Dispersant Application Observer Job Aid

NOAA's Office of Response and Restoration • Emergency Response Division

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Acknowledgements

This job aid was prepared as a companion guide for individuals who have completed training in dispersant application observation. It is designed to be a refresher on observing and identifying dispersed and undispersed oil, describing their characteristics, and reporting this information to decision-makers. We recommend that this book be used with the Open Water Oil Identification Job Aid for Aerial observation to help describe both surface oil and dispersed oil.

Photos for this document were provided by Dr. Ron Goodman, Imperial Oil Resources; Charles Huber, Mobil Oil; Dr. Per Daling, IKU Petroleum Research, Dr. John Fraser; Charlie Henry, NOAA; Dr. Karen Purnell, ITOPF; Heidi Snell, Charles Darwin Foundation; OHMSETT; and Louisiana Department of Environmental Quality. Technical support was provided by Alan A. Allen, Spilltec and Dr. Robert Fiocco, Exxon.

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Table of Contents

Black Oil: Area of black colored oil sometimes appearing with a latex texture. Often confused with kelp beds and other natural phenomenon.

Brown Oil: Typically a 0.1 - 1.0 µm thickness of water-in-oil emulsion. Thickness can vary widely depending on wind and current conditions. Maybe referred as heavy or dull colored sheens.

Dispersion: The breaking of an oil slick into small droplets mixed into the water column as a result of breaking waves, other sea surface turbulence and/or action of chemical dispersants.

Emulsification: The formation of a water-in-oil mixture. The tendency for emulsification to occur varies with different oils and is much more likely to occur under high energy conditions (winds and waves, oil well blowouts). This mixture is frequently referred to as mousse.

Mousse: Water-in-oil emulsion often formed as oil weathers: colors can range from orange or tan to dark brown.

Sheen: Sheen is a very thin layer of oil (0.0003 mm or less) floating on the water surface and is the most common form of oil seen in the later stages of a spill. Sheens vary in color according to their thickness, ranging from almost transparent for the thinnest layers, to silvers, and rainbows and grays for the thicker layers.

Light Sheen: A light, almost transparent layer of oil. Sometimes confused with windrows and natural sheen resulting from biological processes. Sometimes referred to as transparent sheen.

Rainbow Sheen: Sheen that reflects colors.

Silver Sheen: A slightly thicker layer of oil that appears silvery or shimmers. Occasionally called gray sheen.

Slick: Oil spilled on the water that absorbs energy and dampens out the surface waves, making the oil appear smoother or "slicker" than the surrounding water.

SMART: Special Monitoring of Applied Response Technologies: establishes a monitoring system for rapid collection and reporting of real-time, scientifically based information, in order to assist the Unified Command with decision-making during in situ burning or dispersant operations. SMART recommends monitoring methods, equipment, personnel training, and command and control procedures that strike a balance between the operational demand for rapid response and the Unified Command's need for feedback from the field in order to make informed decisions. Refer to SMART manual for details.

Streamers: Oil or sheen oriented in lines, windrows or streaks. Brown oil and mousse can be easily confused with algal scum collecting in convergence lines or mats of kelp, Fucus, or seagrass. Sometimes called streaks, stringers or fingers.

Tarballs: Weathered oil that has formed a pliable ball. Size may vary from pinhead to about 30 cm. Sheen may or may not be present.

Code	Description	Layer-Thickness Interval		Concentration	
		µm	in.	m^3 per Km^2	bbl/acre
S	Sheen (silvery/grey)	0.04 - 0.30	1.6×10^{-6} – 1.2×10^{-5}	0.04 – 0.30	1×10^{-3} – 7.8×10^{-3}
R	Rainbow	0.30 – 5.0	1.2×10^{-5} - 2.0×10^{-4}	0.30 – 5.0	7.8×10^{-3} – 1.28×10^{-1}
M	Metallic	5.0 – 50	2.0×10^{-4} – 2.0×10^{-3}	5.0 – 50	1.28×10^{-1} – 1.28
T	Transitional Dark (or True) Color	50 – 200	2.0×10^{-3} – 8×10^{-3}	50 – 200	1.28 – 5.1
D	Dark (or True) Color	>200	$> 8 \times 10^{-3}$	>200	> 5.1

Chart modified by A. Allen from Bonn Agreement Oil Appearance Code (BAOAC) 02 May, 2006.

While observing dispersant applications, remember these important points:

General Information

- The monitoring observer does not make operational decisions (e.g., how much dispersant to apply, when or where to apply it, etc.) or volumetric estimates. These decisions are made by the Operations Section.

Factors Affecting Visual Observations

- Oil surface slicks and plumes look different for many reasons; for example, oil or product characteristics, time of day (different sun angles), weather, sea state, and rate at which oil disperses.
- Low-contrast light conditions (i.e., overcast, twilight, haze, etc.) make observations difficult.
- For best viewing, the sun should be behind you, with the aircraft at an altitude of about 500 to 1,000 feet observing the slick at a 30-degree angle.
- Appearances of dispersant action can range from brown to no visible plume. The visibility of the dispersed plume will vary according to water clarity. In some cases, remaining surface oil and sheen may mask oil dispersing under the slick and thus interfere with observations of the dispersed oil plume.
- Sometimes other things, such as suspended solids or algal blooms, may resemble dispersed oil.

