DISPERSANTS — HUMAN HEALTH AND SAFETY

Things You **Should Know**

Toxicity is the potential of a chemical to cause adverse effects. Most substances are toxic at a high-enough dose.

Dispersants are less toxic than most crude oils and adding dispersant in low levels at the appropriate application rates does not increase the toxicity of the oil.

Most dispersants are biodegradable and contain ingredients which are similar to those found in many common household soaps, cosmetics, detergents, and shampoos and even food.

Personal protective equipment (PPE) is required when handling chemicals and basic PPE is required to protect responders while transferring and handling dispersants.

The general public will not come in direct contact with dispersants when dispersants are properly applied.

Concerns that human health might be affected from consuming dispersant tainted seafood are unfounded; the ingredients in most dispersants are not persistent because they biodegrade, therefore they don't move up the food chain for shrimp, fish, etc.

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. For more information on Dispersants and microbial degradation refer to **Fact Sheet #1 — Introduction to Dispersants**.

All materials have some ability to cause toxic or adverse effects in living organisms that may be exposed; these effects are responses exhibited outside the normal range for healthy organisms. In fact, most substances are toxic at a high enough dose — even food and water. However, the ability of a material to cause adverse effects (its toxicity) is directly related to the concentration of the material and length of exposure (Rand, 1995; Capuzzo, 1987; Gilfillan et al., 1983). During an oil spill response, the challenge is to characterize the risk from the oil, chemically dispersed oil, and to a lesser extent, the dispersants themselves, to potential receptors (humans, wildlife, environment, etc.). Although dispersants increase the amount of dispersed oil in the water column, the trade-off is that they enhance the removal of oil from the water surface, increase the rate of microbial degradation, and reduce overall toxicity through rapid dilution within the water column. For more information on toxicity and the impacts to species in the water column, refer to **Fact Sheet #4 — Toxicity and Dispersants**.

This Fact Sheet summmarizes the potential human health and safety considerations for dispersant use for the public and response workers. This includes the likely routes of exposure and the relative exposure risks to the oil, and dispersed oil, and dispersant that may result when applying dispersants to spilled oil on the water surface and at depth.

Fact Sheet Series

Introduction

Dispersants are applied offshore (either to the surface of the water or injected at depth) and therefore the chances of the public being impacted by the dispersant or the dispersed oil are remote. The potential adverse effects to spill responders would need to be evaluated for the spilled oil itself, the dispersant itself, and from dispersed oil droplets that are mixed into the water column. The likely adverse effects of exposure to the oil, dispersants, and dispersed oil to humans are a function of both the **duration of exposure** and the **concentration** of the material during that exposure.

Exposure Routes

One of the greatest concerns during an oil spill response is ensuring the health and safety of the response workers and the public from the effects of the spilled oil, the response options, and cleanup efforts. An initial risk evaluation is conducted to clearly define how response workers and the public can be exposed during an oil spill response. Key government public health organizations, such as the Occupational Safety and Health Administration (OSHA, part of the U.S. Department of Labor), and the National Institute of Occupational Safety and Health (NIOSH, part of the Centers for Disease Control and Prevention (CDC)/U.S. Department of Health and Human Services) have defined the primary potential pathways for human exposure to spilled oil, dispersant and dispersed oil:

- **Inhalation** — with emphasis on volatile organic compounds (VOCs), especially, the toxic aromatic hydrocarbons, BTEX (Benzene, Toluene, Ethylbenzene and Xylene). Inhalation is the primary route of exposure to VOCs.
- **Dermal Contact** — also considered a significant route of exposure for Humans.
- **Ingestion** — with emphasis on polycyclic aromatic hydrocarbons (PAHs) contained in crude oil which are taken up by seafood and have the potential to be consumed by people.

Exposure Risks

The following are summaries of the exposure risks from spilled oil, dispersants, and the dispersed oil relative to human effects. Keep in mind that the requirements for dispersant use makes it unlikely that the public will come in contact with oil or dispersed oil by requiring applications be offshore so that the treated oil has mixed into the water column, preventing it from coming ashore. Dispersants also reduce exposures of cleanup workers to the oil and oil fumes while recovering it at sea or on the shoreline.

Spilled Oil

Crude oils are mixtures of thousands of different "chemicals" that may display different potential for adverse effects depending on the composition. For example, light, low viscosity oils have a higher level of the more toxic components of the oil (VOCs) that evaporate more readily and may be more likely to be inhaled. Heavier oils, on the other hand, generally contain less of these more toxic compounds and their relative toxicity is due mostly to direct dermal contact rather than inhalation.

For most people, brief contact with a small amount of petroleum will do no harm; however, if an individual is exposed for a long period of time, permanent health impacts may result (ATSDR, 1999). Additionally, some individuals are more sensitive to chemicals, including those found in crude oils, and these individuals may have a more severe reaction from exposure than the general population (Magill and Suruda, 1998). According to the CDC (2010a), individuals may experience the following after short-term exposure to petroleum oils (oil type dependent):

- **Inhalation:** Irritation to eyes, nose, throat, breathing difficulties, increased dizziness, disorientation, or headache.
- **Dermal Contact:** Skin reddening, swelling, rash, and burning which may get worse if the skin is also exposed to the sun. May make one more likely to develop a skin infection.
- **Ingestion:** Upset stomach, vomiting, and diarrhea, but is unlikely to have long-lasting health effects. Consumption of seafood contaminated by oil may be a secondary exposure route; however, contamination via seafood is unlikely due to government controls on consumption of potentially contaminated seafood and the natural ability of seafood to remove hydrocarbons from their system.

