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I am a Professor Emeritus with the Department of Environmental Sciences, in the LSU School of Coast and Environment with over 34 years experience studying the environmental impacts of oil spills. I have also been the principal investigator of grants from NOAA's Office of Response and Restoration to provide chemical hazard assessments during spills of oil and hazardous materials in marine environments under U.S. jurisdiction. I want to thank Senators Boxer and Inhofe for the invitation to testify before this Environment and Public Works Subcommittee.

Dispersants are soaps for oils. They are used during oil spills to break up surface slicks and enhance the natural dispersion of the oily materials into the water column. Dispersants work because they are made up of compounds that have water-soluble parts as well as oil-soluble parts. When sprayed onto oil slicks, the oil looses its attraction for itself (its cohesion), and this allows wind/wave energy to break apart the surface slicks. The oil is then dispersed into the water column as very tiny droplets with micron sized diameters. These tiny droplets have a very large surface area and are much more rapidly degraded by naturally occurring bacteria than is oil floating in large patches on the surface. Further, dispersed oil micro-droplets are also diluted into the water column by ocean currents. Both of these processes, degradation and dilution, work to lessen the impact of oil floating on water surfaces. Dispersants application, however, is not without risk and can cause impacts through water column exposures as well as oxygen depuration. For these reasons, dispersants should only be used in deep water, well off shore.

Dispersant use has been controversial for years because initial formulations were shown to cause more environmental damage than was caused by the oil itself. Over the years, these formulations have evolved, and the current formulations are relatively benign in terms of potential environmental damage from the dispersant. In fact, most of the offshore environmental impacts associated with dispersant use are from the oil that has been dispersed rather than from the dispersant.

Clearly, dispersants should only be used off shore in deep water to lessen the impacts of oil floating on the surface if that slick comes ashore. So, quite simply, the decision for surface use of dispersants represents a trade off between off shore impacts and on-shore impacts. When shoreline impacts include thick oil coating of marshes and coastal grasses, the most vulnerable types of environments to spilled oil, generally the decision will be to protect these valuable coastal recourses and allow off shore dispersant use. This decision implies acceptance of the fact that impacts from oil to coastal marshes will be greater than water column impacts far off shore.

In the Deepwater Horizon incident, in addition to surface use of dispersants, these chemicals have been used at the well-head some 5000 feet below the surface. The primary driving force for this at-depth application was to limit the amount of oil surfacing right above the well-head, since virtually all recovery and relief-well efforts were concentrated in this small area of the Gulf. Subsurface dispersant application greatly limits the inhalation exposure of the rig workers to the oil's toxic evaporative fumes. However, deep-water wellhead dispersant application has never been used, and the environmental impacts are not clearly defined. In fact, very little is know about deepwater ecology, and consequently, very little is known about the toxic and oxygen depleting impacts of dispersant use at depth. Dispersant use at depth is truly a trade off between human exposure verses environmental exposure. Initial testing of these deepwater environments has been very limited, but has not indicated depressed oxygen levels or other environmental impacts at this point.

Over the last several decades, billions of dollars have been paid to the government as royalty income from production in outer continental shelf areas along the northern Gulf of Mexico region. Very little of this royalty income has been used to study the environment, particularly the deep Gulf environment, in the areas that are used for deepwater oil production. Additionally, little money has been applied to develop better engineering solutions to respond to a massive underwater leak and be able to monitor effectively the leak and assess its deepwater damages. Further, little money was spent to understand how oil changes and moves both subsurface and at the surface from a deepwater release. Both surface and subsurface containment and removal technologies need to be developed, and again, no money from the royalty income was used to protect our environment from the impacts of a spill such as the Deepwater Horizon incident. At least a portion of these types of research and development cost should come from government expenditures. Billions of dollars of royalty income from northern Gulf production was used for other purposes. As a consequence, we were not adequately prepared to respond to a massive deepwater spill and evaluate its full impact.

There are three tools in the toolbox to respond to an oil spill: use of mechanical means for oil removal (skimmers, oil/water separators); use of chemicals (dispersants) for oil treatment; and removal of oil by burning (in-situ burning). In the perfect world, skimming with effective oil/water separation should always be the first choice for oil removal. Skimming can allow a significant portion of the spilled oil to be recovered and recycled, thus minimizing waste from the incident. Oil that cannot be skimmed should be dispersed off shore. Oil that is thick enough to be burned is also thick enough to be skimmed, and skimming allows recycling. If skimmers are not readily available, offshore dispersant use and in situ burning are generally preferable to on-shore oil impacts.

According to Nalco, COREXIT 9500 is made up of a mixture of surfactants and solvents. These components, as well as some of their common uses, are listed below. The first four components are approved by the FDA for use in cosmetics, pharmaceuticals, or as food additives. The last two components are use in and around the home.