Factors Affecting Visual Observations, *cont.*

- Dispersed oil plume formation may not be instantaneous after dispersant application. In some cases, such as when oil is emulsified, it can take several hours and may not show a visible plume at all.

What to Watch for

- A reduction in surface area or the change in appearance of the treated slick versus an untreated slick might indicate that the dispersant is working.
- A visible cloud in the water column may indicate that the dispersant is working.
- If you cannot detect a visible cloud in the water column, it is difficult to determine whether or not the dispersant is working.
- The initial dispersant application may have a herding effect on the oil making the slick appear to be shrinking when, in fact, the dispersant is "pushing" the oil together. This effect may cause the oil slick to "visibly disappear" from the sea surface for a short time.
- Dispersed oil plumes are often highly irregular in shape and vary in oil thickness. This may lead to errors in estimating dispersant effectiveness.

What to Watch for, *cont.*

- It may not be possible to determine the thickest area of oil concentration. The actual dispersant application dose will vary according to the oil thickness. This will lead to overdoses and underdoses of dispersant and variations in the effectiveness of application. The observer should note these variations.
- Boat wakes through oil may appear to disperse oil. However, this could be just the vessel wake physically parting the oil or mechanically dispersing it. Mechanically dispersed oil may recoalesce and float to the surface.
- Observers need to report the presence of marine mammals, turtles, and birds in the area of dispersant application.

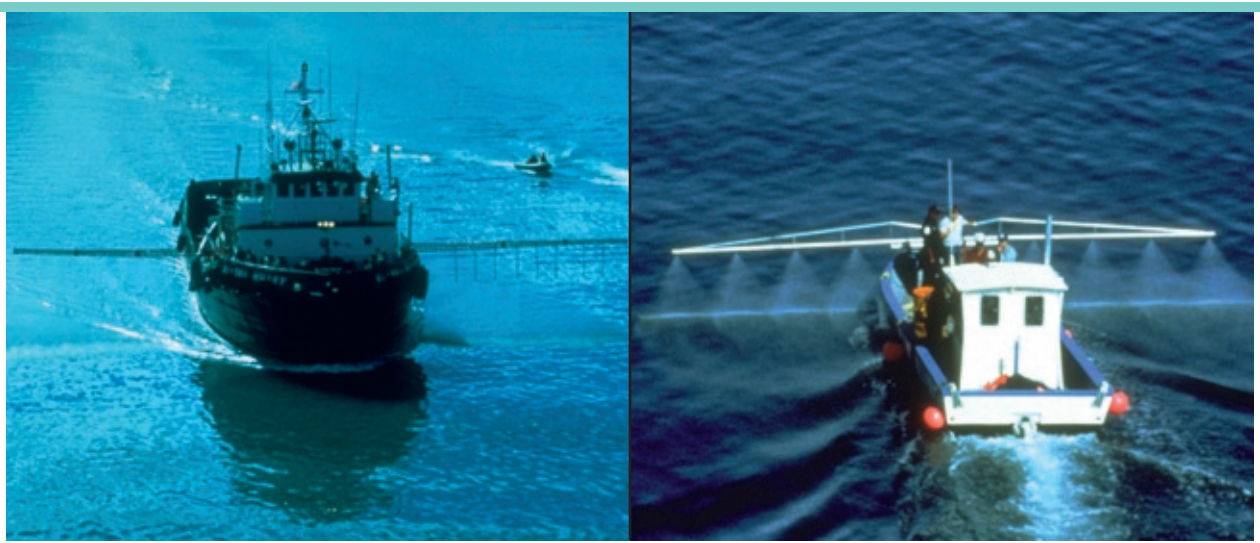
Is it Working?

- Observers may see color changes in emulsions due to reduced water content and viscosity, and changes in the shape of the slick due to the demulsification action of the dispersant, which enhances the dispersion. Sometimes other things, such as suspended solids or algal blooms, may resemble dispersed oil.
- Different observers at the same site may reach different conclusions about how much of the slick has been dispersed. This highlights the importance of standard reporting criteria and training of individuals with a common set of guidelines. Focus should stay on determining if it is working or not.

This is a side view of a DC-4 during dispersant application methods tests by the Southern California-Petroleum Contingency Organization and API in September 1978 and 1979. The dispersant has been dyed red for increased visibility.

Dispersant application from a C-130 Hercules using an Aerial Dispersant Deployment System (ADDS). The dispersant has been dyed red for experimental purposes.

