Guidelines for the use of dispersants

for combating oil pollution at sea in the Mediterranean region

Part IV: Operational and technical sheets

MEDITERRANEAN ACTION PLAN (MAP)
REGIONAL MARINE POLLUTION EMERGENCY RESPONSE CENTRE FOR THE MEDITERRANEAN SEA (REMPEC)

REGIONAL MARINE POLLUTION EMERGENCY

RESPONSE CENTRE FOR THE MEDITERRANEAN SEA (REMPEC)

MEDITERRANEAN ACTION PLAN

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Part IV: Operational and technical sheets

Regional Information System

www.rempec.org

May 2011 Edition

Note

This document is aimed at facilitating the implementation of the “Protocol concerning Co-operation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency” of the Barcelona Convention (Emergency Protocol, 1976) and the “Protocol concerning Co-operation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea” (Prevention and Emergency Protocol, 2002) by the Contracting Parties of the Barcelona Convention.

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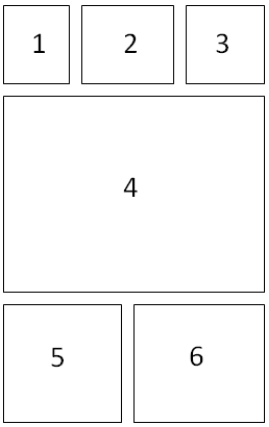

Helicopter mounted spraying system

Airborne treatment

Aerial monitoring operation

Ship mounted spraying system

Airborne treatment

Shipborne treatment

The Guidelines are downloadable from REMPEC’s website (www.rempec.org) in the section “Information resources/Regional Guidelines/Preparedness & Response”.

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Foreword

In a large part of the Mediterranean coastal States, the use of dispersants as a response method for combating accidental oil spills at sea has not as yet been covered by specific national regulations.

Controlled and appropriate use of selected dispersants on types of oil amenable to chemical dispersion, is widely recognized as one of the useful methods for combating accidental oil spills, and in particular the massive ones. Moreover, under certain sea and weather conditions the use of dispersants might be the only applicable response method for protecting sensitive natural resources, coastal installations or amenities.

However, the opportunistic attitude regarding the use of dispersants is hardly acceptable. Selection of products which might be used, definition of zones in which their use is either allowed or prohibited and their place in the general strategy of pollution response need to be adequately regulated if the use of dispersants is expected to produce desired results without creating additional risks for the environment.

Considering the developments in the field of dispersants since the October 1998 edition of the "Guidelines for the Use of Dispersants for Combating Oil Pollution at Sea in the Mediterranean Region", the Ninth Meeting of the Focal Points of the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), Malta, 21-24 April 2009, tasked the Mediterranean Technical Working Group (MTWG) to review their content.

This new edition of the Guidelines, endorsed by the Tenth Meeting of the Focal Points of REMPEC, Malta, 3 to 5 May 2011, has been prepared with the technical support of the 'Centre of Documentation, Research and Experimentation on Accidental Water Pollution' (CEDRE) and reviewed by the Centre in collaboration with the MTWG.

They aim at assisting the Mediterranean coastal States in developing and harmonizing national laws and regulations regarding the use of dispersants in response to oil spills at sea. It does not refer to the use of dispersants on shore.

The Guidelines are divided into four independent parts addressing different issues. Each part has been developed with a specific objective and is aimed at different end-users:

PART I REGIONAL APPROVAL

Part I which remains unchanged when compared to the version adopted by the Eighth Ordinary Meeting of the Contracting Parties to the Barcelona Convention (UNEP (OCA)/MED IG.3/5, Appendix I, Antalya, Turkey 15 October 1993), provides regionally approved guidance for the development of national laws and regulation on the use of dispersants.

PART II BASIC INFORMATION ON DISPERSANTS AND THEIR APPLICATION

Part II provides theoretical information on dispersants and their application. It is aimed at providing background information on the matter to any person interested in the subject.

PART III OUTLINE AND TEMPLATE FOR A NATIONAL POLICY ON THE USE OF DISPERSANTS

Part III has been prepared with a view to assisting coastal States in the development of their national policy on the use of dispersants. It has been developed as a template which can be followed and adapted by the authorities in charge of the development/maintenance of the national policy on the use of dispersants and can also be used for the implementation of national or local contingency plan for dispersants.

PART IV OPERATIONAL AND TECHNICAL SHEETS

Part IV is based on the publication entitled “Using dispersant to treat oil slicks at sea. Airborne and shipborne treatment. Response manual” (CEDRE 2005). It provides a set of practical technical sheets which point out the different operational issues when using dispersants. It has been developed for operational users with a view to providing them with the required knowledge for efficient dispersant application.

In order to keep the coastal States regularly informed of the current situation regarding the use of dispersants, REMPEC shall update this document to include any new and significant developments in the research field.

GUIDELINES FOR THE USE OF DISPERSANTS FOR COMBATING OIL POLLUTION AT SEA IN THE MEDITERRANEAN REGION

P A R T IV

OPERATIONAL AND TECHNICAL SHEETS

TABLE OF CONTENTS

P A R T IV

OPERATIONAL AND TECHNICAL SHEETS

1. HOW TO APPLY DISPERSANTS?

1.1 Possible vectors for applying dispersants

Dispersants can be used by ships, helicopters and planes (small, average or large size). These vectors all afford different operational options.

1-1-1 Aircraft

Aircraft always use neat dispersant.

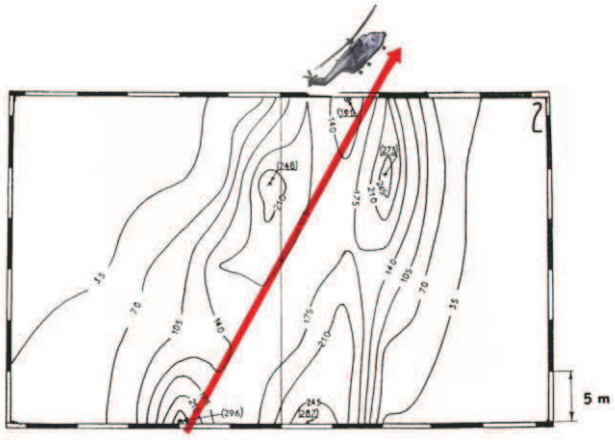
Features:

- Rapidity: they can get to the scene of operations very quickly and get the job done whilst the oil is still amenable to dispersion.

- High prospecting rate: they can spray large areas quickly.

- They can spray even in bad weather.

- The need for aerial guidance may well be less: if the plane is flying too low over the sea to actually see the slick when spraying, it can, from time to time, climb higher and spot the slick in between two passes.



