http://www.epa.gov/bpspill/dispersants-qanda.html

EPA United States Environmental Protection Agency

EPA Response to BP Spill in the Gulf of Mexico

Questions and Answers on Dispersants

In response to the BP oil spill, EPA monitored air, water, sediment, and waste generated by the cleanup operations. Ongoing response and restoration efforts are posted to RestoreTheGulf.gov.

While emergency response data collection has ended, results continue to be available on this site. Any new data will continue to be posted to this site, and data will continue to be available here for the foreseeable future.

Much of the content of this site continues to be available for historical and information purposes, but we are no longer updating these pages on a regular basis.

On this page:

More information on dispersant use in the Gulf:

- Directives and addenda; related letters
- Press releases, statements, conference call transcripts
- Dispersant-related data
- EPA's toxicity testing of dispersants

Dispersant Application

- What is the current situation with subsea and surface dispersant use in relation to the BP Oil Spill?
- Given reports of dispersant toxicity, why would you even allow any application to continue?
- One step in the Lower Marine Riser Package (LMRP) Cap tactic is cutting the riser attached to the Blowout Preventer (BOP). Once BP cuts the riser, there could be an increased flow. Are you going to allow BP to increase their usage of dispersant then?

What is the current situation with subsea and surface dispersant use in relation to the BP Oil Spill?

Since the well was capped on July 15, 2010, there has been virtually no dispersant use--only 200 gallons total applied on July 19. Additionally, dispersant use has dropped 72 percent from peak volumes following the joint EPA-U.S. Coast Guard directive to BP on May 26th. Though the use of dispersant has stemmed almost entirely, EPA will continue environmental monitoring in the Gulf.

The BP spill could potentially be one of the greatest environmental challenges of our time. In responding to this spill we have had to make some tough decisions. That includes the use of dispersant chemical to break up the oil and speed its natural degradation and prevent it from reaching fragile wetlands and the shoreline.

On May 26, 2010, EPA and the Coast Guard issued a directive to BP requiring them to decrease overall volume of dispersant by 75 percent and to cease use of dispersant on the surface of the water altogether unless provided prior written authorization from the Coast Guard.

Dispersants are no longer being used at the site of the spill.

Given reports of dispersant toxicity, why would you even allow any application to continue?

Dispersants are generally less harmful than the highly toxic oil leaking from the source and biodegrade in a much shorter time span. This is an important step to reduce the potential for damage from oil reaching fragile wetlands and coastal areas.

Government Response

- RestoreTheGulf.gov: official federal government site for spill response and recovery
  - File a claim
  - Report a concern
  - Volunteer
  - Hotlines and phone numbers

Other federal government information:

- Worker health and safety:
  - from OSHA
  - from CDC
- CDC review of EPA data for possible adverse health effects
- OSHA sampling data
- White House response site
- NASA satellite imagery of the spill
- Sign up for text message alerts

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EPA advised continuing to allow BP to apply dispersant undersea because it appeared to be having a positive effect on the oil at the source of the leak and thus far has had no significant ecological impact.. On August 2, 2010, EPA released peer reviewed results from the second phase of its independent toxicity testing on mixtures of eight oil dispersants with Louisiana Sweet Crude Oil as part of an effort to ensure that EPA decisions remain grounded in the best available science and data. EPA's results indicate that the eight dispersants tested have similar toxicities to one another when mixed with Louisiana Sweet Crude Oil. These results confirm that the dispersant used in response to the oil spill in the gulf, Corexit 9500A, when mixed with oil, is generally no more or less toxic than mixtures with the other available alternatives. The results also indicate that dispersant-oil mixtures are generally no more toxic to the aquatic test species than oil alone. EPA continues to post all data on its Web site, www.epa.gov/bpspill.

One step in the Lower Marine Riser Package (LMRP) Cap tactic is cutting the riser attached to the Blowout Preventer (BOP). Once BP cuts the riser, there could be an increased flow. Are you going to allow BP to increase their usage of dispersant then?

EPA told BP to cut down its use of dispersant. BP has done that to a certain extent and knows that even in the case that the riser is cut, with the increased flow, the maximum amount of subsea dispersant will remain capped at 15,000 gallons per day. BP has committed to stay within the 15,000 gallon/day cap, even with the riser cut.

