NRC (2005) DISPERSANT REPORT RECOMMENDATIONS
Organized by Topics to be Discussed at the
NOAA/Coastal Response Research Center Workshop
"Research & Development Needs For
Making Decisions Regarding Dispersing Oil"

Overall Workshop Objective

Work together to establish an integrated research plan, which focuses on collecting and disseminating peer-reviewed information about key aspects of dispersant use in a scientifically robust, but environmentally meaningful context.

Effectiveness – Chemical

Develop and fund a research program to identify the mechanisms and rates of weathering processes that control the chemical effectiveness of dispersants. The research program should include both bench-scale tests and wave-tank experiments. Because of the limited funds and costs of wave-tank experiments, it is especially essential that wave-tank studies be well-coordinated.

Initiate a detailed investigation of wave tank studies that specifically address the chemical treatment of weathered oil emulsions.

Develop and implement a focused series of studies that will enable the technical support staff advising decisionmakers to better predict the effectiveness of dispersant application for different oil types and environmental conditions over time.

Experimental systems used for bench-scale effectiveness tests should be characterized to determine the energy dissipation rates that prevail over a wide range of operating conditions. Future effectiveness tests should measure chemical effectiveness over a range of energy dissipation rates to characterize the functional relationship between these variables. Finally, evaluation of chemical effectiveness should always include measurement of the droplet-size distribution of the dispersed oil.

Coordinated research should be undertaken at bench-and wave tank scales to define those parameters that control oil dispersability as the oil is allowed to weather under carefully controlled but realistic environmental conditions.

Coalescence and resurfacing of dispersed oil droplets as a function of mixing time should be studied in flumes or wave tanks with high water-to-oil ratios (to promote leaching of surfactant into the water column).

Future field-scale work, if deemed necessary, should be based on the systematic and coordinated bench-scale and wave tank testing recommended in this report.

Effectiveness – Operational

The design of wave-tank dispersant-effectiveness studies should specifically test hypotheses regarding factors that can affect operational effectiveness.

Tank tests that determine the ability of mechanical recovery methods to recover oil that has been treated with dispersant but not effectively dispersed, or re-floated oil, should be carried out.

Develop updated SMART protocols and consider adding a detailed Standard Operating Procedure (including instrument calibrations and data quality objectives) for each sampling and analytical module. Develop a definition of field effectiveness.

Develop and implement detailed plans (including preposition of sufficient equipment and human resources) for rapid deployment of a well-designed monitoring effort for actual dispersant applications in the United States.

Effectiveness - Hydrodynamic

Energy-dissipation rates should be determined for wave tanks over the range of operating conditions that will be used in dispersant effectiveness tests.

The concentration of oil should be measured in all identifiable compartments to which it could be transferred when dispersant effectiveness is investigated in wave tanks.

Develop a coordinated program to obtain needed information about turbulence regimes at a variety of interrelated scales.

Initiate a detailed investigation of upper sea-surface turbulence with particular emphasis on quantifying horizontal and vertical diffusivities and the rate of energy dissipation.

Effectiveness – Integration/Modeling

Develop and fund a research program that provides the data needed to predict, through modeling of the chemical, environmental, and operational conditions, the overall effectiveness of a dispersant application. These models should meet the needs of both planning and real-time decisionmaking in complex nearshore settings.

Relevant state and federal agencies, industry, and appropriate international partners should conduct a series of transport and fate modeling and associated biological assessments with and without dispersants, and develop operational envelopes of the dispersant use (e.g., for what oil types and volumes; when, where, and what type of water bodies) for planning prior to actual oil spills.

Effects – Fate

Additional work is recommended to reconcile the differences between the empirical evaporation approach utilized by Fingas (1996, 1997, 1999) and more traditional pseudo-component approaches as considered by Jones (1996, 1997), who has proposed a simplified pseudo-component (SPC) model relating molar volume, vapor pressure, and molecular weight to the boiling point of the components.

Develop and implement a focused series of experiments to quantify the weathering rates and final fate of chemically dispersed oil droplets compared to undispersed oil.

Develop and implement a focused series of studies to quantify the weathering rates and final fate of chemically dispersed oil droplets in high SPM-concentration regimes compared with non-dispersed oil.

Future research on the kinetics of dispersed oil biodegradation should be conducted at low oil-water ratios to simulate conditions that represent those that follow significant dilution of the dispersed oil plume.

Due to the difficulty of designing laboratory-scale experimental systems that adequately simulate the *in-situ* processes that are expected to affect the biodegradation rate of chemically dispersed oil, future biodegradation studies should be designed to support dispersed oil fate and transport modeling. Ideally, droplet-scale models of biodegradation kinetics should be developed and the appropriate kinetic parameters should be estimated.

The biodegradation kinetics and ultimate biotransformation products of high molecular-weight PAH should be investigated using indigenous microbial communities from seawater.

Oil trajectory and fate models used by relevant state and federal agencies to predict the behavior of dispersed oil should be improved, verified, and then validated in an appropriately designed experimental setting or during an actual spill.

Effects – Exposure Regime

Develop and implement steps to ensure that future wave tank or spill of opportunity studies (or during NRDA investigations of oil spills that are not treated with dispersants) implement a field program to measure both dissolved-phase PAH and particulate/oil-droplet phase PAH concentrations for comparison to PAH thresholds measured in toxicity tests and predicted by computer models for oil spill fate and behavior.

Develop and implement detailed plans (including preposition of sufficient equipment and human resources) for rapid deployment of a well-designed monitoring effort for actual dispersant applications in the United States.

To improve the quality of field data collected during dispersant applications, more robust monitoring capabilities should be implemented. Specific attention should be given to:

- Developing an environmental monitoring guidance manual for dispersant application monitoring with suggested sampling and analytical techniques, sampling methods, and QA/QC to ensure cost effectiveness and maximum utilization of the data
- Developing a detailed standard operating procedure (including instrument calibrations and data quality objectives) for each sampling and analytical module (SMART is guidance only)
- Measuring dispersed oil droplet and dissolved-phase TPH and PAH concentrations with grab samples of filtered and unfiltered water (these data can then be compared to model predictions and toxicity data for both dissolved and particulate/oil-phase components) as a function of location and time.

Effects – Toxicity

Relevant state and federal agencies, industry, and appropriate international partners should develop and implement a series of focused toxicity studies to:

1) provide data that can be used to parameterize models to predict photo-enhanced toxicity;
2) estimate the relative contribution of dissolved and particulate oil phases to toxicity with representative species, including sensitive species and life stages; and
3) expand toxicity tests to include an evaluation of delayed effects.

Future field-scale work, if deemed necessary, should be based on the systematic and coordinated bench-scale and wave tank testing.

Studies should be undertaken to assess the ability of fur and feathers to maintain the water-repellency critical for thermal insulation under dispersed oil exposure conditions comparable to those expected in the field.

Ensure that the spill response research community continues to monitor developments in the broad field of ecotoxicology, as various applications of increased understanding of toxicological effects, on various time scales, at the population and community-level may be of significant value to dispersant decisionmaking.