The litres per hectare iso-spraying curve for a SOKAF Bucket dispersant spraying system

But:

- Uneven spraying (cf. figure above) and dispersant losses may well reach as high as 50 per cent: as dispersant is sprayed at a height of anywhere between 10 and 30 metres above the sea surface, part of the dispersant is more or less lost and does not reach the slick.

Situation with helicopters

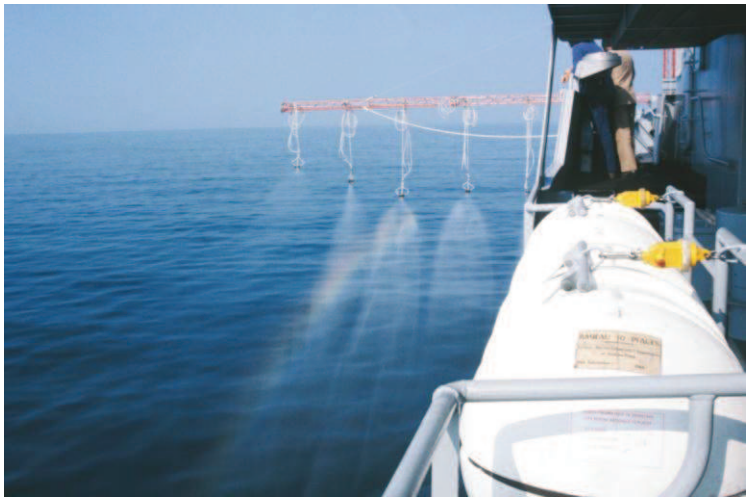
Helicopter payload capacities drop very quickly when transit distances increase.

Calibration trials on the ground for dispersant spraying PROTECMAR trials.

1-1-2 Vessels

Spraying equipment for vessels can use neat dispersant or, (with older equipment) spray dispersant once it has been pre-diluted in seawater. Using dispersant neat is preferred to pre-dilution as it is more effective on weathered and/or emulsified oil.

➔ *Cf. 5 " How much dispersant is to be used when spraying from a vessel?"*



Spray boom in full swing

1-1-3 Items to note:

- Slow response: unless you have to treat a slick in the immediate vicinity, a vessel needs time to reach the scene of operations which means that the chances of being able to spray the slick during the requisite window of opportunity during which the oil will be amenable to dispersion will be slighter.

- Low prospection rate (in hectares treated per hour): simply because vessels cannot manage more than 4 to 6 knots (rarely 8) knots.

- Sensitivity to sea state: as soon as the sea state gets a little rough, vessel manoeuvres slow down. Furthermore, as dispersants produce a herding effect, vessels have to spray into the wind, which is not a very comfortable option especially when sea conditions are poor.

➔ C*f. 3.4 "Dispersants can contract surface oil".*

But:

- The stirring effect produced by the bow wave can help to initiate dispersion if the sea is too calm.

- They can treat very fragmented slicks if they have aerial guidance to spot them.

- They can help to calibrate dispersant spray rates (litres per hectare) either by changing vessel speed or better yet by using special spraying equipment (multiple boom spraying arrays).

- They can treat oil for long periods of time without needing to replenish.

1.2 Dispersant must come into physical contact with oil and must be sprayed

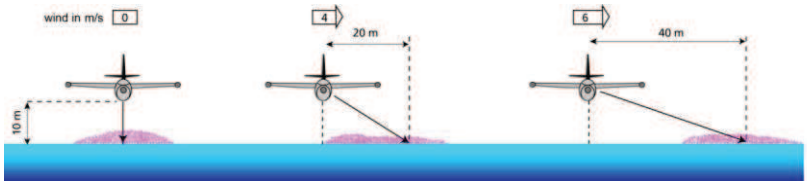
Dispersant spraying has to be geared so as to obtain an even application pattern and an optimum dispersant-oil contact.

- If the droplets of dispersant are too big they will simply traverse the slick and be wasted in the water column.

- If they are too small, the wind will cause them to drift away.

Dispersant spraying modes for vessels, planes and helicopters.

2. AIRBORNE TREATMENT



NB : the use of smoke bombs helps to materialise wind direction and comply with these instructions.

➔ *Cf. 6.5 "Start and stop cues"; Section "Prior reconnaissance, guidance and marking".*

To avoid dispersant wastage (wind carries the dispersant away from the slick), the recommendation is generally to use droplet sizes of between 400 and 700 µm in diameter. This result can be achieved by the use of the right kind of spraying equipment.

➔ *Cf. box page 9 "Spraying equipment: nozzles and check valves"*

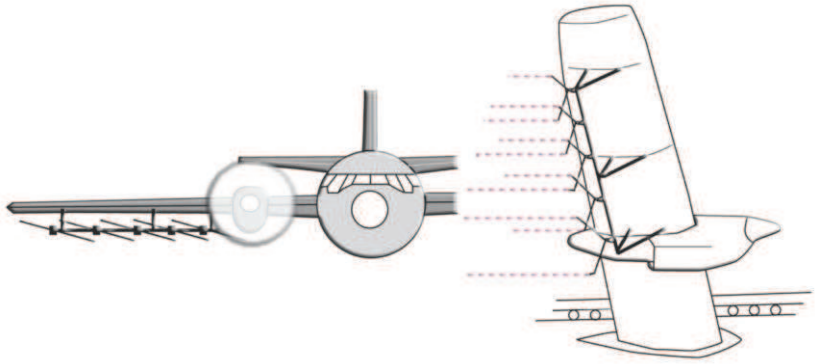
Note: Wind conditions can make spraying difficult and ineffective because dispersant droplets are blown by the wind as they are dropping onto the slick and across wind will push the dispersants away from the slick that is being targeted.

Instructions: During treatment operations, always fly upwind or downwind at the height recommended for the type of plane you are flying.

Spraying equipment: nozzles and check valves

Nozzles

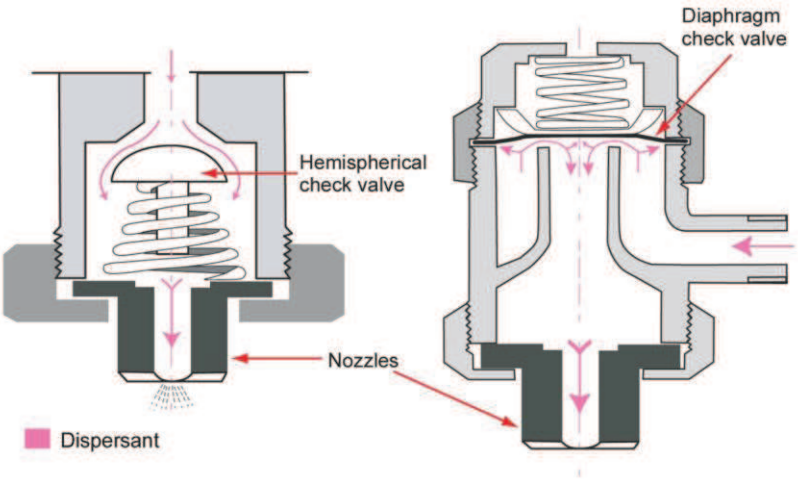
Dispersant spraying equipment generally involves the use of spraying booms fitted with calibrated nozzles that generally produce flat jets. In that case the nozzles must be placed at an angle of anywhere between 10° and 15° in relation to the spray boom in order to generate parallel jets.



