European Maritime Safety Agency

Overview of national dispersant testing and approval policies in the EU

Information Paper developed by the Technical Correspondence Group on Dispersants, under the Consultative Technical Group for Marine Pollution Preparedness and Response (CTG MPPR)

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EMSA

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List of Abbreviations

CTG MPPR	Consultative Technical Group for Marine Pollution Preparedness and Response
ExDET	Exxon Dispersant Effectiveness Test
FET	Field Effectiveness Test
HOCNF	Harmonised Offshore Chemical Notification Format
IFP	Institut Français du Pétrole
MNS	Mackay, Nadeau and Steelman
NEBA	Net Environmental Benefit Analysis
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
TCG Dispersants	Technical Correspondence Group on Dispersants
WSL	Warren Spring Laboratory

Cover photo source: CEFAS, UK

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[1] EMSA workshop: “Towards a harmonised approach in dispersant usage in the EU” (Lisbon, 19-20 May 2008)
[2] Alun Lewis contributed to the 2008 working document, on which this paper is based.

0. Summary

This paper "*Overview of national dispersant testing and approval policies in the European Union"* has been developed by EMSA under the framework of the Technical Correspondence Group on Dispersants (TCG Dispersants). This Group of experts was tasked by the Consultative Technical Group for Marine Pollution Preparedness and Response (CTG MPPR) to describe existing testing procedures for approval of dispersant products in Europe and to explore if further harmonisation of such tests can be achieved, in an effort to avoid further diversification in Europe (*Chapter 1*). The paper is intended for information purposes and provides for the first time detailed combined and up-to-date information on test procedures for dispersants in place in the EU/EFTA States, focusing primarily on the long-established tests of France, Norway and the United Kingdom. Overall, only six EU/EFTA countries have such tests in place; in addition to the above three, this includes also Greece, Spain and Italy.

The paper provides general background information on the use of dispersants as an oil spill response option (*Chapter 2*) and looks into the national policies regarding dispersant use in Europe (*Chapter 3*). Facts on dispersant products currently approved and in stockpiles in Europe are also provided, highlighting that there are currently approximately 75 different dispersants approved for use in the EU/EFTA countries, but only 34 are stocked in Europe. The distinction between dispersants testing for product approval versus authorisation for dispersants use during an actual incident is also emphasised, as different requirements and procedures are in place for these two distinct authorisation phases (*Chapter 4*). Dispersant product approvals and dispersant use authorisations are nationally regulated by the individual countries.

There are currently different approaches in dispersant product approval procedures across Europe. Annex 1 includes a summary table with information on how the different tests are currently performed in the six countries in Europe. While it is known that laboratory tests, in general, do not represent conditions in the open sea, dispersant product approval procedures typically include tests for the:

- Effectiveness of the dispersant (test usually performed first, with low or high mixing energy);
- Dispersant's toxicity or the toxicity of the treated oil (dispersed oil);
- Other additional tests, which usually include biodegradation, bioaccumulation, and similar toxicological tests.

The main objective of such testing, common to all countries, is to select a dispersant product which is efficient and low in toxicity (either on its own – product's inherent toxicity, or when the oil is treated with the product - dispersed oil's toxicity, which is the case for the UK toxicity tests). The paper (*Chapter 5*) describes in detail the background and current approaches to the tests performed in each of the three countries (France, Norway and the UK), explaining the key principles behind each national approach. The paper also includes comments and observations from using these tests throughout the years (*Chapter 7*). All three countries established their dispersant approval procedures over 20 years ago, following extensive research and these procedures are regularly reviewed and submitted to national consultations. The way each of the effectiveness, toxicity and biodegradability tests are performed in each country and the key principles behind the different test methods are described in order to better understand the main similarities and differences, which are also explicitly identified and listed in the paper (*Chapter 6*). This is particularly important for those countries that do not have their own established tests in place and rely on, or accept, the existing tests performed in these (six) countries, or may be considering developing new tests or revising their own procedures. Further diversification of such tests should be avoided in Europe.

EMSA has encouraged the national experts contributing to this paper to explore the possibility to identify commonly accepted principles that would assist the further harmonisation of test procedures in the EU/EFTA countries. The conclusion from the Groups' work is that further harmonisation is desirable, but is not possible for the time being (*Chapter 8*). The reasons for this are complex and are related to difficulties to agree on any guidelines or accept minimum standards that deviate from the long established and nationally accepted procedures. Fundamental differences in testing procedures (especially with regard to the toxicity testing), associated costs and difficulties of changing existing procedures at this stage are additional factors of concern. EMSA encourages further work on harmonisation of dispersant test procedures in Europe, even if it cannot be achieved for the time being. At least, where possible, further deviations from the existing test protocols should be avoided.

The paper concludes with remarks deriving from the TCG Group's work in updating and completing this paper (*Chapter 9*). These include:

- The approaches towards dispersant effectiveness testing are fairly similar across Europe. The most common methods used for performing effectiveness tests are the IFP, MNS and WSL tests. The energy used in the effectiveness tests is of importance; the low energy test (such as the IFP) is more representative of normal field conditions than the high energy test (such as the WSL), and may be more relevant with regard to the efficiency in the field. On the other hand, the high energy tests are easier to perform in the laboratory. The test oils used differ, but they usually have a viscosity from 500 cP to 8000 cP. The Dispersant to Oil ratio (DOR) is mostly between 1:10 and 1:30, and most countries have specific thresholds for approval of dispersant products. Norway is the only country that performs effectiveness tests on weathered oil.

- Toxicity testing is performed on the dispersant alone in five of the six mentioned countries with test procedures in place. Only the UK tests the dispersant toxicity on a mixture of chemically dispersed oil in comparison to mechanically dispersed oil. The impact of dispersed oil in the environment is assessed also differently in the various countries; the UK includes this assessment in the toxicity testing, other countries assess the toxicity in the environment separately from the product approval toxicity tests (e.g. Norway uses advanced software models based on bio–assay studies). Different test organisms (planktonic algae, limpets, brown or white shrimps etc.) are used in the toxicity testing, but there seems to be an aim to select commonly used test organisms that are easily available and preferably described in the OSPAR Convention.

- Biodegradability tests are performed in four of the six countries, usually to verify that the dispersant does not inhibit the biodegradation of the oil. Some experts believe that this test is important as a dispersant with low toxicity and high biodegradability would be preferable to a dispersant with low toxicity and low biodegradability. It should also be noted that intermediate degradation products may be more toxic than the original dispersant substance, as some studies have suggested.

- Decision trees/matrixes for the usage of dispersants and environmental impact studies are very important in supporting decision making during and following the actual dispersant application in an oil spill incident. Examples of existing 'Decision Trees' for the use of dispersants are provided in Annex 3.

- The test results are usually not public information, with only the products having passed the tests being published on national approval lists. The countries not having test procedures in place often use and/or accept the products in the approval lists of other countries. Since the tests are performed differently, it is important to understand these differences and the key principles behind each procedure. The transparency of how tests are performed is of special concern for the countries not having test procedures in place.

1. Introduction

1.1 The European Maritime Safety Agency (EMSA) supports with technical and scientific advice the Member States of the European Union (EU) and the European Commission in the field of maritime safety, prevention, preparedness and response to pollution by ships, as well as response to marine pollution from oil and gas installations. These objectives are addressed through specific tasks, including operational activities in the field of pollution preparedness, detection and response. The Agency implements operational tasks through its annual Work Programmes and "Action Plans" which have been adopted by the EMSA Administrative Board. These address, *inter alia*, the use of oil spill dispersants.

1.2 The document entitled "*Overview of national dispersant testing and approval policies in the EU*" was initially developed in 2008 by representatives from France, Norway, the UK and EMSA and an independent consultant, in preparation for the EMSA dispersants workshop entitled "*Towards a harmonised approach in dispersant usage in the EU*" which was held in Lisbon in May 2008. The mentioned document has since been updated and renamed by EMSA. The completion of this document has been identified as a task of the work of the Technical Correspondence Group on Dispersants (TCG Dispersants), established in 2012 by the Consultative Technical Group for Marine Pollution Preparedness and Response (CTG MPPR). (The CTG MPPR provides a forum for EU Member States to meet, share best practice and expertise and define priority actions in the field of marine pollution preparedness and response).

1.3 The TCG Dispersants, comprised of scientists and experts from national administrations in the field of dispersants, has been tasked with reviewing the existing scientific and operational aspects of dispersant testing procedures in Europe, in view of identifying similarities/differences and exploring options towards a more harmonised approach (in the sense of convergence) or mutual acceptance of such dispersant testing procedures in Europe.

1.4 There are currently many brands and formulations of dispersants on the market, approved for use in the EU/EFTA countries (approximately 75). The existing stockpiles in Europe consist of dispersants tested and approved for use in different ways. The Group's work should facilitate reducing further diversification of testing procedures in the EU. This revised paper describes in detail and discusses the different testing procedures and the possibilities and hindrances for further harmonisation of such tests across Europe, focusing in particular on Norway, France and the United Kingdom, countries with long-established test procedures in place.

1.5 The review of these procedures reveals similarities and differences in the various tests performed. In this paper the key principles and main philosophy behind each national approach are identified. The requirements of all the tests are described and commented by the Group members, and the experiences gained from using the different test methods are included. It is the Group's intention, that this information will enable the other countries to better understand the current tests in place and accordingly to facilitate the national decision making of how to proceed regarding developing or revising their own dispersant testing procedures.

2. General background on dispersants usage

2.1 Once oil is spilled to the sea there will be inevitable impacts to the environment within the geographical area of the spill no matter how much effort is put into spill response. The primary goal of any oil spill response is to minimise the impact and remove the spilled oil as fast as possible, thus minimising the impact to the organisms inhabiting the marine environment and prevent oil on the shorelines. This response goal provides a mechanism for discussion of the environmental trade-offs associated with any response option.

2.2 While the goal of mechanical recovery using oil recovery vessels, booms, and skimmers is to remove oil from the sea surface, a task that can be potentially hindered by rough seas, the purpose of oil spill dispersants is to transfer the oil from the sea surface to the water column in the form of very small droplets. The use of dispersants greatly enhances the rate and extent of the natural dispersion process. Natural dispersion is the conversion of a surface oil slick into oil droplets and is caused by breaking waves. The crests of breaking waves passing through an oil slick convert the oil into droplets of a wide range of sizes. Most of these are large enough to be buoyant and rapidly resurface. A small proportion of these oil droplets will be small enough to be retained in the water column.

The application of dispersants to spilled oil greatly increases the proportion of small oil droplets which will not resurface.

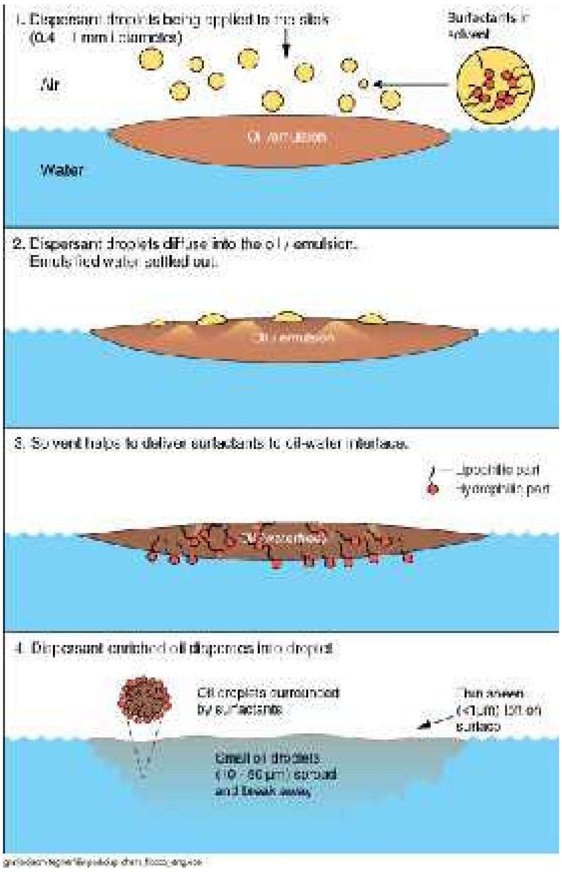

Figure 1: How dispersants work (Source: SINTEF)

2.3 These small droplets are subject to turbulence and remain in the upper meters of the water column. Rough seas that impair mechanical recovery can actually benefit dispersants' effectiveness (as long as the rough sea conditions do not impair the effectiveness of the dispersant application). The initial dispersion distributes the oil over a larger volume thus reducing its concentration. Wind driven mixing and currents further dilute the dispersed oil fairly rapidly. In addition, the formation of these very small dispersed oil droplets increases the surface area of the oil tremendously, thus favouring enhanced aerobic microbial degradation. The oil is essentially "eaten" by the micro-organisms as a carbon source.

2.4 When used in an appropriate and timely manner, dispersants can remove a significant amount of oil from the water surface. This reduces the risk of oiling marine birds and shorelines, but exposes pelagic organisms present to a higher concentration of oil in the dispersed oil plume. While the concentration of the dispersed oil rapidly decreases, one should also consider the type of organisms exposed and the duration of their exposure (dose). Also the recovery potential of the potentially affected species should be taken into account. The organisms in the water column that are primarily affected are plankton and fish eggs/larvae that cannot escape such a plume. Marine mammals and fish on the other hand are able to detect dispersed oil and have been observed to actively avoid such plumes thus reducing their exposure and risk.

2.5 The decision whether to use dispersants or not should always be based on a Net Environmental Benefit Analysis (NEBA)[3]. While discussions on dispersants' use are important and should involve all stakeholders, fundamental decisions need to be made well in advance of a spill and the results should become part of the national or regional (area specific) contingency plans. Prompt decisions are important because the window of opportunity for dispersants' use is generally short due to weathering processes of the oil. The ultimate decision to apply dispersants in an oil spill must always be based on the specific conditions including the current environmental

[3] NEBA is the term usually used. NEEBA (Net Environmental and Economic Benefit Analysis) and NEDRA (Net Environmental Damage and Response Assessment) are also used and specify further the content of the analyses.

(weather, sea-state, presence of endangered species, etc.) situation, possible economic constraints (human activities) and operational realities of the particular incident.

3. National policies regarding dispersant usage and testing in the EU countries

3.1 Within the EU, the decision to use dispersants during oil spill response operations lies entirely with the affected coastal Member State(s) and a number of countries may consider the option of using dispersants in an oil spill with certain reservations. Dispersant usage has been a topic of renewed interest for the European national administrations in recent years, in particular following the *Deepwater Horizon* incident in 2010 in the Gulf of Mexico.

3.2 EMSA publishes since 2005 an "*Inventory of national policies regarding the use of oil spill dispersants in the EU Member States*" (EMSA Dispersants Inventory), which is updated in regular intervals. The latest inventory was published in November 2014 and includes data provided and/or validated by the relevant national administrations in Europe. The aim of this inventory is to regularly collect and disseminate relevant information to the EU Member States, the European Commission and the interested public regarding dispersant usage policies and dispersant application operational capabilities across the EU. The EMSA Dispersants Inventory has been used as background information for this paper and also serves as a building block in determining appropriate EMSA "added value" activities in this field. It contains information for each EU coastal Member State, as well as for Norway and Iceland, with respect to:

- Policies regarding dispersant use as an oil spill response option;
- Dispersant testing and product approval procedures in place;
- Stockpiles, means and equipment available for dispersant application (including GIS based maps).

3.3 Of the twenty five coastal EU /EFTA Member States (MS) in the 2014 EMSA Dispersants Inventory, twenty three countries would consider dispersant usage in their pollution response strategy, alongside the mechanical recovery of oil or only under very specific conditions, as shown in Figure 2 below. Two countries (Bulgaria and Slovenia) would not use dispersants in an oil spill situation at all. Dispersant testing and approval procedures have been developed in six countries (France, Greece, Italy, Norway, Spain and the United Kingdom). Of the remaining nineteen EU/EFTA countries that don't have their own testing and approval procedures, at least seven of these would allow the use of dispersants approved in a neighbouring country or within the Bonn Agreement region.

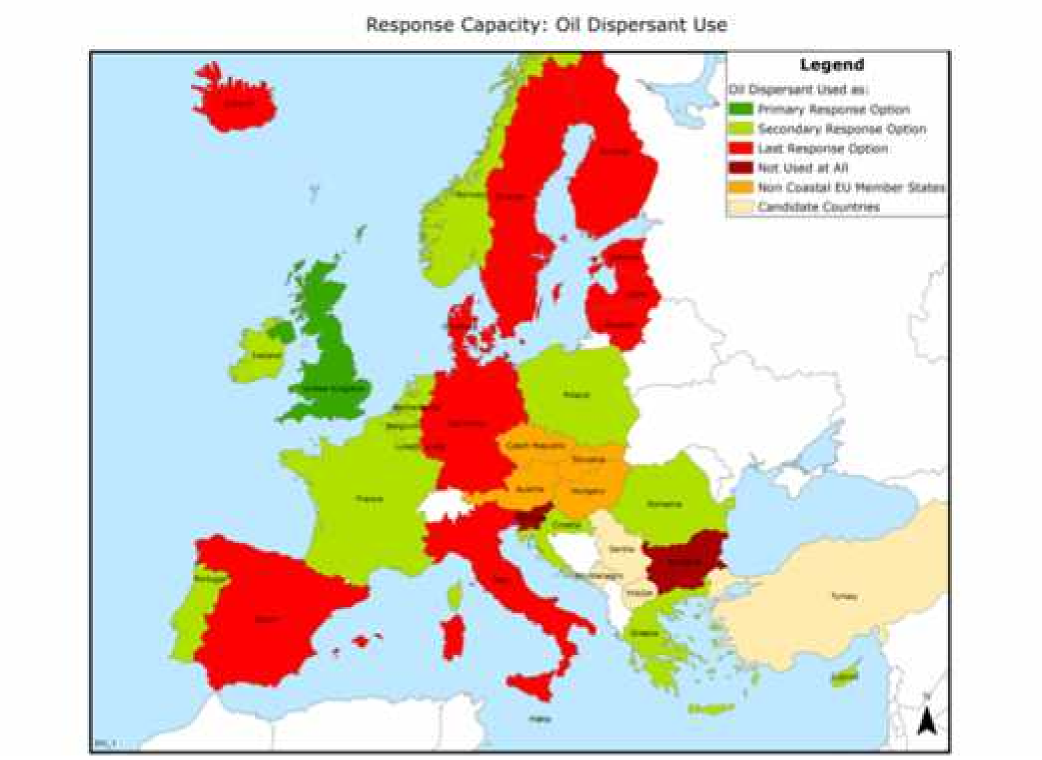

Figure 2: Dispersant usage policies in Europe (Source: EMSA Dispersants Inventory published in 2014).

3.4 In all countries that allow the use of oil spill dispersants, a specific authorisation from the responsible national administration(s) is required prior to the actual use/application of dispersants at sea. The procedures for authorising the use of dispersants for a specific incident (approval to use) vary among the EU countries and they are also clearly different from those procedures approving a dispersant product at national level, meaning which products are approved for use when a decision to disperse has been made (dispersant product approval *versus* dispersant use authorisation; see also Chapter 4).

3.5 In 2013, the national stockpiles of dispersants in EU/EFTA countries, based on information from the EMSA Dispersants Inventory published in 2014, were approximately 3900 tonnes[4]. The private Oil Spill Response Ltd (OSRL) has a dispersant stockpile of 2500 m^3 in Europe and EMSA has in 2014/15 bought 400 m^3 of dispersants; accordingly, the total dispersants stockpile in Europe in 2015 is approximately 6800 m^3 (the information about the OSRL and EMSA stockpiles is not included in the 2014 EMSA Dispersants Inventory).

