Efficacy and Effects of Dispersants in Oil Spill Response: Progress Since the 2005 NRC Report

Tying it All Together – Biological

May 4, 2008

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representative of project team: Drs. Ken Finkelstein, Amy Merten, and Lisa Dipinto (NOAA), CRRC Director and staff, most notably Joseph Cunningham and Jennifer Jenks
Rationale for Biological Field Guide

- Water column threat assessment within 96 hours of dispersant application or oil spill
  - Properly evaluate response trade-offs, including dispersant use
  - Synthesize acute toxicity data in graphics useful for decision-makers
- Improve predictive capabilities for estimating biological effects of dispersed oil in water column
  - Major oil types (mixtures) or individual aromatics
  - Time of exposure
  - Species-specific impacts
Relationship of Field Guide to Outcomes Described in CRRC Workshops and NRC Reports

- Supports technical recommendation to enhance data mining efforts and literature synthesis for efficacy and effects of dispersants
- Supports the development of integrated models to improve decision-making when dispersant use is considered
Example Toxicity Plot in Field Guide

Graph 2: Toxicity of Acenaphthene in Saltwater

Approximate Solubility: 3,420 ug/L

- ▲ Crustacean: Non-amphipod
- ★ Crustacean: Amphipod
- ● Fish

Concentration (ug/L; ppb) vs. Time (Hours)
Example Toxicity Plot in Field Guide (2)

Graph 18: Toxicity of PAH's to Saltwater Molluscs

Concentration (ug/L, ppb)

Time (hours)

- Pyrene
- Acenaphthene
- Fluoranthene
- Naphthalene
- Phenanthrene
- Utterbackia imbecillis
- Mytilus lateralis
- Mya arenaria
- Mytilus edulis
- Nassarius obsoletus
- Oenocorinae kisutch

Approximate Solubilities:
- Acenaphthene: 3420 ug/l
- Fluoranthene: 120-265 ug/l
- Naphthalene: 20,000 – 34,000 ug/l
- Phenanthrene: 710-1660 ug/l
- Pyrene: 32-160 ug/l

Note: Species with chemicals that are over the approximate solubility:
- *Mulinia lateralis* with Pyrene @ 96 hours – 240 and 9454 ug/L
  (Approximate Solubility is 32 ug/L)
- *Mulinia lateralis* with Fluoranthene @ 96 hours – 3310 ug/L
  (Approximate Solubility is 120 ug/L)
- *Mulinia lateralis* with anthracene @ 96 hours – 13,330 ug/L
  (Approximate Solubility is 75 ug/L)
Field Guide Contents

- About 50 toxicity plots using data for nine PAHs, six species groupings, and ten species
- Source data for toxicity plots from previous CRRC-funded projects\(^1\) and peer-reviewed literature; only measured concentration data used in toxicity plots
- Toxicity plots paired with interpretive guidance and Microsoft Excel™ spreadsheet with source data

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\(^1\) McGrath and Di Toro (2005). Impacts of Low Level Residual Oils on Toxicity Assessments of Oil Spills
Field Guide Contents (2)

- Microsoft Excel™ spreadsheet templates automatically calculate toxicity of oil mixtures
  - Toxic Units or LC$_{50\infty}$ (McCay 2002; OilToxEx)
- Several common data inconsistencies addressed
  - Measured vs. Nominal concentrations
  - TPH vs. PAH
  - Species-specific data presentation
  - Solubility of PAH in water
  - Source data not paired with tables or figures
Final Thoughts

- Future coordination with diverse group of scientists and modelers, including ongoing CRRC projects\(^1\)
- Documentation of limitations and capabilities equally important. This job aid will not fully address:
  - dissolved vs. particulate concentrations
  - phototoxicity
  - sublethal or chronic endpoints
  - oil weathering and water temperature
  - Physical, chemical, toxicological, and biological uncertainties

Final Thoughts (2)

- For species and chemicals addressed, field guide informs biological risk assessment efforts immediately after a spill or dispersant application
- Field guide supports cross-training of modelers and scientists
- Field guide informs responders and stakeholders about timeliness of water column monitoring or field data collection
  - After dispersant application
  - After oil spill