No-drip check valves

Check valves are often mounted on the spray system upstream of the nozzles and close when the system pressure in the spray boom drops. This will avoid leaks and keep the spray system under pressure and full of dispersant when the spraying operation stops.

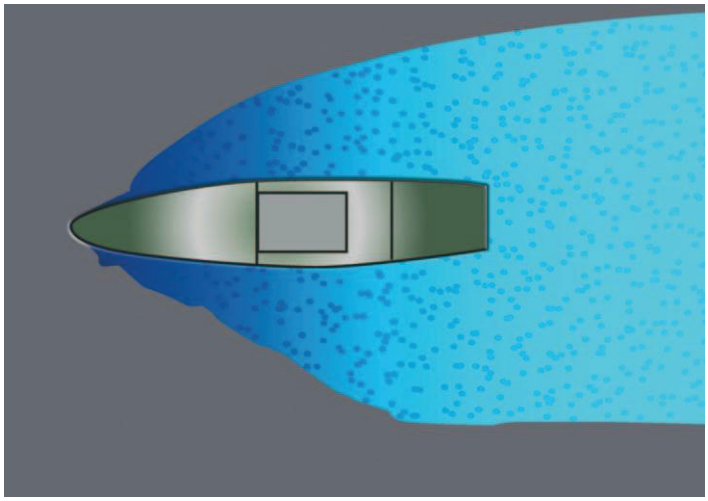
Note: clean check valves make for optimum spraying.



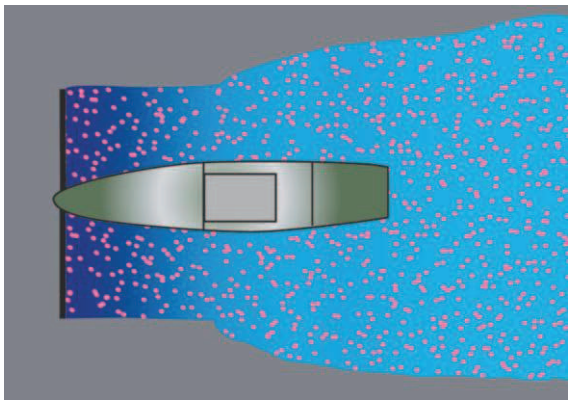
3. SHIPBORNE TREATMENT

3.1 Dispersants have to come into physical contact with oil

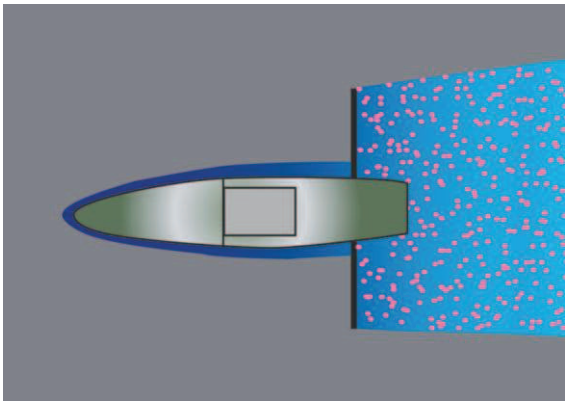
The bow wave pushes the oil away from the vessel



EITHER treat from the bow section in front of the bow wave



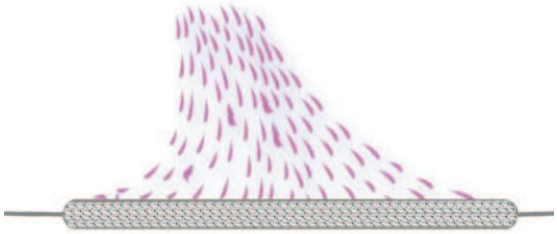
OR Slow down to reduce the bow wave

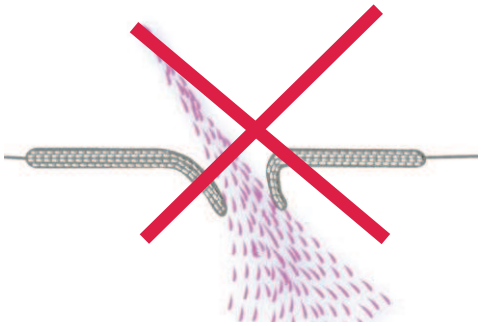


Bow wave as well as ship pitch push the oil away from the vessel and out of reach of the spray booms. Furthermore, the bow wave must not herd the dispersant before it has had a chance of penetrating the oil. The more viscous the oil is, the longer it takes the dispersant to penetrate the oil. In this case you will need to slow the vessel down.

3.2 Dispersants have to be sprayed on the oil

Dispersant droplets must not be too small or too big in order to settle gently onto the oil.

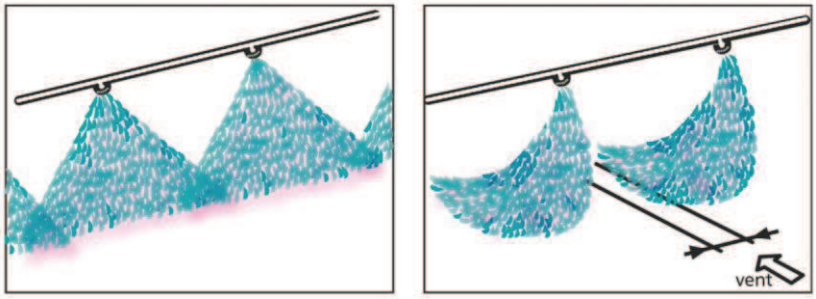




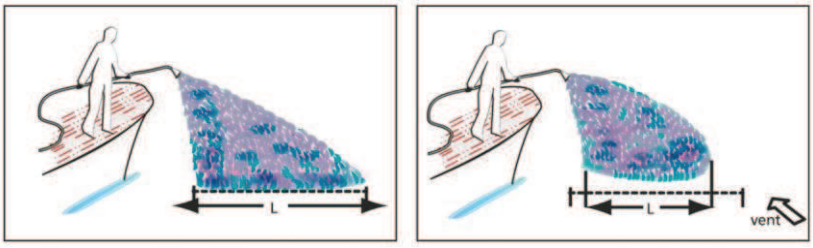
Use	Do not use
- Special equipment: spray booms, pipes… - or else, use fire hoses in fog stream mode.	Fire hoses in solid stream, and avoid pouring dispersant directly onto the slick.

