

## Q&A from Online Participants

*Please note that these are the responses of our guest speakers, and do not necessarily represent the opinions or policies of the U.S. EPA, Tulane University, Sea Grant, or Louisiana State University.*

**1) Question:** Why is EPA testing efficacy using baffled flask test (industry designed and not in regs) when swirling flask test is required (and peer-reviewed and more realistic)?

**Answer:** *The BFT is considered more realistic because it allows for greater mixing of dispersant. The research demonstrating this has been published and also shows that BFT results are correlated with oil properties such as viscosity (see Barron presentation pdf for citation).*

**(2) Question:** How do you integrate emerging studies from GoM BP disaster show unanticipated levels of toxicity from oil-dispersants combined? Maybe EPA needs protocols using evidence-based science rather than all this theoretical testing and modeling, which don't appear to reflect what really happens in environment?

**Answer:** *There have been multiple studies evaluating the potential synergistic effects of dispersants on oil from DWH, and additional reports are likely. I am not aware of any efforts to integrate all of the studies, although it is possible that some investigators may choose to review the multitude of studies and synthesize the results. The conclusions presented in my seminar are based on decades of oil-dispersant research and represent expert opinion documented in the RSC and NRC summary reports (see Barron presentation pdf for citations).*

*Regarding evidence-based science, EPA relies heavily on empirical evidence such as laboratory toxicity and dispersant efficacy testing, in addition to models.*

**(3) Question:** Long range effects on aquatic life in the Gulf of Mexico?

**Answer:** *The long term effects of the DWH may never be known with high certainty because of the complexity of the Gulf of Mexico ecosystems and temporal and spatial dynamics of the oil exposures. Much of this type of investigation was done as part of the Natural Resource Damage Assessment and requires complex modeling. With the Court settlement, it is unclear if the results of the modeling efforts and large scale impact determination will be publically available.*

**(4) Question:** Are any dispersants toxic to oil degrading bacteria?

**Answer:** *Toxicity to bacteria is outside my area of expertise. One of the principles of toxicology is that all chemicals can be toxic if exposures are sufficiently high. Whether adverse effects will occur in the environment depends on the relative sensitivity of the organism and the dynamics of the oil exposure.*

**(5) Question:** Why this presentation indicated that oil plus dispersants showed no increase in toxicity, and minimized toxicity under 10 ppm thresholds? How are these thresholds judged when long term fate has data gaps? How can these chemicals be pre authorized for open water use by FOSC when there are uncertainties, yet many studies I have seen indicate there is environmental damage from the use of these chemicals?

**Answer:** *The conclusions presented in my seminar are based on decades of oil-dispersant research and represent expert opinion documented in the RSC and NRC summary reports (see Barron presentation pdf for citations). In general, dispersants do not increase the intrinsic toxicity of the oil; rather they substantially increase the amount of oil entering the water column. Dispersant + oil mixtures have similar toxicity as oil-only exposures.*

*Listing dispersants in Subpart J of the National Contingency Plan is one of the mandated responsibilities of EPA. EPA does not authorize dispersant use; the Agency only lists the dispersants that can be selected and authorized by the Incident Command of the spill. The decision to use dispersants in a spill is a tradeoff between greater impacts at the water surface and shorelines versus greater impacts within the water column. My seminar included some toxicology aspects for spill responders to consider when determining dispersant use (see Barron presentation pdf for more information).*

**(6) Question:** With oil exploration moving offshore and the approach of at-wellhead dispersant injection now in toolbox is there thought to expanding the suite of model test species beyond those that exist in estuaries or very shallow waters?

**Answer:** *At this time no, for two reasons: 1) Deep ocean species are difficult to obtain and require unique environmental conditions (e.g., high pressure) which will be very difficult to replicate in the lab. 2) A general principle of environmental toxicology is that standard test species can be used as surrogates for other species. It is possible that research done during DWH may be published by some investigators that compares the relative sensitivity of a very few deep ocean species to standard toxicity test species.*

**(7) Question:** What about study stating that the mix of crude oil and Corexit caused 52 times more toxicity?

**Answer:** *I am not familiar with that specific study, but it is likely that the increase in toxicity as due to a 52 times increase in the amount of oil in the water, which can be expected with dispersant application. As noted in my presentation, dispersants substantially increase the amount of oil in the water, rather than change intrinsic toxicity. The conclusions presented in my seminar are based on decades of oil-dispersant research and represent expert opinion documented in the RSC and NRC summary reports (see Barron presentation pdf for citations).*

**(8) Question:** Given that oil disperses naturally at depth and pressure under “fold-out scenario” summarized by Fingas 2014, why is subsurface dispersant use necessary?