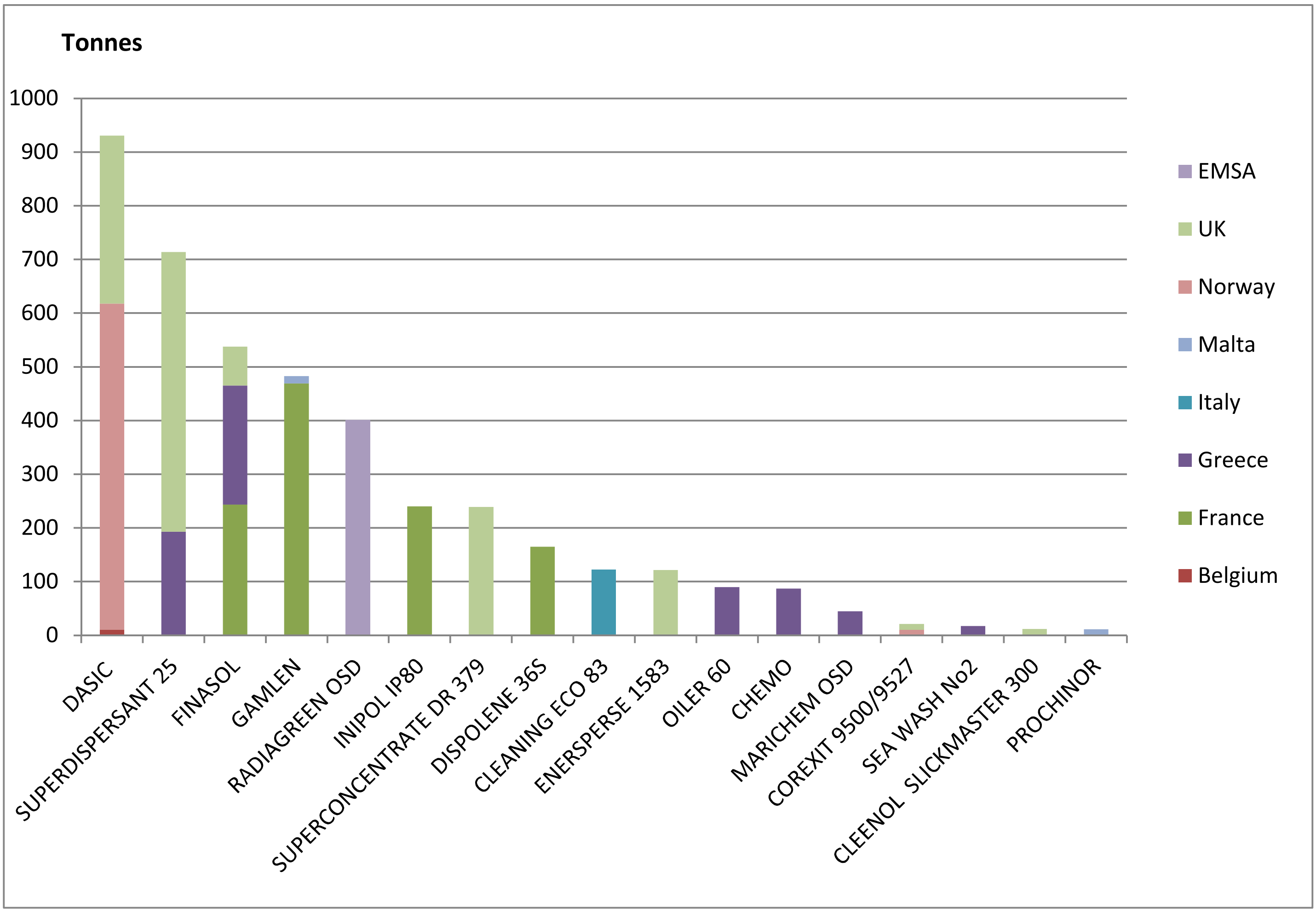

Figure 3: Quantities (tonnes) of dispersants in the EU/EFTA Member States. Dispersants are grouped (e.g. different types of Finasol are in one group) and quantities < 10 t are not included in the graph. The EMSA stockpile is included in the graph, whereas the OSRL stockpiles in Europe are not. (Source for the EU/EFTA stockpile: EMSA Dispersants Inventory, 2014).

3.6 Based on 2014 data in the EMSA Dispersants Inventory, there are approximately 75 brands of dispersants approved for use in the EU/EFTA countries. However, only 34 different dispersant brands are currently in stockpiles in Europe. Figure 4 lists the 19 brands of dispersants of over 20 tonnes currently in stock in Europe (stockpiles of less than 20 tonnes are excluded).

[4] Not all stockpiles from the private sector in the EU countries are included in this number.

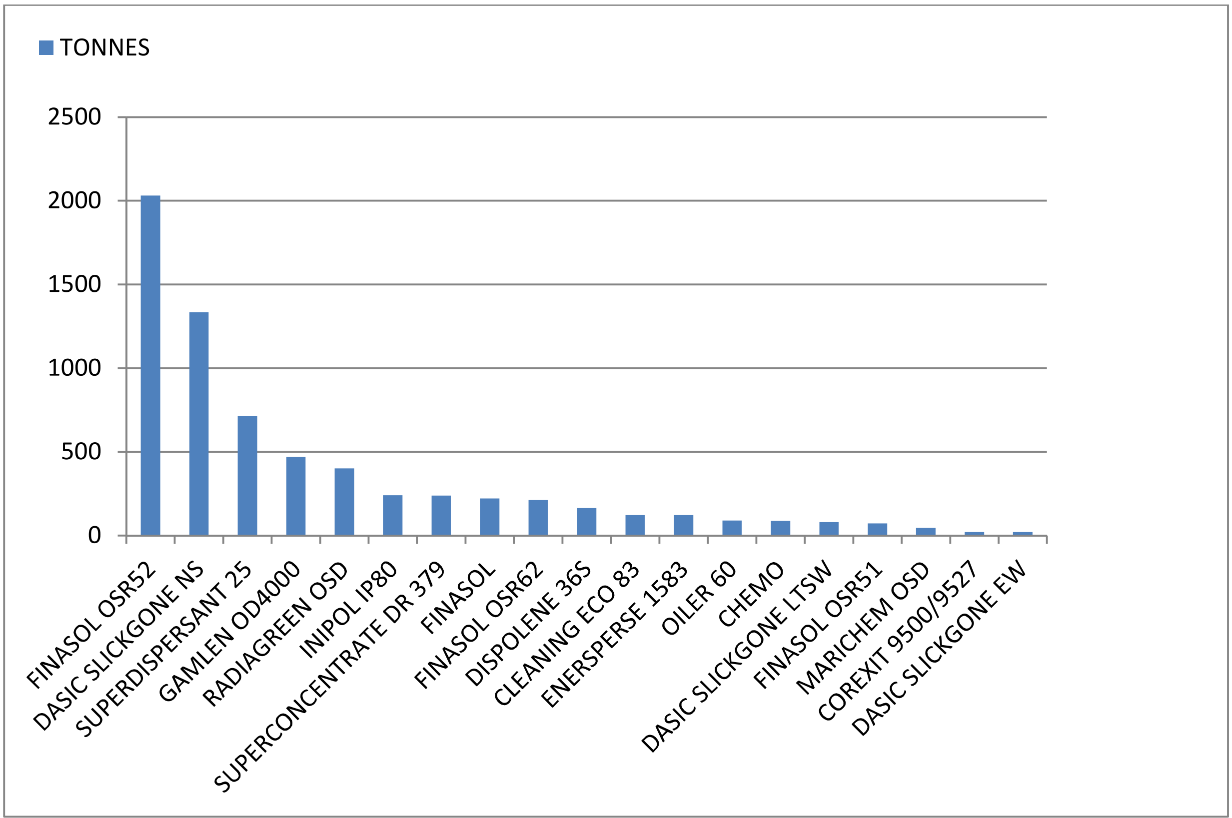

Figure 4: This figure shows the total stockpiles of dispersants in EU/EFTA countries in 2015, including product name and volume (approx. 6800 tonnes in total). The figure includes the national stockpiles, the OSRL stockpile in Europe (2500 tonnes) and the EMSA stockpile (400 tonnes).

4. Dispersants testing for product approval versus dispersants use authorisation

4.1 The licensing of specific dispersants as a response option for marine oil spills typically requires prior approval by the responsible national authority (-ties). Approval procedures typically include tests for the effectiveness of the dispersants and their toxicity, prior to approval for use in oil spill response operations. The effectiveness test is usually performed first, before the toxicity test. Other additional tests may include biodegradation, bioaccumulation, and similar toxicological tests, and in some cases other criteria (e.g. physical criteria such as maximum viscosity).

4.2 These approval tests are conducted *to grant the principal license to introduce the substance into territorial waters of the authorising state*. Laboratory tests, in general, do not represent conditions in the ocean. An accurate simulation of the mixing processes of the sea is not possible on a small scale and there is obviously a very wide range of mixing "energy" levels possible at sea from flat calm to extremely rough seas. Therefore the effectiveness measured in the approval tests cannot directly be related to the effectiveness of the product used in a real application case. Laboratory tests methods (and particularly effectiveness measurements) are originally designed to rank dispersants products in terms of performance. In this respect, tests are meant to demonstrate:

- A minimum level of dispersant performance, and
- A specified maximum permitted level of toxicity of the dispersant (dispersant and dispersed oil in the UK tests).

Approved dispersants are typically published in national lists of licensed products for spill response applications; however, not all countries have such lists (e.g. Norway does not publish a national list of approved dispersants). The test results are often confidential information and only the brand names of dispersants that pass the tests are available for the public.

4.3 These laboratory tests must not be confused with *the authorisation to apply dispersants during the response in an actual oil spill*. This case-by-case decision-making must be linked to the:

- Individual spill situation (e.g. amount and type of oil, release/spill conditions and location, weathering degree of the oil, time frame etc.);
- Environmental conditions (e.g. weather, temperature, sea-state, water depth, distance from shore, salinity etc.);
- Natural resources (e.g. environmentally sensitive areas, presence of aquaculture facilities, presence of endangered species at the prevailing time of the year, etc.);
- Response capability (availability of dispersant and dispersant application equipment, mobilisation time, remote sensing etc.).

4.4 It is very important that the actual effectiveness of the dispersant application in a given spill is monitored and environmental impact assessments are considered <u>during and after</u> the dispersant application is conducted. For more information on the potential impacts to seabirds versus plankton see also French McKay et al. (2006)[5] and the article from the Institute of Marin Research in Norway and SINTEF about dispersants effects on fish eggs and larvae, Vikebø et al. (2015)[6].

4.5 The approval scheme is for products to be allowed to be used, but before they are given permission for use in a particular response scenario, or in relatively shallow water, the request should once again be scientifically reviewed before permission for use is given. The criteria for response options for relevant spill scenarios must be reflected in well-prepared contingency plans in order to make a rapid – but critical assessment and decision-making during the specific spill situation. A number of countries have developed relevant decision support tools and procedures.

4.6 Annex 3 includes examples of “Decision Trees” for use of dispersants, documents which are facilitating decision making regarding the dispersant use during the response to an actual spill.

5. Current dispersants testing procedures in the EU

While six European countries currently have test procedures in place, this paper focusses on describing the test methods in place for the three countries with long established testing and approval procedures, namely France, Norway and the United Kingdom. In addition to these three countries, Spain, Italy and Greece also have tests in place, but their procedures are newer and partly under establishment. A table summarising and comparing the various testing methods of all the six countries is attached as **Annex 1**.

5.1 France

5.1.1 Background

5.1.1.1 France uses three main laboratory tests (for the effectiveness, toxicity and biodegradability of the dispersant itself) to select the most effective and least toxic marine dispersants. In order for a dispersant to be approved, <u>it has to pass all three tests</u>; if a product fails in one of these tests, the procedure is interrupted. Testing of a new product begins with the effectiveness test. The results of this test determine whether or not the other tests will be carried out.

[5] Modelling Potential Impacts of Effective Dispersant Use on Aquatic Biota, Deborah French McCay, Walter Nordhausen, James Payne, Proceedings of the 29th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 855-878, 2006.
[6] Dispersants Have Limited Effects on Exposure Rates of Oil Spills on Fish Eggs and Larvae in Shelf Seas, Frode B. Vikebø, Petter Rønningen, Sonnich Meier, Bjørn Einar Grøsvik, Vidar S. Lien. Environmental Science & Technology 2015, 49, pp. 6061 – 6069.

5.1.1.2 The French approach is based on the following principles:

- Select a product which is efficient (the effectiveness testing is performed first).
- Avoid products which would be too toxic by themselves (the dispersant toxicity testing is conducted second).
- The biodegradability test is conducted third, as a "vestige" of the past.

5.1.1.3 This procedure was set up in 1978 and revised in 1988. Since 2000, test results are valid for 5 years and accordingly, once approval is granted for a product, it is valid for five years. The Centre of Documentation, Research and Experimentation on Accidental Water Pollution (Cedre) is in charge of the dispersant approval process and publishes a list of approved dispersant products, which have passed the various tests (Annex 1 contains a link to this list). While it is not required by law in France to use the approved dispersants listed by Cedre (this list is seen more as a 'recommendation'), it is very unlikely that a non-approved product is used in France.

5.1.1.4 The various test methods used are described in official standards (normes francaises), such as the NFT 90 345 (effectiveness test), NFT 90 349 (toxicity test) and NFT 90 346 (biodegradability test). Today these tests are conducted by Cedre (effectiveness and toxicity tests) and the national institute for industrial safety and environmental protection (INERIS) (biodegradability test).

5.1.1.5 Physical properties are not assessment criteria; however dispersants would have to meet other specific requirements, according to the user (e.g. the Navy requires flash point > 51°C, freezing point < -10°C). The operational stockpiles are subjected to periodic quality controls, first, 5 years after purchase then every two years. These controls cover physical parameters and effectiveness testing (IFP test), and are performed by Cedre.

5.1.1.6 So far the French approach has been not to publish the actual test results. The results are not published in order to not confuse the user / purchaser of dispersant, so as to differentiate between products whose effectiveness would be close (closer than the confidence interval of the measurement).There are many other factors (especially the conditions of application) which can change the results in the field, much more than a small difference of effectiveness in the lab test. Therefore, only the list of approved products is published in France, without the detailed tests results.

5.1.2 Effectiveness test (French standard NF.T.90-345)

5.1.2.1 France uses the Institut Français du Pétrole (IFP) dilution test method, Standard NFT90-345. This test assesses the dispersant effectiveness in relatively "low energy" conditions and with a continuous seawater dilution to 'mimic' the open sea conditions. The test is conducted in a test tank with continuous clean seawater inflow at the surface, which causes gradual dilution of the content. For the effectiveness test method, the principle is to decrease the mixing energy in order to select the best products i.e. those which remain efficient even at low energy level. The method aims at simulating real environmental conditions: contact -the dispersant is added onto the oil- and infinite dilution -this is achieved by the stream of water flowing through the test tank-. The testing method was developed in the 80's according to field tests carried out in Marseilles/Fos[7]. The objective was to develop a test which provides a ranking of the dispersants similar to the ranking issued from the field tests.

5.1.2.2 The reference oil is a mixture of topped crude oil (BAL 110 – a "topped Arabian Light crude oil) and heavy fuel oil, the proportion of the two components in the mixture is adjusted in order to reach the appropriate viscosity of 1000-mPa.s (or cP) (defined in standard NFT 90 345). It should be noted here that the French Navy requests an additional effectiveness test in its call for tenders to purchase new dispersants: an effectiveness test with the same test method (NFT 90 345) but using a reference oil which is more viscous (can be up to 8000 cP). This additional test aims at selecting the very best products among the approved dispersants for the French needs, considering that the spilled oils to be treated in French waters will generally be quite viscous, either due to their weathering at sea or to the fact that the major pollution threat is coming from bunkers. This additional test is performed by Cedre.

5.1.2.3 The threshold value of 60% in the French effectiveness test has been chosen arbitrarily (looking to the results of a panel of commercial products) in order to select the best dispersants. The test oil is in the confined ring and the dispersant (neat concentrated / type 3[8]) is applied on the top, drop by drop. Energy is applied to the test oil on the surface, by a submerged beater-ring (vertical oscillation), and dispersed oil is collected from the bottom of

[7] Article: A field test and assessment of oil dispersant efficiency - J. P. Desmarquest, J. Croquette, F. Merlin, C. Bocard, C. Gatellier - International Oil Spill Conference Proceedings. 02/1983; 1983(1):574-574.
[8] The different types ("categories") of dispersants are described in Chapter 5.3.2.

the tank. The dispersant effectiveness is measured by the amount of oil that is dispersed and collected from the bottom outflow during the test duration (1 hour); the effectiveness is expressed between 0 and 100%, where 100% corresponds to the maximum theoretical quantity that could have been removed in case of a totally soluble compound. The effectiveness reflects the proportion of the oil actually dispersed in the test. This effectiveness is expressed in % compared to what would have been collected if the total oil would have been dispersed. Dispersants pass the test if dispersion is greater than 60%.

Figure 5: French effectiveness test (Source: Cedre)

5.1.2.4 While it is a relatively complex / difficult test to run, this method is good for running studies and obtaining comparative results according to different parameters on the same tests series (relative results). Some of its advantages include that it requires low energy, thus 'pushing' the product to the limits of its capability and it gives a good indication of the dilution process. In the context of the approval procedure, this test is a bit tricky as it involves a long calibration process to get perfect repeatability (absolute results).

5.1.2.5 France is currently exploring options to modify and adapt this test with a new system that allows variable energy levels to be introduced in the test tank (e.g. keep same set-up with less energy). A new standard will be developed after the completion of the validation tests; however, this new energy adjusted IFP test is not foreseen to be completed in the near future.

5.1.3 Toxicity test (French standard NF.T.90-349)

5.1.3.1 The aim for the toxicity test is to avoid products which would be too toxic. The French test method assesses the intrinsic acute toxicity of the dispersant alone in a relatively simple LC_{50} test (lethal acute toxicity), by using white shrimps (*Paleomonetes varians*) and testing equipment similar to the one used in the UK. The choice of this test species is done for practical and historical reasons and it could be changed in the future if needed. At that time the shrimp was used by the UK (grey shrimp) and France (grey or white shrimp) for the toxicity testing. France stopped using grey shrimp (wild species), because white shrimp could be easily supplied from a fish farm – aquaculture.

5.1.3.2 In accordance with this test, the shrimps are exposed for 6 hours (tidal duration) followed by 24 hours recovery time in clean waters, to see the mortality rate. The dispersant toxicity must be at least ten times lower than the toxicity of a reference toxicant (a cationic surfactant Noramium DA50) tested in the same conditions and on the same batch of shrimp as the dispersant. This procedure, which compares the results of the dispersant test with those of the reference toxicant (Noramium), intends to avoid any seasonal variation of sensibility of the test organisms[9]. The Noramium DA50 has similar surface active agents as dispersants and is known to be slightly toxic,

[9] This approach is based on the thesis: Bardot, C. *Evaluation de la toxicité d'un traitement par dispersion d'une pollution pétrolière : emploi au laboratoire de Crangon crangon dans des conditions contrôlées (= Toxicity evaluation of a dilution process of oil pollution by chemical dispersants : use of Crangon in laboratory in controlled conditions).* Thèse de 3e cycle. Discipline : Océanol. biol. Paris : Université de Paris 6, 1985,115 p.

therefore the approved dispersant must be less toxic than this reference toxicant. The threshold value has been chosen empirically: toxicity of the dispersant must not be higher than 10 times the one of the reference toxicant. The method (standard: NFT 90 349) is comparative (comparison of the toxicity levels of the dispersant and of the reference toxicant). This approach has been adopted in order to get results independent of the batch of shrimps and also independent of the season of the year (e.g. the moult).


Figure 6: French toxicity test tank (Source: Cedre)

5.1.3.3 While France does not test the toxicity of the dispersed oil in the product approval phase, this is considered when reviewing the use/application of dispersants for a particular spill; it is generally considered that the better/finer an oil is dispersed, the more toxic it will be and accordingly the most efficient product may be rejected if the toxicity of the dispersed oil is tested in the product approval phase. The toxicity of dispersed oil is considered during the decision making process to use a dispersant in a particular spill.

5.1.4 Biodegradability test (French standard NF.T.90-346)

5.1.4.1 The biodegradability test (standard NFT 90346) is still in force in France, but could be dropped in the future as it is not considered to add much useful information. The French test assesses the dispersant's biodegradability in 28 days by measuring how much carbon dioxide (CO_2) has been produced. The dispersant is considered as a whole (surfactant and solvent) and its biodegradability should be at least 50% of the non-evaporable fraction (fraction which is not stripped during the test by the bubbling of CO_2 in the flasks). So far, there is no clear relationship of the dispersant's biodegradability to its toxicity. (This testing method is derivate from the STURM[10] protocol applied for determining the ultimate aerobic biodegradability of organic chemicals by monitoring CO_2 production in sealed vessels containing the test compound). In the concept of a harmonisation, France could consider to give up this test.

[10] Sturm, RN. 1973. Biodegradability of nonionic surfactants: screening test for rate of ultimate biodegradation. *J. Amer. Oil Chem. Soc*. 50:159-167.

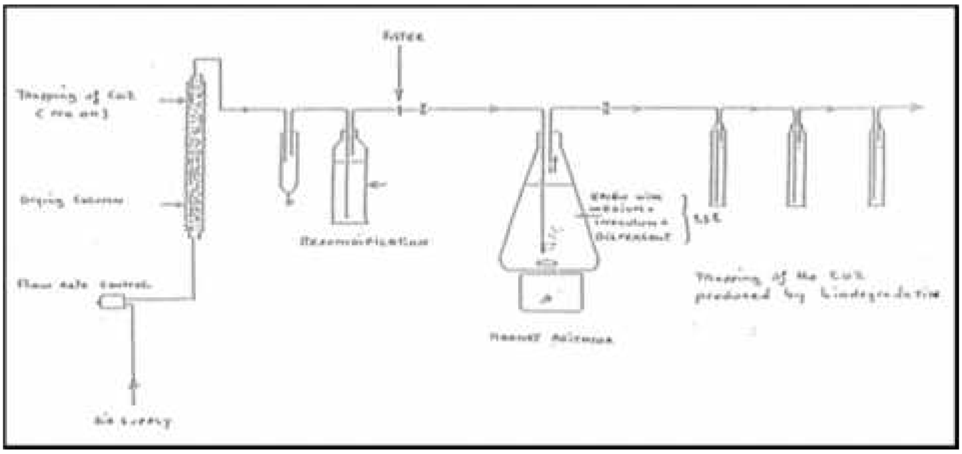

Figure 7: French biodegradability test (Source: Cedre)

5.2 Norway

5.2.1 Background

5.2.1.1 The first Norwegian regulations relating to the composition and use of dispersants in oil spill response were established by the Ministry of Environment in 1980. The regulations were very restrictive, stipulating that the *"Dispersants may be employed only when use of mechanical recovery has shown to be ineffective"*. The dispersant oil spill response in Norway became a non-operative contingency for many years, and there was a lack of maintenance and functionality testing of the equipment. One of the main criticisms of these old regulations was the lack of relevance of the test regimes used. For example, the test conditions for the effectiveness testing (using WSL-test, similar to the still existing UK test) used only a medium fuel oil (MFO, 2000 cP at 10^{o}C), which was not considered as representative for those oil types and spill situations where dispersants were most likely to be used, i.e. in connection to smaller offshore spill incidents where different crude oils are produced and transported. The test oil was also not representative for the type of bunker fuel oils used by ship traffic along the Norwegian coast which often would be IFO 180 and IFO 380. Furthermore, the acute toxicity test was considered not to be representative for "Norwegian spill situations", as the test-organism used was a fresh-water alga (*Clamydomonas reinharti*).