As recent evidence shows, seafood tainting from an offshore oil spill is unlikely (FDA online, 2011; Wright, 2010; BP, 2012).

Long-term exposure studies to document the effects to responder personnel and the public are ongoing. As in all cases of possible exposure to chemicals, it is prudent for individuals to limit their direct exposure to oil and to adhere to health and safety requirements, including using appropriate personal protective equipment (PPE).

Dispersants

Modern dispersants are formulated to be safer for use in the environment than early formulations. Dispersants are less toxic than crude oil and adding dispersant at the appropriate application ratios does not increase the toxicity of the oil (EPA online, 2011). Most dispersants are also biodegradable and contain ingredients which are similar to those found in many common household soaps, cosmetics, detergents, and shampoos and even food (Fabisiak and Goldstein, 2012).

The most widely used dispersant in the United States (Corexit® 9500) was found to be significantly less toxic than common dish soaps to freshwater trout (Environment Canada, 2013). Although dispersants are formulated to be low in toxicity, response workers should use proper PPE and follow sound operational procedures, as in all cases when chemicals are handled (Department of Health and Human Services (DHHS) et al., 2010; NIOSH, 2010a). In addition, the general public is not likely to ever be exposed to dispersants, since dispersant application operations are generally required to be carried out in waters more than three miles from shore and only when people are out of the spray zone. This is especially true since vessel-based and airborne delivery of dispersants is carried out in a well-defined manner with the goal of delivering them accurately to targeted slicks offshore. For more information on application requirements and protocols, refer to **Fact Sheet #5 — Dispersant Use Approvals in the United States** and **Fact Sheet #7 — Aerial and Vessel Dispersant Operations**.

Five things that were considered by the CDC to control a person's health risk from contact with dispersants are (CDC online, 2010b):

- The number of times they are in direct contact
- How long they are in contact
- The volume with which they come in contact
- How much dispersants have been diluted with water
- The primary way they came in contact (eyes or skin contact, inhalation or ingestion)

As with any chemical compound it is a good practice to minimize exposure. Upon consideration of this:

- The most likely exposure will be to any staff handling and transporting the material, although the risk is mitigated with proper PPE.
- Most people in coastal areas will not come in direct contact with oil spill dispersants.
- Brief contact with a small amount of dispersants should not harm a person.
- Long term, repeated exposure to dispersants is unlikely.

As with exposure to oil, potential health threats from dispersant exposure are similar and include (OSHA online, 2010):

- Eye irritation.
- Dermatitis or irritation after prolonged or repeated contact
- Respiratory irritation as a result of repeated or prolonged inhalation exposure.

Ingestion is considered an unlikely route of exposure.

Dispersed Oil

In 2010, EPA tested eight of the 14 dispersants listed on the US Environmental Protection Agency's (EPA) National Contingency Plan (NCP) Product Schedule, including the ones used during the 2010 Deepwater Horizon incident in the Gulf of Mexico. Their tests found that a mixture of dispersants and oil were no more toxic than the oil alone (EPA ORD, 2010).

In general, the public is unlikely to be exposed to dispersed oil since the dispersed oil will be mixed into the water column and be diluted far from shore and away from the public. In the unlikely event that it was to occur, short-term exposures to dispersed oils would be expected to have effects similar to those of being exposed to the oil itself.

Long-term studies to document potential short term exposure effects of dispersed oil to responder personnel and the public are ongoing.

Human Safety Considerations

When addressing the safety of the public and of response workers, one must consider the most likely sources of oil and dispersant contact.

Public Safety

For the public, there are no likely sources of exposure to dispersants or dispersed oil.

As previously mentioned, because dispersant operations are typically carried out more than three miles from shore, contact with dispersant spray itself or significant inhalation of fumes by those on shore is unlikely. The safety of the public is maximized if people avoid contact with oiled areas and avoid handling items that have oil or oil-like sprays on them. Since dispersants serve to remove oil slicks from the water surface, their use will keep oil away from shorelines, therefore limiting the possibility of public exposure.

Seafood Safety and Consumption

An extensive federal and state response was initiated immediately following the Deepwater Horizon incident to monitor for the potential for contamination by crude oil and response methods that would compromise the safety of the Gulf seafood resources. Public concerns about the consumption of seafood tainted from the oil, dispersants, and dispersed oil were addressed by the FDA, NOAA, and state agencies. Through an extensive national effort to evaluate seafood safety protocols and by using multiple methodologies, these evaluations began in early May 2010 (Gohlke et al., 2011). The results have shown that oil and dispersed oil levels are well below Levels of Concern (LOC)[1] for human health risk (Ylitalo et al., 2011; FDA online, 2011).

Response Worker Safety

NIOSH recommends that worker exposures to petroleum distillates, a solvent component present in dispersants, be reduced to prevent harmful respiratory and dermal health effects (NIOSH, 2010b). Since response workers may be in close proximity to oil, dispersants, and dispersant application operations, their protection involves the use of PPE and proper operating procedures. This may include the use of coveralls, boots, gloves, respirators, etc. The decision of what PPE should be used for each response task is based on OSHA guidelines and directives. Other safety-related operational procedure oversight includes such things as how long personnel may work in areas close to oil covered waters and dispersant operations. Due to strict application requirements, most response workers are unlikely to experience any exposure to the dispersed oil.

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[1] The Level of Concern (LOC) is the calculated concentration of chemical that, if found in seafood samples, would be con¬sidered unsafe for human consumption.

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