Through the May 26th Directive, EPA and the U.S. Coast Guard, have told BP to use dispersants in a surface application only as a last resort, and, in that case, in a minimal amount – and BP has agreed. (PLEASE NOTE: the USCG has ultimate sign-off on BP request to use dispersant).

Monitoring and Assessment of Dispersants Used in the BP Spill Response

What directives have been issued to BP with respect to its use of dispersants?

EPA's has issued one directive with several addenda to BP related to its use of dispersants. The Directive, issued on May 10, 2010, required BP to implement a monitoring and assessment plan for both surface and subsurface applications. An addendum (issued on May 14, 2010) provided specific details of the monitoring plan. EPA added additional requirements on May 20, when the Agency required BP to study the dispersants that are being used and to identify whether there are less toxic and as effective alternatives to Corexit – the product it has been using. EPA and the U.S. Coast Guard required BP to conduct its study and analysis within 24 hours. If any new proposed dispersant and plan were approved by EPA, then BP would be required to begin using the new dispersant within 72 hours of EPA's approval. In an addendum issued on May 26, 2010, BP was directed to take immediate steps to significantly scale back the overall use of dispersants and stop surface application of the dispersant without written justification and approval by the U.S. Coast Guard. Finally, in a letter from the Department of Homeland Security (DHS) and EPA, on May 20, BP was told to be more transparent about its own processes, and the letter directed them to share information about the product ingredients so that the American people and have a full understanding of what chemicals are being used to mitigate the crisis.

Has BP been complying with EPA's request to identify a less toxic dispersant alternative?

BP's scientific analysis of alternative dispersants, in response to EPA's May 20 Directive, was found insufficient by both EPA and the U.S. Coast Guard. Therefore, EPA and other government scientists went on to independently verify the alternative dispersant data presented by BP and performed independent scientific verification of the data BP presented. On August 2, 2010, EPA released peer reviewed results from the second phase of its independent toxicity testing on mixtures of eight oil dispersants with Louisiana Sweet Crude Oil. EPA's results indicate that the eight dispersants tested have similar toxicities to one another when mixed with Louisiana Sweet Crude Oil. These results confirm that the dispersant used in response to the oil spill in the gulf, Corexit 9500A, when mixed with oil, is generally no more or less toxic than mixtures with the other available alternatives. The results also indicate that dispersant-oil mixtures are generally no more toxic to the aquatic test species than oil alone.

Since the well was capped on July 15, there has been virtually no dispersant use--only 200 gallons total applied on July 19. Additionally, dispersant use has dropped 72 percent from peak volumes following the joint EPA-U.S. Coast Guard directive to BP on May 26, 2010.

What monitoring is BP required to perform regarding the subsea application of dispersants?

Subsurface water monitoring is performed following dispersant application in order to provide the best scientific information possible. Some of the monitoring parameters include: 1) identification of dispersed oil, 2) oil droplet size, 3) dissolved oxygen (DO) and other physical characteristics such as conductivity, temperature and depth (CTD) and, 4) toxicity information. View the Directive which requires BP to perform this sampling.

What is dissolved oxygen (DO) and why would dispersant application monitoring be stopped if DO levels dropped?

Dissolved oxygen (DO) analysis measures the amount of gaseous oxygen (O2) dissolved in the water. Adequate dissolved oxygen is necessary for good water quality. Normal ranges for DO in the Gulf area are 4 mg/l. The lower the concentration of dissolved oxygen, the greater the stress is on aquatic life. The evaluation criteria to determine further use of subsea dispersant include DO levels that are < 2mg/l and the results of toxicity tests.

The monitoring and assessment directive calls for the use of a "CTD rosette." What is a CTD rosette?

The "rosette" is a cylindrical piece of equipment that holds multiple specialized water bottles that can take separate water samples at different depths every time it goes in the water. The rosette is deployed and lowered a specific depth and then brought back to the surface. On its way to the surface, the water bottles will be "fired" at certain depths, thus trapping water from that depth inside the bottle ready to be sampled on deck.

The CTD is a set of small high-tech probes attached to the rosette and is the primary tool for understanding the physical properties of sea water that are essential for supporting marine life. C stands for "Conductivity," T stands for "Temperature," and D stands for "Depth". A CTD gives scientists an accurate and comprehensive charting of the distribution and change in water temperature, salinity, and density for the water column they are studying. While the CTD is still underwater it reports electronic messages through a cable back to the onboard computer lab. While the CTD is gathering data underwater, computers on the ship are constantly receiving and analyzing the data.

