AERIAL AND VESSEL
DISPERSANT OPERATIONS

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Things You **Should Know**

Aircraft and vessel-based dispersant application platforms have the potential to treat larger and more distant spills more quickly than other response options.

Aerial application of dispersants can be the first response for an offshore spill, often arriving on scene within 4 – 8 hours.

The variety of dispersant application platforms (planes to vessels) allows all types of slicks to be treated efficiently; small to large,near and far from shore.

Spotters are used during dispersant use to ensure accuracy of applicaton and to maximize dispersion efficiency.

Overview

Dispersants are products used in oil spill response to enhance natural microbial degradation, a naturally occurring process where microorganisms remove oil from the environment. All environments contain naturally occurring microbes that feed on and break down crude oil. Dispersants aid the microbial degradation by forming tiny oil droplets, typically less than the size of a period on this page (<100 microns), making them more available for microbial degradation. Wind, current, wave action, or other forms of turbulence help both this process and the rapid dilution of the dispersed oil. The increased surface area of these very small oil droplets in relation to their volume makes the oil much easier for the petroleum-degrading microorganisms to consume.

Dispersants can be used under a wide variety of conditions since they are generally not subject to the same operational and sea state limitations as the other two main response tools - mechanical recovery and burning in place (also known as in-situ burning). While mechanical recovery may be the best option for small, near-shore spills, which are by far the majority, it has only recovered a small fraction of large offshore spills in the past and requires calm sea state conditions that are not needed for dispersant application. When used appropriately, dispersants have low environmental and human health risk and contain ingredients that are used safely in a variety of consumer products, such as skin creams, cosmetics, and mouthwash (Fingas et al., 1991; 1995).

This fact sheet summarizes the operational capabilities and potential benefits of dispersant use at the water surface. This includes the application process, equipment, and planning requirements when applying dispersants to the water surface by aircraft or boat.

Fact Sheet Series

Introduction

Dispersants are used for the rapid removal of oil slicks from the water surface. In general, the primary goal of a response is to remove spilled oil from the environment. When other removal methods (e.g., mechanical tools like boom and skimmers) are deemed to be inadequate for the response or have limited effectiveness due to such factors as weather conditions, distance from useable ports, or water depth, dispersants provide another method to protect vulnerable surface resources and shorelines.

Oil spilled on water poses an ever expanding problem as the slick continues to spread and affect other areas and resources as it moves on the water surface.[1] Responders must determine what response options offer the greatest potential to protect surface resources and shorelines. They must determine whether to attack the surface oil with recovery and removal techniques which may be limited in their recovery capability, potentially allowing for additional impacts to shorelines and wildlife that utilize the water surface, or to remove the spilled oil from the water surface through other means such as the use of dispersants or burning in place (in-situ burning). Both of these methods shift the potential effects from the water's surface to either the water column in the case of dispersant use or the air when in-situ burn is conducted. **Fact Sheet #5 – Dispersant Use Approvals in the United States** summarizes the current requirements for dispersant use for on water spill events.

If dispersants are being considered as a response option, the decision-makers must also consider the toxicity of the oil, dispersed oil, and the dispersant itself since mixing the oil into the water column potentially exposes an array of resources and habitats that normally would not be exposed if the oil were left on the surface. Although scientific research has shown that dispersants are not as toxic as the oil itself and do not increase the toxicity of oil/dispersant mixtures (EPA Office of Research and Development (ORD), 2010), some components of dispersants may be toxic (ASTM, 2006) and their use during an incident must be carefully considered. For more information, refer to **Fact Sheet #4 – Toxicity and Dispersants**.

In different parts of the world, government regulations may require the pre-contracting of aerial and vessel dispersant response resources for dispersant application, including personnel who are trained in and capable of applying dispersants. This may include a requirement for having trained personnel for aerial tracking of oil available.[2]

FIGURE 1. **Dispersant Applications:** *Top Left* – Aerial (plane) application; *Top Right* – Aerial (helicopter) application; *Bottom Left* – Boat spray bar dispersant application; *Bottom Right* – Point source injection (at the wellhead)

Dispersant Applications

After receiving authorization, there are several ways in which dispersants can be operationally applied to spilled oil. These are: 1. aerial dispersant applications (plane and helicopter); 2. boat dispersant applications; and 3. subsea or point source applications.

Dispersants have also been used for the protection of response workers working at a well blowout. As soon as oil comes in contact with the air, it begins to evaporate and the air above a surface slick may contain fairly high levels of Volatile Organic Compounds (VOCs). A number of the smaller molecules contained in the VOCs are known to be harmful to human health. The use of dispersants to keep the oil off of the water's surface was found to be an effective means to keep VOC levels low during the Macondo Well spill response. This was especially important since it improved conditions and allowed responders to work safely in the location of the former platform, an area that had fresh oil present for more than 90 days (Curd, 2011).

Aerial Application Equipment

When applying dispersant from the air, aircraft are equipped with dispersant tanks and spray systems designed for specific aircraft. Current aircraft capabilities vary in size from a helicopter to a Lockheed C-130 Hercules cargo plane (NOAA, 2009). Jet aircraft platforms are soon to be available as well. These platforms will have considerably greater range and can get to a spill site, ready to apply dispersants, quite quickly (OSRL, 2013).

