OIL SPILL EMERGENCY RESPONSE -
MONITORING THE USE OF DISPERSANTS

Oil Droplet Size Distribution

About

Dispersants are chemical agents used to break up oil into smaller droplets throughout the water column. Dispersants are applied to surface oil floating on water, or below the surface closer to an uncontrolled release of crude oil from a well blowout source. This series of fact sheets details monitoring requirements and how to apply the collected data to inform the use of dispersants under **Subpart J of the National Contingency Plan (NCP)**.

Description of the Requirement

The responsible party must collect and analyze water column samples from the ambient background, baseline oil plume, and dispersed oil plume for *in situ* oil droplet size distribution, including metrics such as concentration or mean diameter of droplet sizes ranging from 2.5 to 2000 µm with the majority of data collected between 2.5 -100 µm (Figure 1). See the regulatory requirement in the Code of Federal Regulations (CFR): **40 CFR 300.913(b)**.

Droplet Size Distribution

When liquid oil is forcefully released into water, oil droplets form in varying sizes. The distribution of droplet sizes is a function of oil viscosity, type, and environmental release conditions. Submerged oil droplets vary in size from small to large: measured in nanometers (nm), micrometers (µm), and millimeters (mm), respectively. The time it takes submerged oil to rise to the seawater surface is controlled by buoyancy and droplet size. Oil droplets form in a greater range of sizes when oil is physically or chemically dispersed.

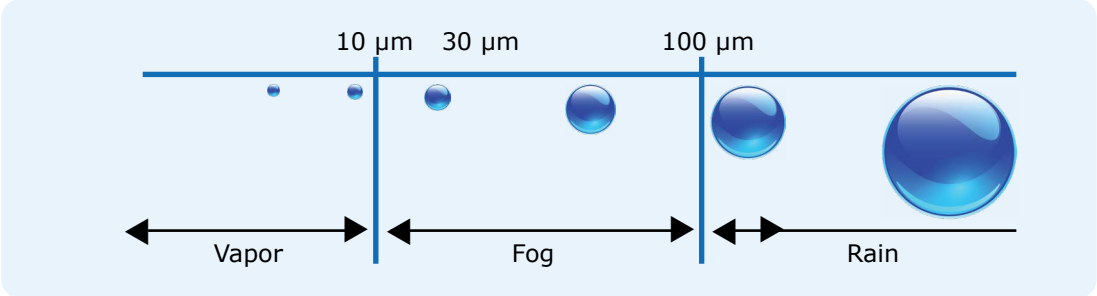
Importance of Droplet Size Distribution Analysis

- Droplet size distribution may serve as an indicator of the effectiveness of dispersant operations.
- Effective dispersants yield a greater proportion of small droplets than large droplets (Figure 2).
- Larger droplets rise to the water's surface faster and can coalesce—forming slicks or sheens.
- Smaller droplets remain suspended longer in the water column and are subject to water fate and transport processes (e.g., biodegradation, dissolution) (Figure 3).

Measuring and Reporting Droplet Size

Analyzers provide droplet size counts throughout the water column. These instruments can be holographic or laser based (Figure 4). For example, particle size analyzers use lasers that hit the particles or droplets in the water column and scatter the light. The scattered light information is collected on a detector, which provides real-time results. Data for a range of droplet sizes, including the mass or volume mean droplet diameter, can be reported in tabular or graph form as nanometer (nm), micrometer (µm), and/or millimeter (mm) to the On-Scene Coordinator for calculating total particle concentration.

Figure 1: Droplet sizes (not to scale) relative to water.



Credit: EPA

Decision Points for Responders

The On-Scene Coordinator should consider all available data and information relevant to the response and consult with subject matter experts. If there is no observable decrease in the average droplet size when compared to the baseline oil plume, this may indicate that the dispersant is not working. The response team should revisit dispersant choice given the conditions present to determine whether dispersant application should continue, continue with modifications, or cease.

