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What the EPA Dispersant Tests Fail to Tell Us

The EPA report "Comparative Toxicity of Louisiana Sweet Crude Oil (LSC) and Chemically Dispersed LSC to Two Gulf of Mexico Aquatic Test Species" released July 31, 2010, summarizes results of testing obtained from short-term acute toxicity tests conducted with LSC oil alone and chemically dispersed LSC oil using eight dispersant mixtures.

First, the report concludes that the main dispersant used in the Gulf, Corexit 9500A, is "moderately toxic" compared with other dispersants to the two aquatic species. The report does not comment on Corexit 9527, the more toxic and bioaccumulative dispersant that was used in the Gulf until late May. Second, the report claims that dispersant-oil mixtures were not more toxic than oil alone on mysid shrimps.

More than 200 million gallons of crude oil and nearly 2 million gallons of Corexit dispersants have been released into the Gulf. The impacts of these vast amounts of oil and dispersants on the 15,000 marine species inhabiting Gulf waters cannot be extrapolated from the EPA's limited tests on two aquatic species in the laboratory.

LIMITATIONS OF THE TESTS

When reporting data, it is critical to present study results in the context of what is already known and make clear the limitations of the test. Unfortunately, this report failed to do either. As a result, the findings have been widely misinterpreted by the media and the general public.

The EPA tests are standard short-term acute toxicity tests on two aquatic species (mysid shrimp and small estuarine fish) in the laboratory. The organisms used in the test are common EPA wastewater surrogate species used for generic toxicity assessments at coastal discharges but have no relevance at all in the deep sea. The tests only measure the concentration causing 50% of the test organisms to die at a specified time interval, in this case, at 48 or 96 hours of exposure.

The tests fail to measure sub-lethal effects such as growth or reproduction and cannot be used to draw conclusions regarding effects of chronic longer-term exposure.

It is well established that the chronic, sublethal, and ecological effects of spilled oil on marine organisms often outweigh acute toxicities. Sublethal effects such as growth, reproduction, fertilization success, and embryo development can be measured in many established EPA tests for ecological toxicity assessment, but the tests were not used.

Lab experiments on shrimp and fish do not help us understand effects on the broad ecosystem.

As the Gulf spill coincided with the spring spawning season, vast but unknown numbers of larval fish and fish eggs were exposed to oil and oil-dispersant mixtures in the water column. At present, with limited information, we cannot evaluate the toxicology of this exposure. Did organisms that survived the acute toxicity of oil-dispersant mixtures sustain organ damage? Endocrine disruption? Cancer? Scientists predict that generations of fish are lost or are severely depleted, possibly triggering long-term ecological impacts including trophic cascades and the collapse of higher organisms.

IMPORTANT OMISSIONS AND DATA GAPS

1. Dispersants Increase Total Petroleum Hydrocarbon (TPH) in the Water

One of the most telling pieces of information in the report details the 10-fold increase in total petroleum hydrocarbons (TPH) measured in the seawater when dispersants, including Corexit 9500, were added to the LSC oil sample in seawater. In the oil-alone treatments, they measured 4.4 mg/L and 2.9 mg/L TPH in the water for the two test organisms respectively. With the addition of 10% Corexit to the oil, the TPH concentration was 44.6 mg/L. Therefore, even if the LC50 values are similar for oil and oil+dispersant, the data indicate that it would be easier to reach a toxic level of TPH in the water when the dispersants are added.

Continuous dispersant use in the Gulf likely resulted in a similar 10-fold increase in TPH in the ocean waters of the Gulf, resulting in a massive oil exposure to fish, corals, and deepwater pelagic species to the fresh crude oil. Without dispersant use, the crude would weather at the surface and only drop to the deepwater pelagic and benthic communities as emulsified, weathered oil that is far less toxic than fresh crude oil dispersed from the source.

2. Are Oil-Dispersant Mixtures More Toxic Than Oil Alone?

In mysid shrimps, the toxicity of LSC oil was similar to that of the dispersant-oil mixtures. In its press release, the EPA failed to place these results in context of what is already known about the comparative toxicity of oil versus oil-dispersant mixtures. As a result, this finding in a single laboratory species has been globalized to mean that adding Corexit 9500 to LSC oil was no more harmful than oil alone to the 15,000 species inhabiting Gulf waters.

