

RRT IX Regional Contingency Plan – Dispersant Use Plan for California

Job Aid 3

Oil and Refined Oil Properties, Dispersant Efficacy on Different Oil Types

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3.a General oil characteristics and dispersibility

| Type | Description and Characteristics | Dispersibility | Crude oil examples | Refined product examples |
|------|---|--|--|--|
| I | Light distillates Specific gravity: <0.80 API gravity: >45 Viscosity: 0.5-2.0 cSt @ 15° C Non-persistent, very volatile, highly flammable, high evaporation rates, rapid spreading rates, highly toxic to biota, little if any emulsification, high penetration of substrate. | No need to disperse. Oil will dissipate rapidly. | Algerian blend | Maui and Kapuni distillate, gasoline blendstocks, motor spirit (RMS/PMS), Avgas, Jet A1, kerosene |
| II | Light crudes Specific gravity: 0.80-0.85 API gravity: 35-45 Viscosity: 4 cSt to solid @ 15° C Non-persistent, moderate to high volatility, low to moderate viscosity, moderate to high toxicity, can form stable emulsions, moderate to high penetration of substrates. | Relatively non-persistent. Easily dispersed if pour point under 41° F. Probably difficult to disperse if water temperature is below pour point (behaves like a Group IV oil). | <u>Pour point <41° F:</u> Brent, Ekofisk, Forties, Murban, Seria Light <u>Pour point >41° F:</u> Ardjuna, Beatrice, Camar, Lucina, Palanca, Angola, Pennington | Unfinished oils; automotive gas oil, marine gas oil, Navy gas oil |
| III | Medium – heavy crudes, fuel oils Specific gravity: 0.80-0.95 API gravity: 17.5-35 Viscosity: 8 cSt to solid @ 15° C Persistent, moderate volatility, moderate viscosity, variable acute toxicity, can form stable emulsions, low to moderate penetration of substrates. | Fairly persistent. Easily dispersed if treated promptly and before significant emulsification occurs. | <u>Pour point < 41° F:</u> Alaskan, Arabian light, Basrah, Dubai, Iranian heavy, Kuwaiti, Maya, Oriente <u>Pour point > 41° F:</u> Bonny light, Coban blend, Gamba, LSWR, Minas, Santa Cruz, Taching, Zaire | |
| IV | Heavy crudes and residues Specific gravity: 0.95-1.00 API gravity: 10.0-17.5 Viscosity: 1500 cSt to solid @ 15° C Persistent, low to moderate volatility, moderate to high viscosity, variable acute toxicity, can form stable emulsions, low to moderate penetration of substrates. | Fairly persistent. Probably difficult to disperse if water temperature is below pour point of material. | | Heavy fuel oil, residues, Fletcher blend, Maui F sands < pour point, lube oils, lube oil blendstocks |
| V | Non-spreading oils Specific gravity: >1.00 API gravity: <10.0 Viscosity: Solid unless heated Persistent, very low volatility, little if any evaporation, very high viscosity, very low acute toxicity, can form stable emulsions, little if any penetration of substrate. | Persistent. Generally not dispersible. | | Heavy bunker fuel oil, bitumen, very heavy fuel oil, asphalt, paraffins, waxes, residual fuels |

In part from Cawthron, 2000

3.b Dispersant “Window of Opportunity”

The “window of opportunity” for dispersant use is generally defined as the timeframe available for application and within which a dispersant can be expected to be reasonably effective. It is difficult to accurately predict the “window of opportunity” for any given dispersant application. The following general points should be considered:

- Most dispersant formulations are designed to work in ocean water with an average salinity of about 35 ppt. The efficacy of most saltwater dispersant formulations drops off significantly as the ocean salinity decreases, such as in bays and estuaries during times of freshwater incursion;
 - Heavier crude oils are more difficult to disperse than lighter crude oils;
 - Dispersant efficacy will vary based on the weathering of oils. **The most significant factors to consider are emulsion formation and evaporation;**
 - At the time of an oil spill, the NOAA Scientific Support Coordinator can run several models estimating the “window of opportunity” for dispersant use, specific to a given incident;
- ✓ **Model results should be supported, whenever possible, by field tests (e.g., tailgate “shaker” efficacy tests, limited test spray runs) of dispersant efficacy on the actual spilled oil, and interpretation of those field-based trial results by experienced dispersant operators, SMART Team members, the NOAA SSC, and/or ART technical specialists.**

