Iceland's policy regarding the use of dispersants in Icelandic waters

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Abstract

The purpose of responding to oil pollution is to reduce the damage that such pollution can cause. The damage can be ecological, such as to seabirds and vulnerable habitats, or economic, such as to fisheries or tourism. Under certain circumstances, the use of dispersants is one of the best ways to respond to oil pollution. The Icelandic government has not approved a policy on the use of dispersants in response to oil pollution in the country's pollution jurisdiction, but if such a policy does not exist, the time window for the use of dispersants may pass before their use can be permitted. The policy decision to use dispersants is based on the information decsrribed and explained below.According to MARPOL Annex 1, states should have such a national policy, and in an audit carried out by the IMO (IMSAS) in 2019, Iceland received a finding as such a policy on the use of dispersants in Iceland's pollution jurisdiction had not been adopted. The Environment Agency proposes that Iceland build up certain stocks of dispersants and dispersing equipment and that criteria be set for the properties of the dispersants that can be used.

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1. Preamble

The purpose of responding to oil pollution is to reduce the damage that such pollution can cause. The damage can be ecological, such as to seabirds and vulnerable habitats, or economic, such as to fisheries or tourism. The use of dispersants is one of the best ways to deal with oil pollution in certain situations.

Iceland is a party to the Copenhagen Agreement, which is an agreement between all the Nordic countries on assistance for acute pollution within the pollution jurisdiction of the Member States and the MOSPA Agreement (*Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, MOSPA*), which is an agreement between the Arctic States on aid for acute pollution within the pollution jurisdiction of the Member States. MARPOL, Annex I provides that states shall have a national policy on the use of dispersants, and in an audit carried out by the IMO (IMSAS) in 2019, Iceland received a finding as such a policy on the use of dispersants in Iceland's pollution jurisdiction had not been adopted.

The Emergency Prevention, Preparedness and Response (EPPR) Working Group was established under the auspices of the Arctic Council in 1991. The Working Group commissioned an assessment of what methods were best used for responding to oil pollution in the Arctic, based on available information on weather and other conditions in the sea. The results were published in a report, Circumpolar Oil Spill Response Viability Analysis (https://www.bsee.gov/sites/bsee.gov/files/2017-circumpolar-oil-spill-response-viability-analysis.pdf). According to the results of the IMO audit, the use of dispersants is, in many cases, the best option in responding to oil pollution and gives the best results (https://maps.dnvgl.com/cosrva/map.html).

The aim of the policy is to ensure that the use of dispersants reduces the potential damage from oil pollution, and to prevent increased environmental damage with such use.
In order for the use of dispersants to be purposeful and effective, a process must be in place for how the decision on the use of dispersants is made. Such a process must consider the potential overall impact that the use of dispersants would have on the environment compared to other methods. It must also be considered that the time that dispersants work effectively after an accident can be very short. One of the most important aspects of this process is to have access to a sensitivity and response map that shows, among other things, main currents, sensitive coastlines, spawning grounds, and shellfish farms.

Dispersants do not dissipate oil but dissolve it down into small droplets in the ocean. During dissolution, the surface of the oil increases, which facilitates the access of microorganisms and thus accelerates its biodegradation. Until sufficient dilution of the oil droplets is achieved, their amount in the pelagic habitat can be so large that animal and plant life can be significantly adversely affected.

This policy is based on guidelines from EMSA (European Maritime Safety Agency) and Norway's policy on the use of dispersants during oil spills. The policy describes the nature of dispersants and the main factors to be considered when deciding whether, where, and when it is justifiable to use dispersants in response to acute pollution.

2. Definitions

Dispersants: Substance (e.g., soap) that dissolves oil floating on water/the sea. The dispersant accelerates the dissolution of oil film into small droplets, thus increasing both the surface of the oil in contact with the water phase and dilution into the pelagic habitat, thus accelerating the decomposition of the oil.

Chemical dissolution: Dissolution of oil with dispersants. A much higher proportion of droplets (<0.1 mm) is formed with the use of dispersants than with natural dissolution processes. Then the number of oil droplets in the aqueous phase increases, and consequently, the surface of the oil in contact with the aqueous phase, which makes it easier for bacteria to break it down.

Toxicity: Harmful effects of substances on humans, animals, or other organisms in the ecosystem.

