SUBSEA AND POINT SOURCE DISPERSANT OPERATIONS

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Things You **Should Know**

Dispersants may only be applied with the appropriate government approvals.

Subsea injection reduces the amount of oil coming to the surface and the potential for exposure by personnel to the volatile organic components of the oil.

Subsea injection may require significantly less dispersant compared to dispersing at the surface. In a subsea release or a puncture of a pipeline or tanker that cannot be rapidly controlled, decision-makers should consider the application of dispersants as close to the leak source as possible.

An efficient subsea dispersant delivery system could potentially treat the vast majority of oil escaping from a single release point before it reaches the surface and forms a widely spread slick.

Subsea injection may proceed day and night and is generally not limited by weather. Other response options are usually limited to daylight hours and could have significant weather limitations.

Dispersants remove oil from the water surface thereby protecting birds, mammals and sensitive shorelines.

Oil discharged in deep waters will be removed from the environment by petroleum degrading bacteria found throughout the water column world-wide. The addition of dispersant will enhance the rate of biodegradation due to the increased surface area accessible to bacteria.

Treated oil is rapidly diluted to the point that biodegradation occurs at low concentrations without depleting oxygen or nutrients.

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., 2001; 2005)

This fact sheet summarizes the benefits and limitations of dispersants use for subsea and point source injection.

Fact Sheet Series

Introduction

If an oil spill occurs, some level of impact is inevitable. The use of dispersants is one response method used to reduce those impacts. In general, the use of dispersants is only authorized with appropriate government approvals. **Fact Sheet 5 – Dispersant Use Approvals in the United States** provides an example of the necessary regulatory authorities and requirements for the use of dispersants.

Dispersants have typically been used for the rapid removal of oil from the water surface when other removal methods (e.g., mechanical recovery) are deemed to be inadequate for the response or have limited effectiveness due to weather conditions, response time, etc. Subsea and point source dispersant operations allow dispersant to be applied at the point of release to more efficiently protect vulnerable surface resources and shorelines rather than waiting for the oil to surface and spread out in large surface slicks that would present a challenge for recovery. While there will likely be some level of impact to water column-dwelling organisms, impacts are expected to be limited and relatively short lived in comparison to effects that would be experienced by sensitive shoreline communities.

Subsea and Point Source Dispersant Application

Subsurface Injection by ROV at the well head. Photo provided by BP.

During subsea dispersant applications (also referred to as subsurface injection), dispersants are transferred from a surface ship or a dispersant storage tank on the sea floor and are applied directly at the point of release by a remotely operated vehicle (ROV) or hard piped into the blow-out preventer (BOP) or some other subsea assembly. A hose and nozzle are manipulated by ROVs to deliver dispersant directly into oil being discharged, such as from a broken pipe or well head, as was done for the Macondo Well response in 2010. This allows:

- The dispersant to mix with oil more effectively. The encounter rate with oil (dispersant interacting with the oil during application) can be as high as 100%, whereas encounter rates with surface dispersant application methods, albeit high, can vary with sea state, wind, etc.
- Dispersion to occur in deeper waters in order to rapidly reduce the size and concentration of oil droplets and prevent them from reaching the water's surface.

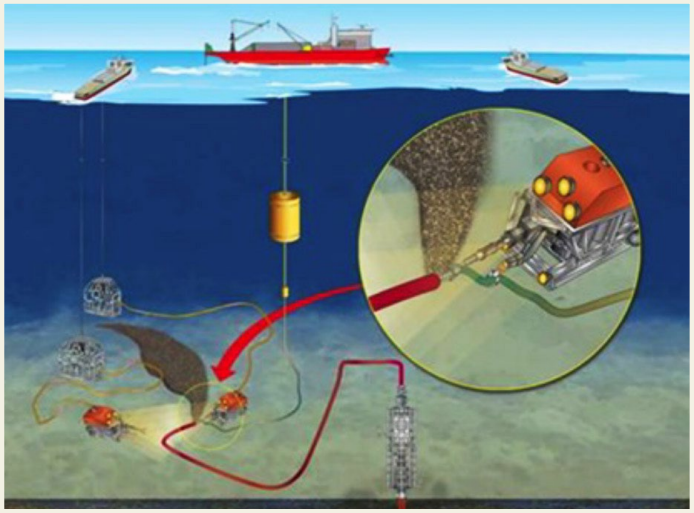
Dispersants can also be directly applied to the source of oil leaking from a foundering ship in heavy weather or to a holed vessel at sea when other response methods may have limited effectiveness, i.e., as a point source application.