5.2.1.2 During the late 1980s and the 1990s, extensive research and testing was performed (funded both by the authorities and in cooperation with the industry). This consisted of laboratory testing, basins experiments and experimental field trials in order to generate better scientific documentation as a basis for coming up with new regulations with testing protocols both for acute toxicity and effectiveness. One important goal and philosophy for these up-coming new regulations was to use the NEBA approach. Therefore, the regulations should cover relevant documentation needed for robust contingency planning, for taking rapid decisions concerning use/non-use of dispersants and also for generating scientific documentation with operational value for the dispersant response action and strategy (e.g. dosage needed for the specific oil, weathering properties and "time-window" for effectiveness use under different sea conditions etc.).

5.2.1.3 With regard to effectiveness testing, several studies were carried out in the 1990s for the Norwegian authorities and in cooperation with the oil industry (e.g. Daling et al, 1991, Brandvik et al. 1993, Lewis et al 1994,). Different laboratory effectiveness tests methods were evaluated including the MNS (Mackay, Nadeau and Steelman), IFP (Institut Français du Pétrole), ExDET (The Exxon Dispersant Effectiveness Test), FET (Field Effectiveness Test), WSL (Warren Spring Laboratory) and the Swirling Flask Test. E.g. a study for the Authorities – SFT: (Knudsen and Daling, 1994:*"Selection of test-criteria for approval of dispersants effectiveness in Norway")* included testing of 13 dispersant products that at that time were on the "Norwegian approval list". They were tested under a variety of test conditions, i.e.: different oils (including weathered emulsions), different dosages, salinities and temperatures. Generally, there are several factors that affect the dispersant effectiveness testing. These include the test's energy level (high-low); mixing time; applying the dispersant pre-mixed with oil or undiluted directly on the oil slick; the oil to water ratio; the test's reproducibility and how simple and rapid a test is. These factors were considered in these studies.

5.2.1.4 Conclusions and experiences drawn from all these studies concerning the various test methods included:

- IFP-test (+ strength / - weakness):
  - \+ Low energy test, representing non-breaking waves
  - \+ Low oil-to-water ratio and included the water dilution concepts (more close to field situation)
  - \+ Sampling taken under dynamic conditions (continues sampling during the agitation period)
  - \+ Correlated to field (IFP, 1985)
  - \+ Is a Sensitive / selective test (i.e. give a large span in dispersant ranking / screening)
  - \- Reproducibility / Calibration may be time consuming when doing pass/fail testing
  - o Trained operators are important

- MNS-test (+ strength / - weakness):
  - \+ Energy generated by wind (realistic to field / no mechanical)
  - \+ Medium / high energy (representing breaking wave conditions)
  - \+ Correlated to field –energy (Mackay 1980)
  - \+ Reproducible (i.e. suitable for pass / fail testing)
  - \- Less sensitive / selective test than IFP-test (i.e. give a large span in dispersant ranking / screening)
  - \- Reproducibility / Calibration may be time consuming when doing pass/fail testing
  - o Trained operators are important

- WSL-test (+ strength / - weakness):
  - \+ Rapid / simple test
  - \+ Reproducible (i.e. suitable for pass / fail testing)
  - \- Less realistic to field conditions:
    - o too high mixing energy (can disperse "everything" if long enough mixing time)
    - o need for settling time / static sampling (i.e. test result reflecting the density of the test oil)
    - o very high oil-to-water ratio (→20,000 ppm oil in water→coalescence /adsorption to a surface
  - \- Less Sensitive /selective (i.e. give less span /differences between the dispersants in screening)

5.2.1.5 Most of the other test methods (e.g. ExDET, Swirling /Baffled flasks) that were evaluated require to pre-mix the dispersant into the oil prior to the testing, and thereby they don't allow to use w/o-emulsified oils as test-oils, which is considered as an important factor for getting a realistic understanding and documentation of the effectiveness of the dispersant for the specific oil to be tested under realistic simulated conditions.

5.2.1.6 Acute toxicity testing: The aim (philosophy) of the acute toxicity testing of the dispersants is to prevent that new products come on the market that have a significant higher acute toxicity than other "well-known" dispersants that have undergone toxicity / bio-assay studies in the laboratory or in the field. The dispersants shall be tested alone, not in combination with dispersed oil. The reason for this is that a test on dispersed oil would actually, in many cases, be a test on the combined mixture of dispersant and dispersed oil. Since it is very difficult to define the content of this mixture, the results may not be sufficiently representative. It is important, however, to emphasize that in addition to these standardized eco-toxicity tests for fulfilling the requirements of the dispersant products that are given in the Norwegian dispersant regulations, extensive bio-assay studies have been carried out over the past decades.

5.2.1.7 In these R&D programs, realistic exposure systems for studying the biological effects (chronic and acute) have been designed for both dispersant enhanced and natural dispersed oils droplets and dissolved oil components (WAF) using different sensitive test organisms (e.g. fish eggs/-larvae) and oil types that are representative for Norwegian waters. Data from these research programs have been used together with advanced 3D-spreading model tools to predict the potential environmental risk connected to the use of dispersant versus non-use in relevant spill–situations. Such model analyses of different spill scenarios have been an important basis for the NEBA assessment used in the scenario-based contingency plans.

5.2.1.8 Norway does not publish any official / public list of approved dispersant products. Although, the dispersants used must fulfil the requirements in the Norwegian regulation for the use of dispersants, requirements are specified according to a specific toxicity threshold and performance of effectiveness testing. For the use of a dispersant in Norway, an application must be sent to the relevant authorities. The stockpiles of dispersants are retested generally every 5 years. For dispersants in tanks on response vessels, testing is performed more frequently. See Annex 1 for further information about retesting of dispersants in Norway.

5.2.2 Current test procedures in Norway

5.2.2.1 All these R&D studies in the 1980s and 1990s formed the basis for the new dispersant regulations that came into force in Norway in 2002. According to these regulations, all tests shall be carried out at laboratories that are either accredited in accordance with EN-ISO-17025 or certified according to EN-ISO-9001 or can document that they have internal quality systems for documentation, traceability and comparative testing corresponding to good laboratory practice (GLP) or specific ISO standards.

5.2.2.2 The Norwegian regulations are founded on the principle of "internal control". This means that the enterprise (company / entity) responsible for the oil spill response has the responsibility for producing the pre-planned documentations in the emergency plans. In principle, the owner of this documentation is the enterprise. However, the Authorities have access to all the documentation. In practise, most of this documentation (e.g. the effectiveness testing of dispersant on the specific oils) is made open for the public through e.g. the oil weathering and dispersibility testing reports produced by the enterprise or other research studies.

5.2.2.3 According to the 2002 new regulations for dispersants usage, the tests described below are used for dispersants. A minor revision of the dispersant regulations was carried out during 2009, linked to the inclusion of shoreline cleaners and bio-remediation products into the same regulations, meaning that the “working mechanisms” of the various agents have to be documented. The Norwegian testing approach is based on long-running experience and is very detailed, since the industry is very much involved in testing dispersants for the specific oils they produce, process or store. Consequently, financial resources and more information on dispersant testing for a variety of different oils is available (compared to the testing on one/two reference test oils used in UK and FR, done to address accidental oil spills).

5.2.2.4 As Norway does not approve dispersant products as such, there exists no official / public list of approved dispersant products; dispersants are always tested per type oil or range of oils for a specific location/area. Information on the test results is available for the authorities and can be available for others upon request. So far, the toxicity test has been performed only for a limited number of dispersants, due to limited brands of dispersants in the present stockpiles in Norway (mainly Dasic NS is in the NOFO[11] stockpile). The present test-procedures produce data that are valuable for the contingency planning and for the NEBA assessment of relevant oil spill scenarios for the specific oils. The dispersant has to document its performance on various test conditions (e.g. dosages) and particularly on various weathered and emulsified "stages" of the different oil types, in order to know more about the performance under realistic scenarios. To this effect, Norway is the only country that tests the dispersibility of oils on varying weathering levels. Such documentation will also have an operational value such as: how to treat the oil slick in an optimal way (i.e. dosage needed, need for double / multi-treatment of the slick etc.). The Norwegian regulations / requirements are focusing on this issue.

5.2.2.5 The dispersant testing results are therefore used as input to operative oil spill models; this is done both to verify the extensive oil spill modelling work done nationally and to define the window of opportunity for using dispersants under different environmental and weather conditions for the oils produced in oil fields and oils transported in Norway.

5.2.2.6 The use of dispersants is regulated, through permits from the Norwegian Environment Agency; any dispersant used at sea, must have performed/passed the tests of effectiveness and toxicity. Norway regulates the testing and approval of the dispersant product and sets requirements for dispersant use in view of the dispersants’ operational use. No dispersants are considered for use if they do not fulfil the requirements in the Norwegian regulations. In principle oil spill dispersants can only be used if they are part of an approved emergency response system of an entity required to have such emergency response systems in place (e.g. entities producing or processing oil); if this is not the case, dispersant use may only take place with a permit from the Norwegian Coastal

[11] NOFO: Norwegian Clean Seas Association for Operating Companies

Administration (NCA). The NCA is also currently considering building up oil spill dispersant capacity for bunker fuels (HFO).

5.2.3 Effectiveness test

5.2.3.1 The procedures for testing the effectiveness of dispersants vary in Norway, depending on whether a company/entity is producing or processing oil or not.

5.2.3.2 For companies/entities that produce, process or store specified types of oil and that plan to use dispersants as part of their emergency response procedures, the effectiveness tests shall be conducted using the specific oil or for those types of oil most likely to be treated with dispersants. As different oils are used, there is no specific effectiveness threshold for approval. The aim of the testing is to compare products (relative ranking) and select the most effective dispersants, the dosage ratios required, and for estimating the "time window" for use of dispersants for the relevant oils, taking into account the oil weathering taking place at sea. The latter is in particular important for the validation of the extensive oil at sea modelling in Norway.

5.2.3.3 In the first step of screening the dispersant effectiveness on oils produced, processed or handled in Norway, the IFP dilution test is used. This is the same "low energy" dispersibility test used in France, where energy is applied to the oil on the surface, by a submerged beater-ring, and dispersed oil is collected from the bottom of the tank. The dispersants selected for the screening are tested on an artificial weathered fraction of the specific oil in question (e.g. 200^{o}C+ /50% water-in-oil[12]- emulsion). A minimum of two parallel tests shall be conducted for each product, at a dispersant-to-oil ratio of 1:25.

5.2.3.4 The next step of the effectiveness testing includes a dosage-test, where the best dispersants (1-3 best products) from the screening testing of the specific oil (200^{o}C+ /50% water-in-oil- emulsion) are tested at varying dispersant to oil dosage ratio (e.g. from DOR 1:10 to 1:200). This is done both with the IFP and the MNS tests. Such a dosage test is very useful operationally, both in estimating the amount of dispersant needed for this specific oil, and also if additional mixing energy will be required during the dispersant application operation.

5.2.3.5 In the last step of the effectiveness testing, the entities have to test the oil's dispersibility at varying weathering degrees for the relevant oil in order to predict the "time window" for effective use of dispersants under various turbulence conditions. For this, the IFP test is used in combination with the MNS test, representing two turbulence conditions. In the MNS test, an air-flow above the surface generates an acute mixing and circular wave corresponding to "medium energy" breaking wave conditions. Samples of the dispersed oil are taken and quantified. This combined use of the IFP and MNS tests is assumed to represent the type of turbulence you may have in the field both without and with breaking waves conditions. This testing of the oils' dispersibility at varying weathering degrees gives information about the upper viscosity limits for the oils and the window of opportunity for use of dispersants. This testing approach has been correlated to field tests which involved release of oils. This type of information is also needed and required for contingency planning in Norway.

Figure 8: Dispersant effectiveness testing - IFP apparatus at SINTEF laboratories (Source: SINTEF)

[12] A 200^{o}C+ /50% water-in-oil emulsion is an oil restudies that has evaporated off all components with boiling point below 200^{o}C and has incorporated 50% seawater. This corresponds roughly to oil that has been weathered from typically 0.5 -1 day on the sea surface.

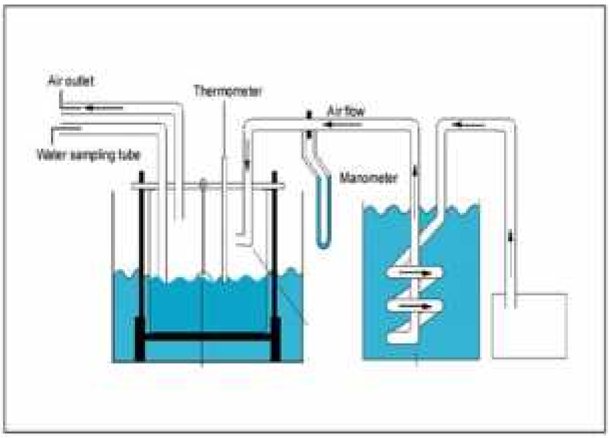

Figure 9: Dispersant effectiveness testing - MNS apparatus – Schematics (Source: SINTEF)

Showing wave actions before applying the oil

Dispersed oil after dispersant application

Figure 10: Dispersant effectiveness testing using the MNS-apparatus at SINTEF (Source: SINTEF)

5.2.3.6 Entities that do not produce or process oil, which are required to have an emergency response system but cannot link this to one or more specific types of oils, must be able to draw up emergency response plans including dispersants as a response option if they have carried out a *standard test procedure* for dispersant effectiveness. This addresses accidental oil spills where the spilled oil is unknown. In these cases, the WSL test is used in Norway, which is a relatively "high energy test" using rotating flasks that cause the dispersant-treated oil and water to thoroughly mix. The test aims to assess the proportion of the total volume of treated oil that is dispersed into the water column. This test is also used in the UK. In Norway, four different standard reference test oils are used for this tests, on varying weathering levels and two different salinities, as listed below. The first two tests (in table below) shall be run for all the products, while the third test is only needed if there are plans to use the dispersant product at low salinity.

5.2.3.7 The required conditions for the WSL test procedure to be conducted are shown below. It should be mentioned however, that the WSL test has not been performed in Norway since the new regulations came into force in 2002. A further specification of the test oils used for the WSL test might be updated in the future.

WSL Test		
	Test oil	**Conditions (temp. & salinity)**
1	Sture Blend 200°C/50% synthetically weathered emulsion	10^{o}C, 3,5% salinity / DOR 1:25
2	Medium Fuel Oil (2000cP at 10°C)	10^{o}C, 3,5% salinity / DOR 1:25
3	Sture Blend 200°C/50% synthetically weathered emulsion	10^{o}C, 0,5% salinity / DOR 1:25
4	IFO 180 (viscosity around 10.000 cP at 10°C)	10^{o}C, 3,5% salinity / DOR 1:25

Table1: Effectiveness testing – WSL test conditions

5.2.4 Toxicity test

5.2.4.1 The Norwegian test method, like the French one, determines the acute toxicity of the dispersant alone, by testing it on planktonic algae (*Skeletonema costatum)*, in accordance with the procedure described in ISO 10253. This is one of the standardised internationally accepted eco-toxicity tests used by the "OSPAR" Convention. This is a test measuring the acute toxicity as the concentration (mg/l) inhibiting the growth of the algae by 50%. The dispersant is not approved if it has a median effective concentration EC_{50} < 10mg/l. The test criteria requirement of EC50 > 10 mg / L is a general criteria for the water column HOCNF (Harmonised Offshore Chemical Notification Format) tests organisms, However, the toxicity measurement does not include "single component" tests, but only determines the acute toxicity of the "whole" dispersant". This is a pass/fail test.

5.2.4.2 It should be noted that the shoreline cleaning agents used in Norway must be tested for acute toxicity; testing is on the same algae (*Skeletonema costatum)* and shoreline cleaning agents are not approved if they have a median effective concentration EC_{50} < 100mg/l. In a more recent study (Hansen et al , 2014[13]), the *S. costatum* test results were extensively validated and correlated to other HOCNF tests, showing a good correlation and similar sensitivity to other water column organisms (e.g. *Acartia tonsa*). However, they did not provide a good correlation to the sediment organism (*Corophium volutator*). This last test is therefore today only included in the regulations/guidelines for testing shoreline cleaning agents.

5.3 United Kingdom

5.3.1 Background

5.3.1.1 The UK philosophy with regard to dispersant use is based firstly on the unlikelihood of getting oil recovery vessels to site in time, thereby aerial application of dispersants is deemed primary response and that mechanism is therefore in place as clear policy. The protocols for the regulation of dispersant use were not developed simply theoretically – but rather through the extensive and thorough laboratory and at-sea real-scale trials. Those trials delivered significant evidence to the process to ensure that decisions on development of UK dispersant effectiveness and toxicity testing were technically, scientifically and realistically sound. One important aspect of the trials, which fed into the process, was the fate of oil at-sea trials where oil concentrations were measured beneath trial oil slicks – both treated and untreated. The trials recorded the relative effectiveness of natural dispersion and dispersant induced dispersion thereby providing a real measure of the effectiveness of specific dispersant products.

5.3.1.2 Understanding the fate of chemically and naturally dispersed oil (and the differences) is fundamental in the development of dispersant use philosophy. In the UK the basis of dispersant regulation is <u>to achieve a best outcome, not to make matters worse</u>. The overall UK philosophy for toxicity therefore is to ensure that the oil +

[13] Bjørn Henrik Hansen, Dag Altin, Kristin Bonaunet & Ida Beathe Øverjordet (2014). Acute Toxicity of Eight Oil Spill Response Chemicals to Temperate, Boreal, and Arctic Species, Journal of Toxicology and Environmental Health, PartA: Current Issues, 77:9-11, 495-505, DOI: 10.1080/15287394.2014.886544

dispersant is not significantly more damaging than the oil alone. For effectiveness – the UK process is very simple – any dispersant presented for testing must attain a minimum of 60 percent. Simply – no point in introducing something which does not work to the degree which senior UK Government maritime scientists and policy makers each deem reasonable.

5.3.1.3 The UK approval scheme for dispersants differs from those of other national protocols. The main difference regards the toxicity tests that include the effect of dispersed oil in addition to the dispersant alone. The UK addresses the dispersant approval testing procedures from an operational perspective (e.g. testing the toxicity of the dispersed oil, as dispersants will always be used in combination with oil), whereas the other countries do not consider these elements in the 'product approval' phase, but rather during the 'dispersant usage approval' phase. This difference of necessary requirements for the '*product approval'* phase, and for the '*dispersant usage approval'* phase should be highlighted. It seems that even though all countries share similar concerns, they deal with these at different phases (either during the product approval or during the approval to use dispersants in a particular spill).

5.3.1.4 The UK testing scheme is designed to provide the appropriate balance between efficiency and environmental acceptability. The UK recognises that a more efficient dispersant product may be more toxic, and in accordance with the UK key principle and its testing approach, this is not an issue; a less effective product will be used, which is less toxic. The selection of dispersants for use should be a 'trade-off' between these - this is a principle inherent within the UK approach. In addition, the UK testing and approval scheme is designed to be able to provide assessments of *all* products used to treat oil spills. The combined "Sea" and "Rocky Shore" toxicity test approach is also used to assess sorbents, surface cleaners, bioremediation agents and a range of miscellaneous products. The "Rocky Shore" test is very pertinent to the testing and approval of several of these product categories.

5.3.1.5 For the UK, dispersant application is considered a primary oil spill response option and therefore substantial financial and human resources have been invested in defining the national testing scheme, with extensive and regular stakeholder consultations, in order to establish a generally acceptable framework. There is a clear link in the UK's testing philosophy with how the dispersant product will actually be used in operations. The latest review of the UK approval scheme for 'oil spill treating products' was held in 2011 and showed that there is a strong support of the current UK testing and approval approach, which aims to represent the risk of the actual use of a product and assess the potential of a product to increase the oil's toxicity. A number of recommendations were also made, including the need to develop a modification of the Sea Test to allow for the assessment of products for the treatment of Heavy Fuel Oils (HFOs).

5.3.1.6 The UK protocol respects the competition element for the dispersant manufacturers. The UK declares publicly whether any product has passed or failed the tests, i.e. the actual results are not public information.

5.3.2 Effectiveness test (LR 448 WSL)

5.3.2.1 The UK is using the Warren Spring Laboratory (WSL) test to determine dispersants effectiveness. Two reference tests oils are used; medium fuel oils with viscosities of 500cP and 2000cP at 10ºC (the test temperature). The WSL test is a relatively "high energy test" using rotating flasks that cause the dispersant-treated oil and water to thoroughly mix. The effectiveness test aims to assess the *proportion of the total volume* of treated oil that is dispersed into the water column. While two reference oils are used, comparing the effectiveness results between the two, the core oil for the pass or fail decision is the heavier fuel oil with 2000cP. Similarly to France, and differently from Norway, the UK effectiveness test does not cover varying weathering degrees of the oil.