Solvents: The part of the dispersant that keeps the surfactants dissolved, reduces the viscosity, and ensures that the dispersant can be sprayed so that the surfactants come into contact with the oil.

Natural dissolution: Oil that mixes into the pelagic habitat as droplets of different sizes up to 1 mm in diameter due to wave action (> 5 m / s wind). The smallest droplets remain in the body of water mass due to their low buoyancy.

Emulsifying agents, surfactants: An active component of a dispersant that lowers the surface tension between oil and water and thus contributes to the oil forming small droplets that mix into the pelagic habitat.

Emulsion: Steady, viscous mass of oil (especially heavier oil) and water, which decomposes very slowly. An emulsion is formed by mixing water droplets into an oil slick due to wave action. The water droplets in the emulsion are usually 1-50 µm in diameter, and the proportion of water in the emulsion is 30% to 80%, depending on the type of oil.

Weathering: Physical and chemical changes in oil which is released into the environment. The factors involved in weathering include evaporation, dissolution, whipping, and oxidation.

3. Development of dispersants

All dispersants consist of surfactants and solvents, but there are differences between different generations and types of dispersants. The dispersants used today have been in development for several decades. These developments have led to a much better understanding of the essential properties and efficacy of the substances, and their toxicity has been reduced.

Dispersants can be divided into three generations. The first generation consisted of so-called industrial soaps that were used, for example, in cleaning machines or vehicles. Substances of this generation were used extensively in response to the Torrey Canyon oil spill on the southwest coast of Britain in 1967 but were later found to cause more damage to nature than the oil that went into the sea at the time of the accident. Subsequently, a new generation (second generation) of dispersants was developed, especially for the purpose of use in fighting oil spills. These dispersants are based on organic solvents but have much less toxicity effect on the marine environment than the first generation of dispersants. In the United Kingdom, these

second-generation materials were called "UK Type 1" dispersants. Dispersants of the "UK Type 1" are sprayed directly onto the oil slick without dilution, and it is recommended to use one part of the dispersant against 2-3 parts of oil.

The third generation of dispersants was developed in the seventies and solved problems with the transport of the substances, as the second generation of dispersants took up a lot of space in transport. Concentrates were also produced, also called water-soluble dispersants, which are diluted with seawater at the same time that they are sprayed. These substances are called "UK Type 2" dispersants, and the typical dilution is nine parts seawater versus one part of concentrate.

Water-soluble dispersant concentrate is not suitable for spraying with airplanes or helicopters. Therefore, dispersant concentrates have been developed, which are sprayed undiluted. Such a concentrate is called a "UK Type 3" dispersant. Today, these are the most common dispersants, and one part of the dispersant can be used against 10-50 parts of oil, depending on the properties and weathering condition of the oil. Compared to "UK Type 2" concentrates, "UK Type 3" concentrates are much more effective at dissolving viscous oil and emulsion. Three types of dispersants exist today:

- Second generation standard (UK Type 1) dispersants that can be useful in minor coastal clean-up operations.
- Third generation seawater-diluted concentrate (UK Type 2) that can be sprayed from boats or ships.
- Third generation extract (UK Type 2 and 3) that can be sprayed from airplanes, helicopters, and ships.

Today, only second- and third-generation dispersants are used. Further information on the content of these dispersants can be found in the supplementary material in the accompanying document.

4. Functionality and types of dispersants

The purpose of using dispersants is to dissolve oil on the surface of the sea into small droplets, which then mix into the pelagic phase and consequently enable bacteria to break down the oil.

Oil dissolution is a natural process caused by wave motions. If natural dissolution were always 100%, an open ocean oil slick would, in most cases, dissolve before reaching land. However, this is not the case. The reason is that natural dissolution slows down and eventually stops as the properties of the oil change due to weathering.

The active ingredient of dispersants is so-called surfactants. Such substances change the physical and chemical nature of the oil so that the resistance to the formation of small oil droplets (surface tension) is greatly reduced (Figure 1).