3.c Appropriateness/effectiveness of dispersant use on different oils and oil products

| Incident Involving: | Spilled Oil | Dispersant Use Effective or Appropriate? |
|----------------------------------|-------------------------------------|--|
| Fishing vessel | Marine diesel oil Marine gas oil | No |
| Small cargo ship | Medium fuel oil | Yes |
| Medium cargo ship | Medium fuel oil | Yes |
| Product tanker | Medium/heavy fuel oil | Yes |
| Product tanker | Gasoline cargo | No |
| Product tanker | Jet fuel cargo | No |
| Product tanker | Diesel cargo | No |
| | Vegetable oil cargo | No |
| Product tanker | HFO for power use | No |
| Large cargo ship | Heavy fuel oil | Possibly |
| Oil tanker | Heavy fuel oil | Possibly |
| Oil tanker | Condensate | Probably not |
| Oil tanker | Crude oil cargo | Yes – for perhaps a significant time window |
| California offshore oil platform | Crude oil | Limited for most platforms, but also see 3.d below |

3.d API gravities of oils produced from California offshore platforms

| | | NOAA ADIOS | Pacific Outer Continental Shelf Study | MMS/EC Catalog | |
|------------------|---------------|------------------------|---------------------------------------|----------------|------|
| Oil Field Name | Platform Name | API | API | Name | API |
| Beta | Ellen | 13.7-15.1 | 17.3-18.3 | | 13.7 |
| | Elly | | | | |
| | Eureka | | | | |
| | Edith | | | | |
| Carpinteria | Hogan | 22.9 | 24.2 | | 22.9 |
| | Houchin | | | | |
| | Henry | | | | |
| Dos Cuadras | Hillhouse | 25.6 | 24.3 | | 25.6 |
| | A | | | | |
| | B | | | | |
| | C | | | | |
| | Holly | | | | 11 |
| Hondo | Hondo | 18.3-20.8 | 21.5 | | 19.6 |
| | Harmony | | | | |
| Hueneme | Gina | | 20.9 | | |
| Port Hueneme | | 14.8 | | | |
| Pescado | Heritage | | 21.5 | | |
| Pitas Point | Habitat | | | | 38 |
| Point Arguello | Hidalgo | Same as MMS/EC Catalog | 22.2 | Commingled | 21.4 |
| | Harvest | | | Heavy | 18.2 |
| | Hermosa | | | Light | 30.3 |
| Point Pedernales | Irene | 11.2 | | | 11.2 |
| Santa Clara | Gilda | 22.1 | 20.9 | | 22.1 |
| | Grace | | | | |
| Sockeye | Gail | 20.6 | 21.6 | | 21.6 |
| | | Same as MMS/EC Catalog | → | Commingled | 19.8 |
| | | | | Sour | 18.8 |
| | | | | Sweet | 29.4 |