Data Collection and Reporting Frequencies

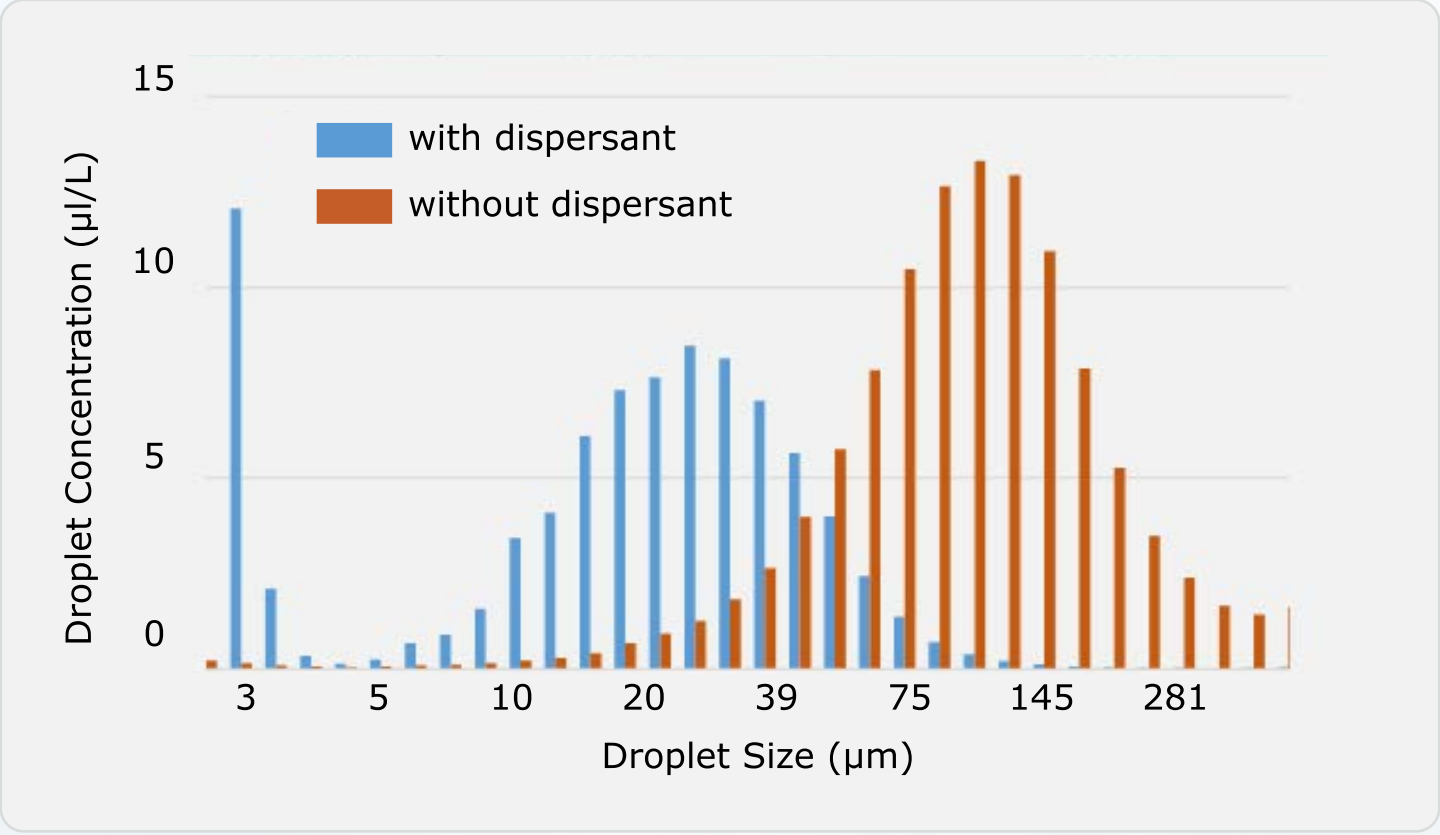
Collection

Oil droplet size distribution data from the ambient background water column and baseline oil plume, as appropriate.
Daily: Oil droplet size distribution data from the dispersed oil plume.

