-coalescence of droplets into slicks, because they contain surfactants (surface active agents). Surfactant molecules possess hydrophilic (water-seeking) head groups that associate with water molecules, and oleophilic (oil-seeking) tails that associate with oil. Oil droplets are thus surrounded by surfactant molecules and stabilized. This helps promote rapid dilution by water movements. To improve the performance of dispersants, several surfactants may be combined.
- 3.2 When applied onto slicks, dispersants reduce interfacial tension between oil and water and allow the natural mixing generated by the waves to split the oil into a myriad of tiny droplets suspended in the water column: the oil is dispersed. Turbulence and streams disseminate the dispersed oil into the marine environment. By removing the oil from the surface, dispersants help to stop the wind effect on the oil slick's movement that may otherwise push the surface slick towards sensitive areas such as the shoreline.
- 3.3 When oil and water are mixed, the wave energy of the water will either encourage natural dispersion of the oil into the water or it may cause the formation of water-in-oil emulsion. The relative rates of natural dispersion and formation of emulsions depend on the prevalent sea conditions and on the composition of the oil. The higher the wave energy, the more likely it is to facilitate dispersion. The rate of dispersion also depends on the composition of the oil – oils with low viscosity are more easily dispersed.

4 Role of Dispersant Response Option in the Combating Strategy

At sea, there are several response options e.g. containment & recovery, in-situ burning, chemical dispersion and monitoring. In the decision-making process, each of these options considered alone or combined should be examined in a comparative way. It should be noted that chemical dispersion may not be compatible with some response options (e.g. containment & recovery). However, the use of chemical dispersion simultaneously with other response options can also be considered on different locations.

In choosing the use of dispersants as an oil spill response strategy, there are several issues that must be considered.

4.1 Dispersant Toxicity

Dispersants may be lethal (cause death) or sub-lethal (do not cause death but cause damaging negative effects e.g. changes in behaviour, growth, reproduction and metabolism). This is however dependent on the **concentration of the dispersant** and the **period of exposure**. If the dispersed oil is rapidly diluted, the exposure to organisms in the upper layer of the water column will be low. For this reason, toxicity tests should be conducted *in situ* and when organisms are present. Where this is not possible, laboratory tests can be conducted but must be interpreted with caution as they are only representative tests of what might happen in the field.

Unless the dispersed oil (in suspension in the water column) has been diluted down to harmless concentrations, dispersants can become toxic. For all these reasons, dispersant spraying is not appropriate in nearby or adjacent sensitive areas, or in places where the dilution factor is too small (shallow waters or confined water area) e.g. near the coastline. Dispersant use may also be restricted in areas that are designated as 'high risk zones' that are very sensitive such fisheries, mariculture areas, estuaries and desalination plant water intakes. Protected areas must be defined according to water depths and distance from the shoreline.

4.2 Sea/weather Conditions

It is important that there is enough wave energy to encourage breakdown of the oil molecules, otherwise the oil will resurface. However, when the sea is too rough or there is too much wave energy, the dispersant spray may be blown away from the oil and thereby miss its target. If the sea is too calm to provide the needed wave energy, the mixing of the dispersant with the oil can be encouraged by either mixing the oil and water with fire hoses, or sailing through the oil slick and stirring it with bow wave and propeller action.

Weather conditions do not directly affect the physical properties of dispersants but rather the application of dispersants. High winds can blow dispersants away, and may also be unsafe for aerial application of dispersants. Poor visibility can impede the spraying of dispersants.

4.3 Application Technique

The application rate of dispersants is determined by the discharge rate of the dispersant pump, the speed of the vessel or aircraft, and the width of the area covered by the spray (swath).

$$\text{Application Rate} = \text{discharge rate} / \text{speed} \times \text{swath}$$

Dispersant needs to be applied as evenly and as accurately as possible to spilled oil. Although the recommended treatment rate for modern dispersants, is a dispersant to oil ratio of 1 to 20–30, lower treatment rates have been shown to be effective with light, freshly spilled crude oils. Undiluted spraying from ships or aircraft is the preferred method of using dispersants, although seawater dilution can be used from vessels if the appropriate equipment is available. The latter is efficient only on low viscosity oils. Appropriate dispersant resistant equipment must also be used.

The dispersant must not penetrate through the layer of oil into the water. For this reason, the proper droplet size must be used. The optimal droplet size is considered to be 350 – 1000 μm . If the droplets are too small, the dispersant will be blown away by the wind and not reach its target. If they are too big, they pass through the oil layer

without binding sufficiently to the oil. Therefore, the spraying system used should therefore be able to achieve this.

Dispersants can also be used in underwater sea spills. For instance, in the Gulf of Mexico oil spill incident dispersants were applied at 1300m depth and served to reduce the amount of oil resurfacing from the damaged well and the amount of oil liable to drift to very sensitive areas.

Dispersant spraying systems can be classified into 3 groups:

- Aircraft mounted spraying systems
- Boat mounted spraying systems
- Portable units for individual use

4.3.1 Aircraft mounted spraying systems

This application method ensures rapid response and high treatment rates and easy assessment of the area under consideration. Typical systems are airplanes (crop spraying airplanes, fixed systems or multi-engine aircraft, self-contained airborne spraying systems) or helicopters (fixed spraying systems, spray buckets).

Aerial guidance is needed to know when and where to spray the dispersant. Consideration must also be given to the payload and range of the aircraft, as well as having a sufficient supply of dispersant for quick refills. Only neat concentrates are suitable for airborne spraying systems.

