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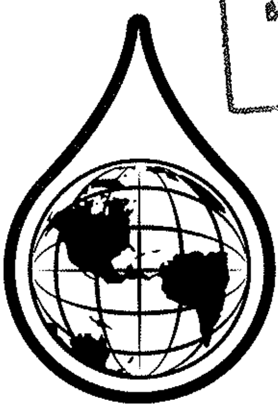
Information Bulletin



Oil Spill Dispersants

A discussion of the chemistry, uses, advantages and disadvantages of oil spill dispersants.

Canada

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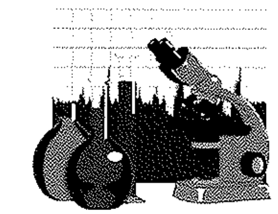
Introduction

Because of its ubiquitous presence in our society, and the scale of its production and use, oil enters the environment, and particularly the marine environment, through a number of routes and from a multitude of sources. These include industrial discharges and urban runoff from the land, natural seeps, atmospheric fallout and offshore exploration and production activities. Oil pollutes the seas as a result of routine tanker and vessel maintenance operations as well, but the most dramatic of all sources, those that capture the attention of the media and the public, are accidents that occur when oil tankers run into trouble, releasing huge amounts of oil into the ocean environment.

To reduce the potential and actual impacts on the environment, several cleanup and removal strategies are available. These include monitoring the spread of oil with the intent of allowing it to be removed naturally, containment and recovery of the oil by mechanical means; burning it in-situ, and treating it with chemicals known as oil spill dispersants.

This booklet addresses oil spill dispersants, what they are, how they work, why, where and when they may be used, as well as their effects on the environment. However, to more fully understand the various aspects of dispersant chemicals, it is necessary to understand some of the basic properties of crude oil and its refined products.

Properties of Oil

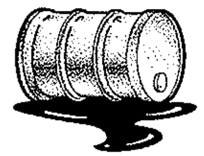


Crude oils are extremely complex mixtures of hundreds of different components, mostly hydrocarbons, with varying and relatively small amounts of sulphur, nitrogen, oxygen and metal compounds. As a result, each crude oil differs from every other to a greater or lesser degree, and their properties vary accordingly. For example, some crude oils possess a higher percentage of "lighter", gasoline-like fractions, and may be relatively fluid and volatile, while others have a higher concentration of heavier fractions, and are thicker and more viscous. In any event, certain of these properties will influence decisions on whether or not to use dispersants, and whether or not their use will be successful. These include, among others, the specific gravity, the boiling point, the surface tension, the viscosity, the pour point, and the solubility.

The **Specific Gravity** is a measure of the weight of a particular oil relative to that of water, which has a specific gravity of 1. If an oil has a specific gravity less than 1, it will float on the sea surface. Freshly spilled crude oils will generally float on water because the light fractions have not evaporated. However, as the spill ages the physical and chemical properties of the oil change as the oil undergoes a process known as weathering, in which the lighter fractions either evaporate or dissolve into the water column. Indeed, it has been estimated that in the first hours after a spill, as much as 25% of many light crude oils will be lost through evaporation, while up to 40% of most crude oils evaporate in the first three to four days. As evaporation continues, the oil becomes thicker and heavier and its specific gravity increases, sometimes to the point where the oil will actually submerge and float beneath the water surface.

The **Boiling Point** is the temperature at which each of the various hydrocarbon fractions in the crude oil will evaporate. Since some of the lighter fractions evaporate at temperatures less than 20° Celcius, the boiling point may be an important factor in the process of evaporation, particularly if the spill occurs during the heat of summer.

Viscosity is a measure of the ease with which oil will flow - the higher the viscosity, the less fluid the oil. Thus, heavily weathered crude oil will be more viscous and spread less readily than fresh, relatively unweathered, and therefore lighter crude oils. The viscosity will also be affected by the ambient temperature, decreasing as the temperature increases.



Surface tension refers to the forces that attract the molecules at the surface of a liquid. The lower the surface tension, the weaker the attractive forces will be, and the easier the liquid will spread. Spilled oils with a higher surface tension will spread less rapidly than those with a lower surface tension. Other factors, such as the viscosity and the ambient temperature, will also influence the rate of spreading. In general, surface tension increases with decreasing viscosity and increasing temperature.

The Pour Point is the lowest temperature at which oil will readily flow. Below the pour point, oil behaves essentially as a solid.