	CAS #	Name	Common Day-to-Day Use Examples
1	1338-43-8	Sorbitan, mono-(9Z)-9-octadecenoate	Skin cream, body shampoo, emulsifier in juice regulated by the FDA
2	9005-65-6	Sorbitan, mono-(9Z)-octadecenoate, poly(oxy-1,2-ethanediyl) derivs	Baby bath, mouth wash, face lotion, emulsifier in food (e.g., barbecue sauce, ice cream, baked goods); food additive regulated by the FDA
3	9005-70-3	Sorbitan, tri-(9Z)-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs	Body/face lotion, tanning lotions
4	577-11-7	Butanedioic acid, 2-sulfo-, 1,4-bis(2-ethylhexyl) ester, sodium salt (1:1)	Wetting agent and solubilizer in cosmetic products, gelatin, beverages; food additive regulated by the FDA
5	29911-28-2	2-Propanol, 1-(2-butoxy-1-methylethoxy)-	Household cleaning products
6	64742-47-8	Distillates (petroleum), hydrotreated light	Air freshener, cleaner

ACCORDING TO NALCO, THE COMPONENTS IN COREXIT 9500 are readily biodegradable. In biodegradation studies performed by Nalco using method NFT 90-346, COREXIT 9500 showed 78% biodegradation in 28 days.

Even if compounds are biodegradable, they may accumulate in living organisms. Typically, bioaccumulation is greatest with compounds that are not water-soluble, and their bioaccumulation potential can be measured in laboratory studies by determining a bioaccumulation factor (BAF). Predictive models (e.g., US EPA EPI Suite v. 4.0, 2009) can also be run to evaluate potential bioaccumulation based on physicochemical characteristics. For COREXIT 9500 components, the bioaccumulation factors are in the range of 2.6-208, well below the regulatory bioaccumulation threshold for concern value of 1000. For comparison purposes, the bioaccumulation factor for a known infamous pesticide DDT ranges from 12,000 to 80,000 depending on the species.

Details are given below on the biodegradation and bioaccumulation potential of Corexit 9500A and its components, as supplied by Nalco.

	CAS #	Name	28 Days Biodegradation % (Method)	Bioaccumulation Factor
		Corexit 9500	78 (NFT 90-346) 62 (OECD 306)	2.6 - 208
1	1338-43-8	Sorbitan, mono-(9Z)-9-octadecenoate	62 (OECD 301C)	150 (calc)
2	9005-65-6	Sorbitan, mono-(9Z)-octadecenoate, poly(oxy-1,2-ethanediyl) derivs	31.8 (OECD 306)	3.2 (calc)
3	9005-70-3	Sorbitan, tri-(9Z)-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs	41.4 (OECD 306)	3.2 (calc)
4	577-11-7	Butanedioic acid, 2-sulfo-, 1,4-bis(2-ethylhexyl) ester, sodium salt (1:1)	66.4 (OECD 301D)	3.47 – 3.78 56 (calc)
5	29911-28-2	2-Propanol, 1-(2-butoxy-1-methylethoxy)-	49.8 (OECD 301D) 96% (OECD 302B)	2.6 (calc)
6	64742-47-8	Distillates (petroleum), hydrotreated light	11% (OECD 301D) 99.5 (OECD 306)	61 – 159

Typical aquatic toxicity values for COREXIT 9500 and its components are given below. Please note, the larger the number, the less toxic the material is to that class of organisms.

	CAS #	Name	Fish LC50 (96h) ppm	Crustacean EC50 (48-96 h) ppm	Algae EC50 (72h) ppm
		Corexit 9500	20 - >400 (9 species)	14 – 83 (10 species)	0.7-20 (2 species)
1	1338-43-8	Sorbitan, mono-(9Z)-9-octadecenoate	>1000	>1000	3 - 970
2	9005-65-6	Sorbitan, mono-(9Z)-octadecenoate, poly(oxy-1,2-ethanediyl) derivs	>1000	1 -250	20 - 1000
3	9005-70-3	Sorbitan, tri-(9Z)-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs	>1000	267	40
4	577-11-7	Butanedioic acid, 2-sulfo-, 1,4-bis(2-ethylhexyl) ester, sodium salt (1:1)	9.1 - 66	36.2 - 100	9.2- 15
5	29911-28-2	2-Propanol, 1-(2-butoxy-1-methylethoxy)-	841- >1000	>1000	138 - 441
6	64742-47-8	Distillates (petroleum), hydrotreated light	2.4 – 1740	23.6 - 4720	4.1 - >5000

COREXIT 9500 has been used in the United States as an effective tool in the event of an oil spill. The components of COREXIT 9500 are well known, and possess well-established biodegradation and ecotoxicity profiles that provide evidence that use of this dispersant in offshore environments will have minimum impact on the environment.

Oil dispersed into the water column will have environmental impacts on organisms exposed to the oil, and can have the potential to cause oxygen depletion in the water column due to natural biodegradation of the oil. Dispersant use represents a trade off between the areas of the environment that will be impacted to the greatest extent if covered with oil. Oil spills cause environmental damage, some very obvious, but much of the damage is to the very small, tiny organisms that are the basis of the ecological life cycle (larval and juvenile life cycle organisms) in both near shore and off shore marine environments. These damages are not readily observed during a spill and may not be obvious for several years after the damage takes place. Dispersant use will enhance the damage to these tiny organisms because it spreads the oil below the surface rather than leaving the oil concentrated on the surface. Therefore, offshore dispersant use represents a decision by responders that damage from on-shore oiling will be more severe than damage to offshore environments. In essence, the choice is discerning the “lesser of two evils”, and is always a difficult decision because offshore dispersant use does cause environmental damage in the water column. However, oiling of grassy marshes is generally considered to cause more environmental damage from an oil spill, so offshore dispersant use is normally considered the “lesser of the two evils”.