4.3.2 Boat mounted spraying systems

Systems can be set up for spraying Types 1, 2 and 3 dispersants. When the dispersant is to be pre-diluted with seawater, the educator system or the injection system may be used; the former is designed to function with the ship's in-built fire fighting system. It should be noted that diluting of dispersants can lower the efficiency of the product. For ship-borne treatments, preset connection set-up for the spraying system on board is recommended to avoid wasting time.

Example of vessels that can be used for dispersant application include anti-pollution boats, trawlers, tug boats and small fishing vessels.

4.3.3 Portable units for individual use

Where dispersants need to be applied near the shoreline, portable individual units such as back pack units and trailer mounted pumps connected to spraying guns may be used. All types of dispersants can be used in this method of application.

4.4 Net Environmental Benefit Analysis (NEBA)

Before deciding on which response strategy to choose, it is often timely to see whether the response will mitigate the pollution and improve the situation or whether it is better to leave well alone and refrain from responding. This approach is called NEBA (Net Environmental Benefit Analysis).

When conducting a NEBA, consideration should be given to the dilution potential in different types of water-body, the toxicity of the likely concentrations of treated and non-treated oil to local flora and fauna, and the distribution (drift) and fate of the treated and non-treated oil in water, sediments and organisms. In the case of mortalities (flora and fauna), the expected ability of the affected populations to recover should also be considered.

For instance, while dispersed oil is more dangerous for the aquatic fauna and flora (corals, fish farm water intakes and industrial water intakes) than oil floating on the water surface, dispersed oil is less detrimental for seabirds and some habitats such as mangrove swamps than free-floating surface oil.

For the NEBA process to be most effective, it should be planned well in advance. Natural and economic resources in an area should be identified in order of sensitivity; the most sensitive areas being higher on the 'priority for protection' list. This list should include habitats with poor flushing, highly productive areas and endangered species. One approach to doing this is to use Environmental Sensitivity Index maps.

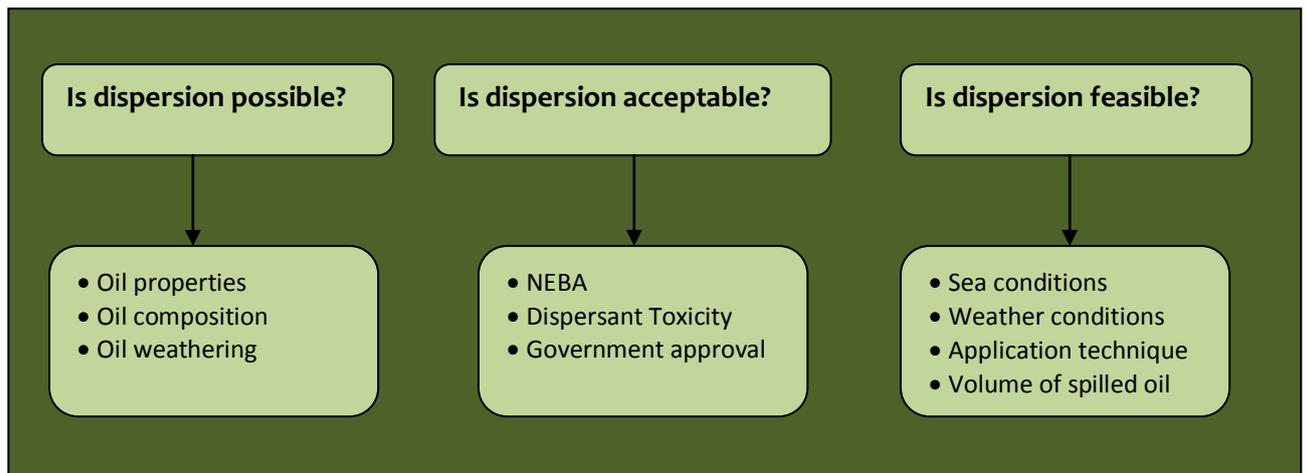


Figure 4.1 *Issues to Consider When Deciding Whether or not to Use Dispersants*

5 Types of Dispersants

5.1 Composition of Dispersants

Oil spill dispersants are composed of two main groups of components

- Surface active agents (surfactants): chemical compounds with two dissimilar parts: a 'water-loving' (hydrophilic) part and an 'oil-loving' (oleophilic) part. They act as a 'chemical bridge' between oily materials and water. Surfactants may be anionic or non-ionic.
- Solvents: liquid chemicals or their mixtures added to dispersant to enhance dissolution of surfactants in the oil and reduce product viscosity. They may be water, water-miscible hydroxy compounds or hydrocarbons.

5.2 Classification of Dispersants

In general, modern dispersants are classified into 2 classes: the second and third generation dispersants also referred to as 'conventionals' and 'concentrates' respectively.

i) 2nd Generation Dispersants

This class of dispersants are known as 'conventionals' are hydrocarbon-based, are of low toxicity and contain a low concentration of surfactants (15 – 25%). They are of low effectiveness. 2nd generation dispersants are usually applied neat at high dosage rates. Typical dosage rates are between 1:1 and 1:3 (dispersant: oil ratio).

ii) 3rd Generation Dispersants

These dispersants are known as 'concentrates' and have higher surfactant content (25 – 60%). Typical dosage rates are around 1:20. They can be applied neat (recommended as more effective) or pre-diluted with seawater as the solvent (1:10). These dispersants contain water soluble compound alcohol/glycol type.

| Dispersant Type (IMO) | UK Classification | Application | Typical Dispersant Oil Dosage |
|--|------------------------------------|---------------------------|--|
| 2 nd Generation Conventionals | Type 1 | Neat (pure) | 1:3 to 1:1 |
| 3 rd Generation Concentrates | Type 2 | Pre-diluted with seawater | 1:20 (i.e. 1:5 dispersant + water: oil) |
| | Type 3 (self mixing dispersant) | Neat (pure) | 1:20 |

