EPA
www.epa.gov/research
science in ACTION
INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

Determining Which Dispersants Will Be Effective In Future Deepwater Oil Spills

Research Value:

Dispersants serve a function similar to detergents. One of their key components is surfactants. These are long molecules that have one end that is soluble in water and one end that is soluble in oils and fats. Surfactants reduce the tension at the points where oil and water meet. With the input of mixing energy (that in the ocean can be provided by waves), this reduced tension will eventually promote the breakup of the oil into smaller droplets that are capable of dispersion into the water column.

These smaller droplets give microbes in the water greater access to the oil to break it down. Some microbes can use oil as an energy source and in the process degrade the oil into smaller, often less harmful molecules. Dispersants also help to remove the oil slicks from the water surface, thereby protecting species of water fowl from the suffocating effect of exposure to petroleum.

According to the National Oceanic and Atmospheric Administration (NOAA), the National Institute of Standards and Testing (NIST), and the U.S. Geological Survey (USGS), over 4.93 million barrels (207 million gallons) of South Louisiana Crude (SLC) oil were released into the Gulf of Mexico after the blowout of the Deepwater Horizon well on April 20, 2010. The amount of dispersants used on the Deepwater Horizon spill dwarf any other spill where dispersants were used. The total volume of dispersants used in the entire Gulf spill was estimated at 1.84 million gallons.

Deepwater spills result in oil distributed from deep in the water column to the water surface. One factor affecting dispersant effectiveness is temperature. Some dispersants are less effective at lower temperatures. In deepwater spills like the Deepwater Horizon spill in 2010, oil is released into significantly colder water (a typical deep water temperature might be ~5 °C) than the water that surface spills encounter (a typical surface temperature in the Gulf might be ~25 °C). For the most effective mitigation of the effects of these deepwater spills, which dispersants are effective at low temperatures? Are there some available dispersants that would be effective at both deep sea and surface temperatures? This study addresses these questions.

Research Details:

The objective of this study was to test eight of the available dispersants (including Corexit 9500A, which was used extensively on the 2010 Deepwater Horizon Spill) on SLC) oil under temperature conditions similar to both the deep sea (5 °C) and in the top 5 m (25 °C) in the Gulf. SLC is similar in composition to the Mississippi Canyon Block 252 oil from the Gulf of Mexico spill. These same eight products were also tested for acute toxicity to aquatic organisms in a separate EPA study.

This study seeks to determine which dispersants will be effective at the lower deep ocean temperatures, and which ones will be effective at the higher ocean surface temperatures.

The National Contingency Plan Product Schedule (NCPPS) is a list of acceptable products like dispersants that may be used when an oil spill occurs. This list is managed by EPA based on assignment by the National Contingency Plan. When a spill occurs, the On-Scene Coordinator and the Unified Incident Command select the

U.S. Environmental Protection Agency
Office of Research and Development (ORD), National Risk Management Research Laboratory (NRMRL)
Land Remediation and Pollution Control Division (LRPCD)

products to be used to combat the oil spill. They rely on the NCPPS to guide their selection. One goal of EPA studies such as this is to ensure effective products are on the NCPPS.

Dispersants work in a similar way to detergents and can help remove surface oil slicks and protect waterfowl.

This study used a modification of the Baffled Flask Test (BFT), which is being proposed to replace the current Swirling Flask Test (SFT) as an official standard protocol because of better reproducibility and mixing, causing more dispersion.

The results indicate that temperature was not as critical a variable as the literature suggested, likely because of the low viscosity and light weight of the SLC. Only three of the eight dispersants tested produced satisfactory results in the laboratory flasks at both temperatures.

Outcomes and Impacts:

By assessing which dispersants are effective at low temperatures, data from this and similar studies will help to mitigate the environmental effects of future deepwater oil spills. This study also provides information useful in choosing effective dispersants for surface spills. The refinement of dispersant testing protocols done in this study will help in further studies that attempt to add to the knowledge of the effectiveness of dispersants to protect the environment from oil spills.

CONTACTS

Technical Inquiries:
Albert D. Venosa
513-569-7668
EPA/ ORD/NRMRL/ LRPCD
venosa.albert@epa.gov

Communications:
Roger Yeardley
513-569-7548.
EPA/ORD/NRMRL/LRPCD
yeardley.roger@epa.gov

MORE LAND RESEARCH ON THE WEB: **www.epa.gov/nrmrl/lrpcd**

REFERENCES

Venosa, A.D., and E.L.Holder. 2012. Determining the Dispersibility of South Louisiana Crude Oil by Eight Oil Dispersant Products Listed on the NCP Product Schedule. Marine Pollution Bulletin, in press.

Hemmer, M.J., Barron, M.G., and R.M. Greene. 2011. Comparative toxicity of eight oil dispersant products on two Gulf of Mexico aquatic test species. Env. Toxicol. Chem. 30(10): 2244-2252.

Kaku, V.J., Boufadel, M.C., and A.D. Venosa. 2006. Evaluation of mixing energy in laboratory flasks used for dispersant effectiveness testing. ASCE J. Environmental Eng. Div. 132: 93-101.

Venosa, A.D., King, D.W., and G.A. Sorial, 2002. The baffled flask test for dispersant effectiveness: a round robin evaluation of reproducibility and repeatability. Spill Sci. & Technol. Bulletin. 7(5-6): 299-308.