How Dispersants Work

March 12, 2013
Dispersants – What are they and what do they do?

• Dispersants are solutions of surfactants dissolved in a solvent

• Surfactants reduce oil-water interfacial tension – allows slicks to disperse into very small droplets with minimal wave energy

• Dispersed oil rapidly dilutes to concentrations <10 ppm within minutes, <1 ppm within hours, ppb range within a day

• Each dispersed oil droplet is a concentrated food source that is rapidly colonized and degraded by marine bacteria

• Dilution allows biodegradation to occur without nutrient or oxygen limits

Graphic consistent with Venosa & Holder, EPA 2007
How Dispersants Work
The Goal: Rapidly Reduce Oil Concentration to Below Impact Levels Rapidly

1) OIL/WATER INCOMPATIBILITY

2) APPLICATION OF DISPERSANT

3) OIL SLICK DISPERSES INTO DROPLETS WITH MINIMAL ENERGY

Surfaces of Droplets Repel Each Other... No Coalescence
Environmental Impact of Dispersant Use

• Toxicity of oil > toxicity of the dispersant
  – Dispersants do not make the oil more toxic
• Modern dispersants use ingredients found in household products
  – NALCO website*
  – NOAA & FDA test results for dispersants in Gulf seafood, "There is no question Gulf seafood coming to market is safe from oil or dispersant residue.”

(http://www.noaanews.noaa.gov/stories2010/20101029_seafood.html)

Other Uses of Corexit® 9500 Ingredients
(from Nalco website)

<table>
<thead>
<tr>
<th>Corexit® 9500 Ingredients</th>
<th>Common Day-to-Day Use Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span™ 80 (surfactant)</td>
<td>Skin cream, body shampoo, emulsifier in juice</td>
</tr>
<tr>
<td>Tween® 80 (surfactant)</td>
<td>Baby bath, mouth wash, face lotion, emulsifier in food</td>
</tr>
<tr>
<td>Tween® 85 (surfactant)</td>
<td>Body/Face lotion, tanning lotions</td>
</tr>
<tr>
<td>Aerosol® OT (surfactant)</td>
<td>Wetting agent in cosmetic products, gelatin, beverages</td>
</tr>
<tr>
<td>Glycol butyl ether (solvent)</td>
<td>Household cleaning products</td>
</tr>
<tr>
<td>Isopar™ M (solvent)</td>
<td>Air freshener, cleaner</td>
</tr>
</tbody>
</table>

*http://www.nalco.com/applications/corexit-technology.htm
It is Important to Remember Relative Toxicity

*Environment Canada Study*

<table>
<thead>
<tr>
<th>Product</th>
<th>Toxicity (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmolive Dish Soap</td>
<td>13</td>
</tr>
<tr>
<td>Sunlight Dish Soap</td>
<td>13</td>
</tr>
<tr>
<td>Mr. Clean</td>
<td>30</td>
</tr>
<tr>
<td>Corexit 9527</td>
<td>108</td>
</tr>
<tr>
<td>Corexit 9500</td>
<td>350</td>
</tr>
</tbody>
</table>

*(96 HR Rainbow Trout LC50)*
NEBA: Floating Oil

Oil alone (oil floats on water)

- mangrove forest
- coral reef
- seagrass bed
- high tide
- low tide
NEBA: Dispersed Oil

Dispersed oil (oil dispersed through water column)

- high tide
- low tide
- coral reef
- seagrass bed
- mangrove forest
Dispersants: One of the Tools in the Toolbox

The goal is to design a response strategy based on *Net Environmental Benefit Analysis (NEBA)*
Encounter Rate is Key to Offshore Response
Release Site May 9: Prior to Injection

Courtesy of Ocean Imaging
Winds @ 0850 40° / 16 knots
Avg winds 64° / 16 knots

Wind direction

05/09/2010 8:52am CST

Copyright 2010 Ocean Imaging Corp.
Release Site May 10: 3 hrs of Injection

Winds @ 0850 40° / 12 knots
Avg winds 91° / 10 knots

Courtesy of Ocean Imaging
Release Site May 10: 11 hrs of Injection

05/10/2010 - 5:05pm

@ 11 hrs. after start of subsurface dispersant release

Copyright 2010 Ocean Imaging Corp.

Wind direction

Winds @ 1700 120° / 14 knots
Avg winds 91° / 10 knots

Courtesy of Ocean Imaging
Release Site May 11: 5 hrs after Injection Ended

05/11/2010 - 9:10am CST
Subsurface dispersant release ended 4am

Copyright 2010 Ocean Imaging Corp.

Winds @ 1700 140° / 8 knots
Avg winds 134° / 10 knots

Wind direction

Oil continues curving toward Southeast

Courtesy of Ocean Imaging

South

North

East
Release Site May 12: 28 hrs After Injection Ended

Courtesy of Ocean Imaging
Winds @ 0850 150° / 7 knots
Avg winds 130° / 7 knots

Wind direction

05/12/2010 - 8:35am CST