The **Solubility** is a measure of how much oil will dissolve in another fluid. The solubility of oil in water is generally very low. Nevertheless, it is an important consideration when determining cleanup options such as the use of dispersants, since some of the lighter components of the oil can be extremely toxic to organisms in the water column.

What Are Dispersants?

Although formulations for oil spill dispersants have changed appreciably since their early use, the basic structure of dispersants remains the same. In general, they consist of one or more surface-active agents (surfactants) which contain components that exhibit both hydrophilic (water loving) and oleophilic (oil loving) properties. Dispersant formulations also generally contain a solvent which allows the dispersant mixture to be applied evenly to the oil slick. In order for dispersants to be effective, they have to contact as much of the oil as possible, and it is here that the solvent base becomes important. In addition to providing the liquid in which the surfactant is dissolved and ensuring a medium for uniform spraying of the dispersant, the solvent also allows the surfactant to dissolve more easily into the oil itself, thus considerably enhancing the effectiveness of the dispersant.

Almost all of the early "first generation" dispersants were in fact merely degreasing agents developed to clean the tank compartments in oil tankers. Most of these "detergents", as they were then called, consisted of highly toxic hydrocarbon-based solvents such as kerosene, mineral spirits or naphtha, as well as surfactants that were essentially non-biodegradable.

In tests to determine the toxicity of these early dispersants, it was found that all of them were highly toxic to marine life. In spite of this, they continued to be used to clean oil from recreational beaches on the premise that while some animals and plants would die, and others might be adversely affected to varying degrees, clean beaches were a higher priority.

One of the most significant events in the history of dispersant use occurred in 1967, when the tanker Torrey Canyon grounded off the south west coast of England. Over 100,000 tonnes of crude oil spilled into the ocean in what was then the greatest oil spill from a single vessel. In an attempt to protect the recreational beaches and to preserve the tourism industry, more than 11 million liters of detergents were sprayed on the oil; both on the open water and the shoreline in the two weeks following the accident. In spite of the enormous quantities of dispersants used, considerable quantities of oil remained undispersed, and extensive ecological damage resulted from the use of these highly toxic chemicals.

The devastating environmental impacts associated with dispersant use in the Torrey Canyon spill led to extensive research on the development of new and much less toxic formulations. In the "second generation" dispersants the solvent base contains none of the more toxic aromatic hydrocarbons previously used as solvents. About 15 - 20% of the formulation consists of a low toxicity surfactant that, unlike the previous generation, is biodegradable. These dispersants constitute one of two basic types that are in use today. The other type consists of concentrates. These dispersants generally have an alcohol or glycol solvent base, with a higher percentage of surfactants than the more conventional formulations. Research and development continues to this day, and dispersants with toxicities up to 30 times lower than those used during the Torrey Canyon oil spill are now available for use.

How do Dispersants work?

When crude oil is spilled at sea, unless the oil is a very heavy crude, it will almost immediately spread into a slick on the water surface. The spread of the oil will depend on a number of forces, including the strength of the wind and currents, the ambient temperature, gravity flow, the surface tension of the water, and the viscosity of the oil. Spreading slows with the passage of time.

However, not only will the slick spread and move with wind, tide and currents, but the wave and wind action at the sea surface will break up some of the oil into droplets of varying sizes. Oil itself contains natural surfactant components, which may also contribute to droplet formation and stabilization. These droplets and the body of the slick itself will begin to undergo changes as the processes of weathering begin to take their toll. In effect, the oil will disperse naturally, to a greater or lesser extent, depending on the type and properties of the oil.

The use of oil spill dispersants is a method of enhancing both the natural rate and extent of oil spill dispersion.

Oil spill dispersants accomplish this in much the same way as laundry soaps break down the grease and oil stains on our clothes. In fact, in the early days, oil spill dispersants were known as oil spill detergents.