5.3.2.2 The Maritime and Coastguard Agency (MCA) research project: "*Determination of the limiting oil viscosity for chemical dispersion at sea*" (MCA project MSA 10/9/180), was commissioned to explore what the key factors might be in limiting the effectiveness of dispersants on heavier oils. The report concludes that some oil spill dispersants will be an effective response to oils with viscosity of 2,000 cP, but will not be effective on oils with a viscosity of 7,000 cP or more, in waves associated with wind speeds of 7 to 14 knots. The precise limiting viscosity between 2,000 and 7,000 cP is not known. The limiting viscosity will increase with wind speed; it is possible that oil with a viscosity of 7,000 cP will disperse at 20 or more knots wind speed. However, it was not possible to test this at sea. Additionally, further research was funded by the UK Department for Environment, Food and Rural Affairs (Defra) (Project ME1309, 2010) which investigated the adaptation of the existing Sea Test for the assessment of products for use in the treatment of heavy fuel oils (HFOs) or heavy crude oils. The new test was successfully developed but, as yet, the separate assessment of products for use on heavier oils has not been implemented as part of the UK statutory scheme.

5.3.2.3 The minimum effectiveness requirements, according to the UK regulation, for a product to be considered effective and to pass the test depend on the type/categories of dispersant being tested:

- UK Type 1 (hydrocarbon solvent-based dispersant applied undiluted) and Type 2 dispersants (concentrate diluted 1:10 with seawater before application) must achieve an effectiveness of 30%. Type 1 and 2 dispersants are on the UK list of approved dispersants, but will most likely not be used in response operations.
- UK Type 3 (high effectiveness concentrate applied undiluted) must achieve an effectiveness of 60%. During response operations, in principle Type 3 dispersants are used. The threshold of 60% means that 60% of the oil must be dispersed in the water column for the product to pass. This differs from the 60% threshold in the French method, according to which the effectiveness is expressed between 0 and 100%, where 100% corresponds to the maximum theoretical quantity that could have been removed in case of a totally soluble compound. Dispersants pass the effectiveness test in France if dispersion is greater than 60%). Often the dispersants used in the UK are Type 2/3, so the same test method is used, but with different threshold values, as mentioned above. (See Annex 1 for more details on the UK effectiveness test protocol).

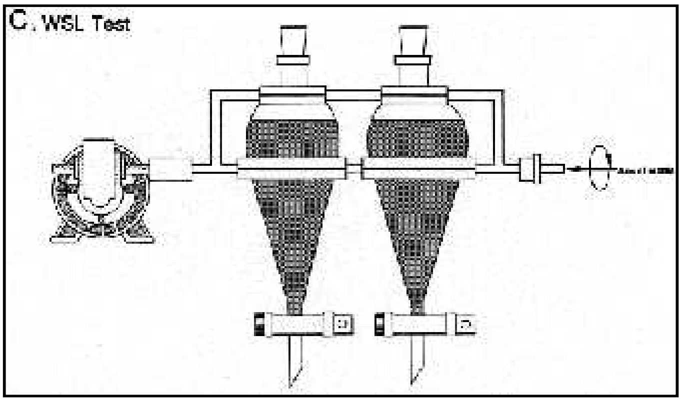

Figure 11: UK effectiveness test: WSL test (Source: CEFAS)

5.3.3 Toxicity tests (Sea Test and Rocky Shore Test)

5.3.3.1 The toxicity tests conducted in the UK for dispersant licensing are different in approach to other toxicity tests conducted in Europe and the United States. The Sea Test compares the toxicity of treated oil (i.e. treated with dispersant or other product) against that of oil alone (no product added, oil that is mechanically dispersed) – it does not ‘estimate’ the toxicity of the dispersant alone. It is generally accepted that the (dispersed) oil is by far more toxic than the dispersants. The UK does not consider the inherent toxicity of the dispersant alone because, if used correctly, animals should only be exposed to it in the environment in combination with oil; so it is important to see how the application of a product changes the oil’s toxicity. The UK policy aims to approve sufficiently effective products that have less potential to make the situation worse than it already is as a result of the oil spill. Taking account of dispersed oil effects in tests could result in the most efficacious products failing due to their potential to increase the bioavailability of oil to test organisms. The UK testing policy accepts this as a legitimate reason for test failure of certain products, especially as several products demonstrate adequate effectiveness for operational purposes and ability to fulfil the requirements for the UK toxicity tests. (If the UK were to test the toxicity of the dispersant alone, it would use the OSPAR Guidelines for Completing the Harmonised Offshore Chemical Notification Format - HOCNF).

5.3.3.2 The two toxicity tests conducted in the UK for a product to be on the list of approved dispersants are the ‘Sea test’ and the ‘Rocky Shore test’, described below. The toxicity tests are conducted by Cefas (the Centre for Environment, Fisheries and Aquaculture Science). The test oil used in both toxicity tests is the Kuwait crude (a medium crude oil relatively high in BTEX[14]). (See Annex 1 for more information on the UK toxicity testing protocols).

[14] BTEX: Benzene, Toluene, Ethylbenzene, Xylene

5.3.3.3 The Sea test is compulsory and involves the exposure of brown shrimp (*Crangon crangon*) to oil treated with dispersant (at a DOR (Dispersant to Oil Ratio) of 1:10) and mechanically dispersed by two shielded propellers rotating at 800rpm. This test compares the relative toxicity of an oil-dispersant mix to that of oil alone. The shrimp are exposed to dispersed oil at 1000ppm concentration in the water for 100 minutes followed by a 24 hour recovery period in clean flowing seawater. Five replicates each of a 'treated' exposure (oil + product) and a control or 'non-treated' (oil only) are conducted simultaneously. The test assessment is based on a statistical comparison of shrimp mortality between the two exposure types.

Figure 12: UK toxicity test: Sea Test (Source: CEFAS)

5.3.3.4 The Rocky Shore test involves the exposure of a representative rocky shore test organism, the common limpet (*Patella vulgata*), to either oil or the test product (i.e. dispersant alone – or oil and product for some product categories, e.g. sorbents) on Perspex plates. Limpets are left exposed on the plates, in a moist controlled environment, for 6 hours before being rinsed with clean seawater and the plates suspended in recovery tanks of clean flowing seawater. The limpets are monitored for mortality and loss of adhesion to the plate for a further 72 hours (including a daily period of 6 hours air exposure to represent tidal conditions). This test is no longer compulsory for products approved for "offshore" use only; the 'offshore' product designation is designed to identify those products which appear on the UK approved list but would not be considered for use on, or in the vicinity of, sensitive rocky shoreline environments. As with the Sea Test, five replicates of each treatment are conducted and the test assessment is based on a statistical comparison of limpet 'mortality' between the exposure types.

5.3.3.5 When the Rocky Shore test was developed dispersants formulations were being produced for use on shorelines as well as at sea. Dispersants have been used in the UK on shorelines and therefore the requirement to assess use impacts on this important ecological area is still considered important – especially by conservation organisations. The use of the Rocky Shore test also provides the basis for the approval of products that may be used near to rocky shorelines as well as on them. It should be noted that the Rocky Shore test is not just for 'shoreline cleaning products'. It is for the additional assessment of any product (incl. dispersants, sorbents, bioremediation agents and shoreline cleaners (referred to as surface cleaners)) that may be used to treat/clean oil on, or in the vicinity of, rocky shorelines.

6. Similarities and differences in existing dispersant testing procedures

6.1 There are similarities and significant differences in the test methods for dispersants effectiveness and toxicity required for government approval in the countries described in this paper. It is worth repeating that all countries share the same concerns and objectives when approving dispersants, they just approach these in different ways and with different tests requirements and procedures. This chapter focus on the similarities and differences in the various tests performed in the three countries with long experiences with dispersants (France, the UK and Norway).

6.2 Main similarities

- France and Norway test the toxicity of the dispersant alone and use an LC50 (lethal concentration)/EC50 (effect concentration) as an indicator of the toxicity. However, France and Norway use different test organisms and test method procedures.
- France and the UK are both conducting their toxicity tests with similar crustaceans; the white shrimp (*Paleamonetes varians*) in the case of France and the brown shrimp (*Crangon crangon*) in the UK.
- There is a common philosophy among the countries regarding dispersants effectiveness testing (specification of a minimum level of performance).
- France and Norway are using the same “low energy” dispersants effectiveness test (IFP test), as described. The “energy level” produced in the different effectiveness test methods cannot be directly related to particular sea conditions or wind speeds and is only relative.
- France and the UK have a specific threshold to determine dispersants effectiveness, although the test oils used and the interpretation of E > 60% are different. In France it is E > 60% whereas the UK LR448 protocol is based on a pass threshold level for UK Type 2 and 3 dispersants; E > 30% for UK Type 2, and E>60% for UK Type 3 with the 2000 cP at 10ºC medium fuel oil. It should be noted here that the official policies of France and Norway only recognise modern, concentrate dispersants (UK Type 3) and do not recognise the classification of a UK Type 2, water-dilutable concentrate dispersant. Also it is important to point out that the efficiency percentage measured with the different methods of the countries cannot be compared directly to each other.
- All three countries (France, Norway and UK) perform the effectiveness test first. Toxicity tests are not performed if effectiveness tests are not acceptable (the products have to pass the effectiveness test, in order to proceed to the toxicity test).
- All three countries (France, Norway and UK) perform recheck of dispersants in their stockpiles. The tests differ a bit, but the focus is on testing the effectiveness after 3 -10 years in stock. The IFP test is used in France and Norway, and the WSL test is used in the UK. How and how often this rechecking is performed depends on the storage conditions. See Annex 1, column “Re-test/check of dispersants”, for further information.

6.3 Main differences

- The fundamental difference in the test methods used for approval is with regard to the toxicity testing of dispersed oil versus toxicity testing of dispersant alone; the UK requires toxicity testing of the dispersed oil for approval. It should be emphasised that all the countries are equally concerned about the toxicity of the dispersed oil, but they deal with this at different phases. France and Norway determine the toxicity of the dispersant alone for approval, but also consider the toxicity of dispersed oil for the following reasons:

  - France considers the toxicity of the dispersed oil for dispersants usage and application in French waters. When setting up the pre-defined geographical limits, where dispersants usage is allowed with no prior official authorisation required, then the dispersed oil toxicity is taken into consideration; no specific toxicity test is carried out at that stage.
  - In Norway, extensive bio-assay studies on the toxicity of both dissolved oil components (WAF - Water Accommodated Fraction) and dispersed oil for different oil types are ongoing as part of the documentation needed for preparing contingency plans for the use/non-use of dispersants in coastal waters. The bio-assay studies are important input to advanced 3-D spreading and exposure models used as tool for NEBA assessment of relevant oil spill scenarios, as part of the contingency planning. Extensive research has been undertaken and is still taking place on oil droplets, toxicity of the oil (which is found to be far more toxic than the dispersants) and the toxicity to fish eggs, embryonic and larvae development for cod, haddock and herring and toxicity to Calanus (marine copepod). This research is based on as much as possible realistic levels of concentration of dispersant after a treatment and uses sensitive and relevant test organisms for Norway. Results are compared, with and without application of dispersants. These bio-assay studies are not directly linked to approval procedures for dispersants, but are needed for contingency plans which aim to prepare for the best possible counter polluting measures in Norway.

- Norway conducts toxicity tests, included in the OSPAR Convention, that are based on the impacts of the dispersants on planktonic algae (Skeletonema costatum test, ISO 10253).
- Only France conducts a dispersants biodegradability test as part of its approval procedure, but is currently considering the possibility of abandoning this test. The UK has conducted specific research in the past to ascertain the general biodegradability of modern dispersants. The result was that they were found to be generally readily biodegradable and therefore the need for a routine assessment as part of the scheme was not considered necessary.
- Norway regulates the dispersant use and not the approval of the dispersant products as such; therefore it does not have a list of approved products, like the UK and France have and maintain.
- Norway is the only country that tests dispersant product effectiveness on oil in varying weathering levels and reflects upon two different salinities in their national regulation.
- Norway has two different dispersant effectiveness testing procedures: one applicable for entities that produce or process oil (dedicated to the oils that are produced/processed) and a different one for entities that do not produce or process oil. Whereas the UK and France address dispersant product approval tests from the point of view of maritime traffic / accidental spills (where the oil types are not known in advance).
- The type of test oils differs for the effectiveness tests. France uses light crude mixed with heavy crude (1000 cP). In France, the Navy requires an additional effectiveness test which uses heavier test oil (8000cP). UK uses two medium fuel oils (500 and 2000 cP). Norway uses specific oils, depending on the enterprise/entity in question and has defined test oils if the oils are unknown/not specific producing oils. Norway has requirements in the regulation that specify the need to test the specific crudes oils.
- The UK is the only country having dispersant Type 1 on their approval list, even if in practice it is not used in response operations in the UK. Type 1 dispersant is not on the approval list in France and not used in Norway.
- In France, the test procedures and approved list of dispersants are not regulated by law requirements. This indicates that products not on the list can be applied/used and that the test procedures can be changed without legal implications. In Norway and the UK the approval procedures are part of regulations and required by law.
- Toxicity testing is also performed for spill response products to be used in environmentally sensitive areas. In the UK, the Rocky Shore Test is used to test dispersants, sorbents, bioremediation agents and shoreline cleaners which may be used on or in the vicinity of rocky shores. In Norway the planktonic algae (*Skeletonema costatum*) is also used for testing shoreline cleaning products. How the countries link the toxicity testing of shoreline cleaning products and dispersants differs, but there is an aim to perform the same tests (use the same organisms) if possible and appropriate.

7. Key principles behind the different test methods

7.1 The dispersant testing methods and requirements in France, Norway and the UK are listed in detail in the table in **Annex 1**. This Overview Paper, which aims to provide as much as possible complete and transparent information on this topic, includes information, as provided by the representatives to the TCG Dispersants of France, Norway and the United Kingdom, on:

- The key principles behind each national procedure (Table 2)
- The requirements of each test (Table 3)
- Comments and observations based on the experiences gained from the use of these tests (Tables 4 & 5).

7.2 It is the intention of the TCG Dispersants, that this paper will enable the other countries to better understand the current tests and with this information to ‘choose’ how to proceed regarding developing or revising their own dispersant testing procedures. For example, if they rely on one of these approval regimes for accepting products to be used in their own country (as many do), to know what that really entails, and if they develop their own new test procedures, to learn from the experiences gained already and avoid duplication of efforts and resources. <u>This may prevent further diversification of test methods in Europe</u>.

7.3 The key principles behind each of the selected national dispersant product approval tests are as follows:

Key Principles behind national test procedures in France, Norway and the UK		
FR	**Effectiveness test**	- Low energy test in order to identify more accurately the effectiveness of dispersant. - Dilution test: effectiveness related to well dispersed oil and not only oil transferred to the water column.
	Toxicity test	- Toxicity of dispersed oil is mostly due to the oil itself & to the effectiveness of the dispersant. - Dispersants are assessed alone to check that they do not have a significant intrinsic toxicity.
	Biodegradability test	- To check that the dispersant does not inhibit the biodegradation of the oil.
NO	**Effectiveness test**	- To compare products and select the most effective dispersants (ranking of products instead of "pass/fail"). - To identify the dosage ratios required. - To test the oil’s dispersibility at varying weathering degrees for the relevant oil tested in order to predict the “time window” for effective use/application of dispersants. - Three different test methods are used for different effectiveness testing purposes (IFP, MNS and WSL). The principles and the pros / cons for these three test methods are summarized in Chapter 5.2.1.4.
	Toxicity test	- The standardised OSPAR acute toxicity test (ISO 10253) is a simple, but robust EC_{50} test. - The aim is to prevent that new products come on the market that have a significant higher acute toxicity than other "well-known" dispersants that have undergone toxicity / bio-assay studies in the laboratory or in the field. - The dispersants are therefore tested alone (not in combination with oil).
UK	**Effectiveness test**	- Aerial application of dispersants is deemed potential response to oil spills and there is a clear policy in place. - Any dispersant (UK Type 3, which is usually used in response operations) presented for testing must attain a minimum of 60 percent effectiveness. - To ensure products introduced work to a reasonable degree.
	Toxicity tests	**Sea Test**: - To assess products for their potential to increase environmental impacts when added to oil. - To assess products specifically for ‘at sea’ applications. - To ensure products are on the approved list that have an appropriate balance between effectiveness and the potential to increase toxic effects of a spill.
		Rocky Shore Test: - To assess products for their potential to adversely affect a representative Rocky shoreline species. - To compare product alone vs oil alone in recognition of the greater potential for product only exposure to occur during shoreline use. - Takes account of other important, ‘non-toxic’ adverse effects, such as adhesion loss.
		Overall: To relate the testing and approval process to actual operational use (dispersants will always be used in combination with oil)

Table 2: Key principles behind national dispersant test methods in France, Norway and the UK

7.4 Due in part to these key principles, different test methods are chosen to be used with different threshold values, test oils and test species for the effectiveness and the toxicity tests performed in these countries.

7.5 With regard to the **effectiveness tests**, the three most common tests performed in Europe today are the:

- IFP – Institute Francais du Petrole
- MNS – Mackay, Nadeau and Steelman
- WSL- Warren Spring Laboratory

7.6 The energy level differs in the tests, from high to low. The high energy tests are often used for pass/fail tests. The low energy tests might also be used for pass/fail tests, but the lower energy tests induce a better ranking of the products. Effectiveness test results can be a way to select the most efficient products. The results can give useful information regarding the use of dispersants if the specific oil type of the spill is known and tested. However, it is important to be aware of the fact that test results only describe what is happening in the laboratory.

7.7 The table below contains a brief summary of the various effectiveness tests performed in France, Norway and the UK (Annex 1 gives a more detailed description of each test method.)

Country	Effectiveness Tests	Energy level	Test oil type(s)	Dispersant to Oil Ratio (DOR)	Threshold(s)
France	IFP test	IFP: Low	Arabian light crude mixed with heavy crude, 1000 cP. More viscous oil, 8000 cP, is used when performing tests for the French Navy (additional test).	1:20 (5%)	60% (where 100% is based on theoretical quantity of a totally soluble compound)
Norway	(i) Entities processing or producing oils: IFP & MNS tests (ii) Others (unknown oil): WSL test	IFP: Low MNS: Medium/High WSL: High	It varies: the oil that is produced / processed by that entity is used as test oil. Test on weathered oil (~ 0,5 –1 day at sea). Defined test oils for WSL test: Weathered Sture Blend, medium Fuel oil (2000cP at 10°C) and IFO 180 (ca 10 000 cP at 10°C).	IFP: 1:25 IFP & MNS: 1:10 – 1:200 (for testing optimal dosage needed) WSL: 1:25	No specific threshold is provided in the Norwegian regulation for any of the effectiveness tests. (Due to the different test oils used each time) Results are used for ranking dispersants.
United Kingdom	WSL	WSL: High	Medium fuel oils: 500cP and 2000cP	1: 20 – 1:30	Dispersants Type 1 and 2: 30% (diluted 1:10 w/ seawater) Dispersants Type 3: 60% (60% must be dispersed in the water column)

Table 3: Summary of the effectiveness tests used in France, Norway and the UK for dispersant product approval (Annex 1 provides more details on each test method)

7.8 The table below includes some **observations and comments** on each effectiveness test, as provided by the representatives to the TCG Dispersants of France, Norway and the United Kingdom, based on their countries' long experience with using these tests.

Test	Comments & Observations
IFP	- A very satisfactory low energy test (representing field conditions with "non-breaking" waves). - Very suitable when doing dispersant ranking; It is a sensitive/selective test (i.e. gives a large span in dispersant ranking / screening). - A calibration procedure (not requested by the norm) has to be implemented by each laboratory. - Calibration may be time consuming when doing pass/fail testing. - Representative of normal field conditions (low oil-to-water ratio and includes the water dilution concepts). - Particular care has to be taken regarding the choice of the reference oil and dispersant. - Sampling taken under dynamic conditions (continues sampling during the agitation period).
MNS	- Medium/high energy. - Interesting for R&D studies on crude oils. - Complementary to the IFP when testing the dispersibility of an oil (MNS representing more "breaking waves" field conditions). Important when defining the upper viscosity for dispersibility of an oil. - The high energy tends to level out the effectiveness between various dispersants when testing on low viscosity oils, but very suitable for testing on more viscous oils. - Samples can be taken under both dynamic (during mixing) and static conditions (after settling). - Representative of field conditions (energy generated by wind - no mechanical energy input). - Suitable for pass/fail testing. - Less sensitive than IFP test.
WSL	- Simple test useful for screening dispersants on non-emulsified oils (can lead to poor efficiencies on emulsions, even at low viscosity). - High mixing energy (can disperse "everything" if long enough mixing time). - Very high oil-to-water ratio (20,000 ppm oil in water→ coalescence /adsorption to the wall). - Requires settling time / static sampling (i.e. test result will reflect the density of the test oil; Can therefore lead to low effectiveness for lighter oils with low density and viscosities. - Rapid and simple test. - Suitable for pass/fail testing. - Limited span/differences between the dispersants. - Less representative of field conditions.