Reporting

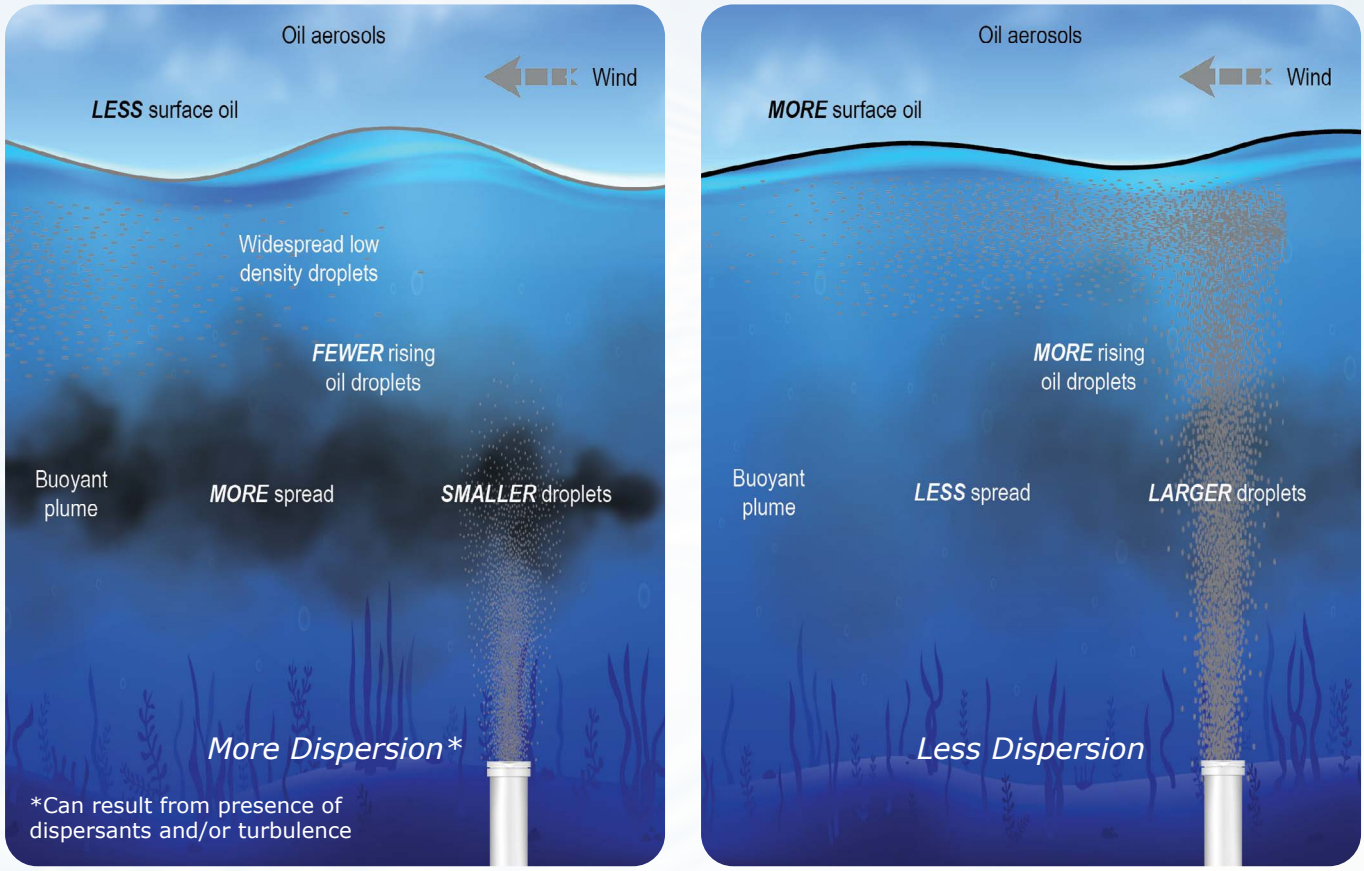
Immediate: Important ecological receptors' exposure to oil droplet size distribution
Daily: Oil droplet size distribution data and analyses.

Figure 2: Droplet size distribution differences for naturally dispersed (red) and chemically dispersed (blue) oil.



Credit: EPA

Figure 3: A combination of small and large droplets form during physical (without dispersant) and chemically-enhanced (with dispersant) dispersion. The presence of dispersants and/or turbulence increases the concentration of small droplets in subsea plumes.



Credit: EPA

Additional Resources

NCP Product Schedule Technical Notebook

This compilation of product bulletins summarizes data requirements and test results for dispersant products listed on EPA's NCP Product Schedule. It includes information on dispersant product application methods, toxicity and effectiveness, and physical properties.

Oil Spill Emergency Response – Monitoring the Use of Dispersants Fact Sheets

- Water Column Sampling

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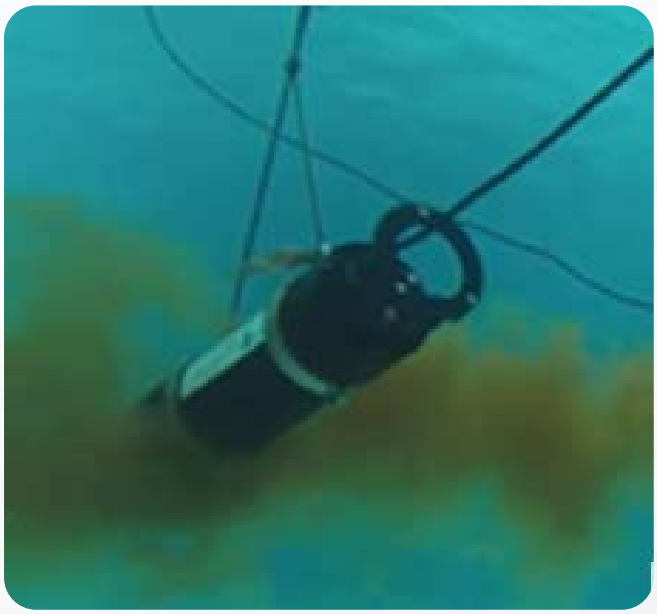
Figure 4: Example particle size sensor.



Credit: Water Mapping, LLC