3.3 Wind can prevent dispersants from being sprayed evenly over the slick

When using spray booms, strong wind can impair spraying quality by altering the shape of the spray and reducing spray width and even miss the oil altogether. This kind of effect will be all the more marked when dispersant is sprayed high over the slick.



Similarly, wind can considerably reduce the range of off centred flat spray nozzles (or systems such as fan air blower).

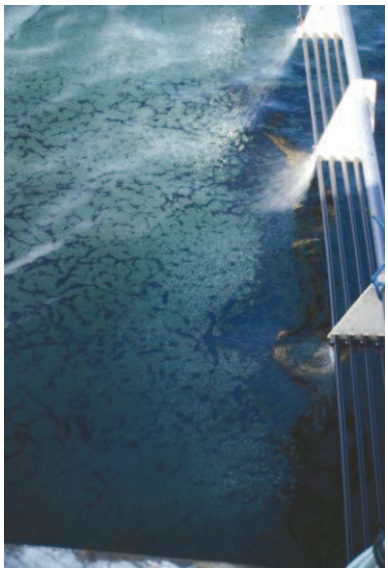


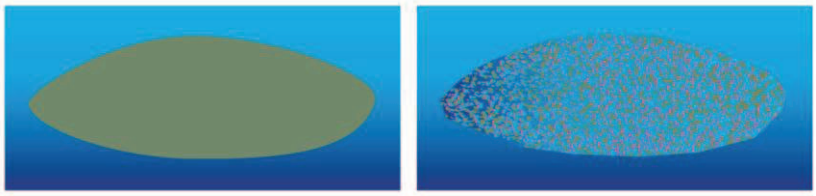
As a rule, the preferred spraying direction is into the wind. However, if the wind is really far too strong to the extent that it compromises spraying operations and adequate droplet dispersion, an attempt can be made to spray downwind but contraction may occur all the same. ➔ C*f. 3.4 "Dispersants can contract surface oil".*

Important note: If you are crosswind only spray from the leeward side.

3.4 Dispersant can contract surface oil

In the event of adverse conditions, dispersants can concentrate oil into small patches or filaments that stay on the sea surface instead of dispersing oil into the water column.





Herding effect

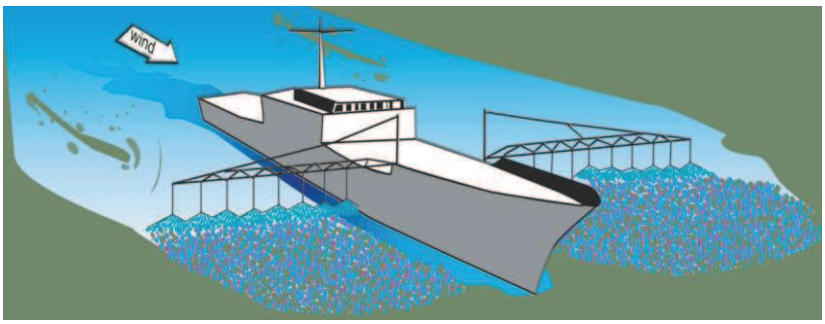
This effect will be observed when spraying dispersant downwind.

In this case, the slick is broken down into smaller patches by fine dispersant droplets that are blown forward in front of the vessel by the wind. When the spraying booms pass over the broken slick, most of the dispersant ends up on the water surface between the small oil patches. The preferred spraying mode is upwind (into the wind).

➔ *Cf. figure in 6.3 "Ship borne treatment"; Section "Standard approach".*

When this effect occurs, there is no point spraying dispersant a second time. It is always better to spray dispersant in one pass and adjust the dose accordingly.

This effect will not occur if oil is thick, emulsified and viscous.



Dispersant application completed downwind, leading to herder effect

3.5 Excessive dilution can cause a dispersant to be ineffective

If dispersant is used pre-diluted with seawater the percentage of dispersant in the mixture must be at least 10%.

4. HOW MUCH DISPERSANT IS TO BE USED WHEN SPRAYING FROM AN AIRCRAFT?

4.1 Required quantities

Required doses are of the order of 5 to 10% in relation to the amount of pollutant. In this case, treatment rates will depend on oil thickness. .

<table>
<tr><td>Viscosity
(in cSt at sea temperature)</td><td>< 500</td><td>500 - 5 000</td><td>5 000 - 10 000</td><td>> 10 000</td></tr>
<tr><td>Amenability to dispersion</td><td>usually easy</td><td>usually possible</td><td>sometimes possible</td><td>usually impossible</td></tr>
<tr><td>Conventional
2nd generation - type 1</td><td colspan="4" rowspan="2">never sprayed by aircraft</td></tr>
<tr><td>Concentrate
3rd generation - type 2 used diluted 10% in seawater</td></tr>
<tr><td>Concentrate
3rd generation - type 3 sprayed neat % dispersant to pollutant</td><td>5%</td><td>5 - 10%</td><td>10% (possibly 15%)</td><td>ineffective</td></tr>
<tr><td colspan="5"><u>Note 1</u> : fresh emulsion
It may be necessary to treat slicks by spraying dispersant twice at around one hour intervals. The first spraying operation will use low percentages of dispersant (1 to 2%) so as to break the emulsion and reduce viscosity. The subsequent spraying operation will effectively disperse the slick.</td></tr>
</table>

Except for special cases such as thick slicks (e.g. 250 litres / hectare for slicks that are 250 to 500 µm thick), the treatment rate can be adjusted by changing pump speeds and/or by changing the nozzles and to a lesser extent by changing aircraft ground speeds (for helicopters). The treatment rate (litres / hectare) can be worked out using the following equation:

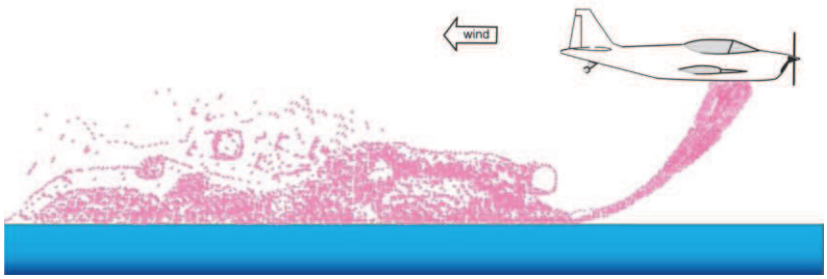
Rate ≈ $(10^3 / 3) \times (D / L \times v)$

D : dispersant flow rate (in liters/minute)
V : aircraft groundspeed during treatment (in knots)
L : effective with treated : 1.2 to twice the lenght of the spray boom depending on the aircraft and height (in meters)

Literal equation : $^{T}_{(l/ha)} = 10^4 \times D / (L_{(m)} \times V_{(nds)} \times 1852) / 60$

In practice, slick thicknesses are unknown and the usual treatment rate is 50 to 100 litres / hectare meaning average slick thicknesses (50 to 200 µm, code 4).