What is a toxicity test?

Toxicity tests are methods for determining the impact of a chemical or an effluent on living organisms and measure the degree of response using commonly tested species. Many different kinds of tests can be used to identify potential toxic effects but since toxic effects differ, comparing the toxicity of one to another may not be appropriate.

What types of toxicity tests are required to monitor the biological impacts of subsurface dispersant application?

The biological impacts of dispersants applied under water are being monitored using a standardized rotifer test that evaluates the potential toxicity of the water. Rotifers are sensitive small invertebrates that occur in the Gulf of Mexico and are important to the food chain. They feed on bacteria and other small pieces of organic matter and, in turn, are fed upon by crustaceans and other organisms. A commercially-available procedure using rotifers (called Rototox®) is used and is specified for the BP dispersant monitoring directive because it is a rapid test that can be performed remotely on a ship. The test exposes rotifers to water collected at different distances from the oil release location. Toxicity is determined by comparing the survival of the rotifers exposed to the deep water samples to survival in clean water.

There is toxicity test data available for the dispersants on the NCP Product Schedule and it talks about LC50s. What is an LC50?

In environmental studies, LC stands for "Lethal Concentration" and is the concentration of the chemical, given all at once, in the water that causes the death of 50% of a group of test animals in a given time (for example, during a 96-hour period). In general, the smaller the LC50 value, the more toxic the chemical. The opposite is also true: the larger the LC50 value, the lower the toxicity. For example, a chemical with an LC50 of 2 parts per million (ppm) would be more toxic than a chemical with an LC50 of 20 ppm. The LC50 is the measure of the immediate (or acute) toxicity of a chemical for the particular animal species being tested. The LC50 was not designed nor intended to give information on the long-term exposure effects of a chemical.

It is also important to note that the LC50 value may be different for a given chemical depending on the route of exposure (e.g., skin contact, ingestion, inhalation) and can be different for different animal species, ages and sexes. The LC50 is only one source of toxicity information and only provides information for the species and concentrations of chemical being tested under laboratory conditions. Toxicity tests resulting from controlled laboratory experiments may not accurately represent the degree of toxicity seen in the environment because of factors such as breakdown of the chemical, different species, different routes of exposure, age, sex, stage of development (e.g., adult versus larval).

To date, how much dispersant has been used in the BP oil spill response? Is BP is running out of dispersants?

For the latest information on the use and amount of dispersants used, go to the Deepwater Horizon Response Current Operations page on the official site of the Deepwater Horizon Unified Command.

How do scientists identify if the oil is dispersed?

Monitoring of oil will be performed using a number of different fluorometers that enable us to determine where the oil plume is located (or the chemical "signature" of the oil) and whether the oil is being broken down chemically (from the use of dispersants) or physically by natural means such as wave action or underwater mixing.

Fluorometers measure fluorescence which helps scientists locate dispersed oil plumes in the water column. Fluorescence is technically defined as the absorption of light of a certain wavelength (typically ultraviolet) that induces the emission of light with a longer wavelength (and lower energy). To measure fluorescence, fluorometers expose a chemical or compound to a specific wavelength in UV light range (similar to a black light). When the compound is exposed to the UV light, one of the chemical's electrons is "excited" by the light and jumps up to a higher wavelength and then back down to its normal state. When the electron drops down to its normal state it emits a "glow" or "fluorescence." The fluorometer measures the emitted light or "fluorescence," which allows scientists to identify certain compounds in the oil and, under certain circumstances, even the effectiveness of the dispersant application.

Why do scientists measure oil droplet size?

By determining the size of the oil droplets, scientists can potentially distinguish between dispersed and non-dispersed oil. Droplet size can also help scientists determine if the oil is being broken up chemically via the dispersants or if its physically being broken up by wave action or wind. Droplet size also helps scientists evaluate how quickly the oil droplet rise through the water column.

How do scientists measure oil droplet size?

Oil droplet size is determined by means of a laser-induced particle size analyzer. This instrument uses a laser which hits the particles, or droplets, in the water column and scatters the light. The scattered light information is collected on a detector which provides real-time instant results to scientists.

EPA’s List of Authorized Dispersants (NCP Product Schedule)

EPA lists all dispersants that have been authorized for use on the National Contingency Plan (NCP) Product Schedule.