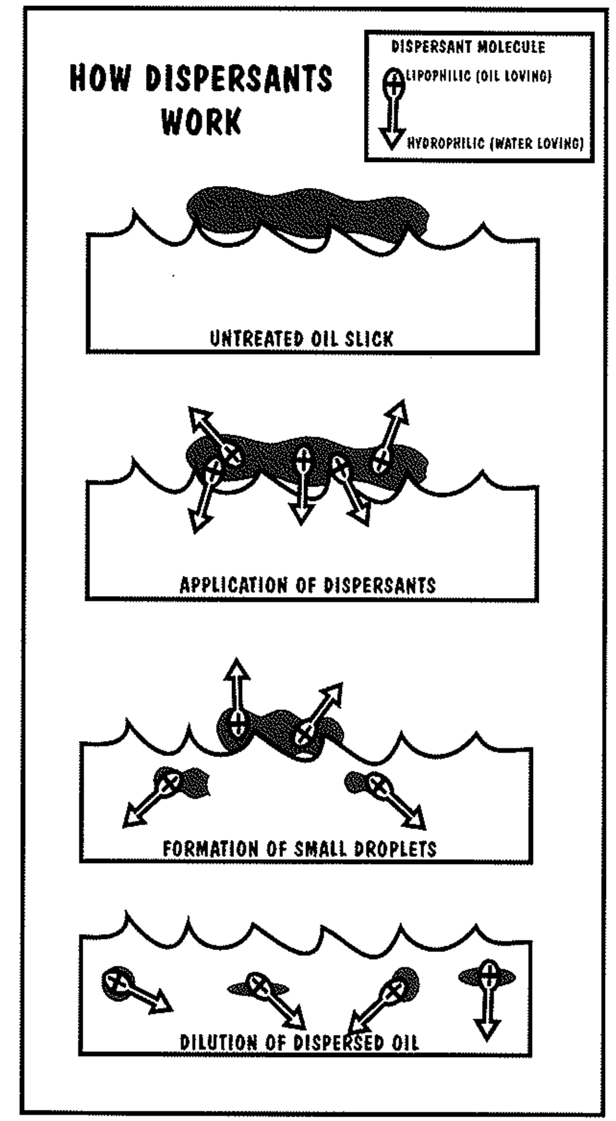
As noted before, the most important constituents of a dispersant are the surface-active agents, or surfactants, with their combination of molecules that have a specific affinity for either oil or water.

Once they have contacted and penetrated the oil, the surfactants begin to work.

Most of the action takes place at the interface where the oil and water meet. The water loving (hydrophilic) part of the surfactant molecule is attracted to the water phase, while the oleophilic portion is attracted to the oil phase. As a result, the interfacial tension between the oil and the water is diminished. When a mixing force, which may be from wave energy or mechanical means or both, is applied, the oil slick is broken up into finely dispersed oil droplets.

Because of the particular nature of the surfactants, they stabilize the oil droplets

once they are formed, and prevent them from coalescing again to form another slick. The figure below illustrates the way in which chemical dispersants act to disperse an oil slick.



Although we know a great deal about dispersants and how they work, a lot of this information has been obtained as a result of research conducted in laboratories and, less often, in trials carried out at sea. As noted previously, there are many factors which influence the dispersion of oil at sea, including the properties of the oil itself, the physical and chemical characteristics of the dispersants used, the manner in which the dispersants are applied, as well as the incredibly varying conditions of weather and sea state. All of these interact in complex ways to affect the way in which the oil is dispersed. The cause and effect relationships at work in these processes are not well understood, and more effort is needed to examine what actually happens when oil, water and dispersants interact.

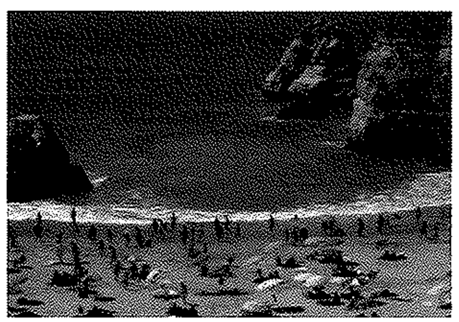
Why and When are Dispersants used?

There are several reasons why decisions are made to use dispersants, almost all of which pertain to reducing the ecological and economic impacts of oil spills.

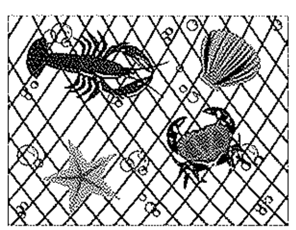
Socio-economic Considerations:

Some of the rationale for the use of dispersants on oil slicks is essentially the same today as it was in the first instances of dispersant use during the Torrey Canyon spill. In that case, it was felt that because the spill occurred in an area where the sea was generally rough at that time of the year, and because the spill had occurred in more or less open water, as opposed to a bay or harbour, dispersants should be used to remove the oil before it came ashore on recreational beaches. The decision to use dispersants in this case was based on the belief that the damage to the fisheries and to the marine ecosystems would be less, from an economic viewpoint, than the damage to the tourist industry if the oil came ashore.