Important note*:* the effective treatment rate is always less than the equation because some of the dispersant will be blown away by the wind. Bearing such losses in mind, and especially in the event of a small patchy slick, it may be advisable to increase dispersant quantities. For instance, step up quantities from 5 to 10%.



4.2 Adjusting dispersant quantities

ON THE GROUND	IN FLIGHT
• Mainly by choosing other nozzles*. • By changing pump speeds (rpm or by opening the «bypass»)*. ➔*Cf. 8 "Technical matters requiring attention prior to treatment".*	• Change the flying speed (helicopter). • Some systems have several booms and the spray rates can be changed by feeding one of the booms **.
** Once the spray system has been adjusted, note the delivery pressure. This will turn out to be very useful subsequently for ensuring effective spraying. Pressure variations can lead to system malfunction.*	*** For instance a twin boom spraying system that can be operated independently.*

5. HOW MUCH DISPERSANT IS TO BE USED WHEN SPRAYING FROM A VESSEL?

5.1 Required quantities

They are of the order of 5 to 10% in relation to the pollutant. In this case, treatment rates are related to slick thickness.

Viscosity (in cSt at sea temperature)	< 500	500 - 5 000	5 000 - 10 000	> 10 000
Amenability to dispersion	usually easy	usually possible	sometimes possible	usually impossible
Conventional 2nd generation - type 1	30%	30 – 50%	up to 100% slightly effective	ineffective
Concentrate 3rd generation – type 2 used diluted 10% in seawater*	5 – 10%**	ineffective	ineffective	ineffective
Concentrate 3rd generation - type 3 sprayed neat % dispersant to pollutant	5%	5 - 10%	10% (possibly 15%)	ineffective
Note 1 : fresh emulsion *It may be necessary to treat slicks by spraying dispersant twice at around one hour intervals. The first spraying operation will use low percentages of dispersant (1 to 2%) so as to break the emulsion and reduce viscosity. The subsequent spraying operation will effectively disperse the slick*				

* *The dispersant dilution rate must not be less than 10%.*
** *E.g., a 50 – 100% «dispersant + water» solution.*

In actual fact, it is very hard to know how thick the slick is owing to enormous slick thickness variations:

- thick patches: anywhere from 0.1 mm to a few millimetres;
- vast but very thin slicks: from 0.01 to 0.1mm.

The chosen treatment rate will be about 50 to 100 litres / hectare, which would mean an average slick thickness of 0.1mm.

To optimise dispersant quantities, the treatment rate can be changed slightly depending on how thick the slick is.

5.2 Adjusting dispersant quantities

5-2-1 Standard approach

To achieve a treatment rate of 50 or 100 litres / hectare, vessel speeds will have to be adjusted to suit spray system requirements.

$V_{(50l/ha)} = D / (0.6 \times L)$

$V_{(100l/ha)} = D / (0.3 \times L)$

V = vessel speed (knots)

D = dispersant pumping rates (neat) delivered by the system (in liters / minute).

L = width (in meters) effectively treated by the system (distance from one boom tip to another including vessel width at spray boom location).

5-2-2 Special cases

- Non-adjustable spray system:

The thicker patches (oil thickness > 0.1 mm) will have to be sprayed at slower speeds or possibly several times to increase dispersant delivery quantities (> 100 litres / hectare).

- Adjustable spray system:

With a small adjustment range (1 to 4 times the flow rate), vessel speeds will have to be varied so as to deliver at least 100 litres / hectare.
v = D mini / 0.3 L
Adjustable systems can facilitate the treatment of thick patches (> 0.1 mm) as delivery rates can be increased to treat such patches with one pass.

With a big adjustment range (1 to 10 times the flow rate), your best bet will be to set vessel speed so as to deliver at least 50 litres / hectare.
v = D mini / 0.6 L

In this case, excess dispersant can be reduced over thin patches (10 to 100 µm) that can stretch for miles on end. Thick patches (> 100 µm) can be treated with a single pass as all you need do is increase delivery rates.

6. HOW TO TREAT A SLICK?

6.1 Areas to treat

Average to thick slick patches are treated by adjusting dispersant quantities sprayed.
Thin areas are not sprayed (codes 1 and 2: sheen, rainbow).

➔ *Cf. 4 "How much dispersant is to be uses when spraying from an aircraft?"*
➔ *Cf. 5 "How much dispersant is to be used when spraying from a vessel?"*

Important note: After weathering for a few days, the oil will be patchy and thick and will be called «chocolate mousse». By this stage, the oil will be so viscous as to render it impossible to disperse.

6.2 What to do

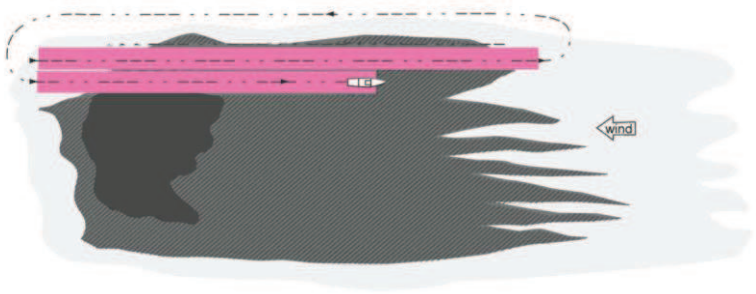
If you are on deck or flying low over the water you will have a hard time trying to identify the outlines of a slick not to mention slick thickness. You will have to be methodical.
You can always decide to «revisit» thick patches that have not been dispersed later on once the bulk of the oil has been treated.