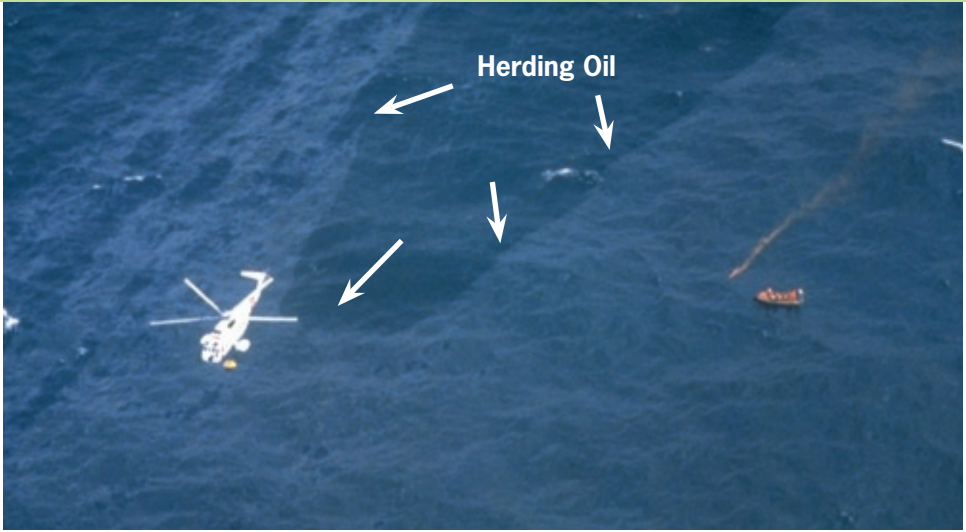
A helicopter applying dispersant using a bucket spray unit (side and top views).



Dispersant application from a ship (front and rear views).

Release of 20 cubic meters (5,300 gallons) of Sture blend crude, weathered for 35 hours before treatment. In the photo, a helicopter applies 800 liters (5 barrels or 211 gallons) of COREXIT 9500 to the oil. Due to the combination of cloudy weather conditions and the oil forming a very dark emulsion, it was difficult for the personnel in the application helicopter to differentiate thicker, emulsified oil from thinner oil films and sheens. This points to the need for a spotter aircraft to achieve successful dispersant application.

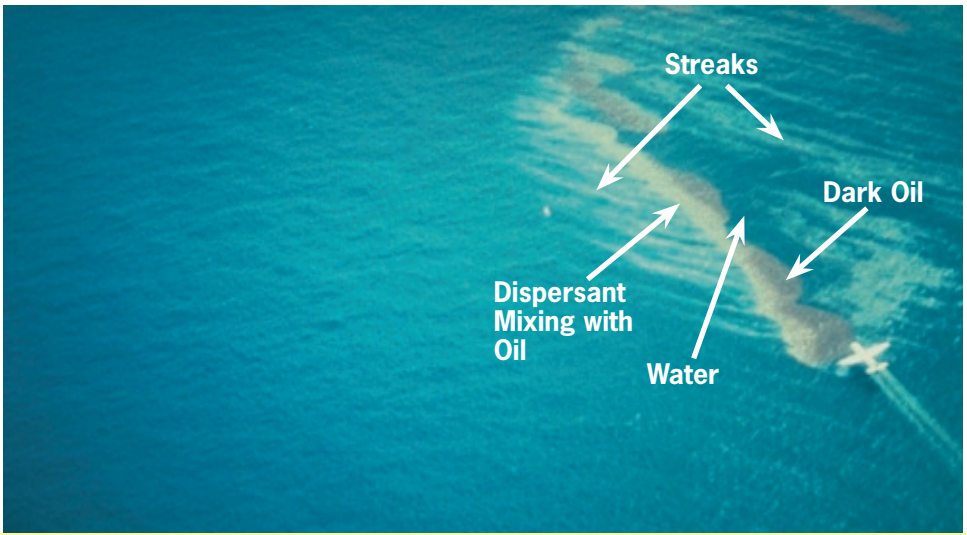
*Norwegian Clean Seas Association for Operating Companies

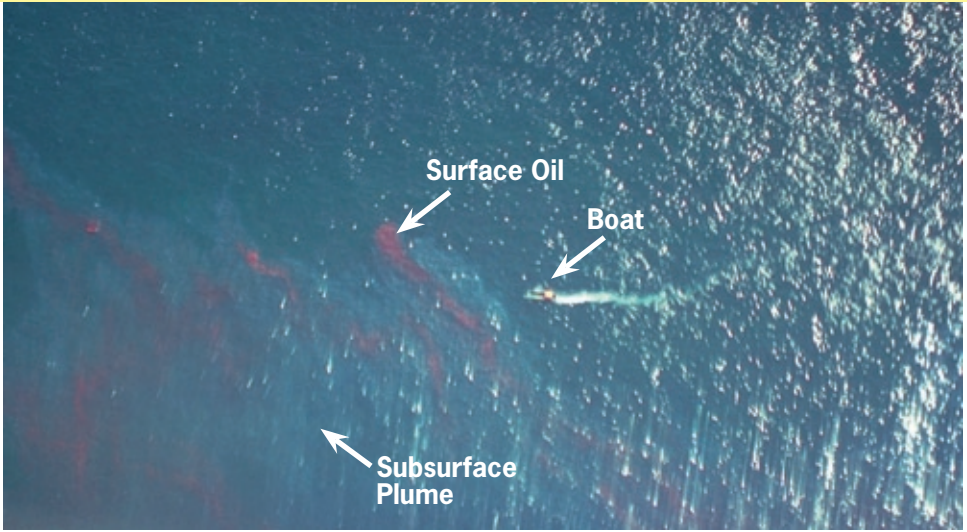


Researchers reported that despite poor conditions for visually observing dispersed plume development, oil was dispersed and the dispersed plume was documented by water column measurements. Shown here is the initial “herding” effect on the thin oil film area - application same as the previous photo.