Table 2.1 Classification of Dispersants in the United Kingdom (UK) (REMPEC, 2010)

5.3 Properties of Dispersants

The **viscosity** of dispersant depends on the temperature. The range of viscosity is shown below:

| Type of Dispersant | Viscosity in centipoise (cP) | |
|--------------------|------------------------------|----------|
| | 0°C | 20°C |
| Conventionals | 10 - 50 | 5 - 25 |
| Concentrates | 60 - 250 | 30 - 100 |

Table 2.2 Typical Viscosity Ranges for Dispersants (REMPEC, 2010)

Conventional dispersants have lower **specific gravities** (0.8 – 0.9) than concentrates (0.9 – 1.05). The **pour point** of most dispersants is below 0°C (-40°C to -10°C). Below this temperature, the dispersants will not solidify. The lowest temperature at which vapours above the volatile substances will ignite when exposed to a flame is called **flash point**. The flash point for dispersants is above 60°C, hence they are considered inflammable. The average **shelf-life** of dispersants is 5 years. Some dispersants are corrosive, so consideration must be given to the type of packaging used for them.

6 Advantages and Disadvantages of Dispersants

6.1 Advantages of Dispersants

- i. Dispersants are relatively cheap, simple to use, can act fast;
- ii. dispersants do not produce wastes that require disposal
- iii. they facilitate natural biodegradation of oil by increasing exposed surface area of the oil to oil-eating bacteria and oxygen;
- iv. larger areas can be treated with dispersant through aerial dispersion;
- v. shorelines and sensitive resources locate downwind can be protected;
- vi. dispersants prevent the contamination (oiling) of seabirds, marine mammals and other resources sensitive to floating oil (surface slick);
- vii. Unlike containment and recovery strategy, dispersants may be applied in strong currents or sea conditions.

6.2 Disadvantages of Dispersants

- i. Dispersants are not appropriate everywhere, particularly where the possibility of dilution and dissemination is reduced.
- ii. When initially efficient, chemical dispersion is applicable only for the first hours/days of the operation, before the oil becomes non-dispersible.
- iii. The use of dispersants is usually localized and the temporary increase in oil in water concentration (Water Accommodated Fractions-WAF, e.g. benzene, toluene, ethyl benzene and xylenes) may be harmful for the marine animals within the immediate vicinity of the dispersant application. If the dilution of the dispersed oil is rapid then the exposure of the marine organisms will be low; hence the impact will also be low. It is pertinent to note those that with or without dispersants, the organisms will still be exposed to some level of naturally dispersed oil.
- iv. On significant pollution, chemical dispersion is not applicable in too calm sea state.
- v. Dispersants are not very effective on high viscosity oils.

- vi. When used near shorelines or shallow waters, it may encourage adhesion of oil to suspended sediments.
- vii. The use of dispersants introduces additional material into the marine environment.
- viii. Pollution is not removed but only dispersed.

PART III
DISPERSANT USE IN NIGERIA

7 Recommendations for the Use of Dispersants

7.1 Recommendation for the Decision Making on the Use of Dispersants

Taking into account that dispersion can be efficient only during the beginning of the oil release, it is of utmost importance that **the decision to use or not to use dispersant should be taken very quickly, without loss of time in assessment and discussions.** The speed of decision will depend on criteria that have been established from the physicochemical, environmental and logistics assessments.

7.1.1 Oil Dispersible and Non-dispersible

Dispersants are not effective in all circumstances. This is because there is an interval during which oil is dispersible. This is known as the 'window of opportunity' or 'dispersion window'. This may range within a few days after the oil has been spilled. Oil properties and weather conditions play an important role in determining the effectiveness of dispersants.

- i. Dispersants are best applied as soon as possible after the oil spill because the composition of oil and physical properties (prevailing temperature, wind speed and sea conditions) changes over time.
- ii. Over the course of time, volatile components of oil evaporate and the water-in-oil emulsions ('chocolate mousse') are formed both of which decreases the effectiveness of dispersants. The more stable the emulsion becomes, the less effective the dispersants.
- iii. The viscosity of oil is an indication of how easily it flows or moves with an applied force, such as a breaking wave. The viscosity of oil increases as the oil weathers and also as the temperature decreases. However, the degree of viscosity change with temperatures varies with oil type. Viscosity is usually measured in centiStokes (cSt) (1 cSt = 1 mm²/s).
- iv. Below a viscosity of 500 cSt (at seawater temperature), dispersants can easily be applied as concentrates or diluted.
- v. Between 500 and 5000 cSt (fresh crudes, medium fuel oils), dispersion is possible using concentrated solutions.

- vi. Chemical dispersion should not be used for pollutants with viscosity greater than 5,000 cSt. Between 5,000 and 10,000 cSt, the effectiveness of concentrates is very uncertain.
- vii. Above 10,000 cSt (heavy, weathered and emulsified crudes, heavy fuels), dispersion is generally impossible. Oils with higher viscosity require more wave energy for dispersion.
- viii. Non-persistent oils – refined products (e.g. petrol, diesel oil, kerosene) do not require the application of dispersants as they are expected to evaporate and self-disperse when released at sea.
- ix. Dispersion may be used for non-persistent oils where the risk of fire or explosion hazard has been clearly identified.
- x. Crude oils with pour points significantly above the sea temperature cannot be dispersed because they are solid.
- xi. If the wax content of any oil is high, it is less likely to be dispersed even though its viscosity is low.
- xii. For oils usually transported inside or in the vicinity of NIGERIAN water or regularly imported in NIGERIAN harbours, specific studies should be conducted on these oils in order to assess the windows of opportunity for dispersion :
 - weathering study using modelling (ADIOS)
 - completion of laboratory tests to assess oil dispersibility
- xiii. Results of the studies conducted in (xii) above should be documented as an Annexure in the National Oil Spill Contingency Plan in the form of tables giving the oil viscosity/window of opportunity of each studied oil according to different environmental conditions (temperature, wind). This is to be done by the National Oil Spill Detection and Response Agency (NOSDRA) in collaboration with oil companies, Nigerian Maritime Administration and Safety Agency (NIMASA), Nigerian Ports Authority (NPA), etc.