DO	DO NOT
Begin treatment from the edges of a slick to the border of medium thickness areas. Treat the slick by parallel close passes (the only way to cover all the slick). Treat upwind or downwind (and for vessels, always upwind*) so as to guarantee spraying conditions and an optimum "dispersant-oil" contact. For aerial application, do not forget equipment response times and droplet drift caused by the wind when you need to start or stop spraying. ➔ *Cf. 6.5 "Start and stop cues".* ** Spray into the wind to avoid the herding effect. (➔ cf 3.4 "Dispersants can contract surface oil"); unless when the slicks are very thick and weathered and the herding effect does not occur.*	Cut up and fragment a slick. By ploughing through it in all directions, as you will soon find it impossible to spot the slick and treat it all properly. For vessels, treat downwind.

6.3 Ship borne treatment

6-3-1 Standard approach

The preferred approach is upwind.



6-3-2 Special case

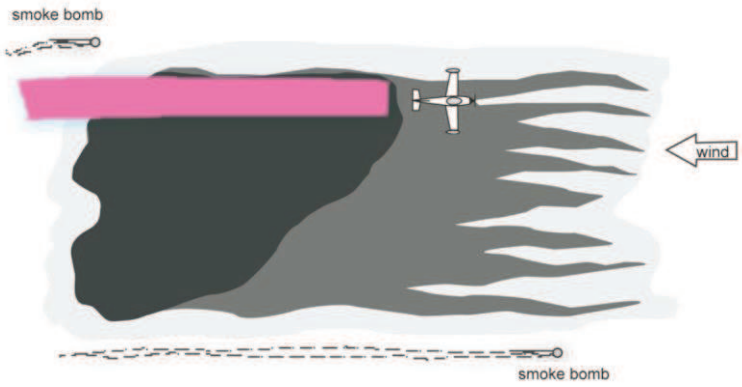
Slick is made up of a number of thin windrows placed abeam the wind: treat from the lee side of the vessel as the vessel sails lengthwise through the slick.

6.4 Airborne treatment

6-4-1 Standard approach

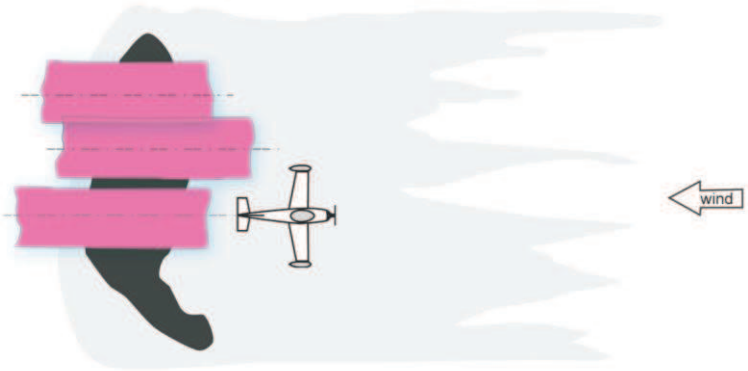
The preferred approach is either up or downwind.

Important note: Smoke bombs can be very helpful for marking a slick and showing wind direction. ➔ C*f. 7-2."* Using smoke bombs and buoys"

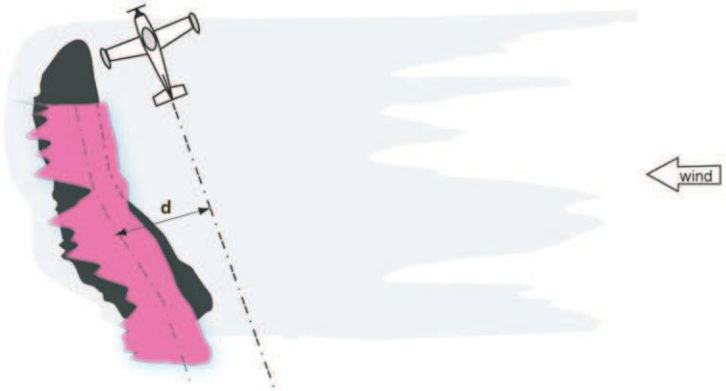


6-4-2 Special case

If the slick is a thin strip abeam the wind: the preferred treatment modality will be to fly several passes into the wind,



or possibly, treat abeam the wind not forgetting that the dispersant will tend to drift sideways with the wind (d).



Start and stop cues

The start and stop spraying cues have to include:

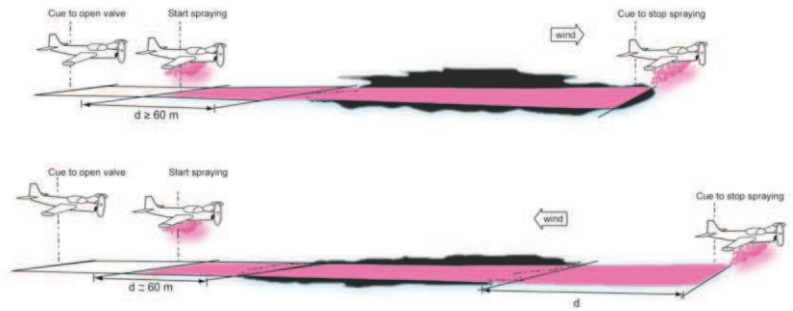
- equipment response times for spraying to start once the cue has been given (lead time is about a few seconds);
- wind effect: as dispersant droplets fall onto the slick, the wind will blow them away. Droplet drift (in metres) can be estimated as follows:

$$d = \frac{(v \times h)}{12}$$

(Where v: wind speed in knots; h: height at which aircraft is spraying).

Flying into the wind, the effect will occur once the slick has passed. Flying downwind, the effect will occur as soon as the aircraft reaches the edge of the slick.

Quite apart from response time considerations always start spraying 60 metres before reaching the edge of the slick, even if wind speed is low.



Spraying dispersant on the ground: spray downwind, spray upwind.

7. HOW TO GUIDE THE TREATMENT ON THE SLICK?

7-1 Prior reconnaissance, guidance and marking

At low altitude (recommended for treatment) it is not easy at all to identify the slick (edges, thickness). It is always advisable to have a second aircraft flying above to guide the sprayer aircraft onto the slick and to give the cues to start and stop spraying with each pass.

If no other aircraft is available, the sprayer aircraft will have to undertake at higher altitude its own reconnaissance of the areas requiring treatment prior to commencement. The pilot will need to take his bearings which will help him during the treatment (ships in the vicinity, platforms, shorelines, buoys, smoke bombs).

7-2 Using smoke bombs and buoys

The oil slick can be marked by:

- smoke bombs dropped by the sprayer aircraft when reconnoitring the slick to be sprayed. Smoke bombs will also be useful to indicate wind direction;

- smoke bombs and buoys launched from a vessel that is guided by an aircraft.

7-3 Aerial guidance procedure

Whenever dispersing or recovering oil, vessels will normally require some form of aerial guidance: as crew on board vessels have great difficulty spotting oil on the water surface, response vessels need to be guided onto the slicks in order to be effective when spraying dispersant.

