Oil Spill Dispersants : Efficacy and Design

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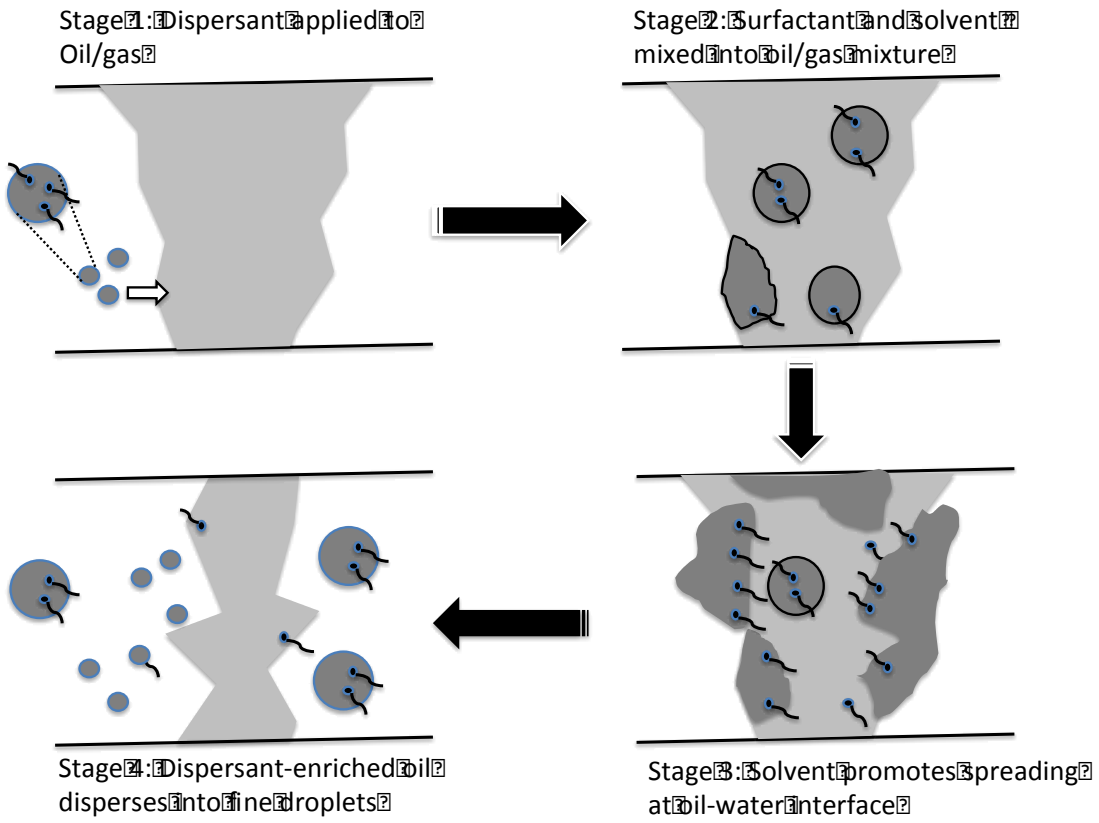
Dispersant Use

- "The objective of dispersant use is to enhance the amount of oil that physically mixes into the water column, reducing the potential that a surface slick will contaminate shoreline habitats or come into contact with birds, marine mammals, or other organisms that exist on the water surface or shoreline." National Research Council Report - *Oil Spill Dispersants, Efficacy and Effects* (2005).

Dispersants

- Dispersants are formulated as liquids containing one or more surfactants and one or more organic solvents.
- Solvent is a carrier of surfactants that are either solid or viscous.
- Dispersant formulations consist of water, hydrocarbons and glycol ethers or alcohols.
- Compositions vary widely – surfactants from 10% to 50% by volume.

Dispersant Mechanism



Advantages

- Can be used over a wide range of environmental/meteorological/oceanographic conditions compared to other options.
- Can be applied over a wide area quicker than other options.
- Emulsification of oil can be reduced.
- Accelerates biodegradation of oil.
- Oil becomes less adhesive.
- Significant cost benefit.
- Generates minimal waste.
- Oil droplets do not re-coalesce back to bulk oil.

Disadvantages

- May reduce efficacy of other methods.
- Not universally effective.
- Oil may be imbibed into sediments.
- Dispersants can be contaminants.
- Lose effectiveness with time.
- Sea water versus fresh water formulations.
- Energy needed to dispersant application.
- Some slicks may not respond.
- Expedited approval and registration needed.

Useful Situations ?

- Natural dispersion is not rapid.
- Mechanical recovery or burning is infeasible.
- Protection of sensitive shoreline ecosystem is necessary.
- Bird population needs protection.

Not Useful Situations?

- Shallow water with poor circulation.
- Potable drinking water intake is nearby.
- Fish or wildlife spawning areas are nearby.
- Spill directly over coral reefs.
- Oil is solidified or extremely viscous.

Effectiveness Factors – Oil Properties

- Viscosity – 1000 to 10000 cP.
- API Gravity – 17 to 45.
- Pour point
- Emulsion formation – asphaltenes, resins and porphorins content.

Effectiveness Factors – Environmental

- State of the sea – wind.
- Temperature – varied effects.
- Salinity – 30 to 35 parts per thousand.
- Toxicity – tests needed.

How to Ascertain Effectiveness in the Field?

- Visual inspection.
- Sampling.
- Real-time measurement – e.g., fluorometry.
- Remote sensing – IR and SLAR.

How to Ascertain Effectiveness in the Laboratory?

- Mackay-Nadeau-Steelman test.
- IFP – Dilution Tests.
- Labofina Rotating Flask test.
- Environment Canada Swirling Flask test.
- US Swirling Flask Modified Test.
- EXDET test – ExxonMobil.

Future Needs?

- Dispersants effective at high P and low T environments?
- Oil/Gas mixture interactions with dispersant constituents?
- Dispersant toxicity information – site specific?
- Dispersants biodegradable?
- Green compatible materials?

References

- *Oil Spill Dispersants - Efficacy and Effects*, National Research Council Report, NAP, Washington, DC (2005).
- *Deepwater Horizon Dispersant Meeting Report* – Coastal Response Research Center, Univ. New Hampshire, June 4, 2010.
- *ExxonMobil Oil Spill Dispersant Guidelines ,* ExxonMobil Research and Engineering Company (2008).