Similar economic considerations exist today when considering the effects of oil on amenity beaches, and the attendant adverse impacts on water sports and other recreational activities.



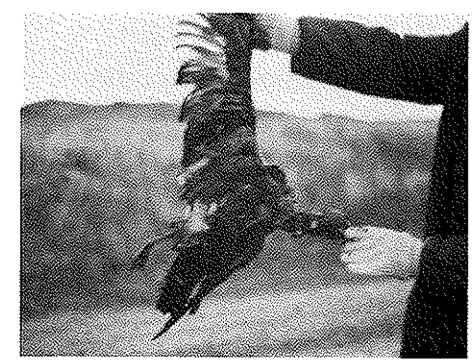
But economic considerations are not limited to beach areas alone. Oil can pollute not only beaches, but marinas, boats, harbour facilities, aquaculture operations, shellfish harvesting areas, and water intakes for power plants and desalination facilities as well. The cost of cleaning oiled boats, marinas, ocean front and harbour properties can be prohibitive. Shellfish growing areas can be contaminated and closed to commercial harvesting. Commercial aquaculture facilities, where fish are often held for considerable time in subsurface enclosures, are also at risk when oil threatens nearshore waters, as are tanks used to cultivate seaweed and to rear the young of fish and shellfish to marketable sizes. Contamination of the clean seawater supplies necessary for these operations could lead to severe damage to the young stages of such organisms. Water intakes for power stations, oil refineries, desalination plants, pulp and paper mills and other industries that use seawater as a coolant are susceptible to contamination of pipelines, pumps, and other infrastructure. Threats to all these operations can be significantly reduced if the oil is successfully dispersed offshore. It is important to note, however, that even under the most favourable conditions it is not possible to disperse all of the oil, and what remains may still threaten these resources. One of the most important economic considerations is the fact that it is often far less expensive to disperse oil at sea than it is to clean it up after it has come ashore. Analyses have been conducted to compare the costs of treating oil at sea with dispersants as opposed to removing it using mechanical means. Comparisons have also been made with the cost of cleanup after the oil has reached the shoreline. The costs of cleaning up oil on shore are estimated to be an order of magnitude higher than the costs of cleaning up the oil at sea using mechanical methods, and two orders of magnitude higher



than when dispersants are used. Economic considerations are therefore one important factor in determining whether or not dispersants will be used.

Environmental Considerations

Ecological concerns are another important reason why dispersants may be used to treat spilled oil. Oil on the sea surface presents a threat to wildlife such as waterfowl and marine mammals, as well as to fisheries, intertidal organisms and ecologically sensitive shoreline areas such as marshlands and estuaries. Oiled seabirds are one of the most visible and poignant indicators of an oil spill at sea, and are also generally the most vulnerable to its impacts. Birds are affected as a result of physical oiling of the feathers and resultant loss of insulation, as well as by ingestion of oil when they preen their oil soaked feathers or eat oil-contaminated food. After an oil spill, only a very small percentage of oiled birds can be caught for cleaning, and fewer still can actually be saved. Costs associated with cleaning oiled waterfowl range up to $30,000 per bird. Spilled oil can also have detrimental effects on such marine animals as seals, walruses, whales, dolphins and porpoises. Floating oil can also kill the spawn and larvae of fish, which are often found at or near the sea surface. Oil can also be very toxic to adult fish as well, and fish kills have occurred after major oil spills, particularly when the oil has been spilled in or has entered confined areas such as bays and estuaries, where the fish cannot easily escape contamination.



When oil reaches the shore, it can smother intertidal animals such as mussels, barnacles, periwinkles, snails and limpets. Marine mammals such as otters and lemmings which spend significant amounts of time on shore are also adversely affected through ingesting oil, particularly while grooming. Shorebirds such as sandpipers and herons can suffer the same fate as birds which are oiled at sea. Effects are magnified if the oil spill enters areas used by large numbers of migrating birds.

Oil can also cause serious damage to intertidal algae and to marshes as well, suffocating the plants or poisoning them directly. Not only can this cause significant loss of marsh vegetation, but it can result in the destruction of important habitats for marsh and intertidal species.