Dispersant Application to a Spill

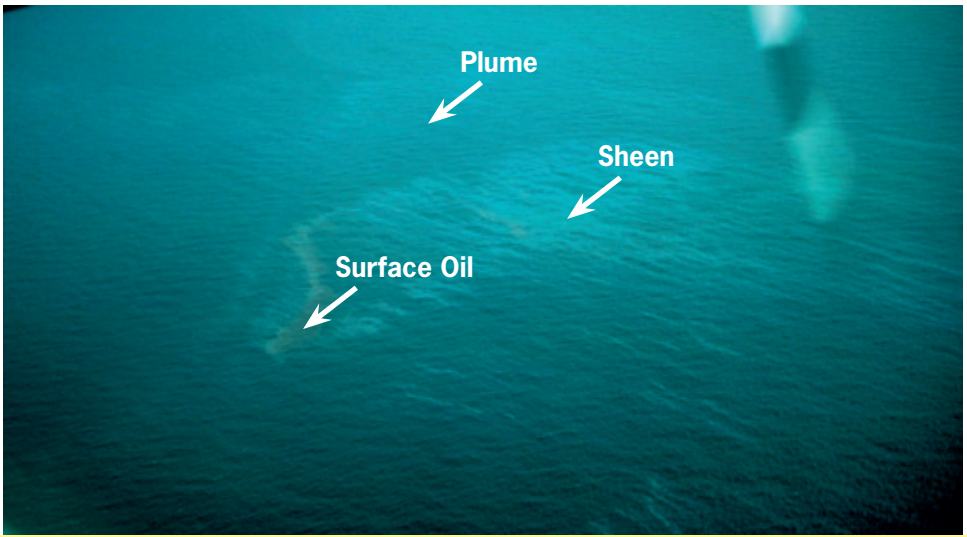
This series of three photographs shows dispersant applications during the *Exxon Valdez* spill in 1989. This photograph shows an application to thick dark oil. Note sheen moving off slick after dispersant was applied. This is due to wind and current moving the surface oil faster than the subsurface dispersed oil, which is moving by current alone. There is no visible subsurface plume. (Time: 14:52)

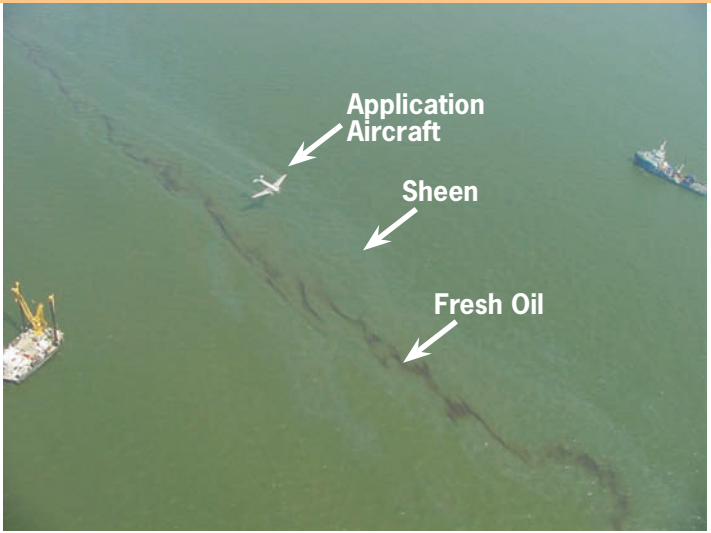




Slick breaking up about 30 minutes after the third dispersant application. A subsurface plume is now visible. (Time: 15:24)

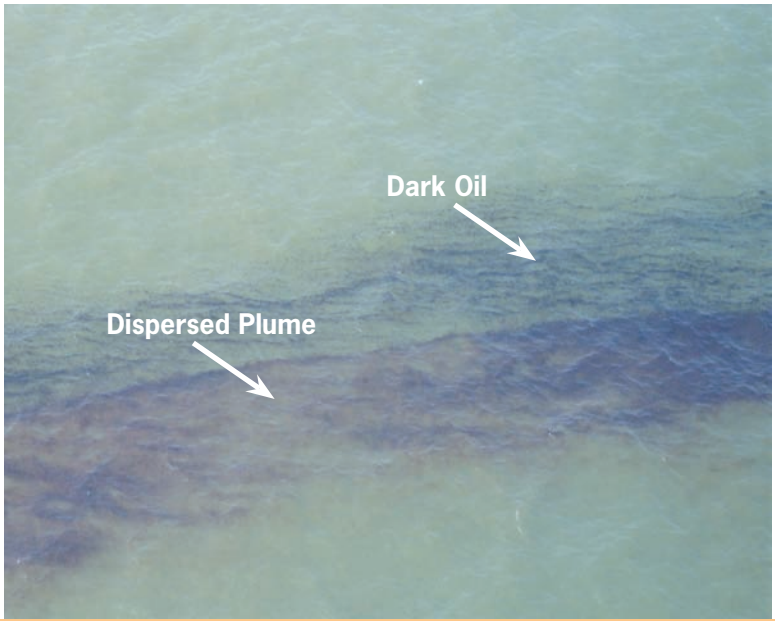
The slick an hour after the previous photo. Note that some of the slick was not sprayed and remains on the surface. The surface oil is moving faster than the dispersed plume due to wind effects. Dispersed oil plume formation may not be instantaneous after dispersant application. In some cases, such as when oil is emulsified, it can take several hours and may not show a visible plume at all. (Time: 16:41)