The preferred modality is to provide a detailed description (with maps) of a slick where the vessel or flotilla are going to start spraying. This will avoid having to tie up a spotter plane all day.

When this is not possible, basic guidance will be taken to mean directing a vessel to the thickest parts of a slick by giving the helmsman a bearing and a distance.

For instance: «the slick is 20 metres wide and 200 metres long bearing 30° and 300 metres from your current position».

The plane (or preferably a helicopter) has to indicate slick position and shape in addition to pointing out where the thickest arts of the slick that will need spraying are .

- Guidance can be given directly over the radio.

- When response time is limited, it is always best to give the crew on board the response vessel an exact description of the slick(s) in addition to the GPS coordinates.

- Guidance to the slick can be improved if the vessel is told where to drop marker buoys or smoke bombs.

Guidance provided by the French Customs aircraft to the French response vessel «Ailette» (Prestige spill, Galicia, 2002).

Using smoke bombs to mark slicks.

8. TECHNICAL MATTERS REQUIRING ATTENTION PRIOR TO TREATMENT

8.1 Treating slicks using aircraft

Before actually starting spraying operations, a ground test using water will show whether:

- the dispersant filter is clean;
- nozzles have been mounted correctly:
  - choosing nozzle type (possibly),
  - nozzle orientation,
- the nozzles are clogged or not;
- the check valves* (mounted just in front of the nozzles) work correctly or not;

➔ *cf. 2 "Airborne treatment".*

- dispersant flow rates and pressures are correct;

➔ *cf. 4 "How much dispersant is to be used when spraying from an aircraft?"*

- spraying controls (remote control) and solenoid valves are working correctly.

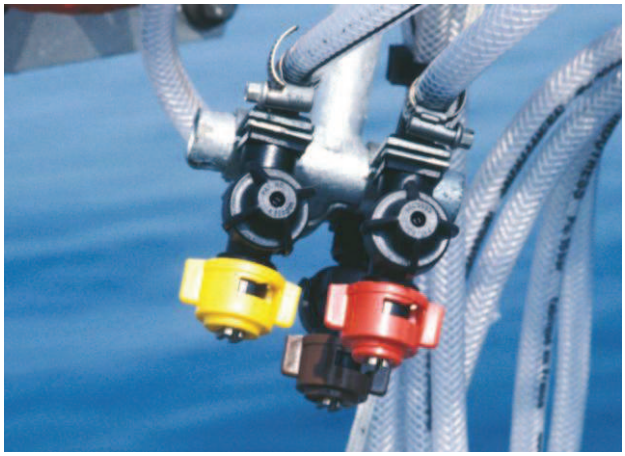
➔ *cf. box p 9 "Spraying equipment: nozzles and check valves".*

8.2 Shipborne treatment

Before turning the dispersant spray system on, care will be taken to:

- check that the main filter is clean;
- do a quick spray test (using water if need be) to ensure that the check valves and nozzles are clean and mounted correctly (orientation);
- check that the solenoid valves and control systems are working correctly;
- check that dispersant flow rates and pressures are correct.

➔ *cf. 5 "How much dispersant is to be used when spraying from a vessel?"*



Nozzles fitted with check valves.

9. PRECAUTIONARY MEASURES

9.1 Response crew

Dispersants can irritate eyes and mucosa, so avoid all contact with the eyes and the skin. Do not breathe aerosols.

When handling dispersants always wear protective clothing (e.g. oilskin) goggles, rubber coated gloves (recommended: rubber, nitrile; and always avoid: latex) and in the event of aerosols wear a mask that will protect the respiratory tract (at least wear a dustproof mask).

If dispersant comes into contact with your eyes or your skin, wash them immediately with a lot of clear water.

9.2 Equipment

Dispersants are natural solvents for products such as paints, elastomers, some plastics, tar, tarmac. Depending on the product in question, it will either soften, swell or detach (eg: coatings do this).

They also have a wetting effect:

- They can soak through the smallest cracks.
- They can make some surfaces slippery (deck) and make for dangerous working conditions.

If dispersant leaks and covers the hull or the deck, spray as much water as you can.

When spraying dispersant from a vessel, it is advisable to use some kind of permanent deck or keel cooling system (e.g. use fire fighting equipment or hawser hole washing systems) to prevent crew members from falling and being injured. You will also need to connect up a fire monitor to hose down the port and starboard sections of the deck all the time and especially to hose down the catwalks.

When spraying abeam the wind from a vessel, never spray from the windward side.

When spraying from an aircraft, check from time to time to ensure that the dispersant is not jeopardising the lubrification of moving parts (such as the rotors) or any part of the command and control system.

At the end of the day, rinse spraying equipment with fresh water in addition to the immediate surroundings (plane, runway or taxiway).

9.3 If a fire breaks out

Remember dispersants are flammable. Their flash point is usually over 60 °C.

If a fire breaks out, use powder extinguishers, CO2, foam or water spray and cool the dispersant storage drums/tanks down.

10. HOW DO YOU ASSESS TREATMENT EFFICIENCY?

10.1 Visual observation

The dispersion operation is being effective if you can see a **brown-orange or even blackish cloud** (with some Heavy Fuel Oils) beneath the surface. This kind of cloud can usually be seen upwind of the area of the slick of medium to large thickness. The surface slick driven by the wind will drift slowly away and leave the dispersion cloud behind.

Note: The dispersion cloud will not always form immediately, particularly when the oil has weathered a bit and has emulsified a little and when wave energy is low. Moreover, the cloud will not always be easy to see and lasts for a long time. It may dilute and tend to disappear (once the oil has started to disperse). The dispersion cloud may form once dispersion has started but providing there is some form of wave action (crest of a wave). When spraying dispersant from an aircraft, the cloud may be harder to spot owing to the height you are flying at.

As time goes by (minutes or hours later), the slick will break up. **Surface areas covered by thick slicks will gradually shrink (gradual disappearance of average to very thick patches, very dark colours such as dark brown or black)**.

As thick slicks recede, much thinner zone appear (rainbow, codes 1, 2 or 3) which spread over large areas before declining and disappearing as time goes by (in the space of a few hours or a few days).

Note: Dispersion must not be mixed up with another visible and well known effect that occurs with fresh, thin oil slicks. Once the dispersant has been sprayed the oil disappears all of a sudden. In actual fact, the dispersant has pushed the oil sideways (herder effect) because it spreads very quickly. This is not real dispersion at all because after a little while the oil film reappears.