If the oil is dispersed into the water column, the risk of birds and marine mammals becoming oiled is considerably reduced. This is often one of the key reasons that dispersants are used in the open ocean. The same rationale exists for the use of dispersants to protect fisheries and environmentally sensitive marine ecosystems such as salt marshes. Oil dispersed into the water column is relatively less available to contaminate fish eggs and larvae than undispersed oil at the sea surface where the developing embryos generally congregate. In addition, oil dispersed at sea will not reach the more sensitive inshore breeding sites such as salt marshes. However, as stated earlier, because it is impossible to disperse 100 % of the oil, some is still likely to impact upon these resources.

The question of when to use dispersants can sometimes present a paradox. Often dispersant use is considered as a last resort, after all other countermeasure options have been considered and rejected, or after the use of specific countermeasures has proven to be insufficient or ineffective. However, dispersant effectiveness decreases with increasing oil viscosity, and as time passes, even comparatively light crude oils become thicker and more viscous during the process of weathering.

Another reason for early use of dispersants is the behaviour of some types of oil when spilled at sea. As a result of wave action, droplets of water may become dispersed throughout the oil, forming a water-in-oil emulsion that generally contains about 50% - 80% water. This emulsion, known colloquially as "chocolate mousse" because of its brown, pudding-like appearance, is extremely stable and very resistant to attack by dispersants.

Therefore, to be most effective, dispersants should be applied as soon as possible after the oil is spilled. As a result, decision makers often do not have the luxury of significant periods of time to ponder whether or not to use dispersants. To obtain maximum benefit from their use, the decision on whether or not to use dispersants must be made quickly.

The dispersant use decision can be made easier by the weather and sea conditions prevailing at the time of the spill. If the sea state is such that countermeasures such as booms and skimmers could not be used, dispersants might be considered, especially in light of the fact that the wave energy would be useful in mixing the dispersant into the oil, thus considerably aiding the dispersion of the oil into the water column.

Why and When are they not used?

Just as there are times when dispersant use is considered to be preferable, there are also many instances when using dispersants is inadvisable. These can relate to a variety of considerations, including physical/chemical (e.g.,weather conditions, salinity, oil

viscosity and pour point, equipment used) socio-economic (e.g., health and safety), and environmental (e.g.,breeding and/or migrating areas).

Physical/Chemical:

Dispersants are generally ineffective on water-in-oil emulsions and on weathered oil. They are also ineffective on oils such as Bunker C, which are highly viscous or which have high pour points. The sea water temperature plays a very significant role as well, since low temperatures increase both the viscosity and the pour point of spilled oil.

In order to be effective, dispersants have to be thoroughly mixed with the oil. Therefore, they should not be applied in calm conditions if the equipment used cannot generate sufficient mixing energy. Another important and sometimes overlooked consideration is that dispersants have to be applied in strict accordance with the recommendations of the manufacturers. If this is not done, not only can large amounts of the dispersant be wasted, but excessive quantities can have a detrimental effect on the environment as well. Dispersants should not be used, then, if the equipment on hand cannot dispense the chemicals at the rate recommended by the manufacturer.

Most dispersants are made for use on spills that occur in the ocean. They are essentially ineffective on spills in fresh water.

Socio-Economic:

One of the reasons to disperse oil is to prevent it from entering intake pipes used by power stations, aquaculture facilities and so on. Paradoxically, this is also cited as one of the reasons why dispersants should **not** be used on oil. Both reasons are in fact valid, depending on where the oil is located. If the oil spill is sufficiently far from shore and dispersants are used, the dispersed oil may be broken down by natural and ecological processes well before it reaches the sea water intake pipes. However, if dispersants are used too close to the shore, then both the dispersed oil and the dispersant can get into the intake pipes and cause considerable problems, in effect making the water unsuitable for use.

Human safety and health concerns can also dictate that dispersants not be used.

For example, some oils, particularly volatile ones such as gasoline or even some light crude oils can ignite or explode under certain conditions. Dispersants can exacerbate the problem by causing significant amounts of the lighter ends to evaporate, presenting a very real danger of fire and explosion to cleanup crews.

Environmental:

As noted earlier, dispersants can be effective in preventing or minimizing environmental damage and harm when used to disperse spilled oil on the open ocean. In these situations, the dispersed oil is easily diluted by the vast volumes of sea water available, and degradation of the oil is readily accomplished. This is not the case, however, if significant amounts of oil are spilled in relatively confined areas such as harbours and bays. Here, the volume of sea water and the depth of the water column may be insufficient for effective dilution and degradation of the oil. In this case, the relatively toxic oil and dispersant mixture would be readily available to organisms on the shore, in the water column, and on the bottom.