In summary, in deciding whether or not to use dispersants on spilled oil, consideration should be given to not just the viscosity of the oil, but also to other properties. A combination of these properties is what actually determines whether or not the oil can be dispersed.

NOTE: Most of Nigerian crude oils fall into the category of light to medium crude with specific gravity 0.80 – 0.85. Pour point is about – 50C and flashpoints range from 187°C to 237°C (in the case of refined

products). It follows that any spilled oil would very easily spread on the surface of water thereby aiding quick evaporation of the light ends of the hydrocarbon.

| | |
|---|--|
| Light refined product (petrol, kerosene, diesel oil etc.) | No chemical dispersion |
| Pollutant viscosity < 500 cSt | Dispersion is generally easy with a concentrated dispersant, applied neat or pre-diluted with seawater |
| 500 cSt < Pollutant viscosity < 5,000 cSt | Dispersion is usually possible with a concentrated dispersant applied neat |
| 5,000 cSt < Pollutant viscosity < 10,000 cSt | Uncertainty as to the result; dispersion is sometimes possible with a concentrate applied neat but in that case it is better to check on the part of the slick whether the dispersant is effective before extending the treatment to all of the slick. |
| Viscosity > 10,000 cSt | Dispersion is generally impossible |

Table 7.1 Generally Accepted Viscosity Limits (REMPEC, 2010)

7.1.2 Locations Where the Chemical Dispersion can be undertaken

- i. Dispersants are recommended for use in specified marine environment in NIGERIA. (See Annex II)
- ii. The toxicity of the dispersed oil can affect marine fauna and flora, hence chemical dispersion is not applicable everywhere.
- iii. Chemical dispersion is not generally accepted on or in the immediate vicinity of the ecologically vulnerable or sensitive areas and in areas where the possibilities of renewal and mixing of water do not offer conditions for rapid dilution of the dispersed oil.
- iv. The definition of areas where chemical dispersion can be reasonably undertaken is relatively complex and must take into account different local environmental parameters and data (current, biological diversity etc.). For this reason, such areas

should be pre-established and geo-localized: geographical limits for the use of dispersants.

- v. The choice of these areas should be based on studies on scenarios which aim at comparing the evolutions and the environmental and socio-economic impacts of the pollution by dispersed and non-dispersed oil (NEBA), taking into account all local characteristics: type of ecological and socio-economic resources, marine protected areas, fisheries-related resources, currents, season, climate variations, migrations of the marine species of interest.
- vi. The geographical limits must be defined for increasing spill scenarios, corresponding to pollution situations of Tier 1 (0 – 25 barrels to inland waters OR 0 – 250 barrels to land or coastal/ offshore waters), Tier 2 (25 - 250 barrels to inland waters OR 250 – 2500 barrels to land or coastal/ offshore waters) and Tier 3 (greater than 250 barrels to inland waters OR above 2500 barrels to land or coastal/ offshore waters).
- vii. The use of dispersants shall be restricted to the following limits:
 - A minimum water depth of 20 m and 1 km distance from shoreline for dispersing Tiers 1 - 3 pollution
 - Because distance from shore varies with location, where the water depth is less than 20m, the distance from the shore shall be used as criteria for determination of use of dispersants
 - Where there is justification that the water depth is up to 20m, but the distance to the shore is less than 1 km, approval for dispersant use may be issued based on a case-by-case consideration
 - The volume of oil spilled shall also be a factor in deciding whether or not to use dispersants near the shore
- viii. A Technical Committee led by NOSDRA and composed of oil companies, the NPA, Clean Nigeria Associates (CNA), NIMASA, Nigerian Institute of Oceanography and Marine Research (NIOMR), the Navy, and in consultation with Environmental Assessment and Pollution Control Departments of Federal Ministry of Environment, Forestry Department of Ministry of Agriculture, relevant State Ministries of Environment/s, Local Government Area Councils, shall be established. Any organisation whose mandate/function is deemed relevant to the

study shall be co-opted into the Committee as necessary. The technical secretary of the Committee shall be decided by the Committee.

- ix. The Technical Committee will examine and study when necessary areas of special interest (harbour entrance, ports, etc), marine protected areas and modifications to these general limits at local scale taking into account local characteristics (environmental and socio-economic).
- x. In carrying out its work, the Technical Committee shall consult with Local communities and Non-Governmental Organizations dealing with marine conservation as well as scientific experts in the marine environment.
- xi. The possibility of using dispersants in harbour areas such as ports, jetties, shorelines, etc should be examined on realistic scenarios in terms of quantity of oil to be involved in expected spill incidents, the main locations where the risk for incident is most important, the prevailing weather conditions, the tidal stream and the surface agitation. These scenario studies will aim at comparing realistically (according to the available equipment) the possibilities for containment and recovery, chemical dispersion and letting oil come ashore for shoreline cleanup. For each of these options the environmental damage and the associated cost will be considered and compared in order to determine the most appropriate option.
- xii. NOSDRA shall be in charge of conducting the investigations in paragraph (xi) above.
- xiii. The charts of the limits shall be integrated into the National Oil Spill Contingency Plan (NOSCP) as well as individual company's OSCP (according to the area of operation) in order to assist persons in charge of the response to decide without delay to disperse or not (to decide quickly as long as the pollutant is still dispersible)(see Annex III).
- xiv. The above charts are to be updated by NOSDRA under the supervision of the Technical Committee designed in paragraph (viii) above.