Table 4: Comments and observations from using the effectiveness tests (based on input from the TCG Dispersants members)

7.9 With regard to the **toxicity tests** performed in Europe today, the fundamental difference is whether the test is performed on the dispersant itself or on an oil/dispersant mixture. Is the toxicity testing of a dispersed oil (dispersant, oil, and water mixed with high mixing energy) the best way to select effective dispersants for national approval? It is clearly recognised that in any field application of dispersants to oil slicks, there are many variables and organisms can be potentially exposed to higher concentrations of dispersed oil than would be the case if dispersants were not used. It is also generally accepted that the dispersed oil has the potential to exert more toxic effects than the dispersant alone or the non-dispersed oil; the dispersed oil is potentially more bioavailable to marine organisms (such as plankton) and thus can have a bigger effect on marine organisms than oil on the sea surface. In this respect, as a 'general principle' the dispersant that is the most effective would produce more, or more finely (smaller oil droplets), dispersed oil and therefore has the potential to exert more toxic effects to exposed organisms.

7.10 The exact relationship between effectiveness and toxicity is not simple, and it may be needed to have an expert evaluation of the connection between efficiency and toxicity test results. The approval procedure aims to select the most efficient and least toxic products. Generally, the more efficient a dispersant product is, the more and finer dispersed oil droplets are formed. This results in a greater potential for increased bioavailability of the dispersed oil to exposed organisms with a subsequent increase in the risk of detrimental effects. Therefore, taking account of dispersed oil effects in tests could result in the most efficacious products failing, due to their potential to increase the bioavailability of oil to test organisms. Except for the UK, all the other countries in Europe with dispersant test procedures in place (France, Norway, Spain, Greece and Italy), test the toxicity of the dispersants alone in the approval process.

7.11 The toxicity data to marine organisms is also used in other chemical registration schemes (e.g. offshore chemicals notification scheme). However, the purpose of this is to rank potential hazard to facilitate product categorisation and is not used as a pass/fail criteria. It is recognised that the actual ability of a chemical to elicit impacts in the marine environment is a result of many factors including, volumes used, the dilution/dispersion potential at the release point and the sensitivity of the receiving environment and inherent toxicity only informs about hazard and not its environmental risk. Furthermore, in the case of appropriate use of dispersants, marine organisms will not be exposed to dispersant alone and the inherent toxicity of a product/dispersant will only partly be relevant to the toxicity of the product/oil combination. For operational use the toxicity of both the dispersant and the oil must be considered. The UK point of view is that the approval process should also consider the oil/dispersant mixture, which the UK considers as a more correct use of toxicity data since the oil and dispersants always work together. The UK states further that the dispersants are designed for a specific use, therefore the approval scheme should take into account the operational use and environmental risk (as opposed to hazard).

7.12 However, the toxicity of the dispersed oil is for some countries (e.g. France and Norway) taken into account not in the approval scheme but when dealing with the conditions for the use of dispersant, the contingency planning, which indicates where and to which extent the dispersants can be used according to the local environmental sensitivity and water exchange. If used correctly, dispersants will not be introduced into the environment in large amounts on their own, but only in combination with the much larger amounts of spilled oil. Taking into account that it is the dispersed oil, then the oil itself and lastly the dispersant that is of greatest toxicological concern during an incident when dispersants are used - as long as modern, concentrate dispersants (UK Type 3) are used. The 1st generation dispersants (1967 Torrey Canyon incident) contained aromatic solvents and were highly toxic; in fact they caused more harm than they contributed to the restoration process. In addition realistic scenario based model simulations should be performed to support the NEBA assessment. The “correct use” (spray onto the thickest oil, good water exchange, not too shallow, use remote sensing observations, etc.) of dispersants is very important for avoiding negative impacts on the natural resources.

7.13 The toxicity test criteria and organisms used should be harmonized with OSPAR as far as possible; this is looked upon as an advantage by members of the TCG Dispersants. Using test organisms mentioned in the OSPAR (The Convention for the Protection of the Marine Environment of the North-East Atlantic) promote the test of representative organisms for Europe and test protocols exist. Internationally standardized methods (e.g. ISO) for toxicity testing can also be applied. Research has been performed to compare aquatic toxicity testing for spilled oil, dispersant and dispersed oil. The US EPA has compared toxicity of Louisiana Sweet Crude (LSC), Corexit 9500A and dispersed oil (LSC + Corexit 9500); a DOR of 1:10 was used. The US test methodology was used (toxicity tests required by the EPA Test Method 821-R-02-012 (USEPA, 2002)) and the results showed that the dispersant alone was far less toxic to the fish species and shrimps than the crude itself. Test organisms used in this research were Mysid shrimp and Silverside fish[15]. Due to the fact that dispersants are less toxic than the dispersant/oil mixture several countries prefer to test toxicity on the dispersant alone. They consider it more appropriate to assess the dispersant alone, as the most efficient dispersants will present quite toxic values when oil/dispersant are tested together. As mentioned before, the toxicity and environmental impacts of using dispersant must be considered, but this process is in many countries separated from the approval process.

7.14 The table below contains a summary of the toxicity tests used today in France, Norway and the UK and some **observations and comments** on each test, as provided by the respective representatives to the TCG Dispersants group, based on their countries’ long experience with using these tests. Annex 1 gives a more detailed description of each test.

[15] US EPA (2010). Comparative Toxicity of Louisiana Sweet Crude Oil (LSC) and Chemically Dispersed LSC to Two Gulf of Mexico Aquatic Test Species. August 2010 and the updated report of September 2010. Environmental Protection Agency, Office of Research and Development. A summary can also be found in: Dispersants: subsea application - Good practice guidelines for incident management and emergency response personnel. IPIECA IOGP Report 533, 2015 (see page 25).

Country	Test	Test Organisms	Oil Type	Comments & Observations
France	French standard NF.T. 90-349	White shrimps (*Paleomonetes varians*)	N/A (Test only on dispersants)	- Advantage: toxicity measured relatively to a reference toxicant. - Shrimps not always available. - Low mortality in the field of dispersant solubility.
Norway	ISO/DIS 10253 Test on dispersant included in OSPAR Convention	Planktonic algae (*Skeletonema costatum*)	N/A (Test only on dispersants)	- A simple test. - Skeletonema costatum is available and representative for Europe. - Shown good correlation to other OSPAR / PARCOM tests.
United Kingdom	a) Sea Test (compares relative toxicity of an oil-dispersant mix to oil alone) b) Rocky Shore Test (compares toxicity of dispersants alone or oil and product). This test is not compulsory for offshore products.	a) Brown shrimp (*Crangon crangon*) b) Limpet (*Patella vulgata*)	Kuwait crude (medium crude)	- Brown shrimp are robust test animals, readily available and representative of exposed species for much of Europe. - The Sea Test is a comparative test (between dispersed oil and oil alone) and therefore takes account of seasonal variations in shrimp sensitivity. - Assesses the effect of dispersant/oil combinations as a standard dispersal. - Is based on assessing operational use but is not regarded as a 'simulation' due to fixed exposure times and concentrations. - General test system can be adapted to take account of different oils, species and exposure conditions. - Designed to assess potential impacts on and near to Rocky Shore zones which are considered to be ecologically important and particularly sensitive to the use of oil spill treatment products. - Allows some assessment of oil/dispersant effects under shoreline specific conditions (e.g. tidal cycle and intermittent air/water exposure). Also assess other important endpoints such as adhesion loss. - Limpets can be more difficult to source and should ideally be removed from chalk shorelines to avoid damage to the test organisms.

Table 5: Summary of toxicity tests and comments and observations on their use (based on input from the TCG Dispersants members)

8. Could there be a harmonised approach of dispersants testing in Europe?

8.1 This question has been brought up in the past at regional (e.g. Bonn Agreement) and EU levels (CTG MPPR, EMSA dispersants workshops) and it was addressed again by the TCG Dispersants Group at its 2014 and 2015 meetings, in accordance with the Group's mandate, as mentioned in Chapter 1. As dispersant use is considered a potential oil spill response option in most European sea regions and taking into account the extensive scientific work undertaken and operational experience that already exists in France, the UK and Norway in this field, further diversification of dispersant test procedures should be avoided in Europe. Several EU countries, especially the ones not having test procedures in place, wish to see a more harmonised approach - in the sense of convergence - of testing procedures in Europe. France, Greece, Italy, Norway, Spain and the United Kingdom are currently the countries in the EU with established procedures for dispersant testing for governmental approval.

8.2 All the countries with established test procedures share the same aim and objectives, even though as already described above the various tests have significant differences. It is important to clearly understand these similarities and differences when referring to these countries' dispersants test methods, especially when several countries in the EU would accept dispersants approved for use in the UK , France or Norway, although they may have been approved with very different testing methods. For example, some dispersants are approved for use both in the UK and in France, which means they have been tested at least twice with different test methods and have passed approval in both cases[16] even though the testing regimes are different. This procedure could be simplified if a more harmonised approach was used.

8.3 It should also be noted that a number of EU Member States have approved dispersants for use, without having national test procedures in place; the approval is based on the product being approved for use in other European countries. This is the case for example of Croatia, Cyprus, Malta, Ireland, Belgium and the Netherlands. Examples of products include the *Dasic NS, Finasol, Radiagreen OSD* and *Superdispersants 25*, which are approved for use in several countries, based on other countries' tests. It should also not be inferred that the absence of approval status in one or other of these countries for an individual dispersant is an indication that it would not be approved. There are commercial reasons why a dispersants manufacturer might choose not to submit a dispersant for approval in some countries.

8.4 Some of the **advantages** resulting from a more harmonised approach in dispersants testing methods across the EU are the following:

- Encourage the common aim of an efficient dispersant with a low toxicity.
- Provide guidance to countries either developing new policies regarding the testing, approval and use of dispersants as an oil spill response option or changing their existing policies on dispersants approval and usage.
- Enable an increased comparability of the results of the testing procedures, a more precise assessment of dispersants (effectiveness and ecotoxicology) and facilitate the acceptance of test results of dispersants approved for use elsewhere based on a common/harmonised testing protocol.
- Simplify the use of existing dispersants stockpiles among countries, in particular in waters of neighbouring states (Regional Agreements), and elsewhere as well; the situation during the Deepwater Horizon spill, where foreign stockpiles of dispersants could not be activated because the products were not approved according to the US national testing protocol, clearly demonstrated to what operational difficulties the lack of mutual acceptance of products may lead, also in Europe.
- Achieve a more predictable situation in regard to regional contingency planning regarding the response to oil spills.
- Allow financial savings for governments and/or manufacturers by avoiding the duplication of tests and by enlarging the possible market for dispersants (European area instead of individual countries).

[16] According to the 2014 EMSA *Inventory of national policies regarding the use of oil spill dispersants in the EU Member States*, six dispersants are currently approved for use both in France and in the UK (this list is not exhaustive and is based on information provided by the respective administrations). These are: *Dasic Slickgone NS; Finasol OSR 51; Finasol OSR 52; OD 4000; Superdispersant 25; and Radiagreen OSD.*

8.5 As demonstrated by the discussions within the TCG Dispersants Group, harmonising certain parts and procedures of the laboratory tests currently conducted in Europe for the approval of dispersant products for potential application on oil spills was also expected to meet some **challenges**. These include:

- While most countries share the same concerns when it comes to approving a dispersant product for use in territorial waters, they deal with it in very different ways. They all want a relatively effective product, which is as less toxic as possible, either on its own, or when applied on oil. However, it should be considered that to achieve this goal, different tests, test methods, reference test oils, test species, energy levels, threshold values (if any) and pass/fail requirements are used across Europe.
- The dispersant toxicity tests currently conducted in France, Norway and the UK have a fundamental difference in their approach, i.e. testing dispersant toxicity vs. testing the dispersed oil toxicity.
- For the countries which have oil exploitation (or offshore oil fields), such as Norway, the type of oil which may cause pollution is known and the dispersant product approval testing is targeted on these individual and known oils, whereas for those countries without oil exploitation activities, the risk of pollution has more focus on maritime traffic and in this case the oil type remains unknown. These countries have to refer to reference oils (a sort of "average" oil) for their dispersant testing procedures. If the oil types are unknown, not crude oils like mentioned above, then test oils should be specified. To define representative oil type(s) for the EU/EFTA would be challenging.
- Test species used in one country may not be relevant for another country nor for a pan European test protocol.
- Any change in existing national regulations may require the consultation by a large number of bodies at national level.
- Countries have different environmental conditions (e.g. salinity and water temperatures), and their dispersant testing protocols and regimes have been established after considerable research and testing, and in some cases after exhaustive consultation across government bodies, in order to meet these specific conditions.
- Test results are usually not public information. In France and the UK lists are published which inform if products pass the tests, without giving more specific information.

8.6 In addressing its task, the TCG Dispersants Group met twice, in 2014 and 2015. The first meeting included the whole TCG Group dealing with this task (13 experts from 8 countries), whereas the second meeting only included experts from France, Norway and the UK. Both meetings aimed to:

- Investigate the possibility for further harmonisation of dispersant tests in Europe, and
- Explore options for developing a guidance document on <u>minimum standards</u> for dispersant test methods, in particular for those countries which do not have dispersant test procedures in place.

8.7 The conclusions from these two meetings of the TCG Dispersants Group were that:

- Further diversification of test methods for dispersant approval in Europe should be avoided;
- Under the framework of the TCG Dispersants Group, harmonisation of existing tests it not achievable at this time, due to the fundamental differences in the current approaches to the dispersants' tests;
- It is also not possible to define minimum standards for the test procedures for dispersant approval in the EU/EFTA area, due primarily to the fundamental differences in the current approaches to the dispersants' tests. Furthermore, there was no agreement to change or adapt existing procedures in place or to identify commonly acceptable minimum test standards for use by other countries. The platform or basis to develop a guidance document at EU level on this issue under the framework of the TCG Dispersants Group currently does not exist.

9. Concluding remarks

9.1 The TCG Dispersants group, as established in 2012 under the CTG MPPR framework, was tasked to address issues linked to the use of oil spill dispersants in Europe. One of its tasks was to explore options towards a more harmonised approach of performing test procedures for dispersant product approval in Europe. As per the Group's Terms of Reference, this task was to be implemented by:

- Updating this Overview Paper describing the current tests in place in Europe, and
- Exploring with the European dispersant experts in this group if and how further diversification of test procedures could be avoided. To this effect it was discussed among the TCG group to develop a guidance document, which based on the experience of the UK, France and Norway with such tests, would identify commonly acceptable minimum test standards for use by other countries, which do not have such tests in place.

9.2 The outcome of the discussions among the TCG group is that further harmonisation is not achievable for the time being, even if the countries agree that further diversification of such tests should be avoided. While there is no requirement for the existing and long-established tests in France, Norway and the UK to change, it seems difficult to agree on any guidelines or recommendations on minimum standards for such tests, since each country has developed these over many years and only accepts its own test requirements.

9.3 Consequently, this Overview Paper has been updated by the Group **for information purposes**, to achieve a good understanding of the test procedures currently in place, their requirements and key principles behind each of them. In particular, it is important to understand how each test differs and the rationale why each procedure is selected by these three countries. Furthermore, some observations and comments on each test procedure, as provided by the TCG members are also included in this Paper.

9.4 This information is relevant, since several of the other EU countries are not performing their own testing, but use existing test results, often performed in neighbouring countries and accept the use of products approved in other EU countries. For these countries which are developing new test procedures or consider revising existing test procedures it is important to have this information, which has been provided by the Group as complete and as transparent as possible. It is the Group's intention, that this information will enable the other countries to better understand the current tests in place and accordingly to facilitate the national decision making of how to proceed regarding developing or revising their own dispersant testing procedures.

9.5 The paper presents how the dispersant effectiveness and toxicity testing is performed in the EU/EEA countries; in total 6 of the countries have tests in place. The procedures are described quite thoroughly for the three countries having most experience with such tests (France, Norway and the UK), while an overview of the tests in Italy, Greece and Spain is also annexed (Annex 1). While the described test procedures are performed differently, a lot of similarities also exist. EMSA encourages the prior review of the existing tests in the EU/EEA countries presented in the Paper when (and if) new test procedures are to be introduced by a country, in order to gain from the experience and expertise in place and make efficient use of valuable human and financial resources.

9.6 While the tests performed in the laboratories do not represent realistic conditions at the field, most countries share the same concerns when testing dispersants and the laboratory testing with the same or similar conditions enables the comparison and ranking of dispersants. However, the development of new and improved test methods should continue and should be based on the experience gained from existing methods.

9.7 From the work of the TCG Dispersants Group in implementing this task, the following **concluding remarks** can be made with regard to dispersant product approval testing in Europe:

- **Dispersant effectiveness testing:** The approaches towards dispersant effectiveness testing are more similar across Europe. There is general agreement that it should be carried out on relevant oil(s) and the viscosity of the test oil(s) should be carefully considered. Test oils from 500 to 8000 cP are usually used, and Norway is the only country which performs effectiveness tests also on weathered oils. The energy used in the effectiveness tests is of importance; the low energy test (such as the IFP) is more representative of normal field conditions than the high energy test (such as the WSL) and may be more relevant with regard to the efficiency in the field.

On the other hand, the high energy tests are easier to perform in the laboratory. The different brands of dispersants have a different efficiency on weathered oil, which should also be considered at some point.

- **Dispersant toxicity testing:** The toxicity tests are performed differently and with different test organisms. Countries often aim to select a commonly used test organism that is easily available and preferably described in the OSPAR Convention. The fundamental difference in the toxicity tests performed in Europe today is that the UK tests the toxicity of the oil/dispersant mixture, with the rationale that dispersant and oil is always used together in operations. France Norway, Spain, Italy and Greece test the toxicity of the dispersant alone, which makes it easier to assess the toxicity of the dispersants used and to separate between the different brands of dispersant. The toxicity tests performed in the laboratory will not necessarily simulate the exposure a marine organism would experience if the dispersants were used in an incident at sea, since in the laboratory the concentration is relatively high and the duration of exposure long. While it is clear to all stakeholders that the impacts of dispersed oil on the environment must be addressed, it is often argued that this discussion should be separated from the initial product approval process. Some countries prefer to assess the environmental impacts of using dispersants under more realistic field conditions. Generally, it is accepted that the toxicity of dispersed oil is much higher than the toxicity of approved dispersants. The use of 3D modelling that predicts oil drift and toxicity (based on bio-assay studies and realistic exposure of dispersant) is useful for the decision of the most appropriate counter pollution measures. Such information is not directly linked to approval procedures, but is useful / needed for contingency planning and to assess the environmental impacts of using dispersants. This difference in toxicity testing will probably remain in the future as the mentioned countries have strong national support of the existing tests in place.
- **Dispersant biodegradability testing**: France, Spain, Greece and Italy are currently performing biodegradability tests to the dispersant products linked to the approval process. The dispersant is considered as a whole (surfactant and solvent) and the test is done to check that the dispersant does not inhibit the biodegradation of the oil. As mentioned in Chapter 5.1.4, France is considering abandoning this test. However, some experts believe that this test is important as a dispersant with low toxicity and high biodegradability would be preferable to a dispersant with low toxicity and low biodegradability. It should also be noted that intermediate degraded products could be more toxic than then original dispersant substance. Norway and the UK do not perform biodegradability tests in the product approval phase.
- **Test results**: The actual test results are not public information, due to often small differences in test results and in order to avoid confusion for the users. Most countries present only a list of dispersants passing the tests. The test results refer to results in laboratories and do not reflect all the variables at a real oil spill. It is clearly not possible to test for the potential effects of exposure to dispersed oil for all the different oil types that might be spilled, for all relevant organisms and all conceivable weather and current situations, so this approach can only provide approximate guidance.
- **Subsea dispersant testing**: So far, no country in Europe has introduced specific procedures for approval of dispersants used for subsea application/SubSea Dispersant Injection (SSDI). A lot ofresearch is going on in this field, and additional criteria might be introduced in the future. Marine life in deep water will be more exposed when subsea dispersants are used. The environmental impact studies and monitoring after the use of subsea dispersants will for sure be of special concern.

9.8 EMSA encourages further work on harmonisation of dispersant test procedures in Europe, even if it cannot be achieved for the time being. At least, large deviations from the existing test protocols should be avoided.

9.9 The aim remains that the test procedures will be further discussed and involve cooperation among European countries. Transparent test procedures are important in this matter, as an oil spill might easily involve several countries. The approval processes and the use of the dispersants are linked, even if the processes often are treated separately. EMSA has annexed to this Paper some examples of “decision trees” for operational use of dispersants, which provide useful information.