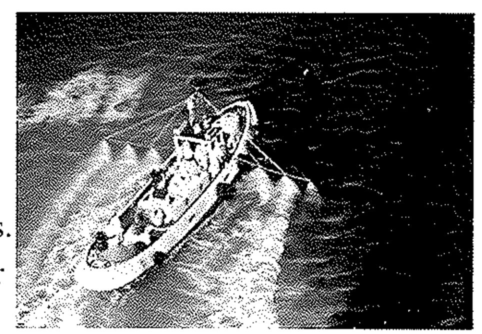
In many instances, if the oil has actually come ashore and must be removed because the area is used for recreational purposes, or because of potential environmental consequences, mechanical removal is preferred over dispersant use. If the oil is deposited on exposed shorelines, doing nothing and allowing natural forces to remove the oil is often the best option. For example,when oil from the tanker Jakob Maersk fouled the wide, sand beaches of northern Portugal in 1975, thousands of liters of dispersants were sprayed on the oil in an attempt to flush it from the shore. When the oil disappeared it was felt for a while that the operation had been successful. However, it was soon found that the dispersants had merely washed the oil down deeper into the beach sands, and considerable and costly effort then had to be expended to manually remove the buried oil from the beaches.

HOW ARE DISPERSANTS APPLIED?

Dispersants can be applied to oil slicks in several ways. At sea they can be sprayed from a variety of vessels or aircraft, while on land they may be applied using mechanical equipment or manually from back packs.

Vessels used to apply dispersants are of two types: specialized vessels and vessels of opportunity.

Vessels of opportunity are generally barges, tugboats, and workboats on to which spray equipment is fitted, while specialized vessels have been constructed especially for applying dispersant mixtures. The spraying equipment generally consists of booms fitted to the ships and extending out over the sides. Dispersants are applied to the oil through multiple nozzles in the booms. If non-concentrate or diluted concentrate dispersants are used, mixing energy has to be applied to ensure that the dispersant is in thorough contact with the oil. This is generally provided by the wake of the vessels. The rate of application of the dispersants, the degree of dilution with water before application, the speed of the boat through the water (generally no more than 5-10 kts), the spray pattern of the dispersant on the oil, the wave and wind conditions, are only some of the considerations that must be taken into account to ensure



effective dispersal of the oil.

There are many drawbacks, however, to attempting to disperse oil using surface vessels. One of the most significant is that in order to be effective, the vessels have to travel at a much reduced rate of speed to ensure proper application of the dispersants. Thus only small spills, or relatively small areas of large spills, can be treated. This is complicated by the fact that the amount of storage space for dispersants on boats is often limited, requiring frequent trips to shore facilities for stock replenishment. This problem can be alleviated to some degree by employing several vessels, and using concentrates that can be diluted with sea water before application.

Another problem with using boats is that unless the vessels have been specially constructed for dispersant application, the spray equipment must usually be mounted amidships on vessels of opportunity. If the spray vessel then exceeds a speed of about 4-5kts, the bow wave generated will push the oil aside and out of the path of the dispersant spray, not only making the application ineffective, but wasting significant amounts of dispersant as well.

Another disadvantage of using boats is that it is extremely difficult to determine when the boat is actually out of the oil slick. When this happens, it is usually necessary for spotter aircraft to guide the boat back into the oil. This is a very real problem if such aircraft are unavailable, or if weather conditions, such as fog, preclude their use.

Getting to the spill quickly in order to implement countermeasures is an essential part of an effective spill response, and this is also an area where spray boats are at a disadvantage. It takes time to fit vessels with spray equipment. It takes time to load the dispersants, and it takes time to get to the spill site. Every hour that is spent before dispersants are applied means an hour that nature has had to work its effects on the oil, rendering it less and less amenable to treatment with dispersants. Often, by the time that spray vessels arrive at the site of a spill, weathering forces have turned the bulk of the oil into chocolate mousse, or it has spread to such an extent as to make dispersant use unreasonable. Weather conditions and sea state also play a major role in determining the effectiveness of spraying from boats.

Because of the many limitations inherent in using vessels for spraying dispersants, almost all of which result in low rates of treatment of the oil, aerial spraying has been used as a viable complement of, and often an effective alternative to, spraying from vessels. Aerial spraying of dispersants offers several advantages and only a few disadvantages.