➔ *Cf. 3.4 “Dispersants can contract surface oil”.*

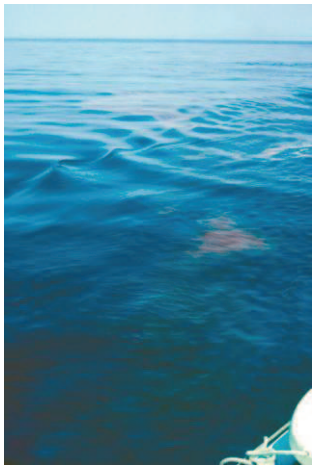
10.2 Infra-red remote sensing

If the dispersion operation is effective, thick patches will gradually disappear from the sea surface and **on board the remote sensing aircraft the IR scans will show less and less white patches**.

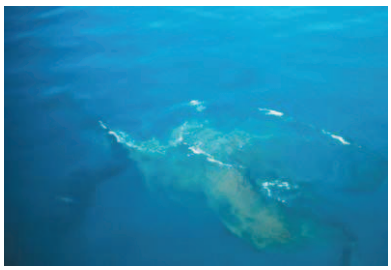
1., 2. Dispersion trial. See the beige colour of the slick just after spraying. This effect will last once a fire monitor has jetted the oil and dispersant.

3. Effect caused by the bow wave of a vessel passing through a treated slick. See the beige colour in the foam.

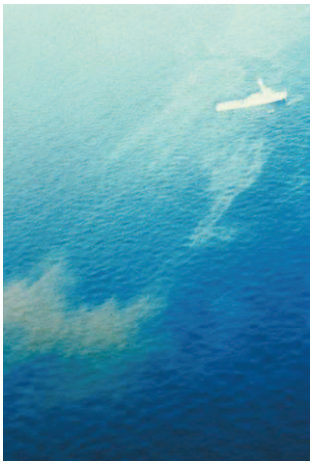
4. When the wave goes through the treated slick, oil is placed in suspension and the beige cloud forms.

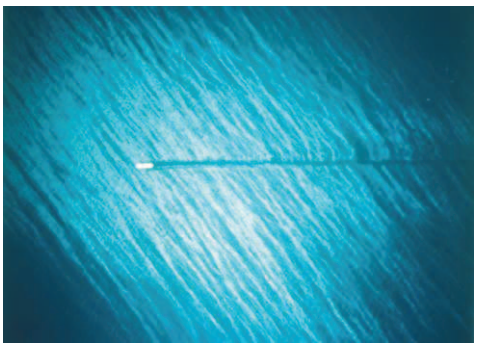


5., 6. Dispersed oil in the wake of a vessel engaged in dispersant spraying operations.

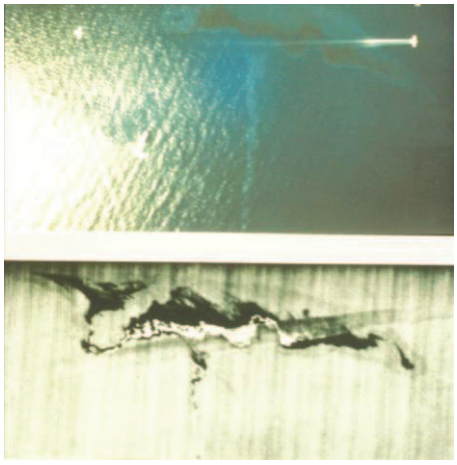


7., 8. What the pilot sees: clouds of dispersed oil (beige) are quite distinct from the appearance of surface oil (which is black or metallic). Note on photo number 7 the presence of white foam which shows that they sprayed too much dispersant.

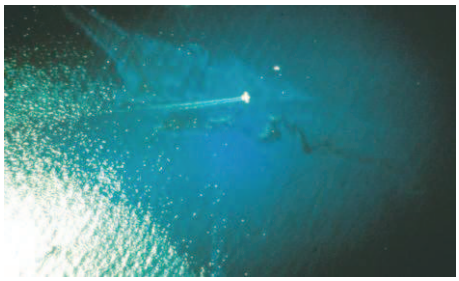




9. Appearance of a slick treated a while ago. Thick patches have gradually subsided and only thin ones are left. (mainly sheen) and are breaking up naturally.



10. A Canadair starting to spray. The bottom picture shows the same slide in a thermal IR scene. Picture taken by the remote sensing aircraft (the thickest layers are in white).



11. Continuation of treatment. Note the appearance of a dispersion cloud (beige yellow) upwind of the thicker patches (black) and also below, temporary disappearance of thinner patches (the herder effect a dispersant can produce but this is not real dispersion in action at all).

12., 13., 14. Gradual disappearance of thicker patches that turn into dispersed oil patches (yellow brown cloud).

15. The same slick a day after being sprayed. The dispersion cloud has dissolved into the background. All that is left is sheen which is waning and disappearing.

11. MONITORING AND ASSESSMENT PROCEDURES

11.1 Testing prior to large scale spraying

As a response operation swings into action but before it really gathers operational momentum, tests should be conducted on part of the slick to check that the spraying operation is likely to succeed and be effective before ramping up to full scale operations.

You will need to do aerial spraying whilst being mindful of a number of operational limitations (such as available response time) to ensure a qualitative approach to efficacy testing by:

- the spotter aircraft, but remote sensing can also be used;
- a vessel in the vicinity; these observations have to confirm the presence of a brown coloured cloud or the gradual disappearance of thicker patches;
- otherwise, the sprayer aircraft will have to provide the input once it has finished spraying all the dispersant payload or possibly before it starts a second round.

When the response operation goes on for longer periods of time, the check will have to be done at least twice a day to ensure the oil is not weathering too much and is still amenable to dispersion.

If there is no indication that dispersion is really working, you might have to decide to stop spraying and ask yourself two questions:

- Dispersion is not producing the expected results. Is this due to the nature of the oil. Has it weathered too much and is it now too viscous to be dispersed? If the answer is yes then dispersion is no longer the option you need.

- Dispersion is not producing the expected results. Is this due to very low or no wave energy at all (sea is too calm)? If the answer to the question is yes, dispersion can only really be continued providing the (very) short term weather report can announce different weather conditions likely to remedy the problem and provide more wave energy.

11.2 Monitoring operations

If response operations are going to last for a few days, you will have to take seawater samples. The sampling will have to be done in areas that have just been treated by the sprayer aircraft. The labs will check the dispersed oil content of the samples which will give an indication as to whether treatment is effective and whether dispersion is justified.

The sampling (a few decilitres) will be conducted just below the water surface and if possible no lower than one metre. The sample must be kept in a glass bottle and when the sample is transferred to the glass bottle just after sampling, the supernatant oil (from the surface slick) will have to be removed if it has been picked up inadvertently with the rest of the sample.

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