Advantages of Subsea and Point Source Application

Subsea and point source applications have several advantages over surface dispersant applications:

- **Safety** — subsea injection reduces the amount of oil coming to the surface and this in turn (a) reduces the potential for exposure of surface vessels and personnel to volatile components of the oil and (b) reduces the need for surface recovery, *in-situ* burn, and surface dispersant operations, thereby reducing the potential for exposure of response personnel to accidents during these operations.
- Point source applications can reduce the potential for worker and public exposures by treating the oil where it is being discharged and preventing it from spreading or coming closer to shore.
- **Oil Removal** — Natural biodegradation processes will remove the oil from the environment as petroleum-degrading bacteria found throughout the water column world-wide consume the oil as a food source. The addition of dispersant will enhance the rate of biodegradation due to the increased surface area of the very small individual droplets that are formed.
- **Efficiency** — Subsea injection may require significantly less dispersant compared to dispersing at the surface.

Example of subsurface dispersant injection using a ROV. Graphic provided by ExxonMobil.



- **Precision** — Subsea application ensures that all dispersant is mixed with the oil at one manageable location before it spreads, instead of trying to treat widely spread oil slicks at the surface.
- **Application** — Surface and point source dispersant applications require favorable weather conditions, while subsea dispersant injection from a vessel can proceed in a much broader range of conditions.
- **Timing** — Application can occur around the clock, whereas surface (aerial and vessel) applications are usually restricted to daylight hours.
- **Effectiveness** — The operational effectiveness of dispersant applications on subsurface and point source oil discharges is likely to be more effective as the oil being treated has not undergone extensive weathering. Weathering of the oil can make it less dispersible. For more information refer to **Fact Sheet 3 – Fate of Oil and Weathering**.
- **Biodegradation Enhancement** — Dispersant treated oil is rapidly diluted to the point that biodegradation can occur at very low concentrations without depleting oxygen or nutrient levels in the water column.

Regulatory Requirements

As of 2013, there are no regulations that apply specifically to subsea and point source dispersant use. The approval process is generally the same as for surface use, however, this may change.

To date, none of the Regional Response Teams (RRTs) have specifically addressed subsea injection and point source dispersant applications in their regional and area planning documents, although its use is a topic of current discussion. The RRTs have the responsibility to evaluate and provide decision-making guidance/policy on the use of response technologies within each region. As this technology has not been widely applied, the National Response Team (NRT) has developed guidance to assist the RRTs as they may be asked to evaluate the potential use of subsea dispersant injection as well as associated monitoring requirements. For more information refer to **Fact Sheet 5 – Dispersant Use Approvals in the United States**.

Areas Under Further Investigation

Numerous research projects are currently investigating various aspects of subsea injuection of dispersants, including:

- Effects of dispersed oil at depth on living organisms and the food chain
- Whether or not sedimentation of oil on the sea floor is affected by the use of dispersants
- Long term effects of oil at extreme depths
- Rate of biodegradation at depth

It is expected that the application protocols associated with subsea dispersant use will be further refined as more data are available.

References

Etkin, D.S. 2009. **Analysis of U.S. Oil Spillage**. The American Petroleum Institute, Regulatory and Scientific Affairs Department. Washington, D.C.: American Petroleum Institute. 86 pages.

Fingas, M.F., R.G. Stoodley, N. Stone, R. Hollins, and I. Bier. 1991. **Testing the Effectiveness of Spill-Treating Agents: Laboratory Test Development and Initial Results**. In: *Proc. 1991 International Oil Spill Conference.* API. Washington, DC.

Fingas, M.F., D.A. Kyle, N.D. Laroche, B.G. Fieldhouse, G. Sergy, and R.G. Stoodley. 1995. "The Effectiveness of Spill Treating Agents." **The Use of Chemicals in Oil Spill Response**, ASTM STP1252, P. Lane, Ed. ASTM, Philadelphia, Pennsylvania.

International Association of Oil & Gas Producers (OGP). 2010. **OGP Risk Assessment Data Directory – Blowout Frequencies**. Report No. 434-2. 20 pages. Available online from: www.ogp.org.uk/pubs/434-02.pdf.

SINTEF. 2012. SINTEF Offshore Blowout Database – Definitions. Available on line from: http://www.sintef.no/home/Technology-and-Society/Safety-Research/Projects/SINTEF-Offshore-Blowout-Database/.