1 For more information on the forces and weathering effects on oil spilled in water, refer to **Fact Sheet #3 – Fate of Oil and Weathering**.

2 In the US, these are described in 33 CFR §154.1045(i) and (j), see references.

FIGURE 2.

Use of dispersants to "knock down" VOCs for responder safety

FIGURE 3.

Aerial Dispersant Deployment System (ADDS) being loaded onto a C-130.

One of multiple examples of aerial spray equipment, such as the NIMBUS and MASS spray systems, is the Aerial Dispersant Deployment System (ADDS). This is a removable tank and spray system that can be fitted to a large C-130 aircraft. It is rolled into the airplane's cargo bay and quickly set up to carry and spray up to 5,000 gallons (19,000 L) of dispersant. Helicopters can be equipped with underslung spray buckets to spray dispersant but are limited to carrying up to 240 gallons (~ 900 L).

FIGURE 4.

Spray nozzle system for dispersant

Nozzles on the spray systems of all aircraft are designed to produce a spray at a particular droplet size to cover the surface of an oil slick with an amount of dispersant to meet agreed upon application ratios (ASTM 2011; 2007a; 2007b), generally five gallons per acre (~47 L/hectare).

Operations

Prior to application, spotter personnel in aircraft identify the location of dispersible surface oil and direct the spray aircraft to these areas. The spotter aircraft directs the pilot when to turn on and off the dispersant spray to ensure exact targeting and avoid overspray. Spray aircraft apply dispersant at altitudes from 50 to 100 feet (15 to 30 m) and at application speeds of 125 to 145 knots (230 to 270 kph). Figure 5 shows a "Race Track" model, which diagrams one of several dispersant application strategies using aircraft (NOAA, 2009).

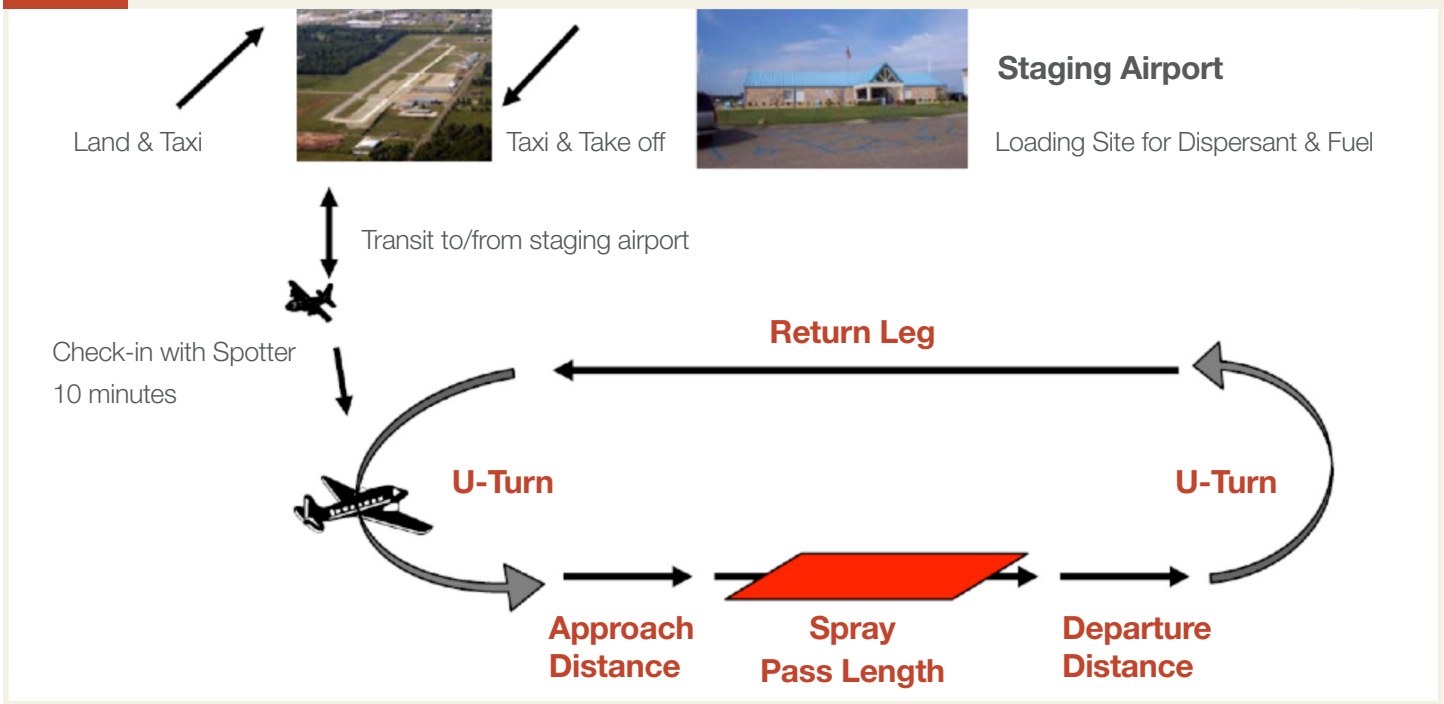
Boat Application

Boat applications are conducted for two reasons: 1) targeted small scale dispersion operations, and for 2) VOC suppression to protect response worker health and for areas where aircraft cannot fly.