One of the main advantages is the considerable saving in time when aircraft are used. They are able to get to the spill site far more quickly than vessels, and once at the site, are able to distribute the dispersants over a much larger area than can boats. When aircraft are used, considerable time is also saved because they can act as their own spotters, thus ensuring that they are always applying dispersants to the oil, and not wasting the chemicals because they have lost sight of the oil slick. A further advantage is that aircraft can operate in weather conditions that would severely restrict the effectiveness of vessels. Although they are obviously limited by visibility-reducing conditions such as fog, boat operations are also hampered by these conditions, often to an even greater extent.

Aircraft are also limited in the quantity of dispersants that they can safely carry, but the development of increasingly effective concentrates has served to significantly reduce this problem. Today, all types of aircraft are used to apply dispersants, the type usually depending on the size and location of the spill. For small spills not too far from shore, small fixed wing aircraft can be used. The requisites for such aircraft are that they be efficient consumers of fuel; be able to stand up to rugged conditions, and be able to land and take off from short and often improvised runways. Larger aircraft such as the DC-3, DC-6, and the C-130, are best used for large spills in the far offshore, because they have a greater range, larger cargo capacity, greater speed and can thus cover a much greater spill area.

Helicopters are also used in combating oil spills, but their range and cargo capacity are limited. Their greatest advantage is that they can operate from practically any makeshift base - they do not need an airport. However, specially equipped helicopters are needed for spray systems that attach to the fuselage. Because of the expense and effort required to construct the necessary equipment, spray buckets, complete with storage tanks, booms and pumps, have been developed to be carried in a sling under the helicopter. These have proven to be very effective. Helicopters are particularly useful in the offshore if the spill occurs from or near an oil rig, as the platform can then be used for a landing and replenishing site.

How is dispersant use controlled?

The use of dispersants in combating oil spills is generally a highly controversial matter. It is often argued that the practice of adding potentially toxic chemicals to the environment in order to remove other toxic chemicals compounds the problem rather than alleviates it. The concern over the use of dispersants has been exacerbated by the chequered history of their use. The use of highly toxic dispersants during the 1967 oil spill from the Torrey Canyon, and the disastrous impact on plants and animals focussed concern on the dangers

of dispersant use. Since that time, however, much less toxic and more effective dispersant formulations have been developed.

Nevertheless, nations around the world have recognized the need for controls on the use of dispersants, and many have implemented policies and guidelines governing the use of dispersants.

In Canada, a list of dispersants that are acceptable for use in treating oil spills has been developed by Environment Canada. The dispersants on this list have met stringent criteria outlined in Environment Canada's Guidelines on Acceptability of Dispersants, and are the only ones that can be used on oil spills. These criteria have been developed to ensure that all dispersants used in Canada meet specific standards for effectiveness and toxicity, as well as for chemical content and labelling.

To determine its acceptability, a dispersant must undergo an acceptance procedure in which it is subjected to a series of tests by Environment Canada. In this process, the dispersant manufacturer submits a sample of the product, along with required data on its chemical properties and composition and a copy of the proposed label. Once it has been determined that the dispersant contains no prohibited chemicals, it is first tested to judge its ability to effectively disperse oil. The chemicals are subjected to a number of experiments and must demonstrate an ability to effectively disperse at least 50% of oil under strict test conditions. Once this step has been successfully achieved, the dispersant must then pass a toxicity test. In this test, a number of rainbow trout are exposed to a standard dispersant and water mixture for a period of 96 hrs. If more than 50% of the fish survive, the dispersant is considered acceptable and is placed on Environment Canada's approved list.

