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What happens to chemical dispersants used in deepwater oil spills?

The Deepwater Horizon Oil Spill saw the first ever use of chemical dispersants to reduce the impacts of an oil spill at a deepwater level. A new study has investigated the fate of these dispersants in deepwater and concluded that they do not biodegrade well.

Dispersants can prevent large slicks caused by oil spills by reducing the size of the oil droplets. They have been used successfully on surface oil spills, but last year's Deepwater Horizon incident was the first time they were used at a deep level, when they were applied to the wellhead on the seafloor. Approximately 2.1 million gallons of dispersant were used for the Deepwater Horizon oil spill; 1.4 million gallons to the surface water and 0.77 million gallons to the wellhead. Two types of dispersant were used.

In order to trace the fate of these dispersants, the study analysed a component that is present in both, known as dioctyl sodium sulfosuccinate (DOSS). Concentrations of DOSS were examined in samples of water collected from the Gulf of Mexico during and after the leakage of oil and gas from the Deepwater Horizon wellhead in May, June and September 2010.

DOSS concentrations were first assessed when oil leakage occurred near the wellhead in May/June 2010. Here concentrations ranged between 0 and 12 micrograms (µg) per litre. Only one sample from near the surface had a considerable DOSS concentration, which may be because it was close to the wellhead (1200m away).

Most of the high DOSS concentrations were found in waters between 1000m and 1200m in depth. These coincided with increased methane concentrations, suggesting that the two compounds were released at the same time. It is thought the dispersants are in fact trapped in the plume of hydrocarbons (which includes methane) and gas that rise from the oil spill and upwards through the water. This would be consistent with data that suggest that the dispersants travelled into this 1000-1200m level and were not transported further towards the surface.

After the oil flow from the well ceased in July, DOSS concentrations fell significantly at all sampled sites. In the sample sites furthest from the spill site, the DOSS level was undetectable. Levels ranged from 0 to 0.07 µg per litre, which is approximately 2 to 3 orders lower than earlier detected.

It was suggested that this decrease was the result of strong mixing with water near the plume and the data appeared to support this when compared to estimates based on the rate of mixing at different distances. For example, it was estimated that mixing would cause the concentration of DOSS to be between 0.001 and 0.02 µg per litre at 500 km and the observed levels was 0.003 µg per litre. It is possible that biodegradation contributed to the decrease in DOSS concentrations but the study suggests that, in the main, it was caused by dilution and mixing within the water. Calculations indicate that plant and animal life travelling through the plume are likely to encounter 1-10 µg per litre of DOSS, but further tests are needed to assess the responses of marine wildlife to oil, gas, dispersant and mixtures of these.

Source: Kujawinski, E.B., Kido Soule, M.C., Valentine, D.L. *et al.* (2011) Fate of Dispersants Associated with the Deepwater Horizon Oil Spill. *Environmental Science & Technology* 45:1298-1306.

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