In fact, a large literature exists from previous spills showing that dispersant-oil mixtures, and specifically Corexit-oil mixtures, are much more toxic than oil alone to many marine organisms including coral, invertebrates, and small fish such as herring. This literature was summarized in the 2005 National Academy of Sciences Report (NRC 2005), and thus was known to the EPA going into this spill.

> The 2005 NRC report cites numerous studies showing that dispersants can increase the uptake of oil by organisms. This is scientifically plausible when you consider that cells of all animals, including humans, have walls made of lipids. Lipids are fats, very similar to simple oil hydrocarbons that are in crude oil. Detergents, surfactants, and solvents make it easier to move through the oil.
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> The properties that facilitate dispersants moving into an oil spill to disperse it, also make it easier for them to move through cell walls, skin barriers, and many other protective coatings we rely on to protect vital organs, underlying layers of skin, the surfaces of our eyes and other structures. In discussions of the potential health effects of individual chemical ingredients in dispersants, evidence is provided regarding dispersant chemicals' ability to increase oil uptake into the cells and organs of the body.

3. Failure to Disclose Corexit Ingredients and to Test Corexit 9527

To date, the ingredients of Corexit 9527 and 9500A, the two dispersant products used in the Gulf, have not been fully disclosed by the producer (Nalco). Without this information, toxicologists cannot predict with any confidence the chemical interactions and possible breakdown products of these mixtures in oil and water.

The EPA tests did not include the chemical dispersant Corexit 9527. This dispersant was used in the Gulf until late May, and is known to be more toxic and bioaccumulative than Corexit 9500A. Corexit 9527 contains 2-BTE (2 butoxy-ethanol), a compound that ruptures red blood cells and causes internal bleeding. At the very least, acute toxicity tests of Corexit 9527 should be conducted.

REMAINING QUESTIONS AND CONCERNS

Looking at the Chemistry, Projecting Impacts on Endangered Species

Crude oil contains thousands of chemical compounds, many of which are toxic to every organ, every system in the body. Dispersants enhance the release of the toxins and put more hydrocarbons into water column. Dispersants make toxic components of the oil more available and facilitate their entry into cells, into organs of the body. For the endangered species in the Gulf, this toxic exposure may represent a tipping point of stress on already fragile populations. Kemp's Ridley sea turtles that nest on the Texas coast, for example, are highly endangered. If the oil impacts the food chain, we may not see these turtles return to Texas for many, many years, perhaps never. Sperm whales are also endangered. They come to the Gulf to calve and feed on squid, cephalapods. Dispersants and oil mixtures could seriously impact the food supply for these and other endangered species.

Biodegradation?

Some officials claim that the dispersed oil is "rapidly biodegrading" in the water column. However, our understanding of microbial biodegradation of oil is limited to the surface, whereas the natural breakdown rate of deep oil is unknown. In dark, colder waters, there is little microbial activity, thus the biodegradation of oil at depth is predicted to be relatively slow.

Bioaccumulation?

Many substances in oil are carcinogens, such as benzene and polycyclic hydrocarbons (PAHs). PAHs can be metabolized, broken down by enzymes in the body, but the metabolites (which are retained) can also be carcinogens. The impacts of the components of oil, in combination with the components of Corexit, will be a chronic concern over the long-term.

Spare the wetlands, sacrifice the sea. Was the "trade-off" the right decision?

We went into this with limited knowledge and no understanding whatsoever of the consequences of releasing such an unprecedented volume of Corexit dispersants on gushing oil at such depth. Did we understand the environmental toxicology of this decision? No, we did not.

Most scientists believe that the amount and the way dispersants were applied in the Gulf constitutes an unprecedented ecological experiment with unknown outcomes.

According to Jane Lubchenco, head of NOAA, ecological damage has already occurred and there is potential for more. She stated, "I think we don't know yet the full impact of this spill on the ecosystem and the people of the Gulf"

THE NEED TO KNOW

Given the large data gaps and concerns about marine life and people in the Gulf, there is an urgent need for dedicated, independent research to determine short- and long-term impacts of this oil spill at multiple levels throughout the ecosystem. This information is critical in order to address and begin to mitigate the damage to the Gulf environment and human health going forward.

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