Will DWH Research Impact Future Use of Chemical Dispersants in Oil Spill Response?

February 16, 2018

AAAS Annual Meeting

Nancy E. Kinner
Professor, Civil & Environmental Engineering
Coastal Response Research Center
University of New Hampshire
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Coastal Response Research Center
(CRRC)

- Partnership between NOAA’s Office of Response and Restoration (ORR) and the University of New Hampshire (UNH)
- New Hampshire = No Oil = No “Politics”
- UNH = Marine Science and Environmental Engg. Research Strength
- Since 2004
  - UNH co-director - Nancy Kinner
  - NOAA co-director - Ben Shorr
Coastal Response Research Center

- Conduct and Oversee Basic and Applied Research and Outreach on Spill Response and Restoration
- Transform Research Results into Practice
- Serve as Hub for Oil & Environmental Spill R&D
  - ALL Stakeholders: Federal, State, NGOs, Academia, Industry
- Facilitate Collaboration on R&D Among Stakeholders
- Educate Next Generation of Oil Spill Community
- Application to All Hazards

Will DWH Research Impact Future Use of Chemical Dispersants in Oil Spill Response?

- Oil Spill Response
  - Objectives/Stages
  - Response Roles and Responsibilities
- Types of Spills
- Response Options
- Response Decision-Making
- Post Response “Game Changers”
  - Previous spills
  - DWH
Has/Will DWH Research Impact Future Use of Chemical Dispersants in Oil Spill Response?

- O. Henry’s vs. Robert M. Day’s Rules:
  - No O. Henry Finish; Give the Answer Early
    - Yes
    - Yes
- Will Dispersants Remain a Spill Response Option?
  - Yes
  - Only under limited circumstances

Caveats

- My Opinion
- Dispersant Use = Offshore Focus
- U.S. Focus
- 30 Minutes to Cover 5 Day Course
- “Devil is in the details”
  - Talk is a high level due to time constraints
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Oil Spill Response: Objectives
Priority #1 = Stop Fire, Rescue People
Human Health and Safety Paramount

Priority #2 - Stop Source of Leak

- Railcar or Ship/Barge:
  - Drain car/ship hold
  - Patch leak
- Pipeline:
  - Shutdown flow
  - Plug leak
- Well:
  - Start Relief Well
  - Install “Cap” to Stop Flow
Priority #3 - Identify Resources at Risk

- Charismatic Marine Mammals
- Recreational Beaches
- Commercial Fishing
- Subsistence Fishing
- Human Health

Priority #4 - Minimize Damage to Resources

- Natural Resources
- Human Resources
  - Open Ports/Continue Commerce
- Key Is Select Most Appropriate Response Techniques
- Unique to Each Spill and Each Day of Spill
  - e.g., Weather, Oil Type, Ecosystem
Priority #5 - Assess Damages

• U.S. Oil Pollution Act 1990 (OPA 90)
• NRDA
• Lisa DiPinto’s Talk in this Session
Priority #6 - Restore Environment

• Usually After Response and Damage Assessment Completed
• OPA 90 Requirement
• Natural and Human Resources
  • Not Civil Damages
• To Condition “But for the Spill”
  • Pre-Spill
Priority #4 - Minimize Damage to Resources

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Oil Spill Response: Roles and Responsibilities
Response Organization

- Command Post(s)
- Field
- Fast Pace
  - 12 - 24 hour Planning Horizons
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**Very Large Source, Large Flow**

- Example: Well Blowout
- Continuous Flow
- Long Time

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**Large Source, Medium Flow**

- Tanker Spill
- Duration Depends on How Quickly Source Controlled
- Examples: Sunken Iranian Tanker in East China Sea
**Small Source, Small Flow**

- Example: Oil Tank Cars
  - 28,000 gal capacity
- Does Not Mean No Problems for Response

**Oil Types**

- Each Behaves Differently in Environment
- Types:
  - Crude Oils - Light, Medium, Heavy
  - Condensates
  - Diluted Bitumen
  - Residuals
  - Bunker Fuels - (Fuel for Ships)
  - Refined Products
Nature’s Response

- Function of Environmental Conditions
  - Temperature
    - (H₂O, Air)
  - Wind
  - Currents, Tides

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Nature’s Response

- Far Offshore: May Be Only Option in Very Bad Storm
- Example: Damaged Freighter with Only Ship’s Fuel
Booms and Skimmers
Capture and Concentrate Oil, Deflect Oil from Critical Area

Typically < 10% oil recovered

Skimmers
Protective Booming
Response: *In Situ* Burning

Typically < 10% oil burned and residual remains
Response: Chemical Dispersants
Surface Application

Response: Dispersants
Sub-Surface Application
Dispersion Estimates for DWH

- Natural Dispersion from Wave Action
  - ~16%
- Chemical Dispersion from Surface and Subsea Application
  - ~8%

Source: http://www.response.restoration.noaa.gov
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Dispersant Restrictions

- Established by Regional Response Teams (RRT)
- Typically:
  - ≥ 3 nm offshore
  - ≥ 10 m water depth
- Many RRTs Have Restricted Zones
Oil Spill Response Decision-Making

- Oil Spills Are Always **BAD**!
- Damage Will Occur
- Responders Must Minimize Damage
  - Use Multiple Options for Different Areas
  - Each Spill is Unique Circumstances
  - Select Response Options that Result in **Least Bad** Scenario

Why Use Chemical Dispersants?