Note on the use of oil spill dispersants in inland waters: in inland waters, the rationale can be different and the environmental considerations may differ. This document is prepared for marine application, not for inland waters. For inland waters, see Section 10.

SUMMARY

As a first approach, the following basic principles can be considered:

- 1) Consider the use of dispersant in open sea/offshore/ ahead sensitive resources to avoid oil reaching the shoreline or possibly sensitive items (where the water quality needs to be preserved)
- 2) Generally speaking, no use of dispersant on or in the immediate vicinity of sensitive items.
- 3) On coastal areas where several sensitive items are of concern, NEBA based on realistic scenarios is required.
- 4) When NEBA is needed:
 - a. Local sensitive items should be listed and their possible vulnerabilities assessed;
 - b. Consider the NEBA approach in terms of vulnerability rather than sensibility (vulnerability = sensitivity and restoration time);
 - c. If conflicting conclusions:
 - Preserve the habitat before the species;
 - Preserve the reproduction possibilities rather than the young stages
- 5) Warning: special concerns for the application of dispersants when the wind is blowing in the direction of flocks of birds (contact between dispersants and feathers of seabirds should be avoided)

Note 1: The use of dispersants should be a response to incidental pollution; in sheltered areas a chronic usage on repeated incidents can lead to chronic contamination.

Figure 7.1 Basic Principles to Set Environmental Considerations to the Use of Dispersants Particularly in Coastal Waters (REMPEC, 2010)

7.1.3 Logistics for Dispersion Application

- i. Logistics required for the application of dispersants include the spraying system, the product and other related items. These products and means required are listed in individual company's OSCCP and the NOSCP (location, quantities, characteristics, compatibility, availability, operational limit conditions, and mobilization & deployment timeframe) such as:
 - Operational stocks of dispersant;

- Shipboard spraying systems;
 - Vessel on which spraying equipment can be used;
 - Vessels equipped with spraying systems;
 - Aerial spraying aircrafts;
 - Facilities from where means would be deployed (airports, ports etc.)
 - Aerial surveillance aircrafts aimed at guiding the operations
 - Communication means;
 - Transport means.
- ii. The OSCP and NOSCP must also include information (characteristic, performances, requirements and conditions of availability) related to the equipment which is likely to be mobilized:
- At national level, public and private equipment;
 - At regional level, equipment available through bilateral or regional agreement(s) with neighbouring countries;
 - At international level, equipment available through international, regional, sub-regional or bilateral agreements or through contracts with international cooperative companies.
- iii. Details must also be provided on the persons in charge of the equipment (contact person).
- iv. NOSDRA in cooperation with the stakeholders (oil companies, NIMASA, NPA etc.) is in charge of keeping the listing of equipment and related logistics up to date.

7.2 The Decision Making Process

The decision **at the time of the incident** is led through 3 questions:

- Q1) Is dispersion *a priori* possible from a physicochemical point of view? That is, is the viscosity of the pollutant compatible with dispersion? (This question refers to the recommendation in Section 7.1.1)
- Q2) Is dispersion acceptable from an environmental viewpoint? Is the pollution located in an area where a priori dispersion is possible? (This question refers to the recommendation in Section 7.1.2; also see Section 4.4)

- Q3) Is dispersion feasible from a logistics point of view? Are the logistics a priori available (products and spraying equipments) and sufficiently mobile to conduct the operation within the time limit (period when chemical dispersion remains effective, “window of opportunity for dispersion”)? (This question refers to the recommendation in § 7.1.3)

At the time of the incident, the approval for using dispersant is taken by NOSDRA. For this decision, NOSDRA can request the assistance of other relevant stakeholders/ institutions.

NOTE: Authorization must be obtained prior to application of dispersants. The process for the authorization shall be first by phone call to NOSDRA to get authorization (092911971, 092911972, 08098964887, 08100494702). Authorization shall be on a case-by-case basis. Afterwards, proper documentation must be sent to NOSDRA.

7.3 Selection of Dispersant Products

- i. The dispersants used in NIGERIA marine waters must be approved for pollution countermeasure use by the authorities. (**NOTE:** such acceptance/approval do not prevent the compliance of a dispersant with the general regulations on chemicals)
- ii. There shall be a list of approved dispersants to include product names. These products shall be of low toxicity, efficient and biodegradable.
- iii. The list will be built from lists from other countries (UK, France, USA)
- iv. The list of approved dispersants shall be from products that have been tested for efficiency, toxicity & biodegradability according to national and international standards
- v. Additional tests may be required, where necessary according to Nigerian environmental regulations.
- vi. For efficiency prospective, only concentrate dispersants are recommended for use in NIGERIA specified marine environments.
- vii. For safety reasons, dispersant products flashpoint should be above 60°C.

