Mystery Mixture: Emulsions and Treatment

Holly Nestle, Technical Warrant Holder

Wet Environmental Systems and Discharges

NAVSEA 05P5

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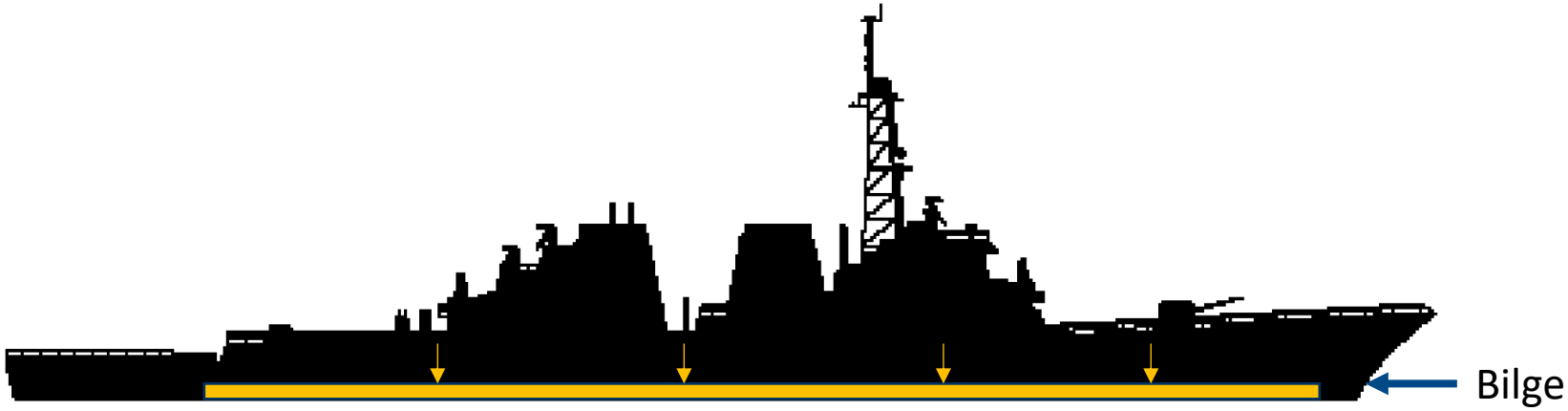
Bilgewater

- Bilge – The lowest inner part of the hull where liquid drains from the interior spaces and the upper decks of the vessel is referred to as the bilge
- “Bilgewater” or “oily wastewater” – Liquid collected in the bilge
- Composition – Varies in constituents and concentration, by vessel, and from day to day operations
  - Drainage from main engine room(s) and auxiliary machinery room(s), which house the vessel’s propulsion system and auxiliary systems (i.e., water purification systems), respectively
  - Fuels, lubricants, hydraulic fluid, antifreeze, solvents, and cleaning chemicals



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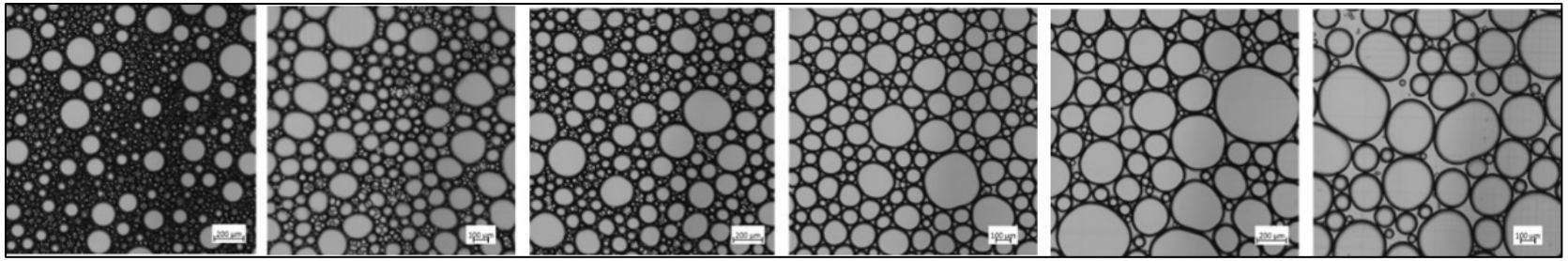
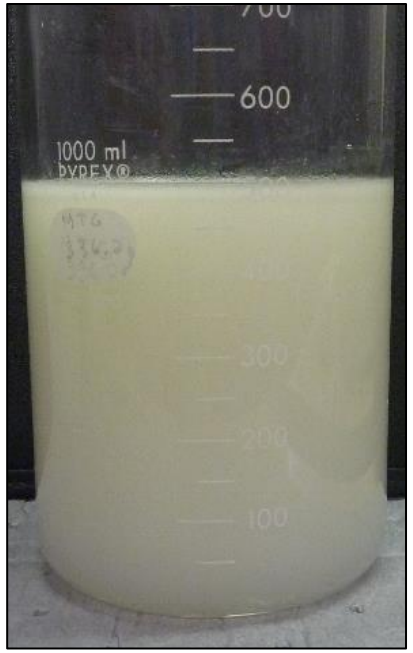
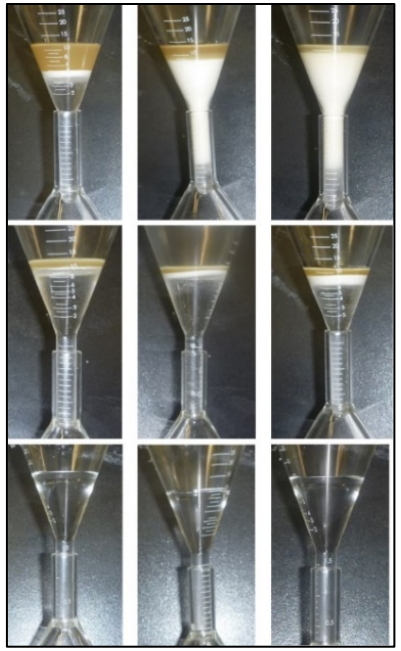
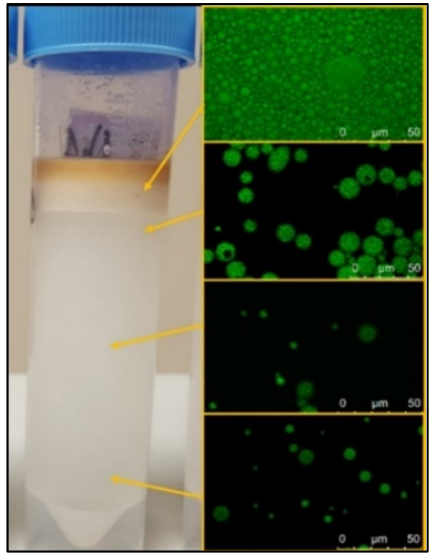
Bilgewater Emulsions









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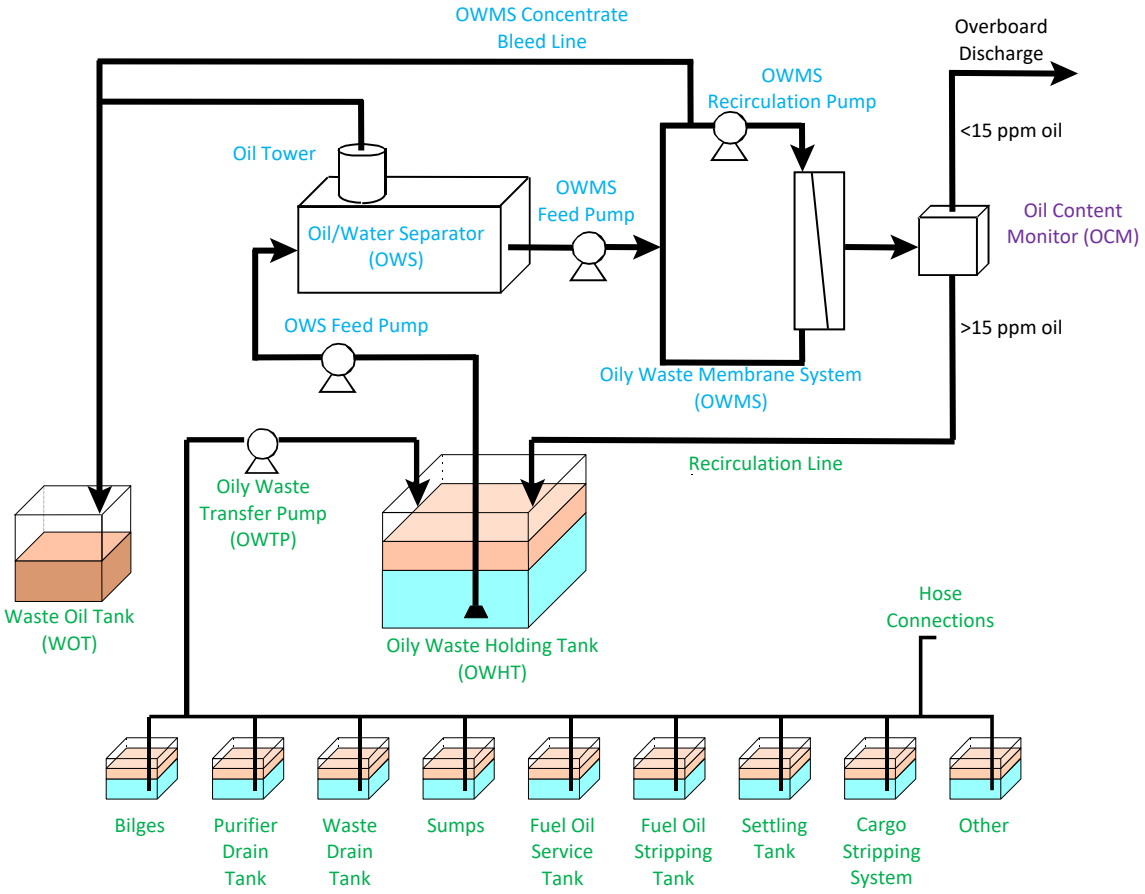
General Oil Pollution Abatement System



Mitigations to emulsions are limited in legacy design

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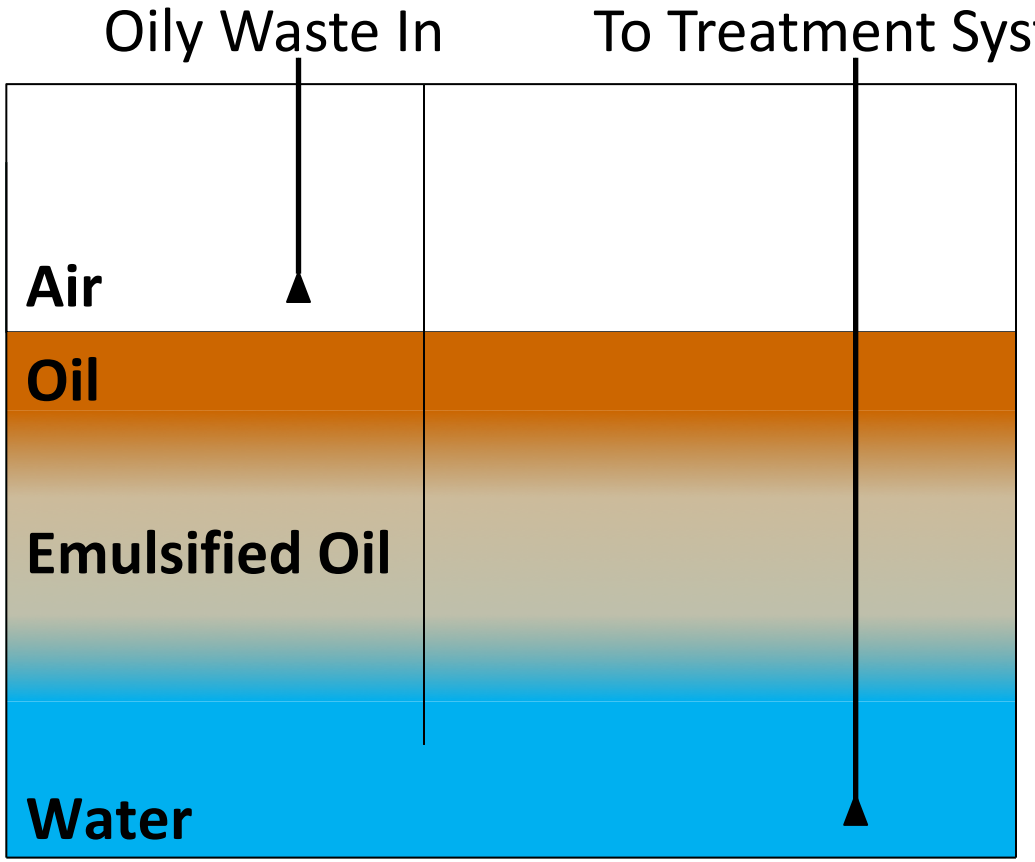
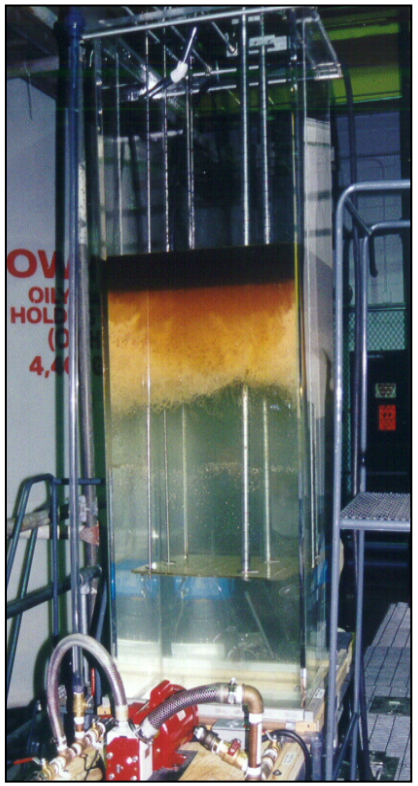
Challenges with Emulsions
Holding Tank





Treatment decision making lacks an assessment of tank contents

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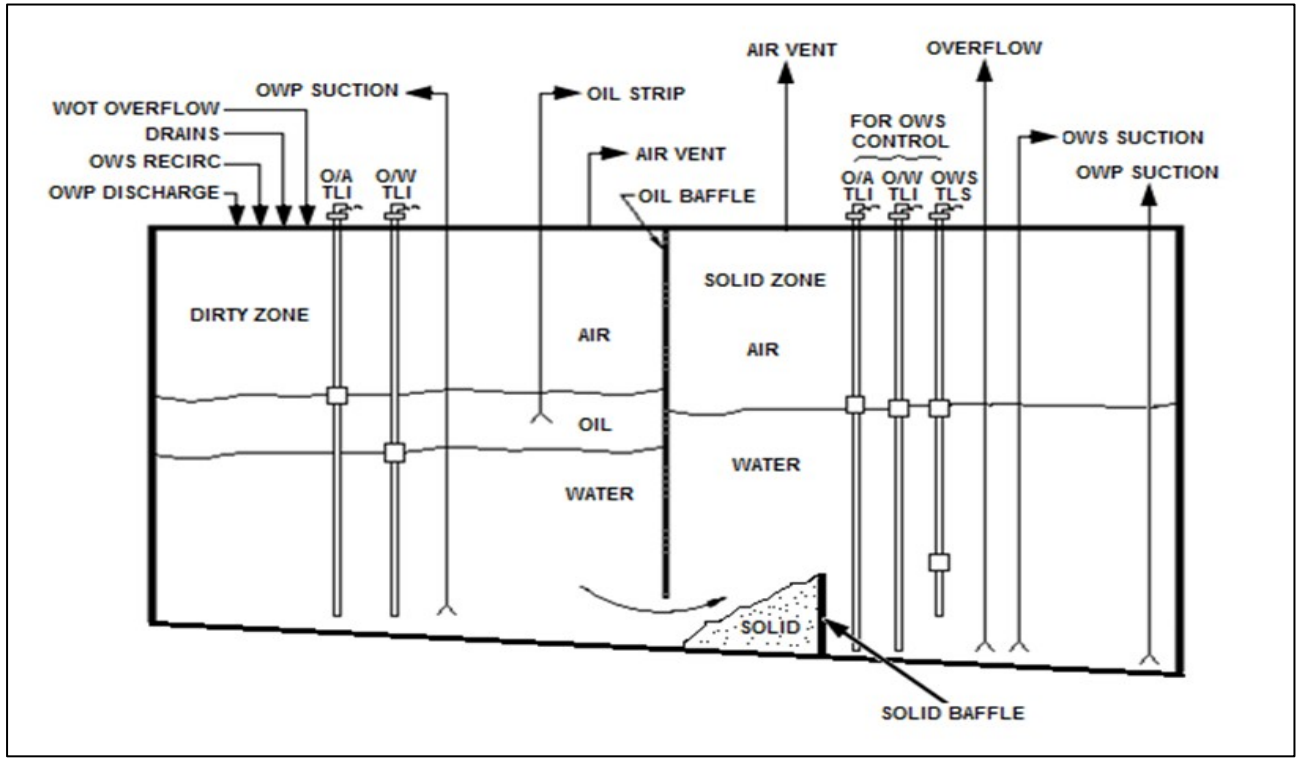
Improvements in Processing Tank Design

- Oily Waste Holding Tank Design for New Construction Ships



Increase treatment system performance and reliability by reducing constituent entrainment in processed wastewater

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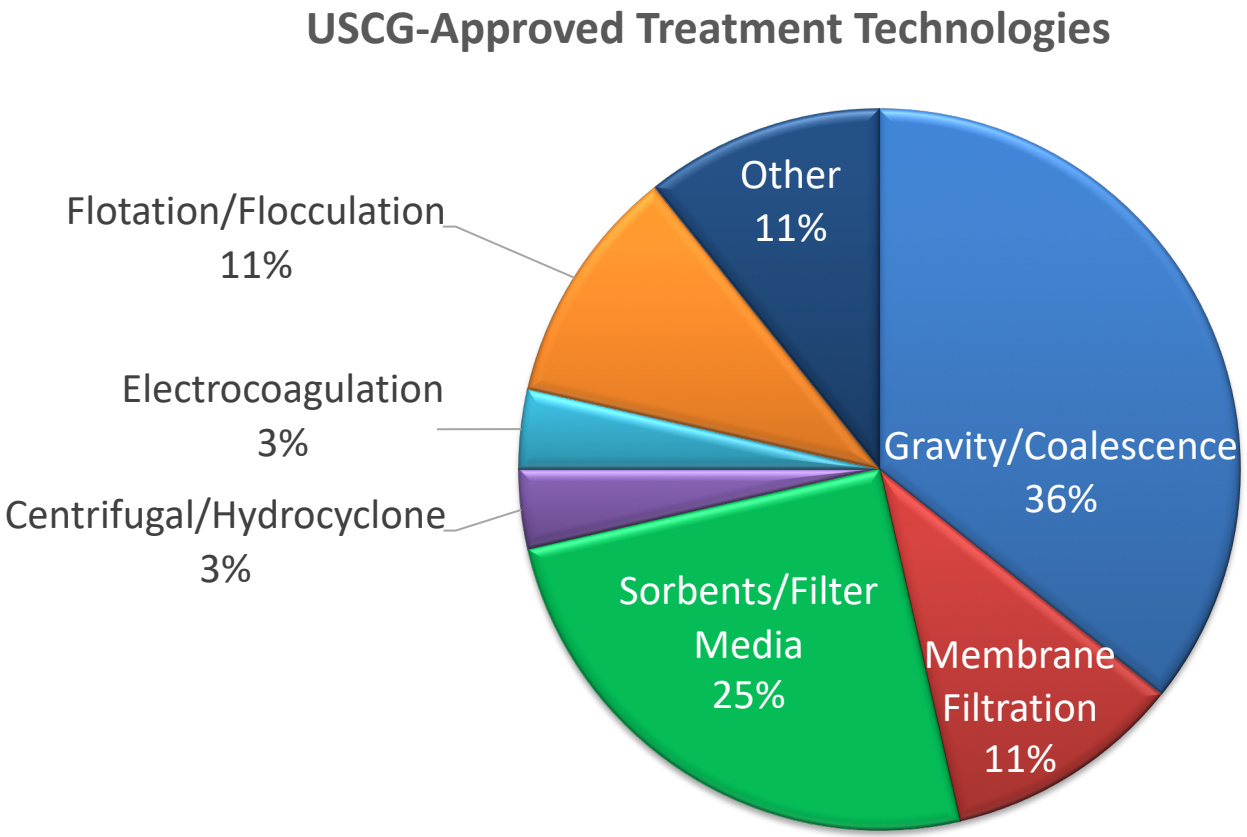
Challenges with Emulsions
Treatment



Emulsions significantly impact treatment performance and maintenance requirements

Limitations of Certification Testing

- Bilgewater Separator Certification Requirements
  - International Maritime Organization (IMO) Marine Environmental Protection Committee Resolution (MEPC.107(49))
  - United States Coast Guard (USCG) Code of Federal Regulation (46 CFR 162.050)
  - Emulsions test (2.5 hour duration) for 15 ppm Bilge Separator – MEPC Test Fluid “C”
    - 947.8 g of fresh water
    - 25.0 g of Test Fluid “A” – marine residual fuel oil
    - 25.0 g of Test Fluid “B” – marine distillate fuel oil
    - 0.5 g of surfactant – sodium salt of dodecylbenzene sulfonic acid (anionic)
    - 1.7 g of iron oxides
- Limitations:
  - Test fluid may not represent intended vessel’s wastewater
    - Impact to successful treatment performance
  - Consumables while treating emulsions may not be adequately reflected in certification results
    - Impact to reliability by increased maintenance frequencies and high support costs (e.g. consumables, labor, equipment repair, etc.)

Navy Bilgewater Treatment Test Protocols

- Navy recognized short fall in certification process
- Test protocols developed to establish confidence in treatment systems
  - Performance Testing
    - Determine equipment performance using Navy relevant test fluids and contaminants
    - Varying concentrations and contaminants over a series of tests
    - Perform test series twice for repeatability of results
  - Reliability Testing
    - Long term testing to assess reliability, maintainability, and availability over an operational time scale similar to Navy vessels
    - Ensure non-degradation of performance through intermittent checks
    - Demonstrate equipment operability and maintenance actions
- Standardized test protocols allow for comparisons amongst previously tested equipment

Evaluations are necessary to assess operational risks before committing to equipment

Technical Challenges
Operating Environment

- Operability
  - Frequent crew turnover
  - External operator demands
- Bilge management practices
  - Oily waste holding tank settling time
  - Variability of bilgewater constituents
  - Tank content monitoring to support treatment decisions
- Shipboard operations
  - Deployment schedules (long, varying operational tempo)
  - Logistics for consumables (spares, shipping, procurement, etc.)
  - Military qualification requirements (Shock, Vibration, EMI)
  - Operational profile (ship motion, at-sea, littoral water, special areas, etc.)
  - Autonomous operation and decision making (manned, unmanned)

Effectiveness of RDT&E depends on addressing technical challenges of DoD's operating environment

Technical Challenges
Incoming Changes

- Increased segregation of waste streams
  - Legacy vessels: “Wet” Bilge – non-oily machinery wastewater NOT SEGREGATED from entering the bilge; results in higher volumes, lower oil concentrations in bilgewater
  - Current vessels: “Dry” Bilge – non-oily machinery wastewater SEGREGATED from entering the bilge; results in lower volumes, higher oil concentrations in bilgewater
- Potential for more stringent discharge requirements
  - Current discharge requirements limit to 15 parts per million (ppm) oil by volume
  - Consideration for a 5 ppm oil discharge in discussions by regulatory bodies
    - Canada Shipping Act – Oil Pollution Prevention Regulations – 5 ppm discharge
    - Det Norske Veritas (DNV) Type Approval Program (TAP) 771.61 – 5 ppm Bilge Alarm
- Heavy use of automation
  - Strong push for automation on manned and unmanned systems
  - Increased reliance on technology (e.g. sensors, program logic, etc.) for operation and decision making

Smart, efficient, reliable treatment is critical for successful environmental compliance and DoD mission effectiveness

Reducing Risks with Emulsions
Enhance DoD Mission Effectiveness

- Avoid – Reduce emulsion formation but retain effectiveness
  - Cleaners
    - Determine characteristics associated with emulsion stability
    - Develop requirements for cleaners for effectiveness and consistent results
- Identify - Determine emulsion characteristics to assess best management practice
  - Sensors
    - Develop sensor technology (e.g. level sensors, in-situ, etc.) and data interpretation techniques for detecting emulsions
    - Integrate information into “smart” bilgewater management practices
- Mitigate – Apply treatment with consideration to DoD technical challenges
  - Pre-treatment
    - Research pre-treatment technologies and methodologies to enable conventional treatment techniques
    - Develop design practices to implement emulsion treatment cost effectively

Diversity of research areas for addressing emulsions

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