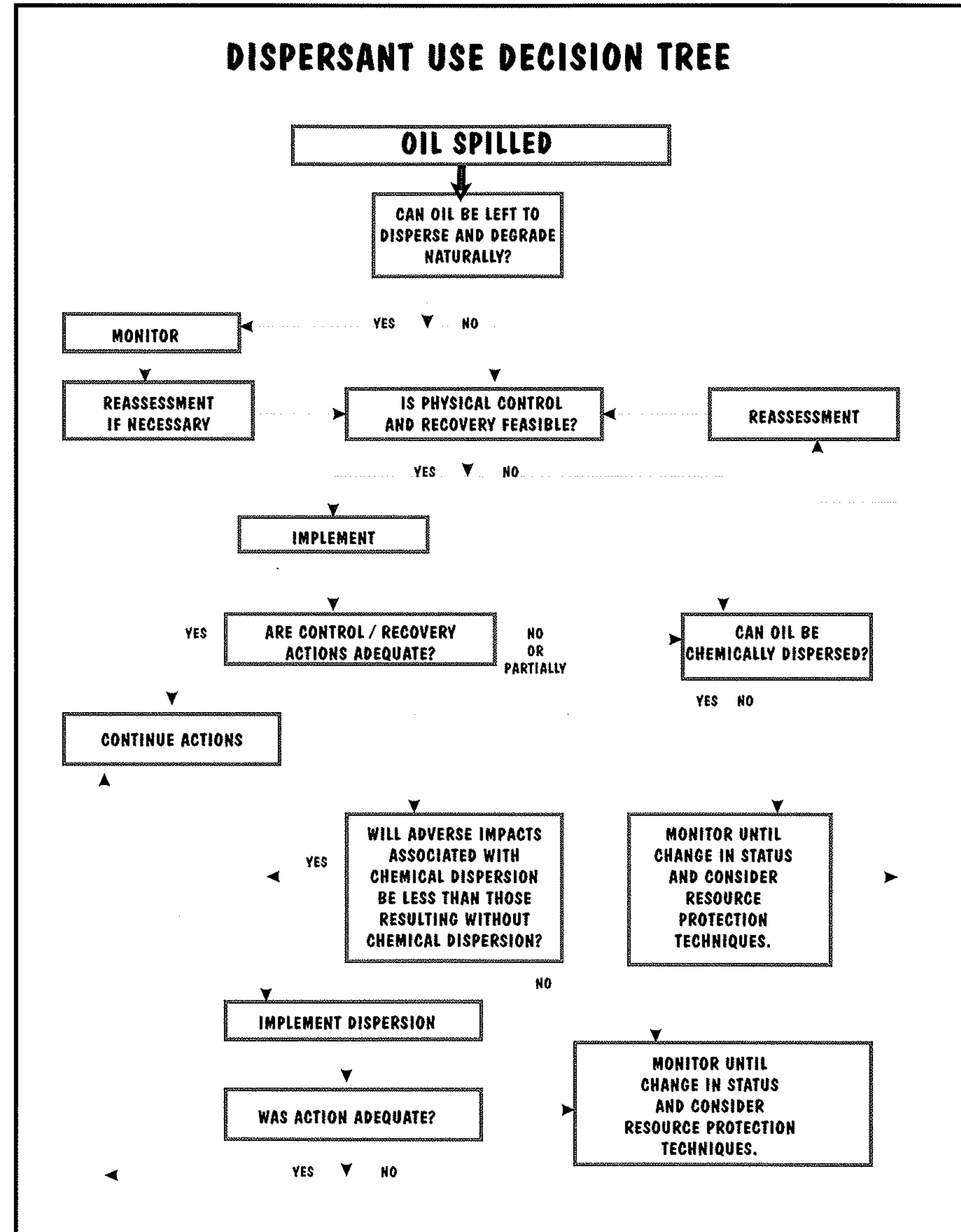
Who makes the decision to use dispersants?

In Canada, dispersants can only be used if permission is given by Environment Canada, which also consults with provincial and\or territorial authorities.

As noted previously, the decision on whether or not to use dispersants is seldom an easy one, and each situation is carefully examined before approval is granted or denied. The various factors that must be taken into consideration are numerous and often seemingly conflicting. For example, should dispersants be used to protect high amenity beaches at the height of summer, or should they be prohibited because of the risk of contaminating commercial fish stocks offshore? Should an offshore spill be left to disperse naturally until and unless it threatens to come ashore, at which time the effectiveness of dispersants may be considerably diminished? Is it more environmentally acceptable to remove the oil using mechanical means rather than chemical? In spite of the many issues that must be considered, the choices that must be weighed, and the priorities that must be assigned, the decision on whether or not to use dispersants has to be made quickly. To facilitate this process, many agencies have developed decision trees, schematic diagrams which are used in conjunction with extensive background data to arrive at intelligent and informed decisions. An example of a dispersant use decision tree is shown below.

Summary

When oil spills occur, a number of options are available to those responsible for responding to them. These may range from doing nothing and allowing nature to take its course, to cleaning up the oil using skimmers and booms. Often, however, the only feasible choice from both an operational and environmental perspective is the use of dispersants. However, the decision to use dispersants almost always involves trade-offs and compromises, an assessment and weighing of priorities that includes socio-economic, human health and safety, and environmental issues. Nevertheless, despite the controversy which often surrounds their use, dispersants still remain an important tool in the treatment of oil spilled into the oceans.



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IN NOVA SCOTIA

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