- viii. The product should be documented through the manufacturer's recommendations.
- ix. Dispersants should be guaranteed by its producer to be stable and to keep its properties for 5 years minimum when stored in proper conditions.
- x. The products approved are registered on a list of approved products constantly revised.
- xi. In the event of pollution concerning neighbouring countries, the decision related to the use and to the application of dispersant must take into account the existence of bilateral (or regional) agreements with the neighbouring country(ies). These agreements refer to: the dispersants approved by the related country(ies), the application equipment which can be pooled, and the integration in the NIGERIA response capacities brought from the related country(ies).
- xii. As a principle, in the case of a joint operation at regional level, dispersants approved in the partner countries will be accepted if they have been tested for effectiveness and toxicity.
- xiii. In the event of major pollution requiring international assistance (Tier 3), dispersants can then be products which have been examined at least from the point of view of their effectiveness and their toxicity and which are acceptable.
- xv. The approval procedure and its possible revision are under the responsibility of a Technical Committee led by NOSDRA and composed of oil companies, NIMASA, NIOMR and NPA in consultation with Environmental Assessment and Pollution Control Departments of Federal Ministry of Environment, Forestry Department of Ministry of Agriculture, relevant States Ministry of Environments, and Local Government Area Councils. The technical secretary of the Committee shall be NOSDRA.

Note on the use of oil spill dispersants in inland waters: the choice of dispersant product is different (products efficient at sea are often not efficient in fresh water). See Section 10.

7.4 Choice of Application Equipment

- i. The equipment used for the application of dispersants is specialized material or materials converted for this purpose

- (e.g. agricultural plane equipped with proper nozzles or mobile spraying equipment to be set in/under transport planes).
- ii. The equipment ensures a regular spraying and distribution of the dispersant (diameter of the dispersant droplet, rate of application).
 - iii. The equipment is regularly maintained (individually checked once a year at the warehouse) and periodically tested through exercise.
 - iv. The choice of application equipment of the national stockpiles should be approved by NOSDRA with the technical advice of CNA, Relevant Research Centres, and environmental NGOs. Any organisation whose mandate/function is deemed relevant to this study shall be co-opted into the Committee as necessary.

7.5 Logistics Related to Dispersion Application

The application of dispersants requires a complete logistics. In addition to the spraying equipment, it is necessary to envisage the logistics to carry this equipment (ships, helicopters and planes), the required consumables (in particular fuel), adapted facilities (airport, port and runway) as well as other related provisions (e.g. means of transport of the materials or products).

- i. Aircrafts can be in NIGERIA or coming from external countries. They can belong to public sector or private companies.
- ii. In the case of aircrafts owned by external private or public bodies, contracts should be set to ensure the availability of the equipment at the time of the incident (availability within 6 hours after the call for mobilization).
- iii. Reciprocal compatibilities of equipment and materials deployed must be checked in order to guarantee the reliability of the whole logistic chain (e.g. compatibility of the spraying systems with the ships, compatibility of planes or helicopters with the local facilities etc.)
- iv. For these aircrafts, the different authorities linked to the Civil Aviation regulations should be prepared in advance in order to allow a fast deployment of the aircrafts at the time of the incident.

- v. Considering the aerial application equipment, NOSDRA makes an inventory of the possible available resources at a regional level (existing spraying aircrafts).
- vi. Considering application equipment, taking into account that private resources will be needed, contracts must be set with bodies owning the equipment.
- vii. At Tier 3 level, NOSDRA is in charge of establishing contracts with private/external bodies owning application equipment which are planned to be mobilized in the NOSCP.
- viii. At Tiers 1 & 2 level, individual operators are in charge of establishing contracts with private/external bodies owning application equipment which are planned to be mobilized in their OSCP.
- ix. NOSDRA keeps updated inventory of equipments and products available from public and private sector.

Operational Stocks of Dispersants

- x. In order to ensure prompt dispersant application, dispersant stockpiles must be set up. A guide to the quantity of dispersants that can be stocked at any point in time is to have at hand enough stock to allow responders to deal continuously with a spill for at least one day in a facility that can house or accommodate treatment vessels or aircrafts.
- xi. These stockpiles should be quickly deployed or localised near the spraying systems. They must also be dimensioned to enable a day of dispersion with the spraying system available at the location. Regarding the vessel-mounted spraying systems, stockpiles should be located preferentially in the ports where the vessels are located. Concerning the aerial spraying aircrafts, stockpiles should preferably be available at the airport.
- xii. Additional dispersants required for responding, can be shipped in from one or several stockpiles provided they are packed accordingly (rail tanker, containers that can be loaded very quickly on trailers) and can be shipped during the course of the first day so as to replenish the response vessels and aircrafts. It is also recommended that additional dispersant (admittedly in limited quantities) will have to be secured from manufacturers.
- xiii. The date of manufacture of the product must be given by the supplier

- xiv. The dispersant must be stored according to the manufacturer's instructions and their material safety data sheet (MSDS).
- xv. The batches of dispersant of the operational stockpiles are checked periodically (physicochemical parameters – aspect, viscosity, density; effectiveness) to check their good conservation.
- xvi. The shelf life for dispersants is limited (5 or 6 years according to manufacturers but in actual fact more than 10 years providing storage conditions are good). Periodical testing needs to be carried out to ensure that dispersants stockpiles are still effective. The testing may be done by:
 - Visual inspection: physical characteristics of the dispersant (appearance, deposits, density and viscosity);
 - Efficacy and toxicity testing of the batches that have undergone changes to their physical characteristics.
- xvii. The periodic checking/testing plan shall be: 5 years after purchase if the product has been kept in its original tank/drum, and further every 2 years, taking cognisance of the lifespan of the dispersant and date of purchase.
- xviii. Disposal of unusable dispersants is the responsibility of the dispersant owner. The dispersant must be disposed off in environmentally acceptable norms akin to any chemical substances which are disposed in accordance to the environmental regulation that are in force.
- xix. An inventory of stockpiles of dispersants and spraying systems should be kept up-to-date. This inventory must take into account stockpiles of the countries or entities with which bilateral agreements or agreements of assistance exist as well as the industry capacities.
- xx. The public stockpiles of dispersants are under the responsibility of NOSDRA.