9.10 This Paper is intended for information purposes and will be published on EMSA’s website in 2016.

Effectiveness test

Country	Type of test & test protocol	Objective(s)	Test Oil used	Dispersant type & DOR	Test duration	Number of tests	Threshold(s)
France	Low energy test, Institut Français du Pétrole (**IFP**) with continuous seawater inflow / dilution, with a submerged beater-ring (vertical oscillation) [French standard NF.T.90-345	Objective: selecting efficient dispersants for the emergency stockpiles. The test method selects dispersants which keep efficient at low energy. The testing equipment is a flow through test (continuous dilution). designed to mimic the open ocean. *Note: however the effectiveness measured in laboratory for standard conditions does not reflect necessarily the operational effectiveness of the product in real use	One reference oil: Arabian light crude, mixed with heavy fuel oil, 1000cP viscosity. The French Navy requires an additional effectiveness test, a more viscous oil, 8000 cP, is used.	Dispersant (neat concentrated / type 3) applied on the top, DOR = 5% (1:20)	1 hour	2 tests if results keep in the confidence interval [+-3], possibly 3 tests.	Amount of dispersed oil collected at bottom & quality of dispersion tested should be 60% of what would have been collected in the same conditions with a pure soluble compound (instead of oil and dispersant mixture).
Norway	**(a)** For entities producing / processing oil: Low energy test (**IFP**) with continuous seawater inflow / dilution, with a submerged beater-ring (vertical oscillation); the IFP test is used in combination with the high energy **MNS** test, to test the oil's dispersibility at varying weathering degrees for the relevant oil in order to predict the "time window" for effective use of dispersants under various turbulence conditions. In this test the air-flow above the surface generates an acute mixing and circular wave corresponding to "medium energy" breaking wave conditions. Samples of the dispersed oil are taken and the product effectiveness is checked. **(b)**For entities that do not produce or process oil, the Warren Spring Laboratory (**WSL**) test is used , which is a relatively "high energy test" using rotating flasks that cause the dispersant-treated oil and water to thoroughly mix. The test aims to assess the proportion of the total volume of treated oil that is dispersed into the water column.	Compare products and select the most effective dispersants, the dosage ratios required and the "time window" for use of dispersants for the relevant oils	**(a)** For entities producing/processing oil: Different test oils are used, depending on each entity. However, the specific test oil in question is a synthetically weathered emulsion (e.g. 200ºC+/50% water). **(b)**For entities that do not produce or process oil, four different reference test oils are used in the WSL tests, on varying weathering levels and two different salinities: 1. Sture Blend 200ºC/50% synthetically weathered emulsion 10ºC, 3,5% salinity. 2. Medium Fuel Oil (2000cP at 10ºC) 10ºC, 3,5% salinity. 3. Sture Blend 200ºC/50% synthetically weathered emulsion 10ºC, 0,5% salinity 4. IFO 180 10ºC, 3,5% salinity. Tests 1 and 2 above shall be run for all the products, while the third test is only needed if there are plans to use the dispersant product in low salinity.	DOR: 1:25	IFP: 1 hour mixing / dilution time MNS: 5 min mixing time WSL: 2 min. mixing time, 1 min settling time	2 parallel tests for each product. A third parallel is carried out if large deviation in the two first parallel. Leave out then the "outlayer".	No specific threshold exists, as different oils are tested.
United Kingdom	Warren Spring Laboratory (**WSL**) test is used , which is a relatively "high energy test" using rotating flasks that cause the dispersant-treated oil and water to thoroughly mix [LR 448 WSL].	To assess the proportion of the total volume of treated oil that is dispersed into the water column. (While two reference oils are used, comparing the effectiveness results between the two, the core oil for the pass or fail decision is the heavier fuel oil with 2000cP).	Two reference tests oils are used: medium fuel oils with viscosities of 500cP and 2000cP at 10ºC (the test temperature).	DOR = between 1:20 and 1:30	All reagents in fridge for 24 hrs prior to test. Rotating flask test 5-6 mins. Then chloro extraction x 2 which could take	Effectiveness index is determined by the average of 3 determinations.	Depends on the type of dispersant being tested: - Type 1 (hydrocarbon solvent-based dispersant applied undiluted) and Type 2 (concentrates diluted 1:10 with seawater before application) must achieve an effectiveness of 30%. - Type 3 (high effectiveness concentrates applied undiluted) must achieve an effectiveness of

Effectiveness test							
Country	**Type of test & test protocol**	**Objective(s)**	**Test Oil used**	**Dispersant type & DOR**	**Test duration**	**Number of tests**	**Threshold(s)**
					20 mins. In all less than one hour for each of 3 tests.		60%. The threshold of 60% means that 60% of the oil must be dispersed in the water column for the product to pass.
Spain	Evaluation of potential effectiveness of a dispersant. Test based on the 'Swirling Flask Dispersant Effectiveness Test' (EPA, 2003), but using manual agitation and establishing different agitation and settling times (Spanish Standard UNE 77101:2014	The test evaluates the effectiveness of the dispersant products available in the market. The aim of the test is to measure the effectiveness facilitating the best mixture of the oil and the dispersant by providing an energetic manual shaking. The new regulations for dispersants are currently being developed by the Maritime Authority and will include the Spanish Standard effectiveness test in the dispersant approval process. The selected demands little calibration compare to other effectiveness tests.	Reference crude oil (density at 15ºC>0,84 g/ml and viscosity at 15ºC>14cP) Two test oils: South Louisiana and Proudhoe Bay The low viscosity of test oils enables an easy mixing of oil and dispersants.	DOR = 1:11	2 minutes of manual shaking and 10 minutes of settling.	4 tests are used to calculate the average capacity of the crude oil to be dispersed, both naturally and chemically.	The potential effectiveness of a dispersant must be over 50%. The potential effectiveness is calculated as the difference between the capacity of a crude oil to be dispersed in seawater when dispersed chemically and when dispersed naturally by manual shacking.
Greece	Type of test: WSL test LR 448 (OP) Annex II of Ministerial Decision No 5219/F.11.4.2000 (Government Gazette 455/B/4.4.2000). Test protocol: The oil spill dispersant is mixed with reference fuel oil and synthetic sea water in a conical flask. Circumvolution of the flask for 120 sec to prepare a representative mixture of reference fuel oil-sea water-dispersant. The quantity of reference fuel oil in a sample of this mixture is determined by spectrophotometry.	Selecting of efficient dispersants with low toxicity.	Two reference fuel oils are used: 1st: dynamic viscosity at 10°C 1800-2200 mPa·s at 4s-1 shear asphaltenes (IP 143/78): max 6,0%w/w pour point (IP 1567):<5°C. 2nd: dynamic viscosity at 10^{o}C 450-550 mPa·s at 4s-1 shear. The 1st reference oil is diluted by kerosene to deliver the 2nd.	DOR = 1:25 for 3rd generation dispersant - type 3. DOR = 1:2,5 for 3rd generation dispersant – type 2.	Less than 1 hour for each of the three tests	The effectiveness index is the average of 3 separate determinations.	3rd generation type 2 dispersants: - 30 % minimum for 2000 mPa·s fuel oil 3rd generation type 3 dispersants: -60% minimum for 2000 mPa·s fuel oil -45% minimum for 500 mPa·s fuel oil.
Italy	National Decree 25/02/2011 Modified by the Decree 3/02/2014 A mixed solution of oil and dispersant is prepared and manually shaken for 2 min. Total hydrocarbons are measured according to the method UNI EN ISO 9377-2-2002 water quality - determination of hydrocarbon oil index - method using solvent extraction and gas chromatography.	The effectiveness of the dispersant is determined in terms of suspended and emulsified oil after the addition of the product in standardized conditions of shaking.	Arabian light crude– Viscosity 14 cSt at 15°C	There is no specific indication of the type of dispersant addressed by the DD 2011 DOR = 1:10	2 minutes of manual shaking.	1 test with 1 control + 3 replicates.	The product must disperse at least 60% of oil.

Toxicity test

Country	Test dispersed oil or only the dispersant	Oil type	Type of test & test protocol	Test Organism(s)	Test duration / exposure time	Number of tests	Threshold(s)	Objective(s)	Included in OSPAR Guidelines
France	Only dispersant product is tested for toxicity	Not pertinent as the test is completed on dispersant alone	Simple LC_{50} test (lethal acute toxicity) test. [French standard NF.T.90-349]	White shrimps (*Paleomonetes varians*)	The shrimps are exposed for 6 hours (tidal duration) followed by 24 hours recuperation time in clean waters, to see the mortality rate.	A large range of concentration (around 10 increasing concentrations)	The dispersant toxicity must be at least ten times lower than the toxicity of a reference toxicant (a cationic surfactant Noramium DA50) tested in the same conditions and on the same batch of shrimp as the dispersant.	This procedure compares the results of the dispersant test with those of a reference toxicant and intends to avoid any seasonal variation of sensibility of the test organisms.	No
Norway	Only dispersant product is tested for toxicity	No test-oil used	Simple EC50 test (measuring acute toxicity as the concentration(mg/l) inhibiting the growth of the algae by 50%. [Test procedure described in ISO/DIS 10253]	Planktonic algae (*Skeletonema costatum*)	Test temperature: 20 deg C . Exposure time: 72 h	Three replicates	The dispersant is not approved if it has a median effective concentration EC_{50} < 10mg/l (pass/fail test)	This is an acute toxicity on a relevant pelagisk organism. Pass and fail test. The aim is to avoid that new products coming on the market have not a significant higher acute toxicity than "well-known" dispersants that have previously undergone and documented toxicity / bio-assay testing in the laboratory or in the field.	Yes. The measurement determines the acute toxicity of the "whole" dispersant" (not "single component" test.
United Kingdom	The dispersed oil is tested for toxicity	The test oil used in both toxicity tests is the Kuwait crude (a medium crude oil relatively high in BTEX)	a) **Sea Test**: (compulsory): Oil is treated with dispersant (at a DOR of 1:10) and is mechanically dispersed by two shielded propellers rotating at 800rpm. b) **Rocky Shore Test**: The common limpet is exposed to either oil or the test product (i.e. dispersant alone – or oil and product) on Perspex plates (This test is no longer compulsory for offshore products).	a) Brown shrimp (*Crangon crangon*) b) Common limpet (*Patella vulgata*)	a) The brown shrimp are exposed to dispersed oil at 100ppm concentration in the water for 100 minutes followed by a 24 hour recovery period in clean flowing seawater. b) Limpets are left exposed on the plates, in a moist controlled environment, for 6 hours before being rinsed with clean seawater and the plates suspended in recovery tanks of clean flowing seawater. The limpets are monitored for mortality and loss of adhesion to the plate for a further 72 hours (including a daily period of 6 hours air exposure to represent tidal conditions). Five replicates of each treatment are conducted and the test assessment is based on a statistical comparison of limpet 'mortality' between the exposure types.	a) Five replicates each of a 'treated' exposure (oil + product) and a control or 'non-treated' (oil only) are conducted simultaneously. b) Five replicates of each treatment are conducted.	a)Mean % mortality of the treatment must not be >20% above that of the controls. Borderline results require a retest. Statistical significance (p<0.05) between treatment and controls is also taken account of. b) As above.	a) This test compares the relative toxicity of an oil-dispersant mix to that of oil alone. The test assessment is based on a statistical comparison of shrimp mortality between the two exposure types. b) The test assessment is based on a statistical comparison of limpet 'mortality' between the exposure types.	No

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Toxicity test

Country	Test dispersed oil or only the dispersant	Oil type	Type of test & test protocol	Test Organism(s)	Test duration / exposure time	Number of tests	Threshold(s)	Objective(s)	Included in OSPAR Guidelines
Spain	Only dispersant product is tested for toxicity	No test-oil used	Various toxicity test protocols: 1) LC50 test, determining the dispersant toxicity based on ASTM Standard Guide E1440-91 (Spanish Standard UNE 77106:2014) 2) LC50 test determining the dispersant toxicity (UNE-EN ISO 11348-3 of 2009) 3) LC50 test determining the dispersant toxicity based on the French standard NF.T.90-349 (Spanish Standard UNE 77105:2014	1) Marine rotifer *Brachionus plicatilis* 2) Bioluminescent bacterium *Vibrio Fisheri* *3) Crustaceans Palaemon serratus and Palaemon elegans*	1) Marine rotifers are exposed for 24 hours to different concentrations of dispersant 2) Bacteria are exposed for 30 min to different concentrations of dispersant 3) Crustaceans are exposed for 6 hours followed by 24 hours recuperation time in clean waters, to different concentrations of dispersant.	1) range of 5 different concentrations of dispersant 2) 3 tests, each with a range of 9 different concentrations 3) range of 4 different concentrations	1) Negative result: After 24h CL_{50} must be higher than100mg/l. 2) Negative result: After 30 minutes CL_{50} must be higher than100mg/l. 3) The dispersant toxicity must be at least ten times lower than the toxicity of a reference toxicant (benzalkonium chloride) tested in the same conditions.	This method consisting in several tests evaluates the toxicity of the dispersants available in the market. The dispersant is considered non-toxic if the results for either test 1 or test 2 are negative. If not, test 3 must be performed considering the fixed threshold. This two phase method determines if the dispersant is non-toxic. The new regulations for dispersants are currently being developed by the Maritime Authority and will include these tests in the dispersant approval process.	No
Greece	Only the dispersant is tested for toxicity	Not pertinent as the test is completed on dispersant alone	Ministerial Decree No 5219 (2000) ANNEX III	1) Microscopic Organisms (*Artemia, Brachionous, Acartia*) 2) Shrimps (Species Palaemon)	1) Microscopic Organisms: Concentration of dispersant-sea water mixtures: 0,001%-0,01% - 0,1% - 1% - 10% 10 ml of every mixture is used - 24 hours (at 25 °C) 2) Shrimps: Concentration of dispersant-sea water mixtures: 0,01% - 0,1% - 10% 3 litres of mixture is added in 4 litres of sea water - 48 hours (at 15 °C)	Five increasing concentrations	1) Microscopic Organisms: EC_{50} or LC_{50} (24 hours) > 100 ppm 2) Shrimps: EC_{50} or LC_{50} (48 hours) > 10.000 ppm	It intends to avoid permission of using dispersants that its EC_{50} or LC_{50} is below 100 ppm	No
Italy			Various toxicity test protocols for algae, crustaceans and fish are used. -EC50 test on algal	**1. Diatoms:** *Skeletonema costatum, Phaeodactylum tricornutum*	Test duration varies according to test species and protocol, as previously specified .	One for each trophic level, so at least 3 tests.	1. EC_{50} > 10mg/l 2. EC_{50} > 10mg/l 3. EC_{50} > 10mg/l	Evaluation of toxicity of the dispersant product for three different trophic levels: algae, crustaceans and fish.	Toxicity tests for algae in the OSPAR guidelines are the same

Toxicity test

Country	Test dispersed oil or only the dispersant	Oil type	Type of test & test protocol	Test Organism(s)	Test duration / exposure time	Number of tests	Threshold(s)	Objective(s)	Included in OSPAR Guidelines
	Only the dispersant product is tested for toxicity	No test oil used	growth inhibition at 72h according to UNI EN ISO 10253:2006, AND; -EC50 at 48h for the crustacean *Acartia tonsa* according to UNICHIM pr MU 2365 (2010), OR -EC50 at 96h for the crustacean *Artemia franciscana* according to APAT-IRSA-CNR 8060 (2003), OR -EC50 at 48h for the crustacean *Amphibalanus amphitrite* according to UNICHIM pr MU 2245 (2010), OR -EC50 at 96h for the crustacean *Corophium orientale* according to UNICHIM pr MU 2246 (2010), OR EC50 at 96h for the crustacean *Tigriopus fulvus* according to UNICHIM pr MU 2396 (2010), AND -EC50 at 96h for the fish *Dicentrarchus labrax* or *Sparus aurata* according to OECD n. 203 (1992).	2. **Crustacean**: *Acartia tonsa* *Artemia franciscana* *Amphibalanus amphitrite* *Corophium orientale* *Tigriopus fulvus* 3. **Fish:** *Dicentrarchus labrax, Sparus aurata*					as those used in Italy, but not the tests for crustaceans and fish.

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Biodegradability test		Re-test/checking of stockpiles
Country	**Specification of test(s), if performed**	**Type of tests, thresholds(s) and frequencies of tests**
France	[French standard NFT90-346]. The test assesses the dispersant's biodegradability in 28 days by measuring how much carbon dioxide (CO_2) has been produced. The dispersant is considered as a whole (surfactant and solvent) and its biodegradability should be at least 50% of the non-evaporable fraction (fraction which is not stripped during the test by the bubbling of CO_2 in the flasks).	The operational stockpiles are subjected to periodic quality controls, physical parameters and effectiveness tests (IFP tests) are performed every five years.
Norway	N/A	In the guidelines to the Regulations are recommendations to the enterprise responsible of the stockpiles for re-testing the products in stock. As a general rule: dispersant stored in original containers are tested every 5 year. For dispersant in tanks on response vessel: is going to be tested every 3 year. Test parameters are: Visual observations (colouring, transparance, precipitation), viscosity, density, effectiveness (same criteria as the screening test, effectiveness minimum 2/3 of the original dispersant effectiveness test result using the IFP test).
United Kingdom	N/A	Effectiveness tests (WSR test) required on one sample of each batch of dispersant 10 years after manufacture and while container remains unopened. Then every 5 years. If opened then every 5 years thereafter.
Spain	Evaluation of the biodegradability of dispersants under the action of aerobic microorganisms. For 28 days the biological oxygen demand (BOD) is measured in a manometric respirometer. The dispersant's biodegradability must be over 50%. (Spanish Standard UNE 77103:2014)	Currently, there are in place Spanish standards for effectiveness, toxicity and biodegradability tests for dispersants. The Spanish Maritime Administration is currently working on new regulations for approving dispersants, including the frequencies of re-test of dispersants.
Greece	French standard NF T 90 346 (as above) 50% minimum	The Ministerial Decision No 5219/F.11.4.2000 (Government Gazette 455/B/4.4.2000) foresees that re-check is performed whenever needed. The WSL test is used when re-check is performed.
Italy	"Closed bottle" method OECD n. 306 (17 July 1992). All the product's components shall be biodegradable with an oxygen depletion greater than 60% of the ThOD.	The approval granted by the Italian Ministry of the environment land and sea is valid for 5 years and it can be renewed for further 5 years if the composition of the product remains identical. Re-test is required if even one single component of the product has been changed.

Annex 2. Further Information

Guidance documents, hyper links, comments etc.

France	List to approved dispersants, which fulfil acceptance criteria for effectiveness, toxicity and biodegradability according to French standards: http://wwz.cedre.fr/en/content/download/3070/32680/file/dispersants_sea_gb.pdf
Norway	Norwegian regulation for use of dispersants: **http://www.miljodirektoratet.no/no/Regelverk/Forskrifter/Regulations-relating-to-pollution-control-Pollution-Regulations/Chapter-19-The-composition-and-use-of-dispersants-and-shoreline-cleaning-agents-to-combat-oil-pollution/** The Norwegian Control Form and Decision Matrix: **http://www.kystverket.no/Documents/Beredskap/Skjemaer/Kontroll-%20og%20beslutningsskjema%20for%20bruk%20av%20dispergeringsmidler%20(inkl%20veiledning).doc**
United Kingdom	Link to approved oil spill treatment products: https://www.gov.uk/government/publications/approved-oil-spill-treatment-products Protocols for effectiveness- and toxicity testing: **http://www.marinemanagement.org.uk/protecting/pollution/documents/approval_lr448.pdf)**
Spain	The Maritime Authority maintains an updated list of approved dispersants considering the effectiveness, toxicity and biodegradability tests performed in other countries. The new regulations for dispersants are currently being developed by the Maritime Authority and will consider the Spanish Standards for effectiveness, toxicity and biodegradability tests in the dispersant approval process. The legislation is not yet in place, but the standards used for testing will be the following: UNE 77101:2014 Evaluation of the potential efficacy of oil dispersants in marine environment. Dispersants efficiency test (2014-02-05) UNE 77103:2014 Evaluation of biodegradability of dispersants and bioremediation agents by determination of biological oxygen demand in a manometric respirometer (2014-05-07) UNE 77104:2014 Bioassay for the characterization of the ecotoxicity of oil pollution response products by the bioluminescent bacterium Vibrio fischeri (2014-05-07) UNE 77105:2014 Bioassay for the characterization of the ecotoxicity of dispersants by the crustacean species Palaemon serratus or Palaemon elegans (2014-05-07) UNE 77106:2014 Bioassay for the characterization of the ecotoxicity of dispersants by the marine rotifer Brachionus plicatilis (2014-05-07)
Greece	According to Ministerial Decision No 5219/F.11.4.2000 (Government Gazette 455/B/4.4.2000): - the use of 1st generation oil spill dispersants is banned - the use of 2nd generation oil spill dispersants was allowed until 31.12.2003 and only if they complied with the provisions of Ministerial Decision No 5219/F.11.4.2000 - the use of 3rd generation oil spill dispersants is allowed. Information for oil spill dispersants, national legislation and approval procedure in Greece: http://www.gcsl.gr/index.asp?a_id=289&txt=y&show_sub=1
Italy	The approval procedure is carried out according to the Italian Decree D.D. 25.2.2011. The list of approved products and other information can be found on the WEB Site of the Italian Ministry of the environment land and sea: http://www.sidimar.tutelamare.it/tutelaEcosistemiMarini.do
Other	IPIECA report from December 2014: “Regulatory approval of dispersant products and authorization for their use”. http://www.ipieca.org/ (go to Library & select “oil spill preparedness”)

Annex 3. Decision trees for the use of dispersants

This Annex includes:

1. **The Norwegian Control Form and Decision Matrix**
2. **The UK decision tree**
3. **French operational guide on dispersant use**
4. **Decision tree for the Dutch Caribbean**
5. **Decision tree, IMO Dispersant Guidelines**

1. The Norwegian Control Form and Decision Matrix (3 pages)

Provided by the Norwegian Environment Agency

Dato: 31.01.14

KYSTVERKET

Unofficial translation **Use of dispersants at sea: control form**

From (name of company etc):	Email:
Contact person(s):	Telephone:

Filled out forms should be sent to the Norwegian Coastal Administration, Department for Emergency Response.
24-hour hotline: +47 33 03 48 00, Fax: +47 33 03 49 49, email vakt@kystverket.no.

If your company's emergency response plan as approved by the Norwegian Environment Agency does not include use of dispersants, you must apply for a permit from the Norwegian Coastal Administration before any such use. In such cases, filling out and submitting both the control form and the decision matrix (compiled by the Norwegian Environment Agency and the Norwegian Coastal Administration) constitutes applying for a permit.