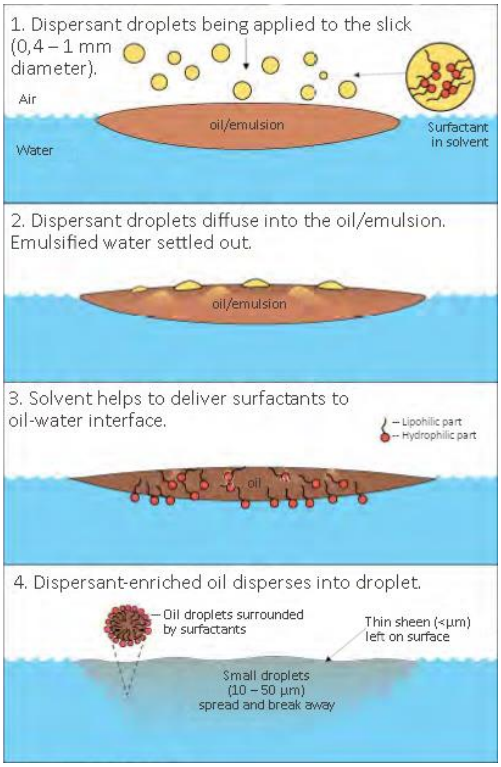

Figure 1: The action of dispersants

5. Environmental impact of dispersants

There is a wealth of information on the toxicity of dispersants from standard experiments in real-world laboratories. These standard test methods have demonstrated relatively low toxicity of the dispersants themselves, much less than the oil that they are used for dissolving. This is very important because dispersants do not dissipate the oil but only allow it to mix with the water mass. The polluting effects of the dispersants themselves are, in fact, added to the effects of the oil and can thus increase the negative effects on the ecosystem.

According to the results of studies on the toxicity of mixtures of oils and dispersants carried out in laboratories, the use of dispersants does not have a significant effect on the embryos of marine organisms and larvae if the oil concentration in the aqueous phase is lower than 5-10 ppm. Less is known about tsuch effects in nature, but observations have not shown significant changes in the stock size of fish in connection with the use of significant amounts of dispersants in the open ocean.

Information on pollution site conditions, such as currents, water depth, and distance from sensitive sea areas and coasts, is important when deciding on the use of dispersants. Based on this information, it is often possible to roughly estimate the maximum concentration of dispersants/oil in the water mass, whether the mixture enters a sensitive area and how long it takes for the oil to dissolve and dissipate. In areas where thinning is rapid, such as in the open ocean, it is unlikely that high concentrations of dispersant/oil will be present except for a short time, and therefore no appreciable/lasting effect on the ecosystem is expected.

It is necessary to assess the impact of not taking action and let nature itself take care of the breakdown of the oil and compare it with what the impact would be on the environment if other methods were used (e.g., oil absorption with special equipment or the use of dispersants). It is necessary to assess the effect on the environment as a whole and not to focus on individual items, such as the effect on fish or a bird. It is important to objectively assess the advantages and disadvantages of different measures and examine their consequences (see the section on risk assessment). Table 1 shows an overview of the main advantages and disadvantages of using dispersants.

Table 1: Advantages and disadvantages of using dispersants to accelerate the natural decomposition

Advantages	***Disadvantages***
Less harmful effects on seabirds and other marine organisms that live on the surface	May cause toxicity to marine organisms due to increased oil concentration in the aqueous phase
Less detrimental effect on the natural resources of coastal areas and beaches	May cause toxicity to marine organisms due to increased oil concentration in the aqueous phase
Increased biodegradation of oil where it dissolves but does not act as an oil film on the surface of the sea or on the beach	Not necessarily effective on all types of oil (e.g., heaviest bunker oils and oils that solidify at 10 – 15°C (above sea temperature))
Short response time	Reduced efficiency of highly weathered oil - limited time window
Less possibility of formation of water-in-oil emulsion	Restrictions on use

6. Safety

It is necessary to ensure the safety of employees and those who intend to use dispersants. Proper use of protective clothing and other safety equipment and following the safety instructions can reduce the risk of personal injury. Table 2 lists the main factors that need to be considered.

Table 2: Based on a table in the "Dispersant Application Field" from Oil Spill Response Limited (OSRL)

	Hazard	Effect	Mitigation measures
General	Contact with dispersants	Risk of contact with eyes. Danger if inhaled or swallowed.	Make sure that unauthorized persons are not in work area. It must be ensured that those workin spraying are positioned downwind to reduce the of contact with the dispersant.
	Noise (85-90dBA)	Risk of hearing damage when using loud equipment for a long time.	Personal ear protectors should be worn.
	Manual handling	Risk of back injury or other injuries.	Before handling dispersants, those involved in spraying should be trained. It must be ensured that the weight is clearly marked on the packaging and that lifting equipment is available, where appropriate.
	Slip, trip, and falls	Risk of minor accidents such as cuts, scratches, and minor fractures.	Appropriate footwear should always be worn. A handrail should be used where appropriate Hygiene and cleanliness reduce the risk of accidents.
	Exposure to Volatile Organic Compounds (VOCs)	No or little impact on ecosystems and environment. Possible effects on human health.	Controlled access. Gas meters and appropriate personal respiratory protective equipment must be provided.