NOTE: It is strongly advised NOT to mix dispersants, be they of the same generation or type, as this can lead to product instability over time (phase separation).

8 Application Procedures

8.1 On Location Dispersion Efficiency Test and Dispersion Monitoring

When spills occur, the degree of weathering is generally unknown, and it is also known that the effectiveness of dispersants (i.e. the dispersibility of pollutant) is largely dependent on amongst other factors, the degree of weathering of the pollutant. For these reasons therefore, any dispersant application should commence with a test run and careful observation (e.g. visual observation to look for brown plume under the sea surface corresponding to dispersed oil). Such tests should be repeated periodically during the operations until when it is established that dispersibility is no longer efficient; this determines whether to continue with dispersant application or not. While monitoring of dispersant application and effectiveness is essential, the practicability of doing this can be difficult sometimes. In such situation, samples are collected and tested in a laboratory for toxicity and effectiveness of dispersion. Generally however, interpreting results of laboratory test for toxicity and effectiveness of dispersant must be done with caution as such results are not always a true reflection of the reality in the field.

Ultra-violet fluorimetry (UVF) is sometimes used to provide 'real-time' (in-situ) data on the concentration of dispersed oil in the water column during the application of dispersants. Typically, the variation in the concentration of fluorescent components is to be measured at least 1 metre under the slick using a fluorimeter that is towed behind a sampling boat. In open water, dispersion is demonstrated by a significant increase in the concentration of oil detected by the sensor compared with that measured prior to dispersant application. However, when used operationally, UVF does not provide a quantitative measurement of the amount of oil that is actually being removed from the sea surface and it should be used in combination with visual observations to decide whether a worthwhile response can be achieved.

8.2 Dispersion Application Procedure

In order to ensure effective application of dispersants, the following amongst other standard procedures must be adhered to by responders:

- i. Dispersant should be applied to thick part of the slick (brown to black colour).
- ii. Systematic application should be adopted, taking into consideration the strength and direction of wind.
- iii. Dispersant application should be carried out by experienced personal.
- iv. Appropriate and functional dispersant spraying equipment should be used.
- v. If a ship is used as a spraying tool, a spotter aircraft should be used to guide the ship in determining the slick zones where the dispersant application must be targeted.
- vi. For the purpose of justifying the decision to use dispersant as well as possible claim for compensation thereafter, dispersion efficiency should be monitored with any of the following:
 - Collecting water samples before and after treatment to determine level of pollutant concentration.
 - Aerial photography or remote sensing (e.g. IR) to assess amount of oil on remaining on sea surface (change in slick appearance due to dispersion).
- vii. The National Oil Spill Detection and Response Agency (NOSDRA) and if necessary, other relevant institutions such as oil companies, NIMASA, NPA, etc (marine environment) would be responsible for monitoring of the efficiency of dispersion.
- viii. The National Oil Spill Detection and Response Agency (NOSDRA) in collaboration with the responsible oil company/ies will decide to continue or stop the application of dispersant.

8.3 Involvement on Fisheries Activities

The dispersion of significant amount of oil can impact some environmental resources as fisheries (e.g tainting of sea food following contact with oil droplets). For sanitary reasons and to justify afterwards claims for compensation, it is useful to monitor the water column quality which may have been in contact with oil as well as the

quality of the sea food and possibly to take appropriate measures such as banning fishing temporarily.

The Monitoring of the effects of the use of dispersants as well as the appropriate decisions (e.g. fishing ban) is under the responsibility of the National Oil Spill Detection and Response Agency (NOSDRA) in consultation with Department of Fisheries, NIMASA, NPA, relevant State Governments, etc.

9 Precautions and Operational Recommendations

9.1 Drills

- i. Drills should be organized periodically to validate the combating procedures, to train the operators and to check the capability of the contingency plan (through table top exercises to check the availability of persons to be mobilized – level 1 exercise), and through practical field exercise to check the capability of the combating equipment to respond to a pollution situation (through real simulations, mobilizing people and equipment on site – level 2 exercise).
- ii. One level 1 exercise (table top) per year should be organized in each local operational area and one level 2 exercise per year should be organized at the national level, in different operational areas.
- iii. Level 2 exercise could be organized in the frame of the NOSCP (involving techniques other than dispersion).
- iv. Corrective actions should be taken according to the observations made during the exercises.
- v. Drills are to be co-ordinated by NOSDRA in collaboration with the concerned organizations.

9.2 Training

- i. People in charge of operating the dispersant application equipment should be specifically trained. This training can be integrated in the general training plan in the NOSCP.
- ii. NOSDRA shall co-ordinate and supervise the training.

9.3 Protection of Personnel and Equipment

- i. People in charge of the spraying operations should be protected against mist of dispersant using individual protective equipment e.g. mask, protective impermeable clothes, gloves etc.
- ii. For safety reasons, solid surfaces (especially ship decks) which may receive spray of dispersant should be flushed with water to avoid being slippery.

- iii. Materials and equipments that have come into contact with dispersant should be flushed with water to avoid any deterioration (e.g. of paint, rubber seals etc.).
- iv. Spraying equipment should be rinsed with fresh clear water after use.