If your company's emergency response plan does include use of dispersants, it is not necessary to apply for such use. The control form must however be filled out and submitted to the Norwegian Coastal Administration as soon as possible. (The decision matrix may be submitted at a later time.)

Is dispersant use included in the emergency response plan? If yes, send in the control form as soon as possible	**YES**	**NO**
Are you applying for a permit to use dispersants? If yes, send in both the control form and the decision matrix as soon as possible	**YES**	**NO**

Information on the incident:

Provide as much information as possible given the circumstances.

1.	**Time and date of spill, start and duration**	
2	**Position of the spill** Latitude, longitude, place name	N E
3.	**Source of spill** (name of vessel, installation, etc.)	
4.	**Description of spill** (oil type, surface/water column/seabed, presence of gas). Has release been stopped?	
5.	**Estimated size of spill (m^3):** Tick a box or fill in quantity	< 10 m^3 / 10 – 100 m^3 / 100 – 500 m^3 / 500 – 1000 m^3 / 1000 – 5000 m^3 / > 5000 m^3
6.	**Estimated area of slick (total area)** If possible, give % of area covered by each category defined in the Bonn Agreement Oil Appearance Code or detectable using FLIR IR camera	km x km = km² Sheen / Rainbow / Metallic / True colours / IR detectable
7.	**Current weather conditions and wind forecast for next 24 hours**	Temp (°C): Sea, Air / Wind: Speed m/s, Direction, Rising/falling? / Wave height (significant)
8.	**Visibility and light conditions**	Cloud base: (m) / Horizontal visibility (m) / Daylight (from – to)
9.	**Application method and quantity/type of dispersant to be used**	

Doe the decision matrix show that :

I. Dispersant use will give less overall environmental damage than taking no action or mechanical recovery?
Yes .... / No........ (tick one)

II. The operational conditions are suitable for dispersant use?
Yes .... / No........ (tick one)

Updated 2014

KYSTVERKET

Use of dispersants at sea:decision matrix

		YES	NO
I	**Will dispersant use give less overall environmental damage than taking no action or mechanical recovery?** *Fill out points 1 – 4 before answering question I (tick the appropriate box)*		
II	**Are the operational conditions suitable for dispersant use?** *Fill out points 5 – 12 before answering question II (tick the appropriate box)*		

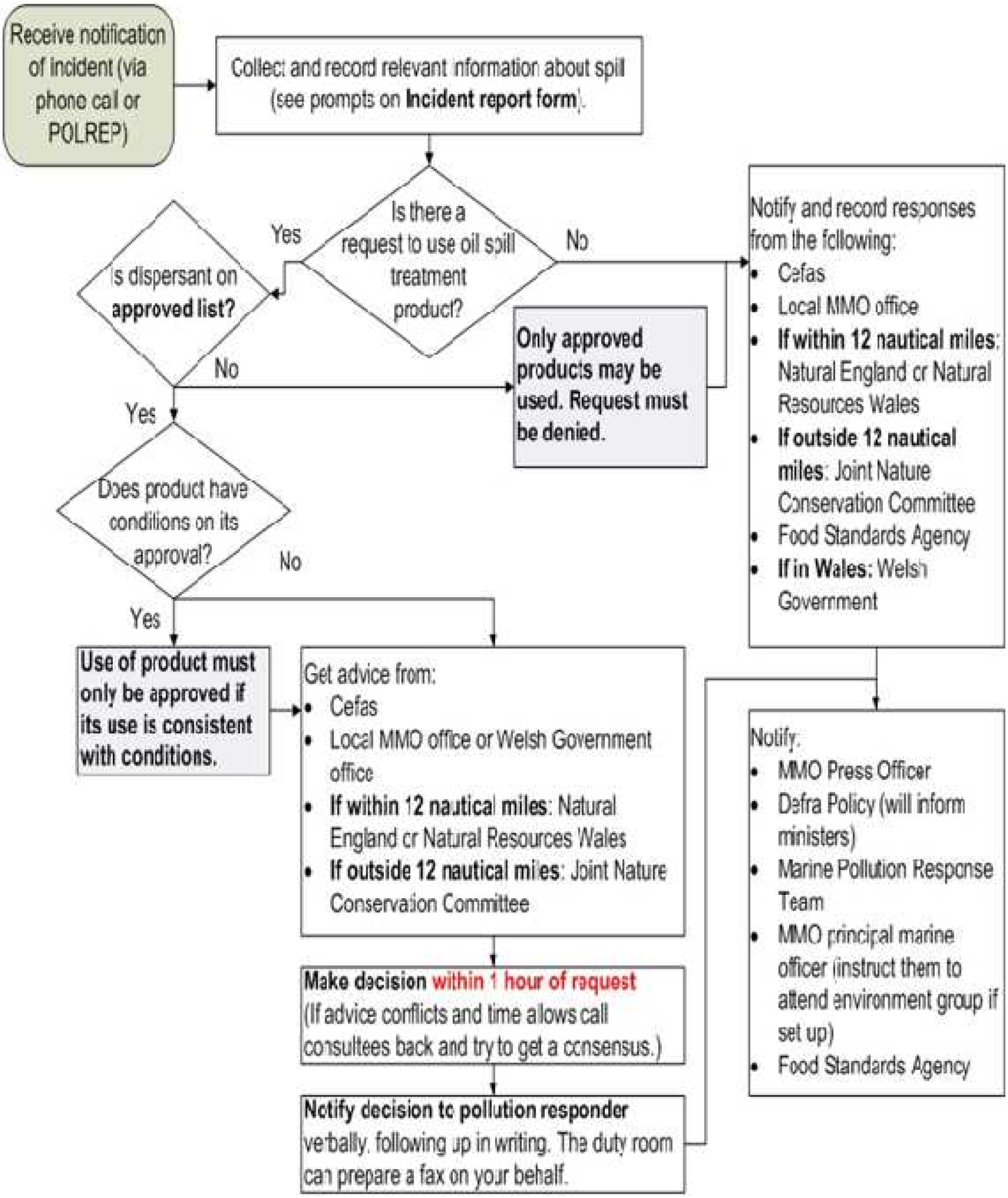
	Criterion		Basis for evaluation	Effectiveness	Comments
	Criterion		**Basis for evaluation** Effectiveness codes: A – Dispersant use will be very effective B – Dispersant use will be effective/of limited use. Further assessment by experts needed C – Dispersants should not be used If A or B options are selected for all points below, dispersant use is considered to be suitable. (Dispersants should not be used if option C is selected in any case)	**Effectiveness** Select one of the A, B or C options for each criterion	**Comments** See the guidelines below for further details. This column can be used to provide information on how the effectiveness code for each criterion has been chosen.
Potential environmental damage/exposure (points 1 - 4):					
1	**Slick lifetime on sea surface**	A: B: C:	Lifetime on surface: > 24 hours Lifetime on surface: < 24 hours Lifetime on surface: < 5 hours		
2	**Natural resources in possible trajectories**	A: B: C:	Large seabird concentrations or priority shoreline locations along the trajectory, but low density of eggs and larvae (spawning products) in the water column High densities of both seabirds and spawning products High density of spawning products, few seabirds		
3	**Water depth, distance to shore**	A B_1: B_2: C:	Depth > 20 m, distance to shore > 200m Depth < 20 m, distance to shore > 200m Conditions in A and B_1 not met, but dispersant use indicated for other reasons (e.g. presence of seabirds, wind or current direction) Conditions in A, B_1 and B_2 not met		
4	**How likely is stranding if dispersants are used?**	A: B_1: B_2: C:	Stranding of surface oil/emulsion can be prevented Stranding of surface oil/emulsion can be considerably reduced Treated oil may strand on moderate- to high-energy shoreline Treated oil will strand on low-energy shoreline or sandy beach		
Operational conditions (points 5 – 12):					
5	**Chemical dispersibility of oil slick**	A: B: C:	Dispersible at planned time of dispersant application Dispersibility will be limited at planned time of dispersant application Not dispersible at planned time of dispersant application		
6	**Wind conditions**	A: B: C:	Wind speed next 24 h: < 15 m/s Wind speed next 24 h: >15 and < 20 m/s Wind speed next 24 h: < 2 or > 20 m/s		
7	**Application strategy**	A_1: A_2: A_3 B:	From helicopter using FLIR camera with option of visual observation From plane with aerial guidance From vessel with aerial guidance and downlink of FLIR data From vessel without aerial guidance (vessel's radar/IR camera as only support)		
8	**Operations in the dark**	B: C_1: C_2:	From vessel with aerial guidance and downlink of FLIR data From vessel without aerial guidance or downlink From helicopter or plane only		

9	**Application capacity**	A:	Sufficient application capacity and dispersant available quickly enough to treat entire slick during time window for dispersant use	
		B_1:	Sufficient application capacity and dispersant to treat a substantial part or priority areas of the slick	
		B_2:	Sufficient application capacity and dispersant available, but not until oil has become less dispersible	
		C	Dispersant spraying equipment not available within time window for dispersant use	
10	**Salinity**	A_1:	Dispersant to be used in open sea or coastal water of normal salinity	
		A_2:	Dispersant to be used in brackish water. Dispersant available is documented to be effective at low salinity	
		B	Dispersant to be used in brackish water. Only marine dispersant available	
		C	Dispersant to be used in freshwater (lake/river)	
11	**Remote sensing/ monitoring**	A:	Remote sensing and monitoring possible	
		B	Remote sensing or monitoring possible	
		C	Neither remote sensing nor monitoring possible	
12	**Quantification and monitoring before dispersant operation is concluded**	A.	Remaining surface oil can be quantified from plane or helicopter and properties and dispersibility of surface oil can be monitored	
		B_1	Oil concentration below surface can be measured by UVF, analysis of remaining surface oil	
		B_2	Aerial monitoring	
		C	Remaining surface oil cannot be quantified	

A guideline for filling out the Norwegian Decision Matrix is also available (not included in this document).

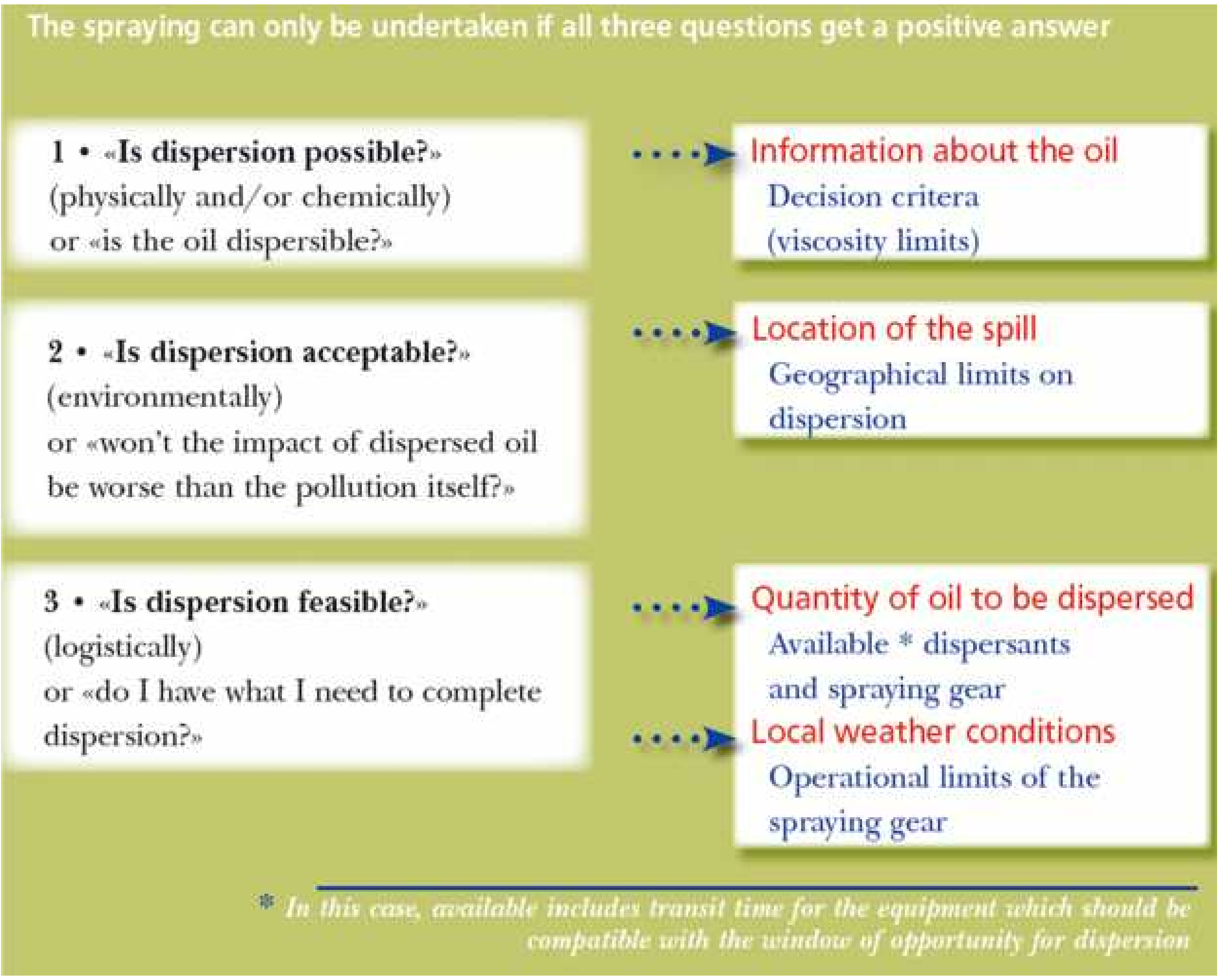
2. The UK decision tree (1 page)

Provided by the MCA



3. French operational guide on dispersant use (1 page)

Provided by Cedre



4. Decision tree for the Dutch Caribbean (5 pages)

Rijkswaterstaat
Ministry of Infrastructure and the Environment

Decision tree for the use of dispersants during oil spills in the Dutch Caribbean

National Committee for Environmental Incidents in Water (LCM)

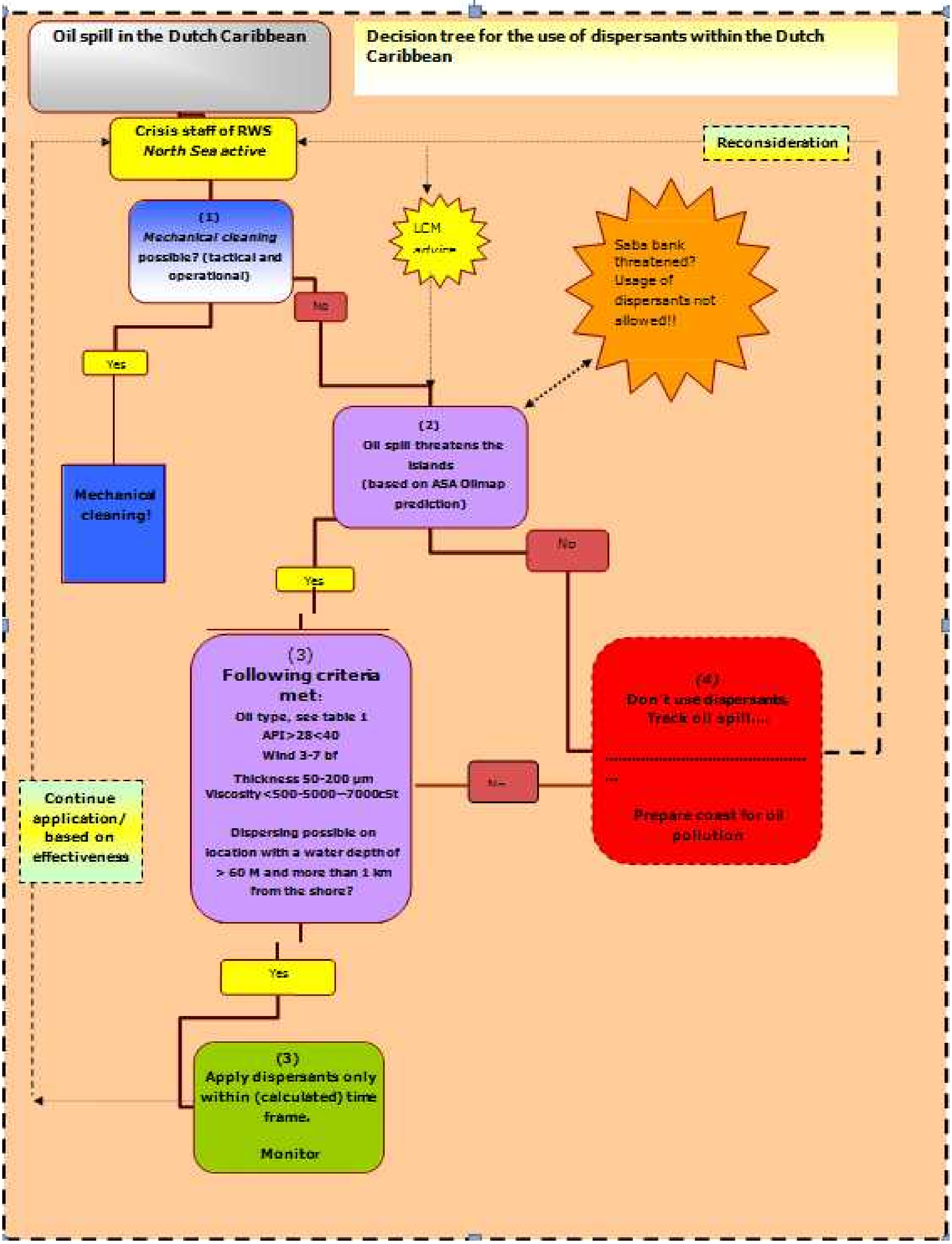
Version: 1.04
Bert van Munster (RWS-VWM)
Serge Rotteveel (RWS-WD)
23 januari 2013

Findings during visit to the Dutch Caribbean, March 2012

People indicate that dispersants are toxic and therefore should not be used. Indeed, application of dispersants in shallow water may lead to additional damage to the environment. However, this is not caused by the dispersants itself but by the concentration of dispersed oil which may lead to negative environmental effects in shallow water. The toxicity of modern dispersants is low. When the water depth is 20 meters or more the possibility of negative effects in the water is small. The decision tree accounts for this by applying dispersants on locations with a water depth larger than 60 m. This way the concentration of dispersed oil stays limited (< 10 ppm). The criterion of application 1 km out of the shallow areas is added to prevent to oil, treated with dispersants, to reach the shallow areas. It is important to realize that the affectivity of disperants is less than 100% and always a residue remains.

The visit confirmed the basic principles of the decision tree.

For an oil slick that threatens the Saba Bank, based on an ASA oil-map prediction, we propose not to use dispersants. The area is relatively shallow and vulnerable (coral) for dispersed oil.



Oil spill in the Dutch Caribbean
Decision tree for the use of dispersants within the Dutch Caribbean
Crisis staff of RWS
North Sea active
Reconsideration
(1)
Mechanical cleaning possible? (tactical and operational)
LCM advice
Saba bank threatened? Usage of dispersants not allowed!!
No
Yes
Mechanical cleaning!
(2)
Oil spill threatens the islands
(based on ASA Oilmap prediction)
No
Yes
(3)
Following criteria met:
Oil type, see table 1
API>28<40
Wind 3-7 bf
Thickness 50-200 µm
Viscosity <500-5000–7000cSt
Dispersing possible on location with a water depth of > 60 M and more than 1 km from the shore?
(4)
Don't use dispersants
Track oil spill....
Prepare coast for oil pollution
Continue application/ based on effectiveness
Yes
(3)
Apply dispersants only within (calculated) time frame.
Monitor

Explanation decision tree Dutch Caribbean

1. **Mechanical cleaning** of oil in the Dutch Caribbean is the preferred option. This is in line with the principles that are used for the North Sea and the Wadden Sea. The area is large. Therefore mechanical cleaning may not always provide a solution. For instance when the means and capacity are not available in time.

2. **ASA-model**: via the ASA-EDS server available information about current and wind is limited, but it is the best there is available in the short term for the Dutch Caribbean. The reliability of the oilmap-predictions is therefore lower than we take into account for the North Sea/ Wadden Sea. This is an important reason that the total coastline of the islands is regarded as vulnerable. With the ASA-model you can have an indication whether it is probable that an oil spill will hit an island. Off course the quality of the prediction improves the more the slick approaches the island. The use of dispersants in this case (close to the island) will usually not outweigh the disadvantages (dispersed oil on land). These improved predictions however are of importance in order to prepare the areas where the oil will come ashore.

3. **Use of dispersants** within the Dutch Caribbean is, based upon effectiveness criteria, applied more often than in the North Sea. A number of factors determine the successful application. In principle, the conditions do not deviate from the Dutch (European) situation. The water depth and the higher temperature are more favourable. The vulnerability of coastal zones (corals, mangroves) for dispersed oil is probably high. Use of dispersants in these areas should be avoided. Also it should be avoided that dispersed oil can reach these areas in high concentrations.