- Does EPA make a determination on the toxicity of dispersants before they are approved?
- What are the chemical components of the dispersants COREXIT 9500 and COREXIT 9527?

Does EPA make a determination on the toxicity of dispersants before they are approved?

EPA requires toxicology tests and reports for all dispersants that are approved on the National Contingency Plan (NCP) Product Schedule, the authorized list of dispersants. All determinations regarding the specific application or use of a dispersant are made by the Federal On-Scene Coordinator in charge of the response.

What are the chemical components of the dispersants COREXIT 9500 and COREXIT 9527?

The components of COREXIT 9500 and 9527 are:

CAS Registry Number	Chemical Name
57-55-6	1,2-Propanediol
111-76-2	Ethanol, 2-butoxy-*
577-11-7	Butanedioic acid, 2-sulfo-, 1,4-bis(2-ethylhexyl) ester, sodium salt (1:1)
1338-43-8	Sorbitan, mono-(9Z)-9-octadecenoate
9005-65-6	Sorbitan, mono-(9Z)-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs.
9005-70-3	Sorbitan, tri-(9Z)-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs
29911-28-2	2-Propanol, 1-(2-butoxy-1-methylethoxy)-
64742-47-8	Distillates (petroleum), hydrotreated light

*Note: This chemical component (Ethanol, 2-butoxy-) is not included in the composition of COREXIT 9500.
Learn more about CAS Registry Numbers from the American Chemical Society EXIT Disclaimer

Dispersant Effects

- What are the tradeoff considerations being weighed regarding the impact of fish and wildlife when making decisions about the subsea use of dispersants?
- Are any human health effects expected as a result of using the dispersants?
- What effects could the use of dispersants have on marine life?
- How will we know the future and total effects on marine life of dispersant use?
- Apart from marine life, has the Unified Command been able to make an assessment on the effects of the dispersant on the environment?
- How will the government ensure the protection of the environment when dispersants are used?

What are the tradeoff considerations being weighed regarding the impact of fish and wildlife when making decisions about the subsea use of dispersants?

Dispersants are generally less toxic than oil. When considering the use of a dispersant in the deep ocean, the federal government weighs the effectiveness of the dispersant in breaking down the oil at such depths, the benefits of preventing the oil from rising to the surface and eventually hitting the shore where it is likely to do significant damage to birds, wetlands and aquatic life, and the long term impacts of the dispersant mixed with oil in deeper waters. We have a monitoring and sampling plan in place to track the movement of the oil and we reserve the right to stop the use of these dispersants at any time based on the results.

Are any human health effects expected as a result of using the dispersants?

People working with dispersants are strongly advised to use a half face filter mask or an air-supplied breathing apparatus to protect their noses, throats, and lungs, and they should wear nitrile or PVC gloves, coveralls, boots, and chemical splash goggles to keep dispersants off skin and out of their eyes. CDC provides more information on reducing occupational exposures while working with dispersants during the Gulf Oil Spill Response.

- Material Safety Data Sheet (MSDS) for Corexit 9500A (PDF) (11pp, 88 K)
- Material Safety Data Sheet (MSDS) for Corexit 9527A (PDF) (11 pp, 132K)

What effects could the use of dispersants have on marine life?

It's important to understand that the use of dispersants is an environmental trade-off. We know dispersants are generally less toxic than the oils they breakdown. We know that surface use of dispersants decreases the environmental risks to shorelines and organisms at the surface and when used this way, dispersants breakdown over several days. However the long term effects on aquatic life are unknown, which is why EPA and the Coast Guard are requiring BP to implement a robust sampling and monitoring plan.

The federal response is intended to ensure that these operations are constantly monitored for any short or long term adverse effects that may outweigh the benefit of using dispersants.

How will we know the future and total effects on marine life of dispersant use?

It is too early in the process to know what the scope of the natural resource damage will be. Look to federal partners such as NOAA and DOI for information on impacts to fish, shellfish, marine mammals, turtles, birds and other sensitive resources as well as their habitats, including wetlands, beaches, mudflats, bottom sediments, corals and the water column.

Apart from marine life, has the Unified Command been able to make an assessment on the effects of the dispersant on the environment?