- Wind and Waves Often Too High to Allow Mechanical Removal (Booms & Skimmers) or Burning
- Surface Slicks Oil Key Organisms
- Kept Oil Out of Nearshore Waters and Marshes
  - Where organisms were breeding and juveniles
  - Marshes hard to clean if repeatedly fouled with oil
During DWH Dispersant Use Evaluation

- Late May 2010
- CRRC Requested by Regional Response Teams to Hold Workshop
- Goal: Assess the Efficacy of Using Subsurface and Aerial Dispersant Application in the DWH

Input Regarding Overall DWH Response Methods

1. Chemical dispersants, mechanical recovery and *in situ* burning are components of an effective response to surface oil pollution.

2. Mechanical recovery is the preferred method of on water oil spill response because it removes the oil from the environment, but is not always effective due to environmental conditions (e.g., weather, waves).

3. No combination of response actions can fully contain oil or mitigate impacts from a spill the size and complexity of the DWH incident.

4. Toxicity must be considered when a decision is made to apply chemical dispersants.

5. The effects of using 2.5 MG of dispersants during the Ixtoc spill in 1979 (Jernelov and Linden, 1981) should be considered as part of the evaluation of the DWH incident.
Input Regarding Dispersant Use for the DWH Incident

6. It is the consensus of this group that up to this point, use of dispersants and the effects of dispersing oil into the water column has generally been less environmentally harmful than allowing the oil to migrate on the surface into the sensitive wetlands and near shore coastal habitats.

7. For the DWH spill, the RRTs should provide for a continual re-evaluation of tradeoff options going forward. Because of the magnitude of the DWH spill and with the expectation of prolonged dispersant application, the RRTs should consider commissioning a Consensus Ecological Risk Assessment, or equivalent, including use of existing temporal and spatial data on the resources at risk and using the most current environmental data.

8. Dispersed oil should be tracked over time and space in combination with 3-D modeling in order to inform future decisions on the use of dispersants for the DWH incident.

9. There are short term laboratory and modeling studies which can be done to aid operational decision making (e.g., effect of high oil temp, high ambient pressure, and the presence of methane on dispersion effectiveness).

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Previous Spill Example

- Tanker Spills:

Post Deepwater Horizon
“Game Changers”
Capping Stack for Blowouts = Stop Source

New Skimmer Technology
Night Operations

Better Detection via Remote Sensing
Better Modeling of Subsurface Releases

Post DWH Dispersants
State of Science Evaluations

- NOAA/CRRC: State of Science of Dispersants and Dispersed Oil in U.S. Arctic Waters
- On-going NAS Dispersants Study

Marine Oil Snow

- Evidence Marine Snow Formation is Increased in Presence of Dispersants
- Oil Adheres to Marine Snow
Oil Sediment Aggregation

- Evidence that Dispersants Enhance Oil Mineral Aggregate Formation

Dispersants Form Smaller Droplets Than Imagined

- Joe Katz Presentation in this Session
  - Nanodroplets
  - Worker Safety
    - Personal Protection Equipment
  - Public Health
    - Air Plume Modeling
  - Implications for Response Monitoring
    - Air
    - Current Focus in Water Column Only on Micron to mm Size Droplets
Toxicity

- Lisa DiPinto’s Talk in this Session
- Decision-Making Must Consider New Sub-Lethal Concerns

New Types of Dispersants

- Current in U.S. = COREXIT 9500
- Goal:
  - More Efficient
  - More Oil Types
  - Colder Temperatures
  - “Natural Materials”
  - Some Research in this Area
Human Health Concerns

• NAS Workshop Summer 2017
• Similar “Constellation”
• Mental Health Concerns
  • Dispersants Fears

NEBA/SIMA Approach

• Net Environmental Benefit Analysis
• Spill Impact Mitigation Analysis
• What Is the Least Bad Option
• Does This Favor Dispersant Use?
NEBA/SIMA Approach

Our Navigational Guide for Selecting Response Tools

If options cannot be deployed within the boundaries of regulations, the oil response community must re-evaluate the process to select tools.

Subsea Impacts of Dispersant Use

Examples

- Deep Sea Corals Killed/Damaged
  - Very Slow Recovery
- Deep Sea Fish
  - Lesions, etc.
- Several Others = GOM Research Initiative
Has/Will DWH Research Impact Future Use of Chemical Dispersants in Oil Spill Response?

• Yes
• Yes

Will Dispersants Remain a Spill Response Option?

• Yes
• Only under limited circumstances
• Offshore:
  • ≥ 3 nm
  • ≥ 10 m water depth
  • Restriction Zones
• Type: COREXIT 9500
Thank you for listening!

Questions?/ Comments?

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