You can reduce the risk of accidents by:

Identify the risks and implement mitigation measures.

To review the risks and mitigation measures with the person concerned before implementation.

It is essential that everyone involved in dispersant operations wears the proper protective equipment. If there is a risk of responders coming into contact with the dispersants, ensure that appropriate equipment is used.

7. Spraying of dispersants

A national contingency plan for responding to acute pollution outside of harbor areas and using places of refuge for ships deals with how to respond to incidents at sea concerning ships in the

Icelandic EEZ that are a threat to maritime safety or are at risk of causing environmental damage. The contingency plan is a joint instrument of the Environment Agency of Iceland, the Icelandic Coast Guard, and the Icelandic Transport Authority. It is intended to ensure smooth procedures and implementation of emergency pollution response.

According to the national contingency plan, the Environment Agency of Iceland is responsible for responding to acute pollution outside of harbour areas and the implementation is in collaboration with the Icelandic Coast Guard.

Spraying of dispersants is carried out with ships/boats, airplanes, and/or helicopters. Today, there are no specialized spraying devices in Iceland, but if dispersants are to be used in Iceland, measures must be taken regarding the necessary equipment. It should be noted that even if there are no specialized devices for spraying dispersants, devices made for other uses can be used. For example, the Coast Guard Ship Þór has tanks that can be used for mixing dispersants and be connected to the ship's firefighting water cannons. Their range from the vessel is about 120 meters in the best conditions. The tugboat Magni, owned by Faxaflói Associated Icelandic Ports, has the same equipment on board, as does a tugboat owned by Port of Akureyri.

It is not possible to equip the Icelandic Coast Guard's helicopters so that the dispersants can be sprayed, as this would require specially designed helicopters. The Icelandic government can request assistance in providing equipment and materials through the Copenhagen Agreement, EMSA (European Maritime Safety Agency), or the Arctic Convention on Cooperation and Response to Marine Oil Pollution in the Arctic (*MOSPA*). In order to be able to request such assistance, it must be clear what substances the Icelandic government has approved for use within the Icelandic pollution jurisdiction.

8. Risk assessment regarding the use of dispersants

The risk assessment aims to assess the total impact concerning positive and negative factors resulting from different response measures. The assessment should cover possible damage to marine resources, including fishing and shellfish farming, and other natural resources on and off the coast. The socio-economic impact and indirect financial consequences of oil pollution also need to be assessed. This is done to prioritize what needs to be protected in the area where the pollution is located. Initially, one should always evaluate what the damage would be if nothing were done.

Although accurate forecasts are impossible, the likely effects of oil pollution can be assessed using expert knowledge of the ecosystem and other environmental conditions at the site in question. The aim is not to gather new information but to provide as soon as possible the best possible overview of all damage that could occur based on the available information. In some cases, the use of dispersants has an overall benefit for the environment by preventing oil from drifting ashore, polluting vulnerable habitats, and harming species living in coastal habitats. In other cases, the opposite can be the case, so the dissolution of oil with dispersants causes more damage to the ecosystem than would be the case without their use.

Time will always be a key factor in the choice of response to oil pollution, both because of weathering, which changes the properties of the oil, and because the time for action is scarce when a pollution accident has occurred. Therefore, a risk assessment for sensitive areas should

be available to avoid unnecessary delays in decision-making and the implementation of mitigation measures.

In the overall environmental impact analysis, emphasis is placed on weighing the risk of adverse effects on marine organisms due to increased oil concentration in the pelagic habitat against the fact that oil will not drift into shallow waters or shores to cause damage. An example would be the possility of seabirds being immersed in the oil slick.

It has to be taken into account that a relatively small dilution can be expected in shallow waters and that the oil can contaminate the sediment before it dissipates. Therefore, the use of dispersants in such situations is generally not recommended. Nevertheless, it might be justified if it results in less damage to another and even more sensitive or valuable coastal area.

The risk assessment takes into account the natural resources that may be damaged by oil pollution, and their location is shown on a sensitivity and response map.