**Answer:** *A deep sea release leads to oil globules that constitute a portion of the jet (together with gas bubbles and gas dissolved in the oil droplets). Unless the globules are broken into much smaller droplets, they will rise to the surface and then spread, forming a surface slick. This was indeed seen during the early days of DWH before dispersant was applied. The role of the dispersant is to break up the globules into much smaller droplets that remain sustained in the water column for extended periods and are therefore dispersed over a very wide area/volume.*

**(9) Question:** You talk about how the dispersant increased the aerosolization of oil/dispersant mixture. Since this occurs at the water/surface interface would the toxic effects related to inhalation for people working on boats or on the shoreline be greater than anticipated compared to the oil concentration measured 8-12 inches deep. In other words the aerosolized substances measured within the working area be what needs to be measured?

**Answer:** *There are a few issues here.*

- *The first is the aerosolization of dispersant that is caused during the aerial spraying of the dispersant. The dispersant solution contains surfactants and petroleum distillates as solvent, so aerosols of the dispersant can cause irritation to workers.*
- *The second is the aerosolization of oil caused by wave action on surface slicks. These aerosols contain oil components and could be harmful.*
- *The third is the aerosolization of oil caused by gas bubbles breaking the surface under a slick. The energy of these bubbles also creates aerosol droplets of the oil.*

*We note however, that the use of dispersants on an oil slick breaks up the slick into oil droplets that go into the water column. When this happens, wave action or bubble breakage at the surface is very unlikely to cause aerosols of the oil.*

**(10) Question:** Since dispersants remain at the oil/water interface (i.e., the surface of oil droplets) do they affect the attachment of oil degrading bacteria (ODG) to the droplets- compared with "naturally" dispersed (wave action only) oil droplets?

**Answer:** *There is a recent paper that may address this question.*

[\*Chemical dispersants can suppress the activity of natural oil-degrading microorganisms\*](#)

By: [Kleindienst, Sara](#); [Seidel, Michael](#); [Ziervogel, Kai](#); et al.

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*The abstract of this paper is as below*

*“During the Deepwater Horizon oil well blowout in the Gulf of Mexico, the application of 7 million liters of chemical dispersants aimed to stimulate microbial crude oil degradation by increasing the bioavailability of oil compounds. However, the effects of dispersants on oil biodegradation rates are debated. In laboratory experiments, we simulated environmental conditions comparable to the hydrocarbon-rich, 1,100 m deep plume that formed during the Deepwater Horizon discharge. The presence of dispersant significantly altered the microbial community composition through selection for potential dispersant-degrading Colwellia, which also bloomed in situ in Gulf deep waters during the discharge. In contrast, oil addition to deepwater samples in the absence of dispersant stimulated growth of natural hydrocarbon-degrading Marinobacter. In these deepwater microcosm experiments, dispersants did not enhance heterotrophic microbial activity or hydrocarbon oxidation rates. An experiment with surface seawater from an anthropogenically derived oil slick corroborated the deepwater microcosm results as inhibition of hydrocarbon turnover was observed in the presence of dispersants, suggesting that the microcosm findings are broadly applicable across marine habitats. Extrapolating this comprehensive dataset to real world scenarios questions whether dispersants stimulate microbial oil degradation in deep ocean waters and instead highlights that dispersants can exert a negative effect on microbial hydrocarbon degradation rates.”*

**(11) Question:** Calculations of amounts of dispersant used based on size and location of discharged oil?

**Answer:** *For the DWH a volume ratio of dispersant delivery rate: oil release rate of 1:20 was used. The dispersant use has to be sufficiently high to reduce the interfacial tension significantly to break up oil globules to small droplets It also has to be well targeted to the oil.*

**(12) Question:** Are particular types of dispersants better for certain types of oil environments?

**Answer:** *The ability of dispersants to reduce the oil-water interfacial tension to sufficiently low levels to break up the oil into tiny droplets, depends upon a number of factors including the type of oil, the temperature, the weather (energy of the waves) etc. Highly viscous oils and low temperatures inhibit the action of dispersants. There is considerable effort that industry is undertaking to formulate specific dispersants for different types of oil. But for now the Corexit class of dispersants and its variants (Slickgone, Finasol, etc.) are the ones used in a spill subject to regulatory procedures.*

**(13) Question:** What happens to the oil over time when dispersants are applied?

**Answer:** *The oil breaks into droplets that are dispersed over a wide area of the ocean. The hypothesis is that the vastly increased surface area of the droplets (compared to the surface area of a slick) will facilitate access to oil-degrading organisms and that the oil will therefore be consumed. The paper cited above indicates that dispersants at the oil-water interface have an effect on biodegradation. There are further theoris that say that attachment of sediment particles at the oil-water interface and the formation of biofilms around oil droplets (marine snow) which entrap particulates, will lead to the sinking of oil. There is much research in this aspect of oil spill fate.*

**(14) Question:** Are dispersants preferentially degraded vs. the hydrocarbons in oil droplets by oil degrading bacteria?

**Answer:** *The organisms that degrade dispersants are distinct from the ones that degrade oil. Dispersants contain various surfactants (Tween, Span, DOSS) each of which have different rates of biodegradation with DOSS considered to be persistent for extended periods. Again, the paper cited above has significant information about relative degradation rates and colonization by various microorganisms.*