   For safe use of dispersants, it's important to use a water depth in which the dispersed oil can be absorbed without serious effects on the ecosystem. In the North Sea we use a water depth of 20 meters, in exceptional cases even 10 meters. At this depth, the oil concentration will not reach a toxic concentration (<10 ppm). For the Dutch Caribbean we propose to apply a depth of at least 60 meters (marine park boundary). Reasons for this are: the steep sea floor and the potential vulnerability of coral reefs.
   Besides the criterion of water depth (60 meters), it is also important to apply a certain distance from the shore (shallow zone). The LCM suggests using a distance of 1000 meters from the coast. This is important because it has to be prevented that oil, treated with dispersants, reaches the coast where further dispersion may occur in the most vulnerable zone. In the European Netherlands only class III dispersants are allowed for containment of oil spills under strict conditions. Our proposal is to use only this class of dispersants also in the Dutch Caribbean.
   Dispersed oil, in a high concentration, can have negative effects on fish larvae and coral larvae. Prediction on the occurrence of coral spawning are available online, for 2012: (http://www.researchstationcarmabi.org/news/latest-news/103-coral-spawning-predictions-for-2012-) The use of dispersants in this period (September-October) is not recommended. For small spills the crisis organisation can consider, based on the amount of dispersants, oil type and expected damage when no dispersants are used. There is no information available on the occurrence of fish larvae.

Saba-bank
The Saba Bank is a fragile reef with special economic and ecological value. A part of the Saba Bank is relatively shallow. There are many coral species here. Application of detergent at or near the Saba Bank is likely to cause more damage than would occur when an oil slick is floating over the Saba Bank. Therefore application of dispersant is not allowed. This is reflected in the decision tree.

4. In situations where mechanical cleaning at sea and the use of dispersants, according to the decision tree, are not an option, measures should be taken to mitigate the effects and/or accelerate subsequent cleanup actions. Vulnerable bays or coasts can possibly be temporarily protected with oil booms. For successful mitigation the most vulnerable areas need to be known and obviously means and capacity need to be available. Therefore it requires essential local area knowledge which was gained during the site visit (Annex 1). Alternative control methods and accepting a low effectiveness when nevertheless a dispersant is applied are options in this. This consideration should be made in the operational crisis team. For the final assessment, a Net Environmental Benefit Analysis (NEEBA) can be developed. In this supplementary assessment framework mainly the economic aspects are of interest.

Preconditions for carrying out the recommendation of use of detergents

1. Actions to make the ASA model optimally suited (link wind and current data, enter geo-data, scenario development)
2. Train people to use the model in the Dutch Caribbean
3. The organizational embedding must be in order: agreements so that communication between islands HMCN / CT / WMCN / LCM goes well and it is clear who has which responsibility. Practice realtime scenarios.
4. Area Knowledge (cards, coast, depth, most vulnerable zones) must remain up to date and available
5. Information on oil type, size and location of spill in an emergency must be known. (in preparation for this scenarios can be developed).
6. Information about the possibilities and (timely) availability for use of dispersants: mechanical capabilities and type, quantity and availability of dispersants.

Table 1: Applicability of dispersants with different oil types

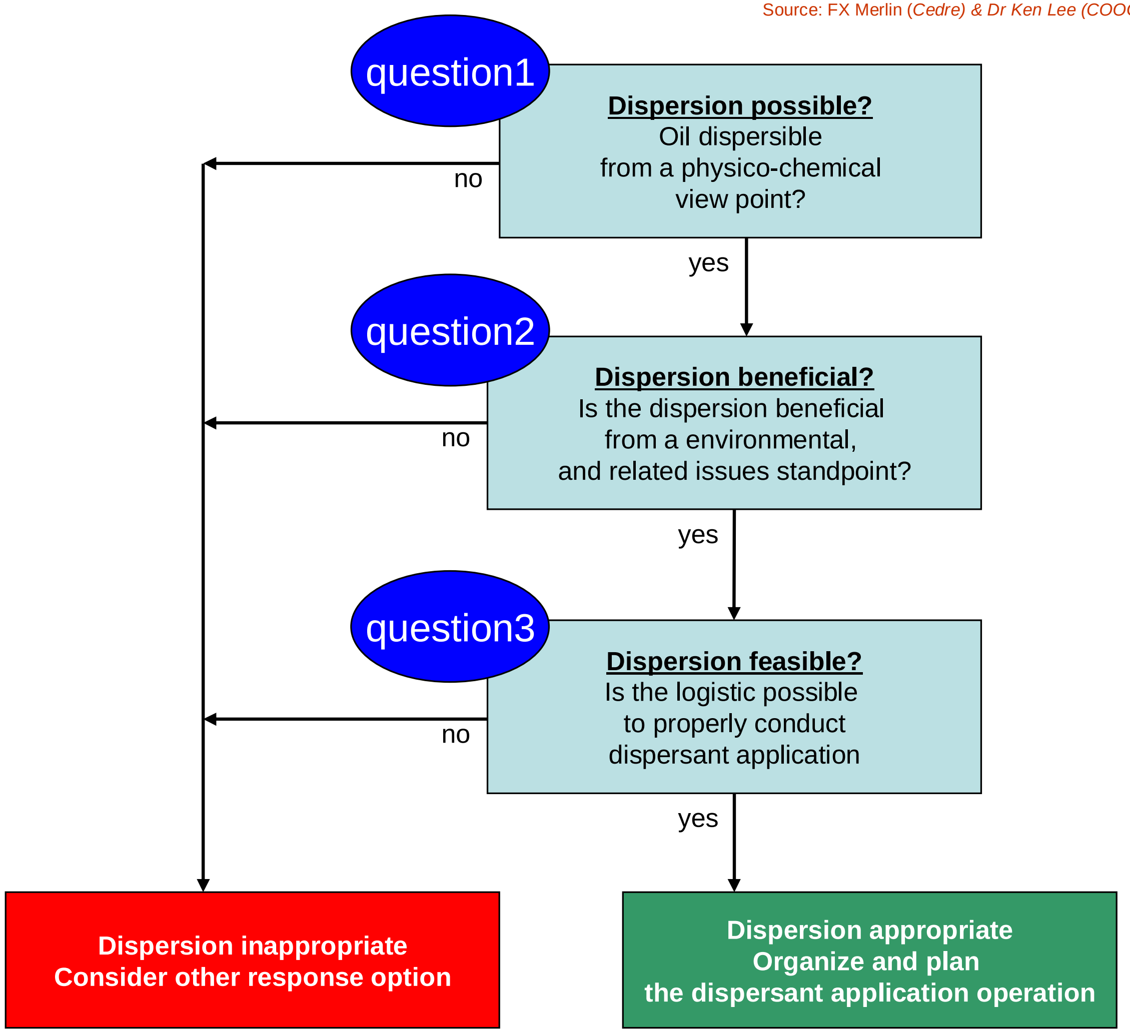
Oil type	DISPERSE?	WHY?
Gasoline	NO	Dispersants would work, but would force toxic components of oil into water column
Kerosene (Jet fuel)	NO	
Marine Gas Oil	NO	
Marine Diesel Oil	NO	
Crude oil (paraffinic)	YES	Until the time "Window of opportunity" runs out
Crude oil (naphthenic)	YES	
Crude oil (asphaltic)	YES	
Crude oil (waxy)	MAYBE	Pour Point?
Hydraulic oil	NO	Refined products should not be dispersed
Lube oil	NO	
IFO-30	YES	Until the time "Window of opportunity" runs out
IFO-80	YES	
IFO-180	YES	
IFO-380	MAYBE	Only at high sea temperature or rough sea
IFO-500	NO	Viscosity too high
IFO-700	NO	

5. Decision tree, IMO Dispersant Guidelines (4 pages)

Lee, K. and Merlin, F. (2012), as reproduced in document “Updating of the IMO Dispersant Guidelines”, Technical Group of the MEPC OPRC-HNS, 14th Session, Agenda item 3, IMO Doc. OPRC-HNS/TG 14/3/2, 6 August 2012

DECISION MAKING PROCESS

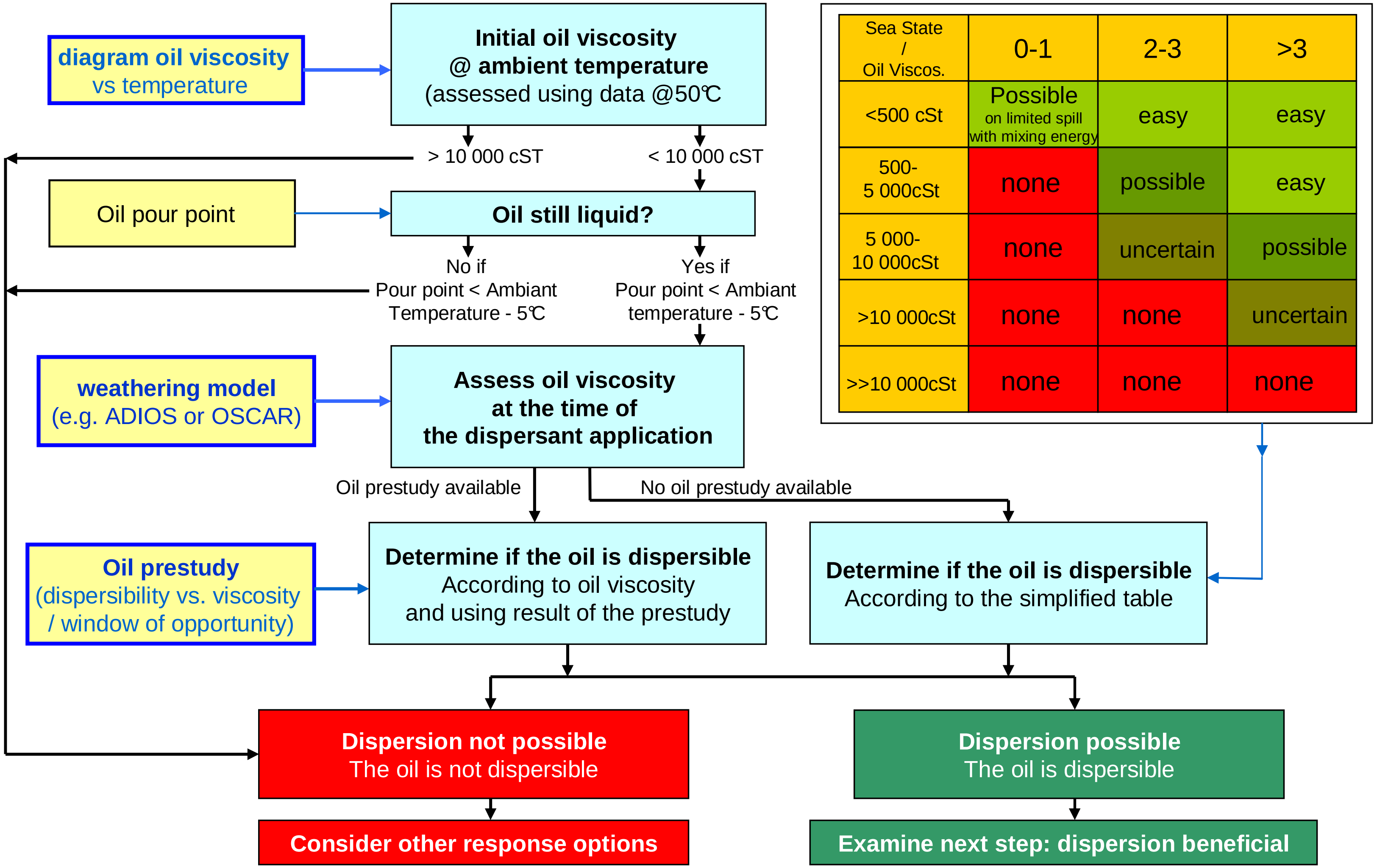
Source: FX Merlin (*Cedre) & Dr Ken Lee (COOGER)*



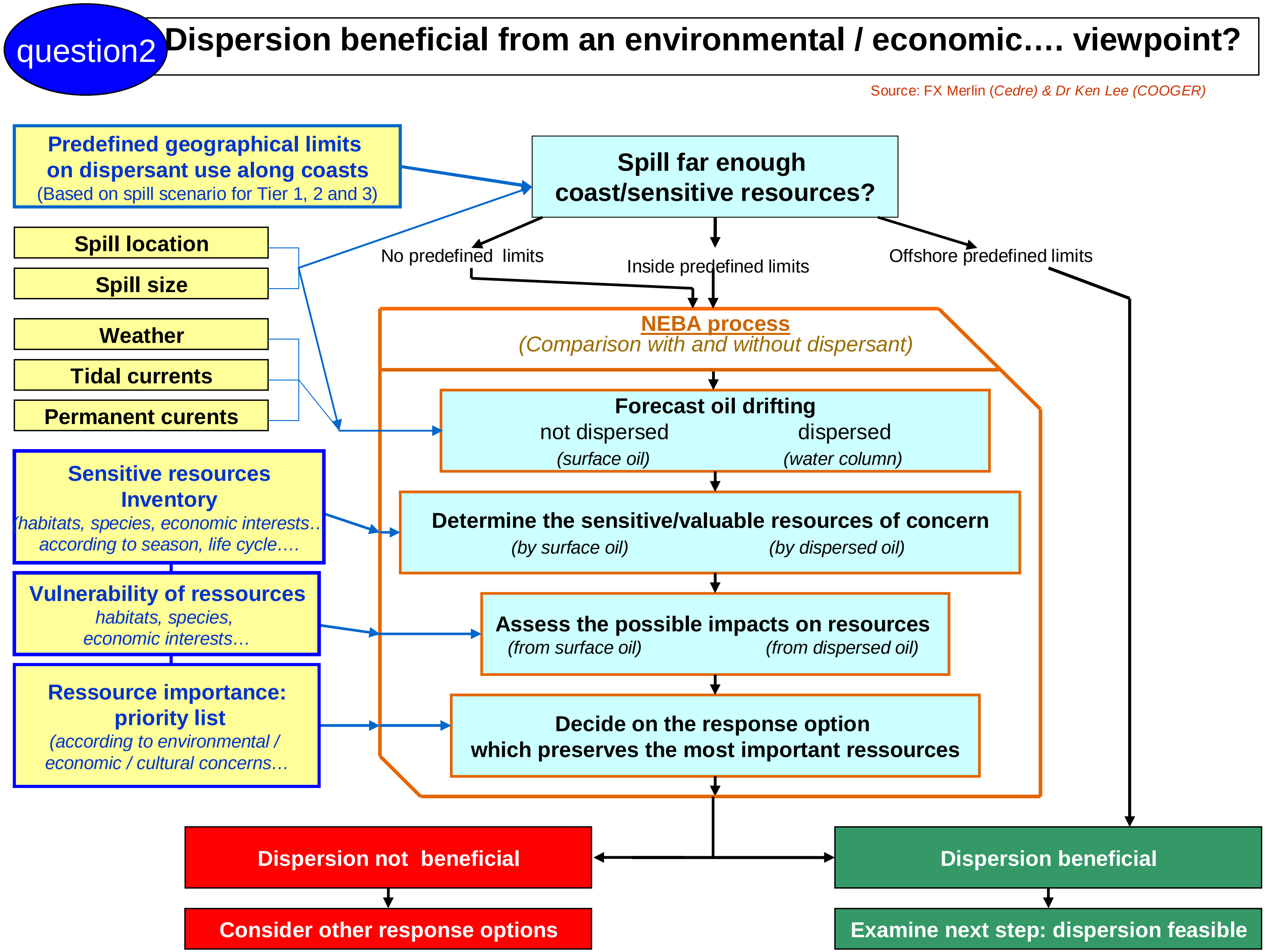
question1

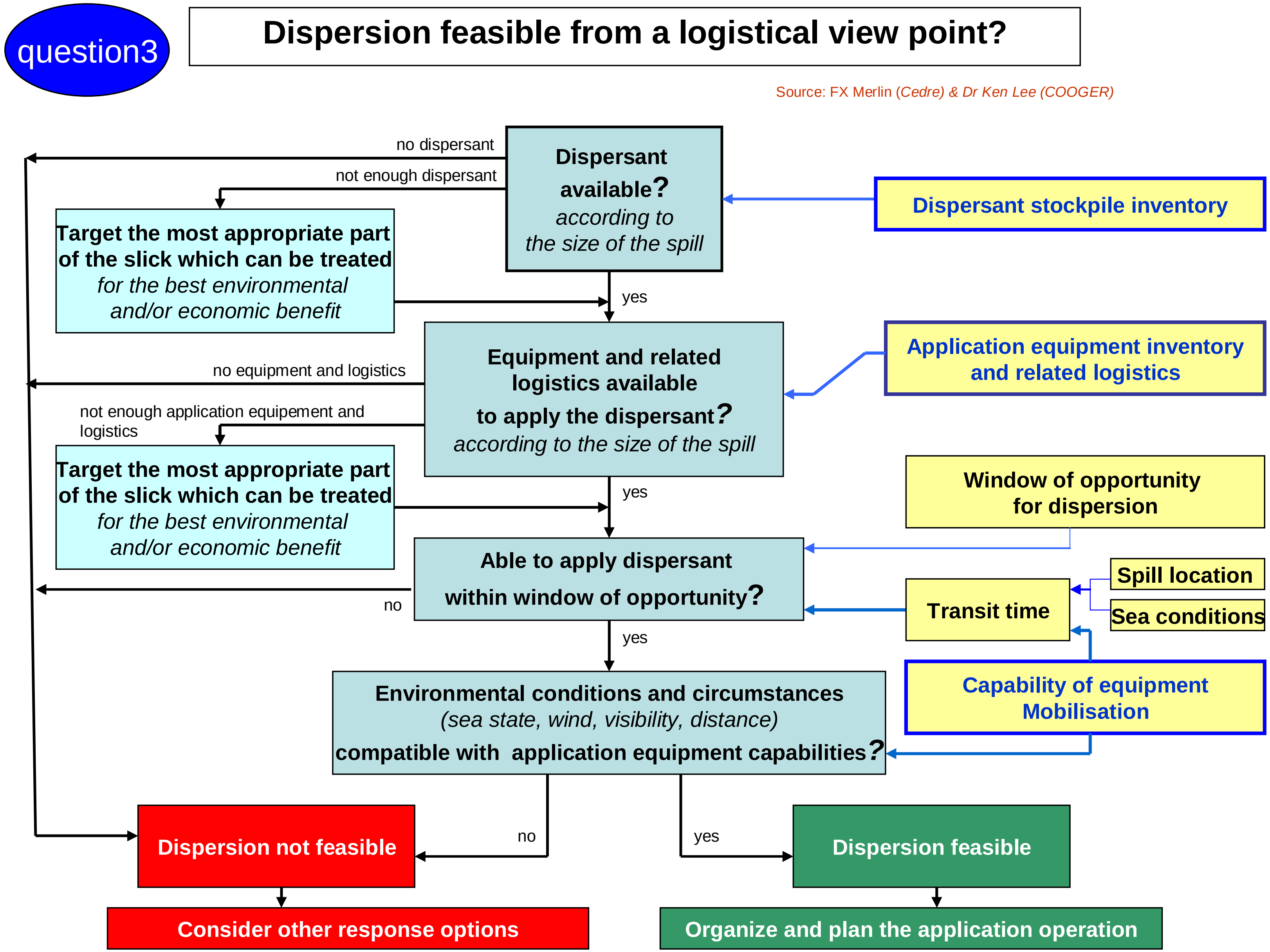
Oil dispersible from a physico-chemical viewpoint?

Source:FX Merlin (*Cedre) & Dr Ken Lee (COOGER)*



Sea State / Oil Viscos.	0-1	2-3	>3
<500 cSt	Possible on limited spill with mixing energy	easy	easy
500-5 000cSt	none	possible	easy
5 000-10 000cSt	none	uncertain	possible
>10 000cSt	none	none	uncertain
>>10 000cSt	none	none	none


question2
Dispersion beneficial from an environmental / economic…. viewpoint?
Source: FX Merlin (Cedre) & Dr Ken Lee (COOGER)
Predefined geographical limits
on dispersant use along coasts
(Based on spill scenario for Tier 1, 2 and 3)
Spill far enough
coast/sensitive resources?
Spill location
Spill size
Weather
Tidal currents
Permanent curents
No predefined limits
Inside predefined limits
Offshore predefined limits
NEBA process
(Comparison with and without dispersant)
Forecast oil drifting
not dispersed
(surface oil)
dispersed
(water column)
Sensitive resources
Inventory
(habitats, species, economic interests…
according to season, life cycle….
Determine the sensitive/valuable resources of concern
(by surface oil)
(by dispersed oil)
Vulnerability of ressources
habitats, species,
economic interests…
Assess the possible impacts on resources
(from surface oil)
(from dispersed oil)
Ressource importance:
priority list
(according to environmental /
economic / cultural concerns…
Decide on the response option
which preserves the most important ressources
Dispersion not beneficial
Dispersion beneficial
Consider other response options
Examine next step: dispersion feasible


question3
Dispersion feasible from a logistical view point?
Source: FX Merlin (Cedre) & Dr Ken Lee (COOGER)
no dispersant
not enough dispersant
Dispersant available? according to the size of the spill
Dispersant stockpile inventory
Target the most appropriate part of the slick which can be treated for the best environmental and/or economic benefit
yes
Equipment and related logistics available to apply the dispersant? according to the size of the spill
Application equipment inventory and related logistics
no equipment and logistics
not enough application equipement and logistics
Target the most appropriate part of the slick which can be treated for the best environmental and/or economic benefit
yes
Window of opportunity for dispersion
Able to apply dispersant within window of opportunity?
no
Spill location
Transit time
Sea conditions
yes
Capability of equipment Mobilisation
Environmental conditions and circumstances (sea state, wind, visibility, distance) compatible with application equipment capabilities?
no
yes
Dispersion not feasible
Dispersion feasible
Consider other response options
Organize and plan the application operation

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