The harm or toxicity of dispersed oil in the environment is generally associated with the oil rather than with the dispersant alone. However, use of dispersants breaks up a slick of oil on the surface into smaller droplets that can go beneath the surface. When applied on the surface before spills reach the coastline, dispersants will potentially decrease exposure for surface-dwelling organisms (such as sea birds) and intertidal species (such as mangroves and salt marshes), while increasing exposure to a smaller population of aquatic life found deeper in the water.

To ensure nearby residents are informed and protected, the EPA is constantly monitoring air quality in the Gulf area through air monitoring air craft, and fixed and mobile air stations. EPA is also monitoring the water along the coast for indicators of water quality and toxicity to aquatic life. Following major oil spills, NOAA conducts annual damage assessments to determine and monitor long term effects on shoreline wildlife and spawning habitats.

How will the government ensure the protection of the environment when dispersants are used?

The authorization given to BP to use dispersants on oil stemming from the BP Oil Spill included specific conditions to ensure the protection of the environment and the health of residents in the affected areas. BP, through the Unified Command, continues to monitor the environment for effects of dispersant use. In addition, EPA is collecting air and water quality data daily.

Under the Oil Pollution Act, state, Tribal and federal Natural Resource Trustee agencies are responsible for assessing the injury, loss or destruction of natural resources due to spills. The trustees will also assess any lost human uses of these resources, for example, fishing, hunting, and beach recreational closures. The trustees are also assessing the efficacy of evaluating impacts from the response, including burning, and surface and sub surface dispersant use.

Surface Use of Dispersants

- How do dispersants work on the water's surface?
- Surface use of dispersants in the response to the BP spill

How do dispersants work on the water's surface?

Oil spill dispersants are chemicals applied directly to the spilled oil in order to break it into small droplets that fall below the surface. Dispersants are usually applied to the oil slick with specialized equipment mounted on an airplane, helicopter or ship. Once applied, dispersants help break up oil into tiny micron-sized droplets which mix into the upper layer of the ocean. Dispersed oil forms a "plume" or "cloud" of oil droplets just below the water surface. The dispersed oil mixes vertically and horizontally into the water column and is rapidly diluted. Bacteria and other microscopic organisms are then able to act more quickly than they otherwise would to degrade the oil within the droplets.

Oil on calm water surfaces is often cohesive and natural degradation processes are slow. In heavy seas, however, the oil gets naturally dispersed into the surface waters. It should be noted that oil released from the BP Oil Spill is also naturally dispersing into the water column due to the physical agitation of the wind, waves, and vessel operations.

Surface use of dispersants in the response to the BP spill:

The authorization given to BP to use the dispersant on oil present on the surface of the water included specific conditions to ensure the protection of the environment and the health of residents in affected areas. At this time, , EPA and the Coast Guard issued a directive requiring BP to decrease overall volume of dispersant by 75 percent and to cease use of dispersant on the surface of the water altogether unless provided prior written authorization from the Coast Guard. The Unified Command will continue to monitor for the effects of this dispersant on the environment and we reserve the right to discontinue its use.

Underwater Use of Dispersants

How do dispersants work under the water?

The use of the dispersant at the source of the leak represents a novel approach to addressing the significant environmental threat posed by the spill. Results to date indicate that subsea use of the dispersant is effective at reducing the amount of oil reaching the surface – and can do so with the use of less dispersant than is needed when the oil does reach the surface. This has been an important step to reduce the potential for damage from oil reaching fragile wetlands and coastal areas. While BP pursues the use of subsea dispersants, the federal government will require regular analysis of its effectiveness and impact on the environment, water and air quality, and human health through a rigorous monitoring program. EPA's directive to BP, including the monitoring plan the company must adhere to in order to ensure the protection of the environment and public health, is available on this page. While dispersant was being used, EPA reserved the right to discontinue use if any negative impacts on the environment were found to outweigh the benefits.

Underwater use of dispersants in the response to the BP spill

The Coast Guard and EPA authorized BP to use dispersants underwater at the source of the Deepwater Horizon leak. Results of monitoring indicate that subsurface use of the dispersant is effective at reducing the amount of oil from reaching the surface – and can do so with the use of less dispersant than is needed when the oil does reach the surface. While BP pursues the use of subsurface dispersants, the federal government required regular analysis of its effectiveness and impact on the environment, water and air quality, and human health through a rigorous monitoring program. EPA issued a directive to BP, which included a monitoring plan the company must adhere to in order to ensure the protection of the environment and public health. Since the well was capped on July 15, there has been virtually no dispersant use--only 200 gallons total applied on July 19. Additionally, dispersant use has dropped 72 percent from peak volumes following the joint EPA-U.S. Coast Guard directive to BP on May 26th. Though the use of dispersant has stemmed almost entirely, EPA will continue environmental monitoring in the Gulf.