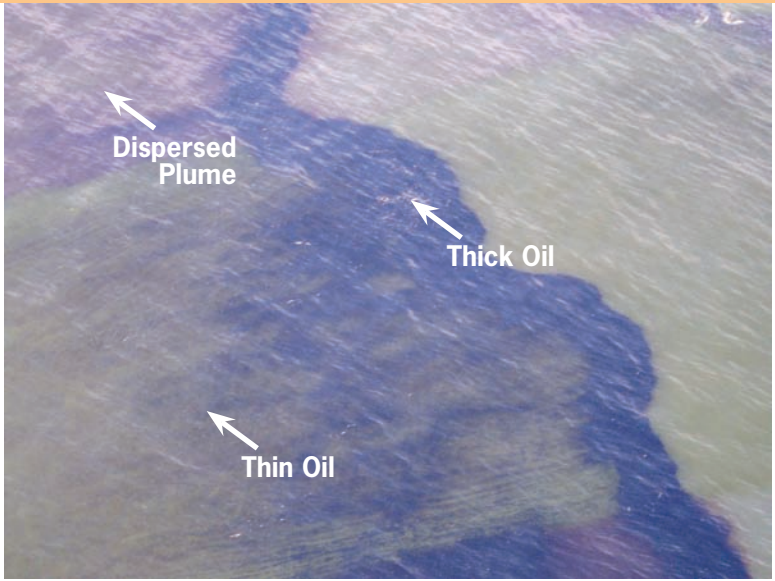




The next three photographs contrast treated vs. non-treated oil only a few minutes after application. The sea state was calm, resulting in a very slow dispersion rate. No subsurface plume was observed in part due to the slow dispersion rate and in part due to the lack of water clarity of coastal waters off the Mississippi Delta. Observation Platform = helicopter. Altitude = 500 ft.

Dispersant applied to a portion of slick only. Changes in the treated oil are clearly visible shortly after application. Observation Platform = helicopter. Altitude = less than 100 ft.

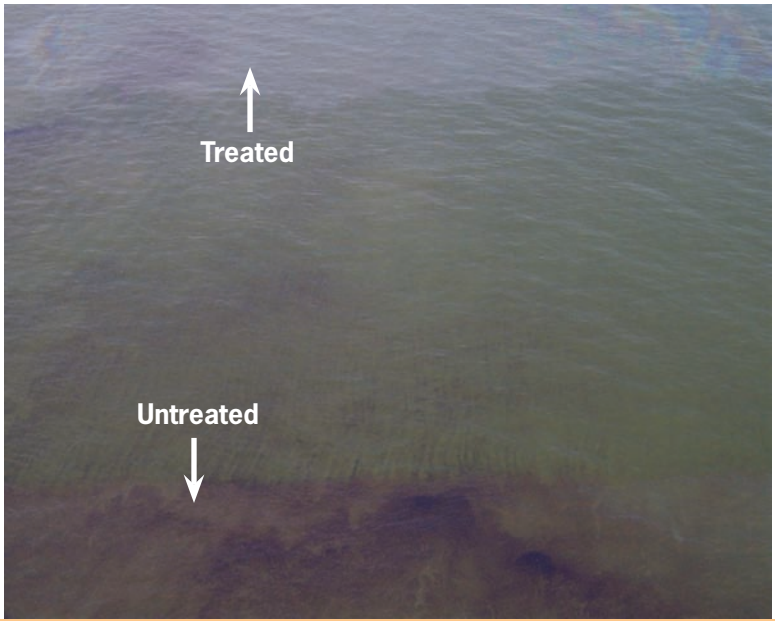


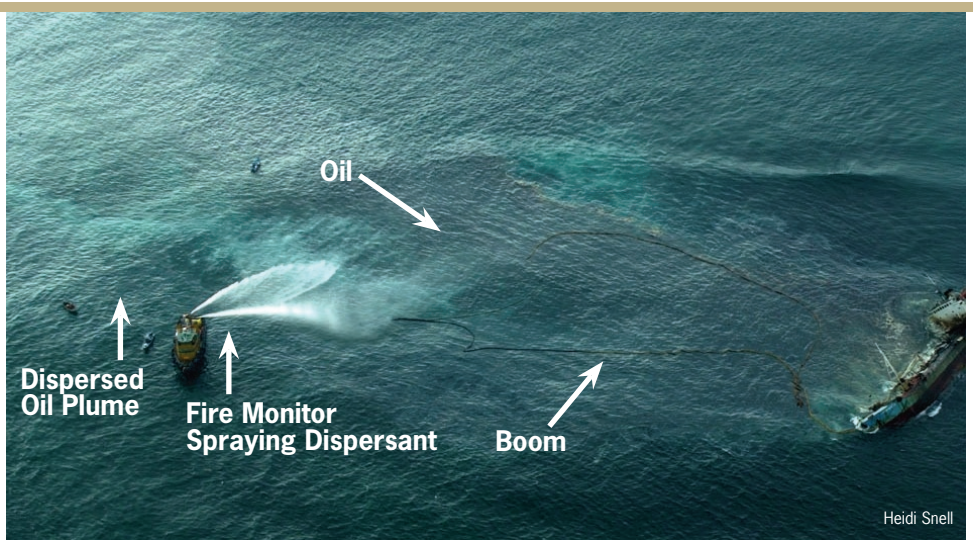


Application across oil slick. Thin oil slick is dispersing, but the thick portion of the slick is slow to disperse, or may require a second application to be efficient. Photograph taken shortly after application.
Observation Platform = helicopter. Altitude = less than 100 ft.