From S.L. Ross, 2002 and NOAA ADIOS

3.e Properties of refined oil products

| Refined Product Name | Specific Gravity @ 15.5°C | API Gravity @ 15.5°C | Pour Point °C | Viscosity cSt @ 20°C | Dispersibility at Specified Sea Temperature Ranges (°C) | | | |
|--------------------------------------|---------------------------|----------------------|---------------|----------------------|---|-------|-------|------|
| | | | | | 7-13 | 13-18 | 18-24 | >24 |
| Asphalt (Bitumen) – no solvent | 0.99-1.2 | NA | +40-+80 | Solid | No? | No? | No? | No? |
| Automotive Gasoil | 0.84 | 36.3 | -15 | 7.5 | Yes | Yes | Yes | Yes |
| Aviation Gasoline | 0.716 | 66.2 | -60 | 1.0 | Yes | Yes | Yes | Yes |
| Bunker Fuel C (No. 6 fuel oil) | 0.984 | 12.3 | +15 | Solid | No? | No? | No? | Yes? |
| Bunker Fuel C | 1.000 | 10.0 | +2 | Solid | No? | No? | Yes? | Yes? |
| Bunker Fuel C (BHP Hawaii) | 0.993 | 11.0 | +10 | >3000 | No? | No? | No? | Yes? |
| Bunker Fuel No. 6 (BP) | 0.991 | 11.3 | -1 | >800 | No? | No? | No? | Yes? |
| Bunker Fuel No. 6 (Phillips) | 1.022 | 7.0 | +26 | >650 | No? | No? | No? | Yes? |
| Bunker Fuel Caltex/Ampol (K-940) | 0.991 | 11.3 | +15 | >2000 | No? | No? | No? | Yes? |
| Bunker Fuel Shell (FO-467) | 0.980 | 12.9 | +15 | >300 | No? | Yes? | Yes? | Yes? |
| Diesel (automotive winter blend) | 0.855 | 34.0 | -20 | 7.0 | Yes | Yes | Yes | Yes |
| Diesel (automotive summer blend) | 0.865 | 32.0 | -12 | 13.0 | Yes | Yes | Yes | Yes |
| Diesel (Marine Diesel/Gasoil) | 0.854 | 34.2 | -11 | 13 | Yes | Yes | Yes | Yes |
| Gasoline | 0.739 | 60.0 | -18 | 3.0 | Yes | Yes | Yes | Yes |
| Gasoline (Leaded) | 0.750 | 57.2 | -29 | 1.0 | Yes | Yes | Yes | Yes |
| Heating Oil (fuel oil #2) | 0.876 | 30.0 | -12 | 7.0 | Yes | Yes | Yes | Yes |
| Heating Oil (fuel oil #5) | 0.925 | 21.5 | -9 | 190 | No | No | Yes? | Yes? |
| Heavy Fuel Oil | 0.94 | 17.5 | -6 – 15 | 1343 | No? | No? | No? | Yes? |
| IF-30 | 0.936 | 19.7 | -6 | 180 | No? | No? | Yes? | Yes |
| IFO-180 Bunker (BHP) | 0.983 | 12.5 | 4 – 15 | >1000 | No? | No? | Yes? | Yes? |
| IFO-280 Bunker (BHP) | 0.986 | 12.0 | 4 – 15 | >1700 | No? | No? | No? | Yes? |
| IFO-380 Bunker (BHP) | 0.990 | 11.5 | 4 – 15 | >2400 | No? | No? | No? | Yes? |
| Jet Fuel (fuel oil #1 A-1) | 0.806 | 44.0 | NA | 1.0 | Yes | Yes | Yes | Yes |
| Jet Fuel (JP-1) | 0.800 | 45.4 | -40 | 1.2 | Yes | Yes | Yes | Yes |
| Kerosene (dual purpose, fuel oil #1) | 0.800 | 45.4 | -25 | 1.5 | Yes | Yes | Yes | Yes |
| Light Fuel Oil | 0.91 | 23.9 | -9 – -24 | 166 | Yes | Yes | Yes | Yes |
| Lube Oil 10W30 | 0.882 | 29.0 | -40 | 200 | No? | Yes? | Yes? | Yes |
| Naphtha (White Spirit) | 0.794 | 46.8 | NA | 1.0 | Yes | Yes | Yes | Yes |
| Naphtha (Exxon) | 0.758 | 55.0 | -17 | 3.0 | Yes | Yes | Yes | Yes |
| No. 2 Fuel Oil | 0.871 | 31.0 | -30 | 6.5 | Yes | Yes | Yes | Yes |
| Mineral Spirits (Petroleum Spirits) | 0.794 | 46.8 | NA | 1.0 | Yes | Yes | Yes | Yes |
| Paraffin/Waxes | - | - | - | Solid | No? | No? | No? | No? |
| Residual Oils #6 | 0.986 | 12.0 | +15 | >45,000 | No? | No? | No? | No? |
| Solvents | - | - | - | 1 – 5 | No? | No? | No? | No? |
| Transformer Oil (Electrical Oil) | 0.883 | 28.8 | -30 | 18 | Yes? | Yes | Yes | Yes |

? Indicates where data on the potential for dispersion are not unanimous or are uncertain