Is the underwater chemical dispersant that EPA approved contributing to underwater oil plumes?

There is no information currently available to connect use of dispersants to the subsurface layers discovered. NOAA continues to work closely with EPA and the federal response team to monitor for the presence of oil and the use of surface and sub-surface dispersants.

As we have emphasized, dispersants are not a silver bullet. They are used to move us towards the lesser of two environmental outcomes. Since the well was capped on July 15, there has been virtually no dispersant use--only 200 gallons total applied on July 19. Additionally, dispersant use has dropped 72 percent from peak volumes following the joint EPA-U.S. Coast Guard directive to BP on May 26, 2010. Though the use of dispersant has stemmed almost entirely, EPA will continue environmental monitoring in the Gulf.

General Information about Dispersants

What do we know about the biodegradation rate of non-dispersed oil?

Extensive laboratory and field research has been done on the biodegradation of crude oil. The South Louisiana crude in the Gulf spill is considered a “light” crude oil and is known to degrade at a faster rate than heavier weight oils from other locations such as Alaska. Some studies suggest that the half-life for Louisiana crude is 12-70 days in seawater. There are a number of factors that affect the biodegradation rates of oil, such as water temperature, oxygen content, and presence of micro-organisms.

What do we know about the biodegradation rate of chemically-dispersed oil?

Chemical dispersants are designed to form smaller droplets when mixed with oil. These smaller droplets are more readily available to be biodegraded by micro-organisms. EPA has published research on the biodegradation of dispersed oil which suggests that the dispersant speeds the biodegradation of oil. Based upon this research, the rate of biodegradation increases almost 50% in the presence of COREXIT 9500 vs. oil without dispersant.

What do we know about the biodegradation rate of the dispersant itself?

We are currently unaware of published scientific information in the peer reviewed literature about the biodegradation of the dispersant itself. We do have information about the individual components (ingredients) of the dispersant, provided by the manufacturer’s Material Safety Data Sheets (MSDS). The available peer-reviewed literature indicates that the components biodegrade fairly rapidly. EPA is working to identify additional information to help us better understand the fate of dispersants in seawater.

Which biodegrades faster, dispersed oil or non-dispersed oil?

In general, based on our research, under similar conditions (temperature, salinity, oxygen, nutrient availability), it takes longer for non-dispersed crude oil to biodegrade than either dispersed crude oil or the dispersant itself.

Have dispersants ever been used this much before?

While dispersants have been used in previous oil spills, this is the largest application of dispersants at an oil spill response in the United States. Since the spill occurred, EPA and its federal partners have closely monitored any potential impacts of the dispersant including air quality monitoring by both planes and through mobile and fixed locations. Air sampling is geared toward looking for significant increases in airborne (volatile) chemicals.

Thus far, preliminary results of EPA’s initial air monitoring efforts have not shown risks to human health from dispersants. We have also developed a plan to monitor the surface and subsea use of dispersants. That plan is evolving and we will continue to update the website. The plan is posted on this page.

What are the future plans for use of dispersants for oil spills? Will the industry and federal government look to continue their use?

Generally, the use of dispersants is restricted under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Dispersants must be on the US EPA Product List, and federal and state agencies have agreements establishing areas where rapid decisions on dispersants may be made by the Federal On–Scene Coordinators. Areas outside those with designated agreements are required to get additional approval from agencies identified in the NCP.

Some history of dispersant use:

- In the US, dispersants have been applied to much smaller spills off the coast of Louisiana and Texas over the last 15 years.
- At the IXTOC-I Well Blowout near Vera Cruz, Mexico in 1979, between 1 million and 2.5 million gallons of mostly Corexit dispersant products were applied over a five-month period on the oil discharge.
- In Australia last year, 50,000 gallons of dispersants were used on the 9 million gallon West Atlas oil platform spill in the northern Timor Sea.
- In the United Kingdom, dispersants are considered the first line of defense because of high seas and rugged coastlines. In 1996, 118,000 gallons of dispersants were used on the 20 million gallon Sea Empress oil spill in Wales.