Main Pass 69, Gulf of Mexico, 2004

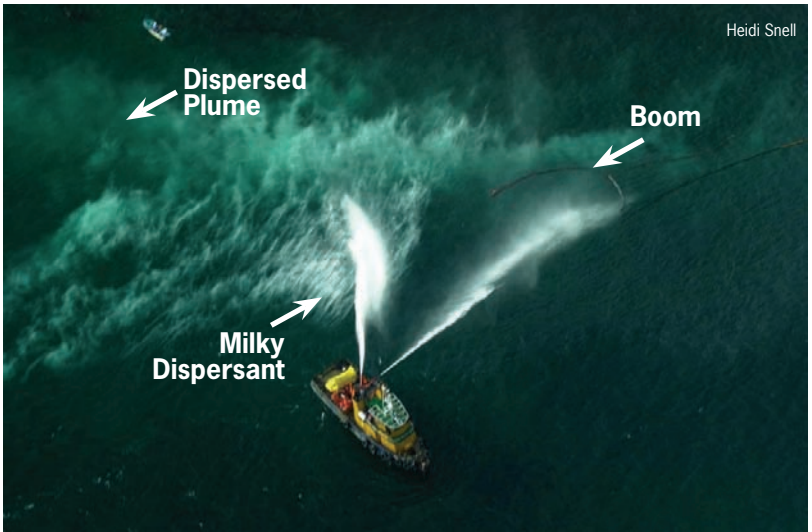
Application applied to upper portion of photo exhibits rapid changes as oil begins to disperse. Oil slick shown on the lower portion of the slide was untreated. Observation Platform = helicopter. Altitude = less than 100 ft.

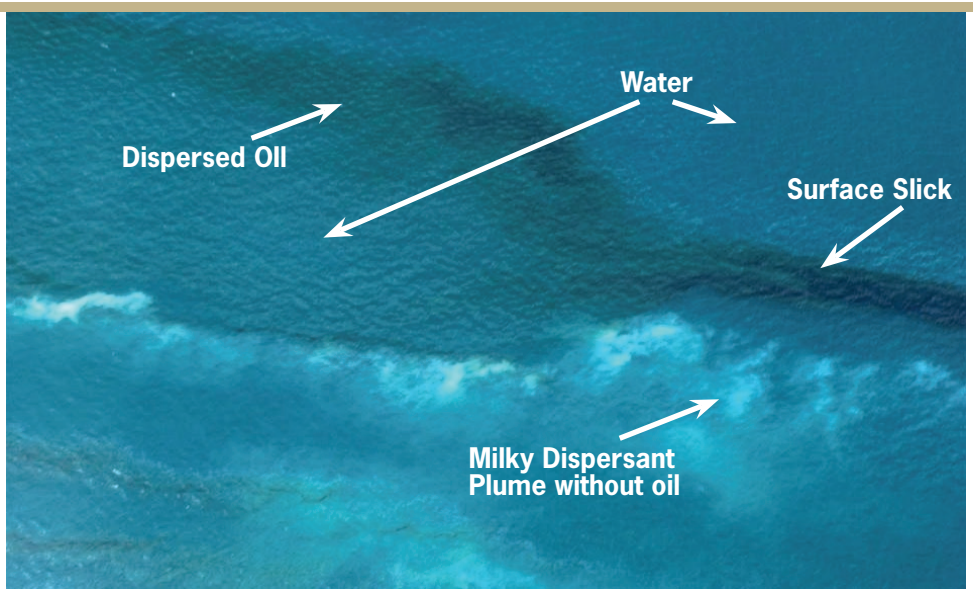




The Tanker Jessica struck a reef off Puerto Baquerizo Moreno on San Cristobal Island on the night of 16 January. The 260 foot vessel was carrying 160,000 gallons of diesel fuel oil and 78,000 gallons of IFO 120. The vessel lost a significant quantity of oil and was hard aground on a shallow shoal off the harbor entrance near Wreak Bay.