According to the contingency plan, decisions on operations outside of harbor areas are taken after assessing the situation on a case-by-case basis, based on the information on the sensitivity and response map, currents, water depth, etc.

Every year, port authorities submit a response plan to the Environment Agency of Iceland that contains a risk assessment for the relevant port area.

8.1 The following should be considered before using dispersants

The advantages and disadvantages of different responses to oil pollution need to be assessed. This assessment must take into account various practical aspects such as the transport of the necessary equipment to the site and the personnel to use it.

Always consider the following points before deciding on the use of dispersants:

- Is it necessary to take action given the probable damage caused by the oil pollution? Is it enough to pay close attention to and monitor the oil pollution, for example, from the air, at this stage? What would be the consequences of doing so?
- If local conditions limit the possible response, can we wait until the oil pollution drifts ashore and clean up the beach? The possible damage should be considered.
- Although it is generally best from an ecological point of view to recover the oil with oil recovery equipment, an assessment of its feasibility must be made available as soon as possible. Such an assessment must take into account, among other things, the following factors:
  - Is it possible to get enough equipment (booms and skimmers)?
  - Is it possible to ship the equipment to the site?
  - Is it possible to acquire equipment from other sources and in time for it to be put to good use before the oil drifts ashore?
  - Where will the recovered oil be stored and/or disposed of?
  - To which extent does the operation reduce the estimated damage?
  - Recovering a small proportion (e.g., 20%) of the oil that was spilled can have minimal effect on the environmental impact; A 4 cm layer of oil on the beach

hardly causes less damage than a layer that is 5 cm thick. Should the emphasis be on the absorption of oil?

- Is it possible to spray dispersants on-site? Would dispersants have effect on the oil that was spilled?
- Will the local ecosystem be severely affected by dissolved oil? Would the use of dispersants prevent the oil that was spilled from affecting particularly sensitive resources, such as mudflats and baylands?

An assessment of these issues needs to be available very soon. Response to oil pollution is an emergency response, not a theoretical exercise. Although a variety of expertise needs to be utilized in the assessment, not all questions need to be answered with great precision, but realistic estimates of the likely consequences of response measures need to be made to reach a realistic conclusion. Responses that minimize the damage - compared to no response - are the right ones.

It should be emphasized that the circumstances are never such that the use of dispersants is a matter of course, but there must always be a choice between methods with regard to the impact on the environment. Doing nothing is also a decision to respond to acute pollution. As a first approach in deciding whether to use dispersants, it is useful to use the following basic criteria:

Dispersants should not be used in very shallow water, i.e., if the depth is less than 20 meters, where dissolved oil enters the sea sediment and thus oil in relatively high concentrations will come into contact with benthic fauna (especially organisms living in clay and sediment) and vegetation.

Dispersants should not be used directly above shellfish habitats as filter feeders such as shellfish can absorb oil droplets.

Dispersants should not be used directly over coral reefs, sensitive seaweed, or spawning grounds, as these areas can be very sensitive to oil pollution.

Due to the increased risk of deteriorating product quality, it is not recommended to use dispersants in the vicinity of aquaculture, shellfish farming, or in shallow waters where fishing is practiced.

It is not advisable to use dispersants near the water inlets of industrial companies, especially if they are protected by fences, as the fences do not contain dissolved oil.

Any decision to use dispersants should be based on the conclusion that the use of dispersants will reduce the overall negative impact of the pollution under the prevailing circumstances when making the decision. This requires a realistic assessment and comparison of the advantages and disadvantages of using dispersants with other available response measures.

9. Implementation of the policy

The Environment Agency of Iceland adopts the government's policy for the use of dispersants within the Icelandic pollution jurisdiction. The policy states that the use of dispersants must be permitted to respond to oil pollution in the sea, provided that certain conditions are met, following a risk assessment. The Environment Agency of Iceland will develop criteria stating the properties that the dispersants must meet in order to be allowed to be used within the Icelandic pollution jurisdiction.

The Environment Agency of Iceland will establish certain stocks of dispersants and ensure access to equipment for their use in response to acute pollution outside of harbor areas, as appropriate.

This policy on the use of dispersants within the Icelandic pollution jurisdiction is confirmed by the Ministry of the Environment, Energy and Climate.

The implementation and responsibility of the policy are the responsibility of the Environment Agency of Iceland.