Dispersants Toxicity Testing - Phase I & II

Phase II - Dispersant Testing

What tests were conducted in Phase II of dispersant toxicity testing?

EPA conducted acute toxicity tests of 1).multiple concentrations of Louisiana Sweet Crude Oil alone, and 2.) combinations of Louisiana Sweet Crude Oil with each of the eight dispersants. The organisms tested were two Gulf of Mexico aquatic species: (1) the mysid shrimp, *Americamysis bahia*, an aquatic invertebrate, and (2) the inland silverside, *Menidia beryllina*, a small estuarine fish. These species are standard test organisms used in toxicity test for a variety of pollutants. The tests were conducted on mixtures of Louisiana Sweet Crude Oil and eight dispersant products found on the National Contingency Plan Product Schedule – Dispersit SPC 1000, Nokomis 3-F4, Nokomis 3-AA, ZI-400, SAFRON Gold, Sea Brat #4, Corexit 9500 A and JD 2000.

What did the test results show?

The results indicate that the eight dispersants tested are similar to one another based on standard toxicity tests on sensitive aquatic organisms found in the Gulf. These results confirm that the dispersant used in response to the oil spill in the Gulf, Corexit 9500A, is no more or less toxic than the other available alternatives.

Is there a difference in toxicity between oil alone and mixtures of oil and dispersants?

For all eight dispersants in both test species, the dispersants alone were less toxic than the dispersant-oil mixture. Oil alone was found to be more toxic to mysid shrimp than the eight dispersants when tested alone. Oil alone had similar toxicity to mysid shrimp as the dispersant-oil mixtures, with exception of the mixture of Nokomis 3-AA and oil, which was found to be more toxic. The oil results for small fish were inconclusive. EPA will perform additional testing of the toxicity of oil to small fish.

Why were the oil results for the small fish inconclusive?

For the highest concentration of oil tested, only 7 % of the the inland silverside, the small estuarine fish, died. To estimate the LC50 – the goal of this standard toxicity test – 50% mortality is needed. The test was conducted over a range of five concentrations and at the highest concentration only 7% mortality was achieved. The test will be repeated using a series of oil in water concentrations with results that encompass 50% mortality of the test organisms.

What tests did EPA use to assess acute toxicity to shrimp and small fish?

Acute toxicity tests are used to determine lethal concentrations of the test chemicals. The acute toxicity to shrimp and fish was determined using a standardized 48-hour mysid shrimp and a 96-hour small fish test to evaluate the potential toxicity of the dispersant. Established testing procedures are specified for both the mysid shrimp and small fish. Both species live in the bays and estuaries of the northern Gulf of Mexico and are commonly used in toxicity tests. These two tests are required by EPA to list a dispersant on the **National Contingency Plan Product Schedule**. The test protocol exposes mysid shrimp or small fish to a range of dispersant concentrations and dispersant-oil mixtures or oil alone separately in the laboratory. Toxicity is determined by comparing the survival of the mysid shrimp or small fish exposed to the dispersants, dispersant-oil mixtures, or oil alone to survival of these organisms kept in clean, untreated seawater. The aquatic organisms used as test species are small mysid shrimp, *Americamysis bahia*, and a small fish, *Menidia beryllina*. Survival of the organisms exposed to multiple concentrations of the dispersants, dispersant-oil mixtures, or oil alone is determined for each species. The concentration lethal to 50 percent of the test organisms is calculated and compared between dispersants and between the toxicities of the oil-dispersant mixtures to determine the most and least toxic chemicals and combinations.

Why did EPA only test eight out of the total 14 dispersants on the National Contingency Plan Product Schedule?

EPA chose eight dispersants (Dispersit SPC 1000; Nokomis 3-F4; Nokomis 3-AA; ZI-400; SAFRONGOLD; Sea Brat #4; Corexit 9500 A; JD 2000) from the dispersants listed on the National Contingency Plan Product Schedule based on three criteria: 1) lower toxicity of the dispersant or of the dispersant when mixed with oil; 2) availability of sufficient quantities to respond to the Gulf spill; and 3) immediate availability of samples for testing.

Phase I - Dispersant Testing

What toxicity tests were conducted to determine the least toxic dispersants?