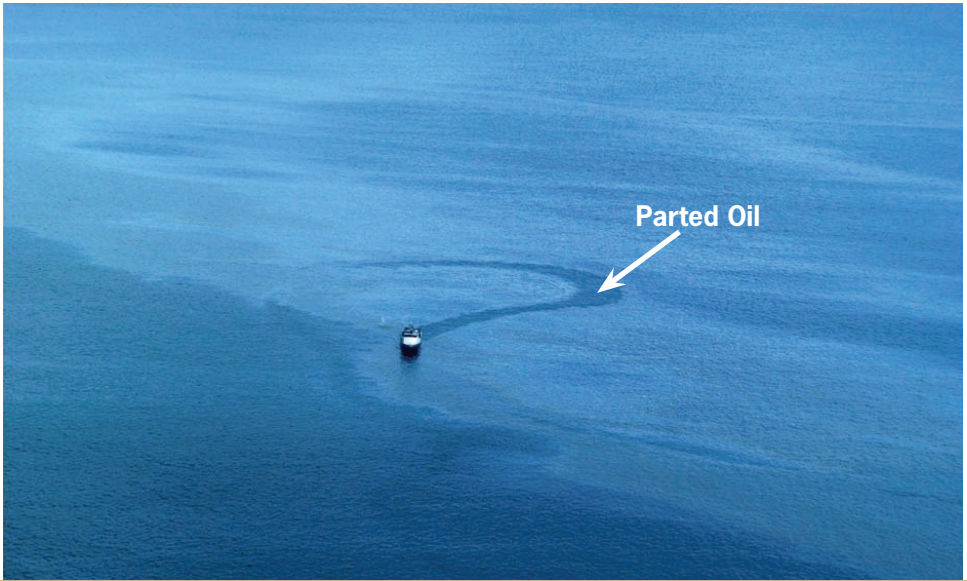
The dispersant (Seacare Ecosperse) was applied to the heavy oil slick by boat application using an inline foam induction system with a hand-held fire monitor beginning on 23 January. The application was effective as the dispersant was being applied to fresh oil which continued to leak from the vessel. The white milky plume observed in this photo is most likely dispersant not hitting the oil.

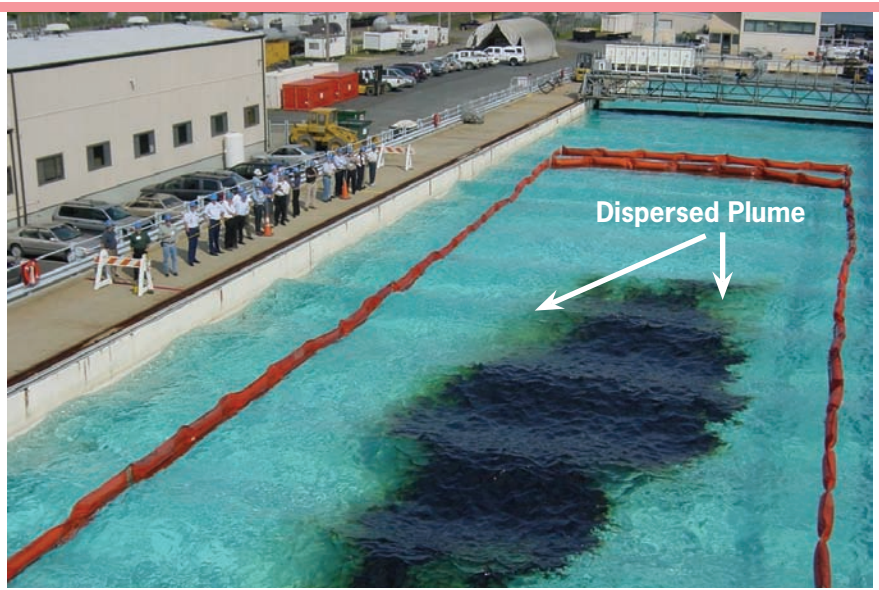




Within 30 minutes the dark coffee-colored dispersed oil plume can be observed separating from the black surface slick. The milky dispersant plume that did not contact oil can also be observed.

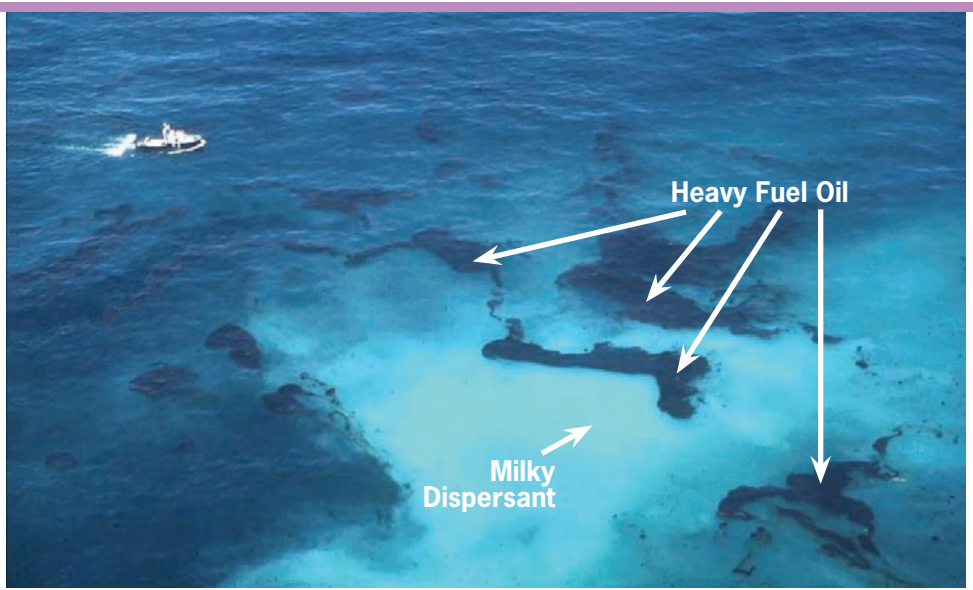
Boat passing through sheen and darker oil. Notice how the vessel wake is breaking a path through the oil, either physically parting the oil or mechanically dispersing it. Mechanically dispersed oil may recoalesce and float to the surface.





