# The Physics of Oil Spill Cleanups

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Oil spills are a major environmental problem because they often occur at sea and in remote, ecologically-sensitive areas where their impact on birds, sea mammals and subsurface life may last for years.

The best way to mitigate this damage is to clean up spills immediately, and typically this starts with skimming off as much oil as possible. Such cleanups may leave large areas covered with a thin slick of spilled oil, which is often dispersed by spraying the spill area with chemical "surfactants" that break the film into small oil droplets that are consumed by bacteria, dissolved, evaporated, or attached to small solid particles and sink to the bottom of the ocean.

When dispersants are spayed over a spill in the open sea, the turbulent mixing forced by ocean currents and the wind actually helps in the cleanup process, but how much such turbulence contributes is not completely understood scientifically. Up to now, the breakup of oil mixed with dispersants has not been thoroughly studied in the laboratory, and there is little information on how wind, weather, and other local conditions contribute to the effectiveness of a cleanup process.

Now Johns Hopkins graduate student Balaji Gopalan and his mentor Professor Joseph Katz have imaged the dispersion of tens of thousands of oil droplets in carefully controlled laboratory settings and observed the effect of local turbulence on this process. Pre-Mixing the oil with the commercial dispersant COREXIT 9527, they observed how it breaks into numerous tiny droplets smaller than the period at the end of this sentence. Following each droplet in three-dimensions, they observed

how tails/thread like structure grew from its surface, the thickness of the tails being less than 17 micron in size, and the breakup of which could produce extremely small droplets.

This better understanding of the basic physics of the dispersion process should allow environmental engineers to better predict how well dispersants will work in the field, says Gopalan, which should help inform decision makers during major oil spills. The work is part of a large collaboration between biologists, ecologists, physical oceanographers, computer modelers, and engineers, primarily associated with the Coastal Response Research Centre, that aims to model and predict the fate of oil after it spills, taking into account the properties of the oil, dispersant, weather conditions, and ecological data. In the future, an improved "response model" based on this larger collaboration may suggest the optimal approach to cleaning up any specific oil spill.

Gopalan's talk, "Formation of Long Tails during Breakup of Oil Droplets Mixed with Dispersants in Locally Isotropic Turbulence" will be held on Tuesday, November 25, 2008, at the 61st Annual Meeting of the American Physical Society

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