EPA conducted several toxicity tests to provide independent scientific information about these eight dispersants. Three types of testing results on the dispersants alone are available from Phase I of the testing:
1) Potential endocrine activity: Some of the dispersants include chemicals called nonylphenol ethoxylates (NPE). NPE breaks down in the environment to nonylphenol (NP) which is a substance that could potentially cause endocrine disruption.
2) Degree each is toxic to living cells – cytotoxicity: EPA used *in vitro* assays to test the degree to which these eight dispersants are toxic to various types of mammalian cells and the potential for each dispersant to exhibit endocrine activity.
3) Acute toxicity to shrimp and small fish -Acute toxicity tests are used to determine lethal concentrations of the test chemicals.

The companies who manufacture the different types of oil spill dispersants already tested both the toxicity and the effectiveness of each of these dispersants and submitted results to EPA for listing their product on the National Contingency Plan Product Schedule. Although these industry-submitted test results provide guidance, the tests were conducted on the dispersants by different laboratories and on the dispersants mixed with No. 2 fuel oil which is not the type of oil in the Gulf. EPA wanted to conduct its own toxicity tests in one laboratory under EPA oversight for better comparative analysis and to test the dispersants mixed with the oil from the Gulf.

What tests did EPA use to assess potential endocrine activity?

Some of the dispersants include chemicals called nonylphenol ethoxylates (NPE). NPE breaks down in the environment to nonylphenol (NP) which is a substance that could potentially cause endocrine disruption. Endocrine disruption can lead to defects in fetal development or can impair reproductive health in humans and aquatic species. The degree to which the eight types of oil spill dispersants are toxic to various types of cells is one good measure for estimating how much of the dispersant it would take to cause cell death. The more dispersant it takes to cause cell death, the less toxic the dispersant. Estrogen and androgen receptors are proteins in the body that interact with the hormones estrogen and testosterone and respectively control development and function of the female (estrogen) and male (androgen) reproductive organs.

What tests did EPA use to assess the degree each dispersant is toxic to living cells (cytotoxicity)?

In vitro assays are fast, often automated chemical screening tests that assess the potential for a chemical to affect specific biological processes that could impact human health and the environment.

What are the dispersant test results for potential endocrine activity, cytotoxicity and acute toxicity to shrimp and small fish?

While the dispersant products alone – not mixed with oil – have roughly the same effects, JD-2000 and Corexit 9500 proved to be the least toxic to small fish, and JD-2000 and SAF-RON GOLD were the least toxic to the mysid shrimp.

None of the eight dispersants tested displayed biologically significant endocrine disrupting activity, with the exception of a weak response for two of the dispersants (Nokomis 3-F4 and ZI-
400) in one of the tests. This estrogenic result is likely not of biological significance. Cell death (degree the dispersant is toxic to living cells) was observed in some tests at concentrations above 10 parts per million. The endocrine and the cytotoxicity screening were conducted at dispersant concentrations from 0.001 parts per million up to 10,000 parts per million.
None of the dispersants triggered cell death at the likely concentrations of dispersants expected in the Gulf.

Why are toxicity tests used?

Toxicity tests are used to determine the potential adverse effects of chemicals on humans and other organisms. Acute toxicity tests are used on different species to determine lethal concentrations. Chronic toxicity tests can be used to determine sublethal chemical concentrations such as those adversely affecting reproduction, growth and developmental processes as a result of long-term (chronic) exposure. In vitro assays are used to screen a large quantity of chemicals using many tests to prioritize which chemicals have the potential to be the most toxic.

What are “In Vitro Assay” screenings and why are they used?

In vitro assays are fast, often automated chemical screening tests that do not use live animals to assess the potential of a chemical to affect specific biological processes that may impact human health and the environment. On average, it would take a researcher eight hours a day, five days a week, for 12 years to do these assays. With computer we can do these tests and get results in three days. These types of tests are used regularly in the pharmaceutical industry to study the effects of drugs and medications and are also used to assess environmental chemicals. Traditional chemical toxicity testing (typically animal tests in the lab) are time consuming and expensive. In vitro assay screening provides fast, often automated screening results for assessing the potential of a chemical to affect human health and the environment. This type of screening can be used to prioritize which chemicals need further toxicity testing using animals. Animal tests on one chemical can costs millions of dollars. In comparison, numerous in vitro tests can be run on a chemical for about $20,000.

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