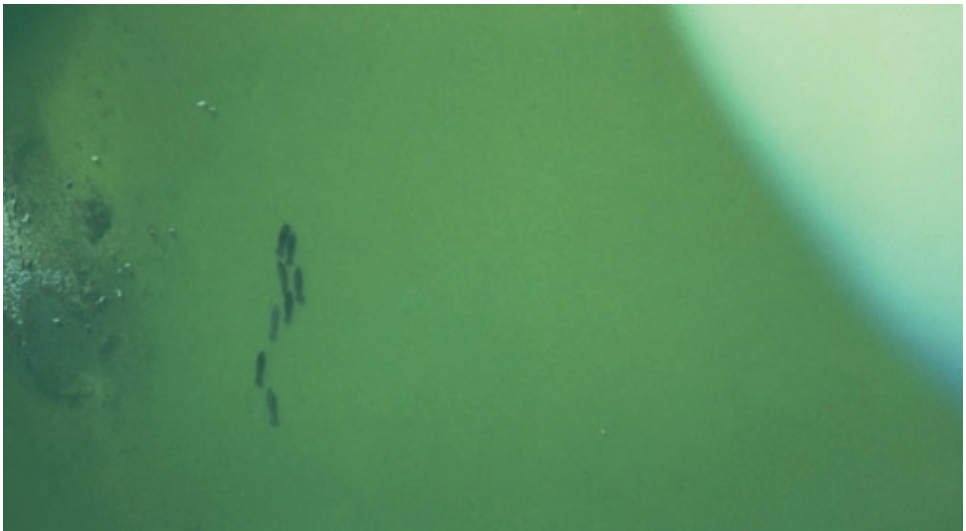
View of surface slick minutes after dispersant application. Coffee color plume is becoming visible beneath surface. Notice the minimal wave energy. In the absence of wave energy and mixing currents, mechanically dispersed oil may coalesce (this picture shows calm conditions).

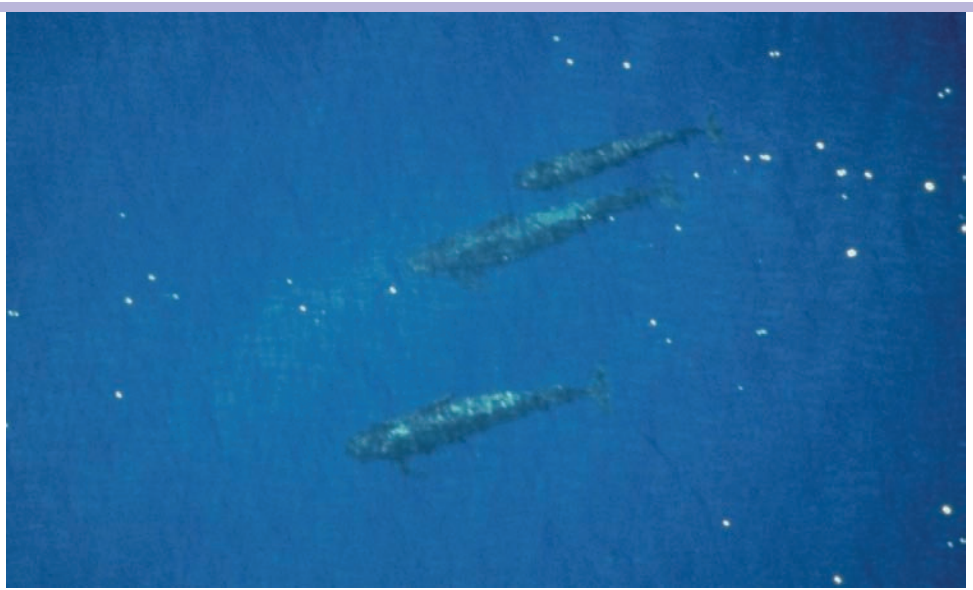
Another test dispersant run viewed from below. Notice the coffee color of the plume and how it spreads out below the surface. The tank is 3.4 meters deep.



This photo shows an ineffective use of dispersants on a heavy fuel oil. The picture was taken off the coast of South Africa following the collision between the Ventpet and Venoil in 1997. The milky plume is the dispersant mixing with the sea water. No oil is being dispersed.

Birds, turtles, and marine mammals need to be reported if they are in the dispersant application area. This photo shows a herd of manatees swimming below the surface. You can see the paddle shape of the tail.





Whales may form patterns in the water that can be confused with dispersing oil.

This photo shows a turtle swimming below the surface.

Observers: _____

Date: _____

Start Time: _____ End Time: _____

Platform: _____

Rank	Standard Phrase	Description	Time	Time	Time
1	No obvious dispersion	Dispersant being washed off the black oil as white, watery solution leaving oil on surface. Quantity of oil on sea surface not altered by dispersant.			
2	Slow or partial dispersion	Some surface activity (oil appearance altered). Spreading out of oil. Droplets of oil seen rapidly rising back to sea surface, but overall quantity appear to be similar to that before dispersant spraying.			
3	Rapid dispersion	Oil rapidly disappearing from surface. Light brown plume of dispersed oil visible in water under the oil and drifting away from it. Oil in some areas being dispersed to leave only sheen on sea surface, but in other areas still some oil present.			

Time of observations should be recorded from initial application or arrival on scene and then approximately 15 minutes apart until observations area ceased.

(Modified from the UK 2003 Dispersant Sea Trials Observation Recording Form)

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