For dispersant applications, boats of various sizes can be equipped with portable totes or ISO tanks and a spray arm system. Like aerial applications, the boat spray arm nozzles are adjusted to spray at a specified rate and droplet size to cover the surface of an oil slick with dispersant. As with spray planes, dispersant boats are directed by spotter planes.

Boats provide a valuable platform to help response operations (including capping and containment activities) progress safely and expeditiously. In order to assure the safety of response personnel working at a source location, dispersants may be applied from a boat to reduce the concentration of VOCs in the work area.

FIGURE 5. Example of an aerial dispersant application model, the Race Track, for efficient dispersant application on water. Source: NOAA, 2009.



Benefits and Limitations of Dispersant Applications

Each method of dispersant application has its own benefits and limitations that must be carefully weighed before beginning operations (Allen, 1988).

Benefits:

- Aerial (plane and helicopter) application of dispersants:
  - Can be conducted over very large areas.
  - Greatly increase the volume of oil capable of being treated in a single day.
  - Can arrive at oil slicks far out to sea and begin treatment on day 1 quickly.
  - Provide rapid response (using dedicated aircraft with 2-4 hour response times), especially when additional releases occur, reducing time for oil spreading.
  - Typically have a fast turnaround time for refueling, refilling, etc., often less than 60 minutes.
  - Can operate during heavy sea states, when skimmers and in-situ burning cannot.
- Boat application provides greater safety for response workers by reducing VOC exposures from oil and fumes while working on water.

Limitations:

- Aerial and boat applications are limited during fog when it may be difficult to spot the surface slicks. Aerial assets cannot conduct spray operations in bad weather (e.g., excessive winds) or low visibility.
- Unlike ship-based systems, aerial applications may not be able to observe an oil slick closely to determine thickness, consistency and presence of tarballs.
- Unlike ship-based operations, aircraft observers cannot always distinguish biogenic materials such as jellyfish blooms, fish spawn or sea grass beds from floating oil.

Operational Requirements

During dispersant application, the use of clearly defined logistics, coordination, communication, and trained personnel are required for safe and effective operations. Additionally, there may be specific requirements and components needed for dispersant application, such as the definition of exclusion zones or the use of monitoring equipment

References

33 CFR §154.1045(i) – **Dispersant Operation Requirements**. Available online at http://ecfr.gpoaccess.gov/.

33 CFR §154.1045(j) – **Aerial Oil Tracking Resources**. Available online at http://ecfr.gpoaccess.gov/.

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. ***Toxicological Profile for Total Petroleum Hydrocarbons***. Available on line from http://www.atsdr.cdc.gov/.

Allen, A. 1988. ***Comparison of response options for offshore oil spills***. Proceedings, Artic and Marine Oil Spill Pollution, Vancouver, June 7-9, 1988, pp. 289-306.

ASTM International. 2011. ***ASTM F2465/F2465M*: Standard Guide for Oil Spill Dispersant Application Equipment: Single-point Spray Systems.** Available for purchase online at: www.astm.org/Standards/F2465.htm.

ASTM International. 2008. ***ASTM F1779-08*: Standard Practice for Reporting Visual Observations of Oil on Water.** Available for purchase online at: www.astm.org/Standards/F1779.htm.

ASTM International. 2007a. ***ASTM F1460 – 07*: Standard Practice for Calibrating Oil Spill Dispersant Application Equipment Boom and Nozzle System.** Available for purchase online at: www.astm.org/Standards/F1460.htm.

ASTM International. 2007b. ***ASTM F1413 – 07*: Standard Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems**. Available for purchase online at: www.astm.org/Standards/F1413.htm.

ASTM International. 2006. ***F2532 – 06*: Standard Guide for Determining Net Environmental Benefit of Dispersant Use**. Available from: http://www.astm.org/Standards/F2532.htm.

Centers for Disease Control and Prevention (CDC). 2010. ***2010 Gulf Oil Spill website***. Specific topic information provided on the Public Health Issues, Hazardous Substances, and General Information weblinks maintained on this webpage: http://emergency.cdc.gov/gulfoilspill2010/.

Curd, H. 2011. **The Use of Dispersant for the Control of Volatile Organic Compounds**. In: Proceedings of the 2011 International Oil Spill Conference, Portland, OR. 7 pages. Available from: http://www.ioscproceedings.org/doi/abs/10.7901/2169-3358-2011-1-359.

National Oceanic and Atmospheric Administration (NOAA). 2009. ***NOAA Dispersant Mission Planner 2*** (DMP2). Available from: http://response.restoration.noaa.gov/dmp2.

Oil Spill Response Limited (OSRL). 2013. **Aviation Capability – Hercules Aircraft Replacement Project.** Available from: http://www.OilSpillResponse.com.