10 Use of Oil Spill Dispersants in Inland Waters (Rivers and Lakes)

The use of dispersants in inland waters differs from its use in the open sea. Generally speaking, chemical dispersion is not appropriate to oil pollutions in inland waters for the following reasons:

- i. The volume of water is often limited and does not allow the same dilution-dissemination conditions as those prevailing in the open sea;
- ii. The agitation is often too weak to promote dispersion;
- iii. The lack of agitation is favourable to the choice of the containment and recovery response option;
- iv. In inland waters, the oil spill incidents involve more often light refined products which do not require chemical dispersion;
- v. There are uncertainties on the environmental and socio-economic impact of dispersant use in inland waters. The environmental considerations may differ from those prevailing in marine environment, in terms of sensibility and vulnerability; these need to be studied in advance in order to check that dispersion would bring more advantages than disadvantages. In particular, chemical dispersion is not suitable in the vicinity of upstream water intakes (which would be polluted in such a case) of fish farms etc.

According to these considerations, generally speaking, the use of dispersants in fresh water environment should be avoided. The situation for which the dispersion process could be applied in fresh water would be ONLY:

- i. On dispersible oil products (viscosity less than 5,000 – 10,000 cSt), and also persistent pollutants (which exclude the light refined products such as petrol, diesel oil, kerosene, which naturally evaporate and self disperse);
- ii. Possibly, on rivers presenting a strong stream preventing any possibility of using the containment and recovery response option, or in great lakes when the agitation resulting from bad weather conditions (wind) is strong enough to prevent any containment/recovery operation;
- iii. Far away from environmentally sensitive items or water intakes;

- iv. On very limited quantities of pollutant, in order not to pollute the local environment.

In such case, it would be necessary to:

- i. Use a specific dispersant designed for fresh water use (refer to French list of fresh water dispersants at http://www.cedre.fr/en/response/dispersants_edgb.pdf) **should this be included as an annexure in this document?**
- ii. If necessary, promote the dispersion process by mixing the slick with water jets after application;
- iii. On location where the depth is higher than 10 metres;
- iv. With warning to the population which use the water;
- v. With report of the incident to the authorities and monitoring the environment.

If some specific persistent oils (e.g. crude) would be frequently transported in known fresh water bodies, it is recommended that these oils be studied in terms of behaviour and toxicity in fresh water environment in order to determine the most appropriate response options and the best conditions for use, including the use of dispersant (determination of the weathering process of the oil dispersibility, dispersed oil toxicity etc.)

PART IV

ANNEXURE & BIBLIOGRAPHY

ANNEXURE

ANNEX I

List of Approved Dispersants Recommended for Use in Nigeria

- | | |
|---------------------|--|
| 1. GOLD CREW | 20. SHELL LTY |
| 2. COREXIT 7664 | 21. SHELL DISPERSANTS LTX |
| 3. COREXIT 9527 | 22. SEAMATE |
| 4. COREXIT 8667 | 23. PIC 6 |
| 5. EMULSON LW | 24. PIC 7 |
| 6. GAMELEN OSR 2000 | 25. OIL LAVE |
| 7. AGMA OSD 559 | 26. PETROLITE W2096 |
| 8. SLICKGONE LTE | 27. OIL SPILL REMOVAL W.S.A |
| 9. SWOSH H.O.D | 28. RIGID OIL SYSTEM |
| 10. DISPOLENE 36S | 29. NAXCHEM DISPERSANT |
| 11. SERVO CD 2000 | 30. FORMULA 98 |
| 12. CONCO K | 31. CHEMISPHERE 32 |
| 13. BP 1110 WD | 32. CHEMICLENE 'A' |
| 14. BP 1100X | 33. EBB CLEAN |
| 15. GULT AGENT 1009 | 34. NEW SHELL DISPERSANT CONCENTRATE |
| 16. INIPOL 90 | 35. KENSOL D.A.C OIL SPILL DISPERSANT DEGREASER |
| 17. SW 1000 | |
| 18. SURFLOW OW.1 | |
| 19. SUPERALL | 36. COREXIT EC9500A |

ANNEX II

Geographical Limits for the Use of Dispersants in Nigeria: Marine Environment

| S/N | Location | Resource(s) at Risk | Recommendations for use of dispersants | Other notes |
|------------|-----------------|----------------------------|---|--------------------|
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ANNEX III

Geographical Limits for the Use of Dispersants in Nigeria: Areas of Special Interest

| S/N | Location | Resource(s) at Risk | Recommendations for use of dispersants | Other notes |
|------------|-----------------|----------------------------|---|--------------------|
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ANNEX IV

French List of Fresh Water Dispersants

(Available from: [http: www.cedre.fr/en/response/dispersants_edgb.pdf](http://www.cedre.fr/en/response/dispersants_edgb.pdf))

ANNEX V

THE BONN AGREEMENT OIL APPEARANCE CODE (APPLICABLE FROM JANUARY 2004)

| Description Appearance | Layer Thickness Interval (μm) | Litres per km² |
|-------------------------------|--|----------------------------------|
| Sheen (silvery/grey) | 0.04 to 0.30 | 40 – 300 |
| Rainbow | 0.30 to 5.0 | 300 – 5 000 |
| Metallic | 5.0 to 50 | 5 000 – 50,000 |
| Discontinuous True Oil Colour | 50 to 200 | 50 000 - 200 000 |
| Continuous True Oil Colour | 200 to more than 200 | 200 000 - More than 200 000 |

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3. IPIECA (2001). *Dispersants and Their Role in Oil Spill Response*. IPIECA Report Series, Volume 5. International Petroleum Industry Environmental Conservation Association (IPIECA)
4. REMPEC (2010). *Draft Consolidated Guidelines for the Use of Dispersants for Combating Oil Pollution at Sea in the Mediterranean Region*. Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC)