

# Oil Recovery with Novel Oleophilic Skimmer Surfaces under Cold Climate Conditions

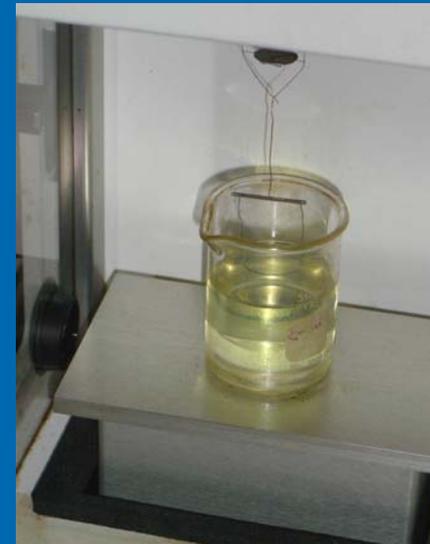
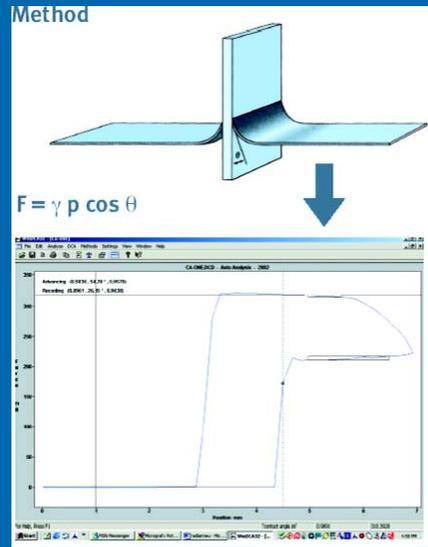
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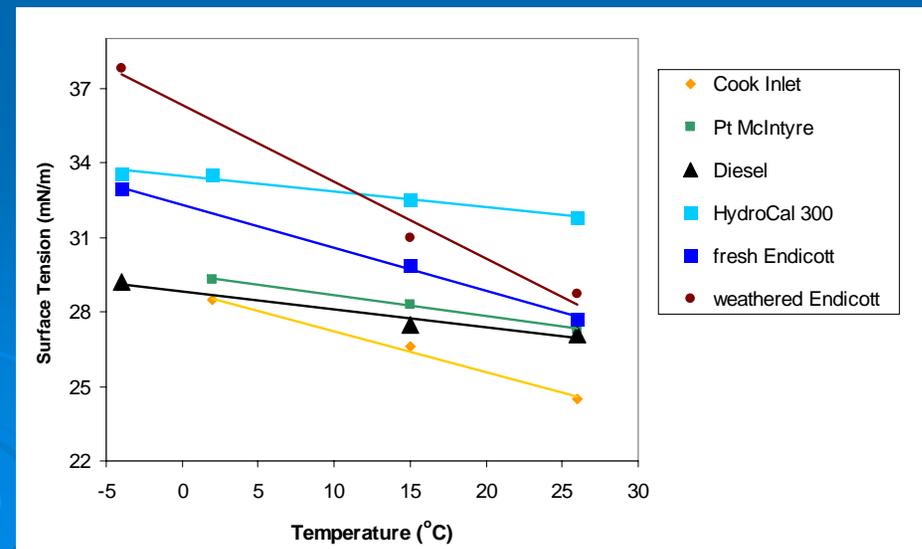
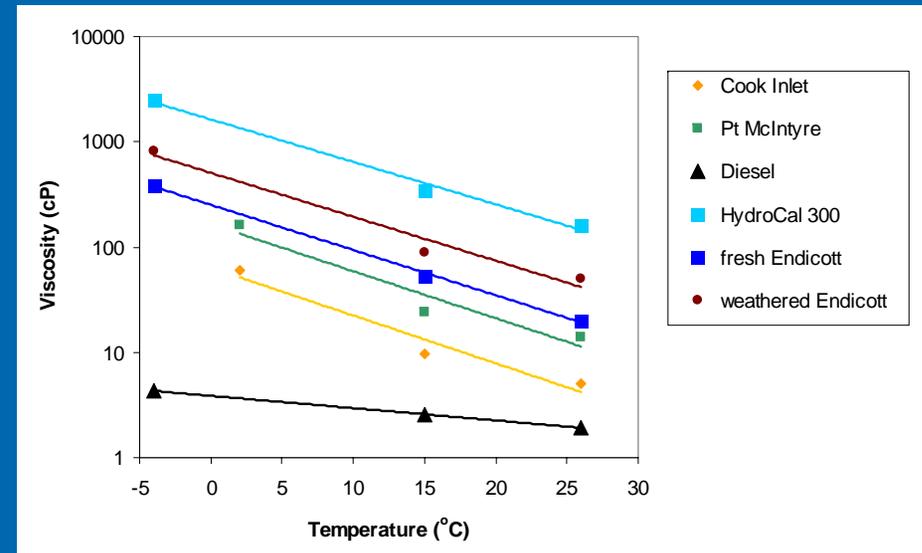
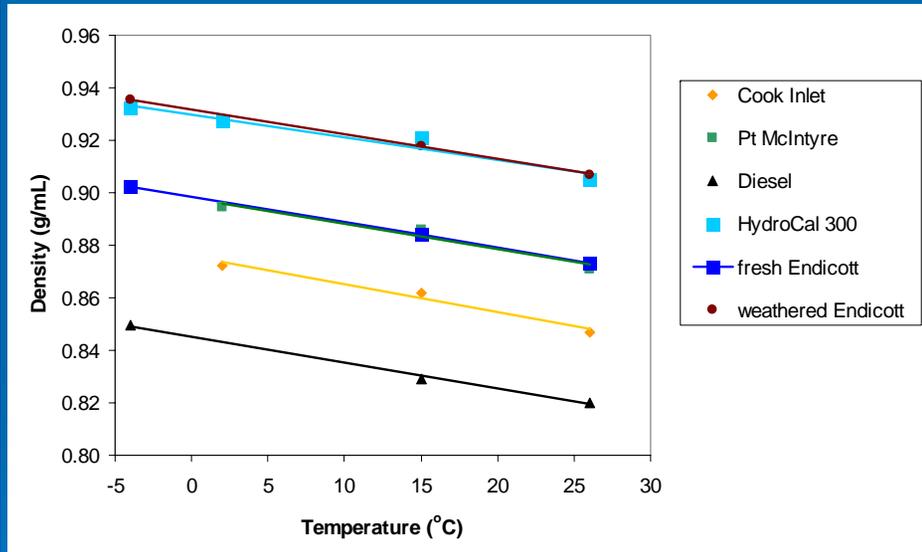
# Objectives

- Characterize properties that affect oil recovery in cold climates
- Perform full-scale test of novel drum recovery surfaces tailored for oil spill recovery under cold climate conditions
- Understand effect on recovery process of:
  - Cold temperature
  - Mixtures of slush ice and oil
  - Different drum geometries and surface materials
  - Skimmer operational conditions

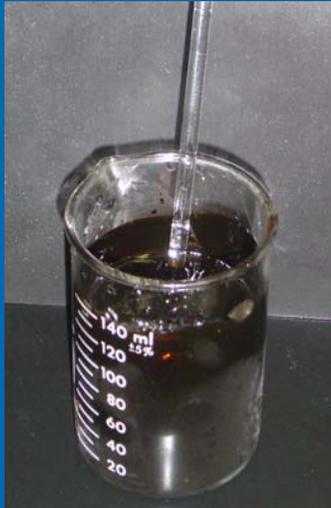
# Preliminary Lab Work



# Physicochemical Properties



# Oil & Ice Mixtures



**30% ice/fresh Endicott mixture**



**60% ice/ HydroCal 300 mixture**

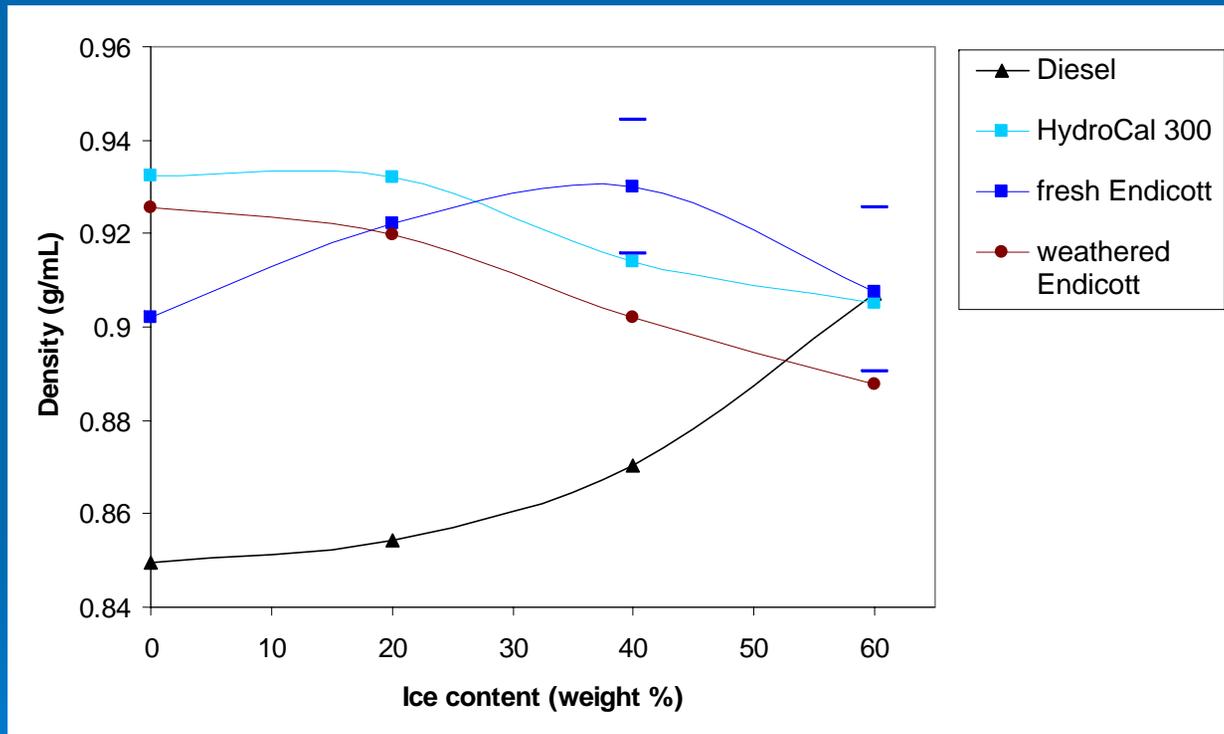


**80% ice/fresh Endicott mixture**



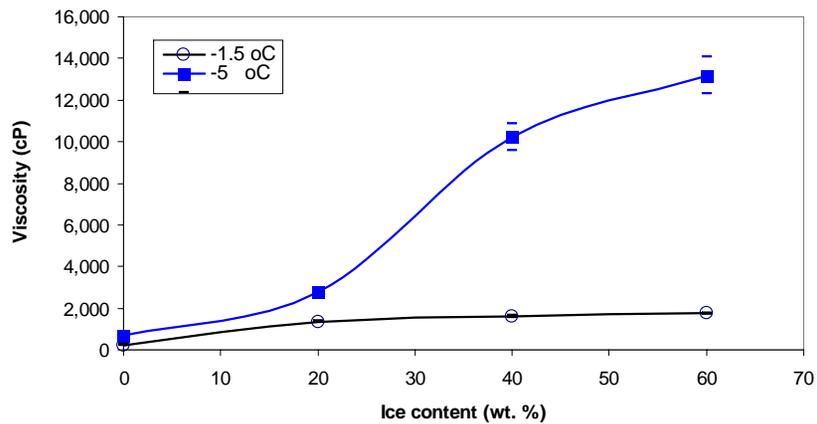
**40% ice/diesel mixture**

# Oil & Ice Mixtures

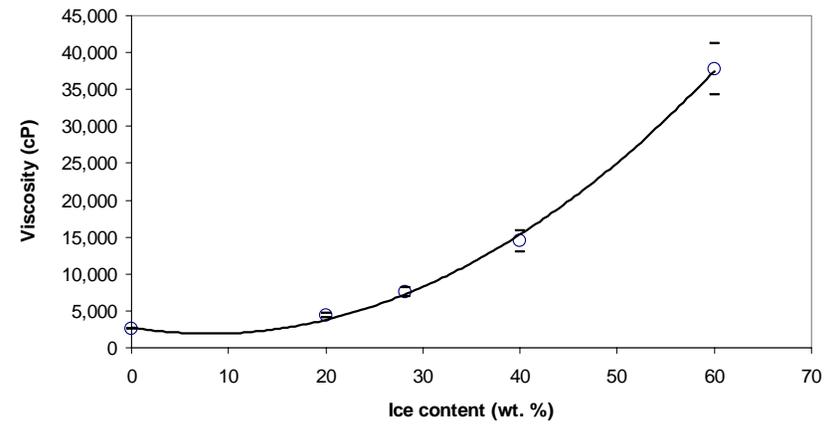


# Oil & Ice Mixtures

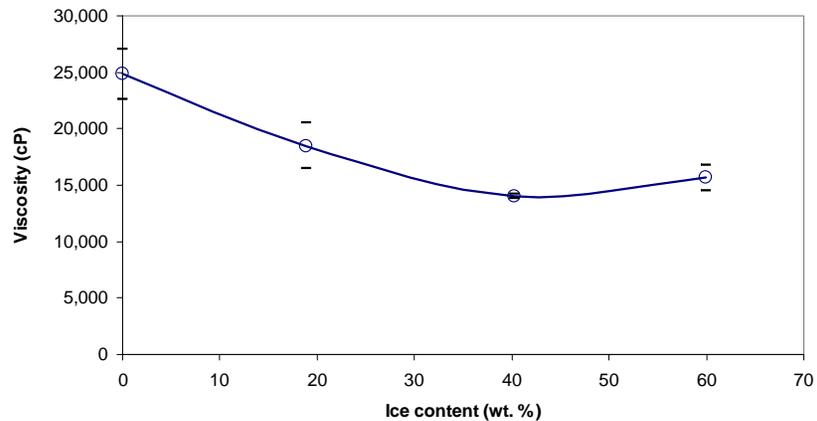
Endicott, fresh



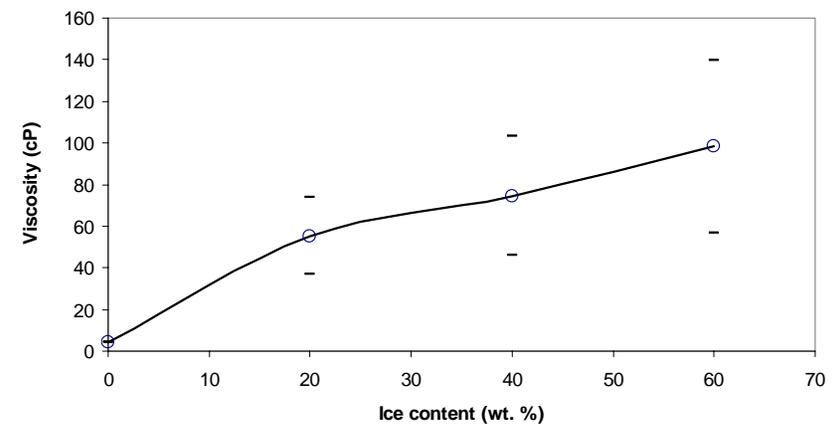
HydroCal 300



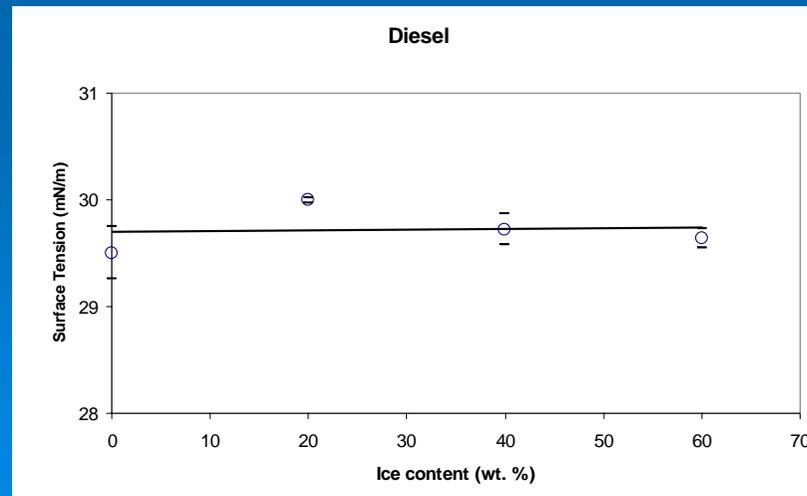
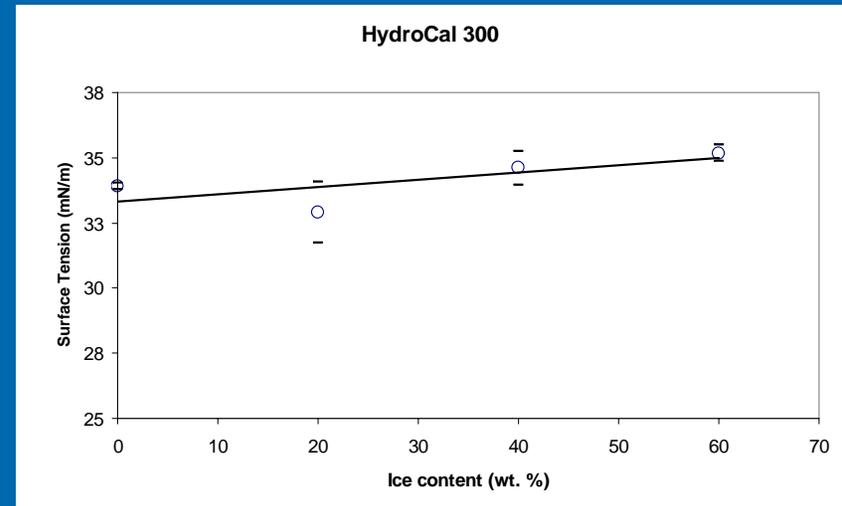
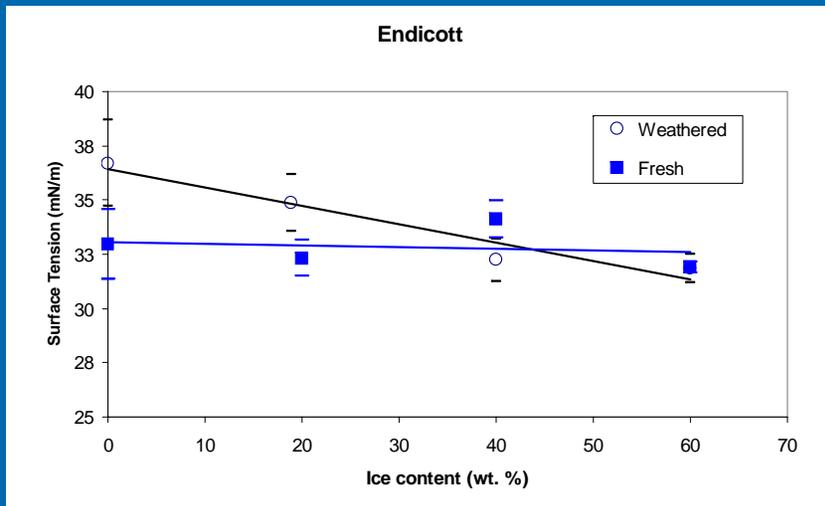
Endicott, weathered



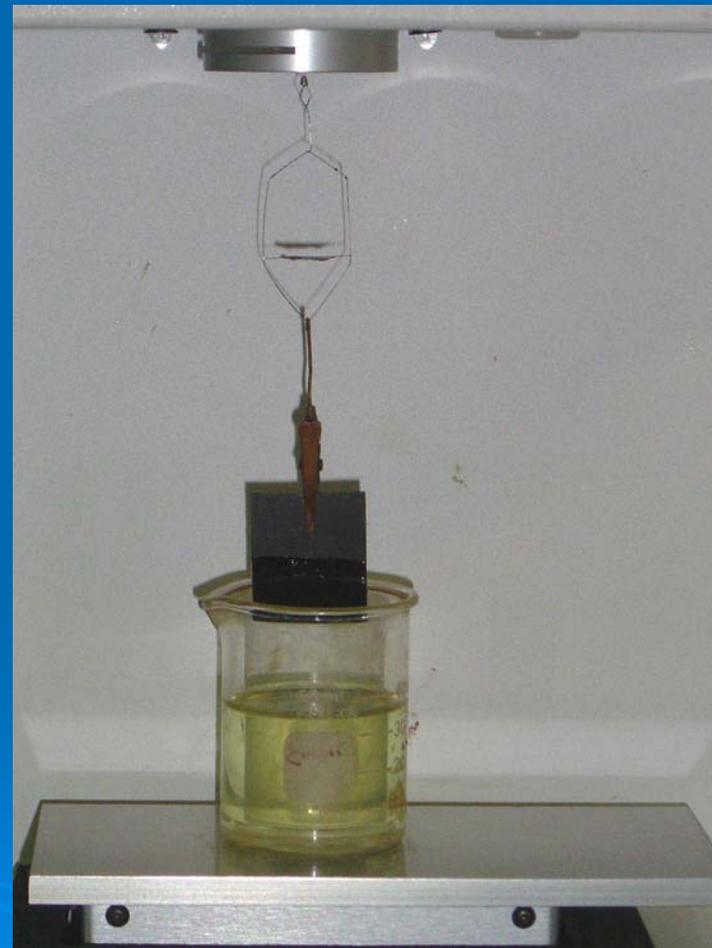
Diesel



# Oil & Ice Mixtures

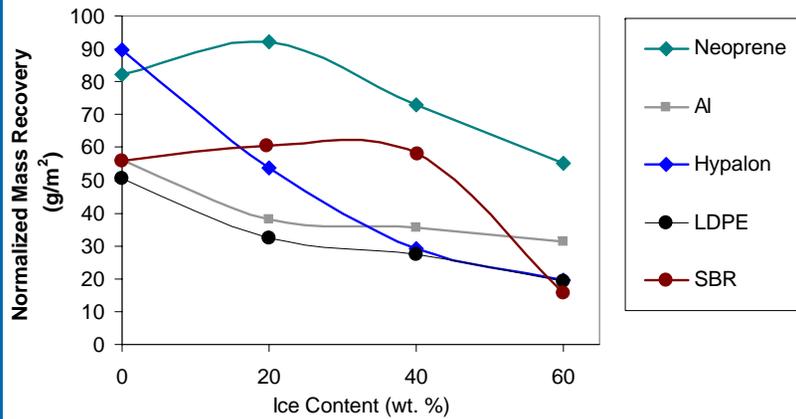


# Oil Recovery

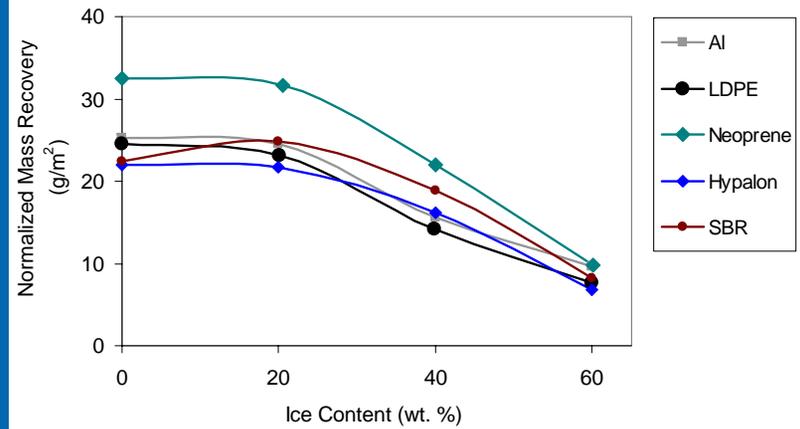


# Oil & Ice Mixtures

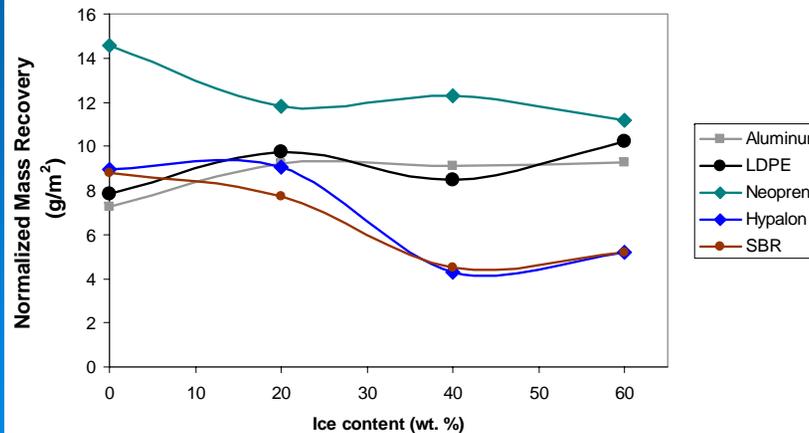
Fresh Endicott



HydroCal 300



Diesel



# Summary of Lab Work

- Expect much higher viscosities
- Ice/oil mixtures likely to separate for lighter oils
- For more viscous oils or higher % ice, expect oil coating ice, very high viscosity
- High recovery at lower temperatures (high viscosity => more adhesion)
  - Decreasing with increasing ice content
- Expect Neoprene to do better than others

# Field Test Variables

- Temperature:
  - -1 to -3 °C
- Oils:
  - Endicott, Hydrocal 300, Diesel
- Oil film thickness:
  - 20-30 mm
- Drum rotational speed:
  - 10-60 RPM
- Drum surfaces:
  - Aluminum, LDPE, Neoprene, Hypalon
- Drum geometries:
  - flat, 20°, 30° and 40° nominal groove angles

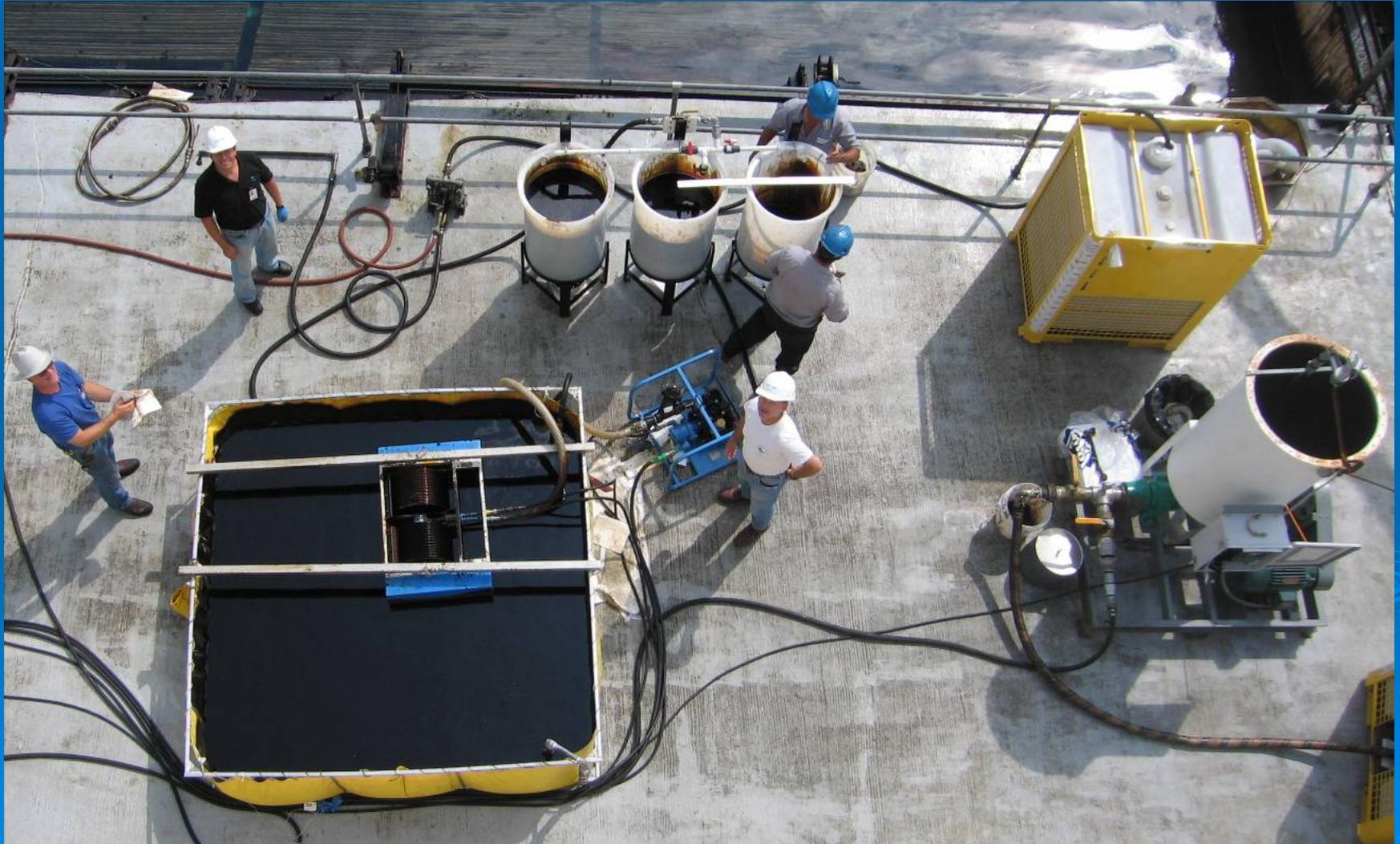
# Field Tests in Feb in NH



# Cold Regions Research & Eng. Lab (Army Corps of Engineers, NH)



# Ohmsett test tank



# Full-scale skimmer

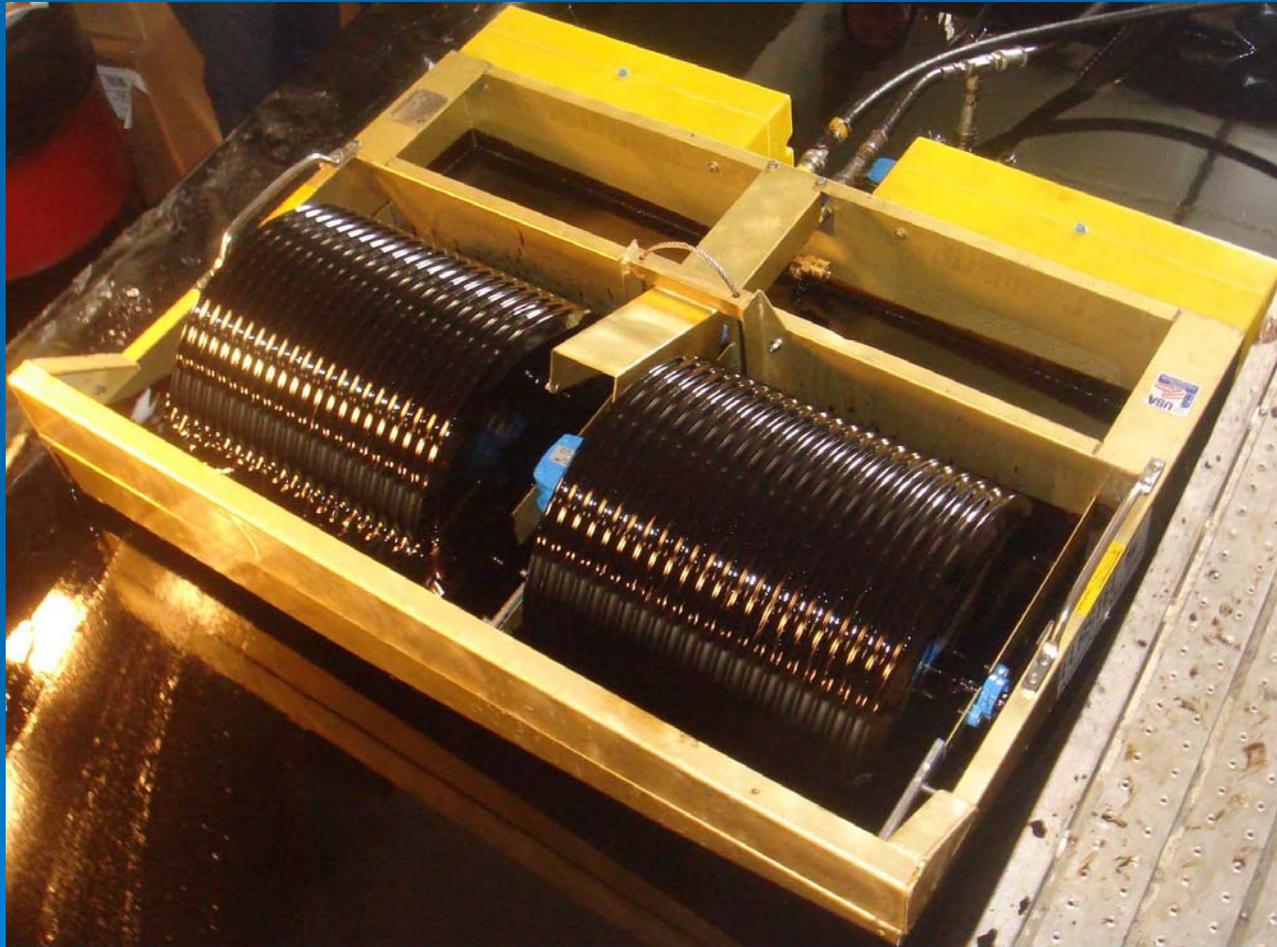


Photo courtesy of American Elastec, Inc.

# Minimax Skimmer

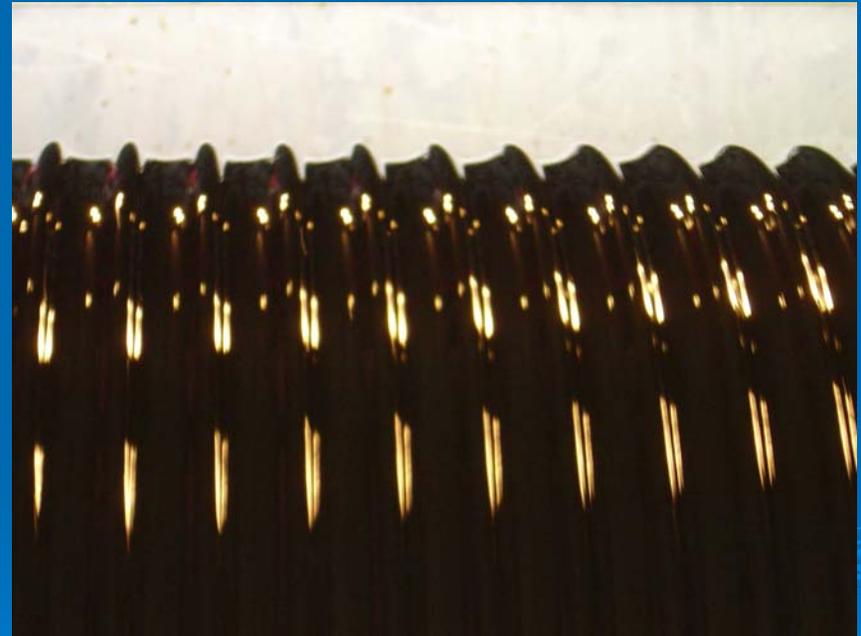


Photo courtesy of American Elastec, Inc.

# Adding Ice



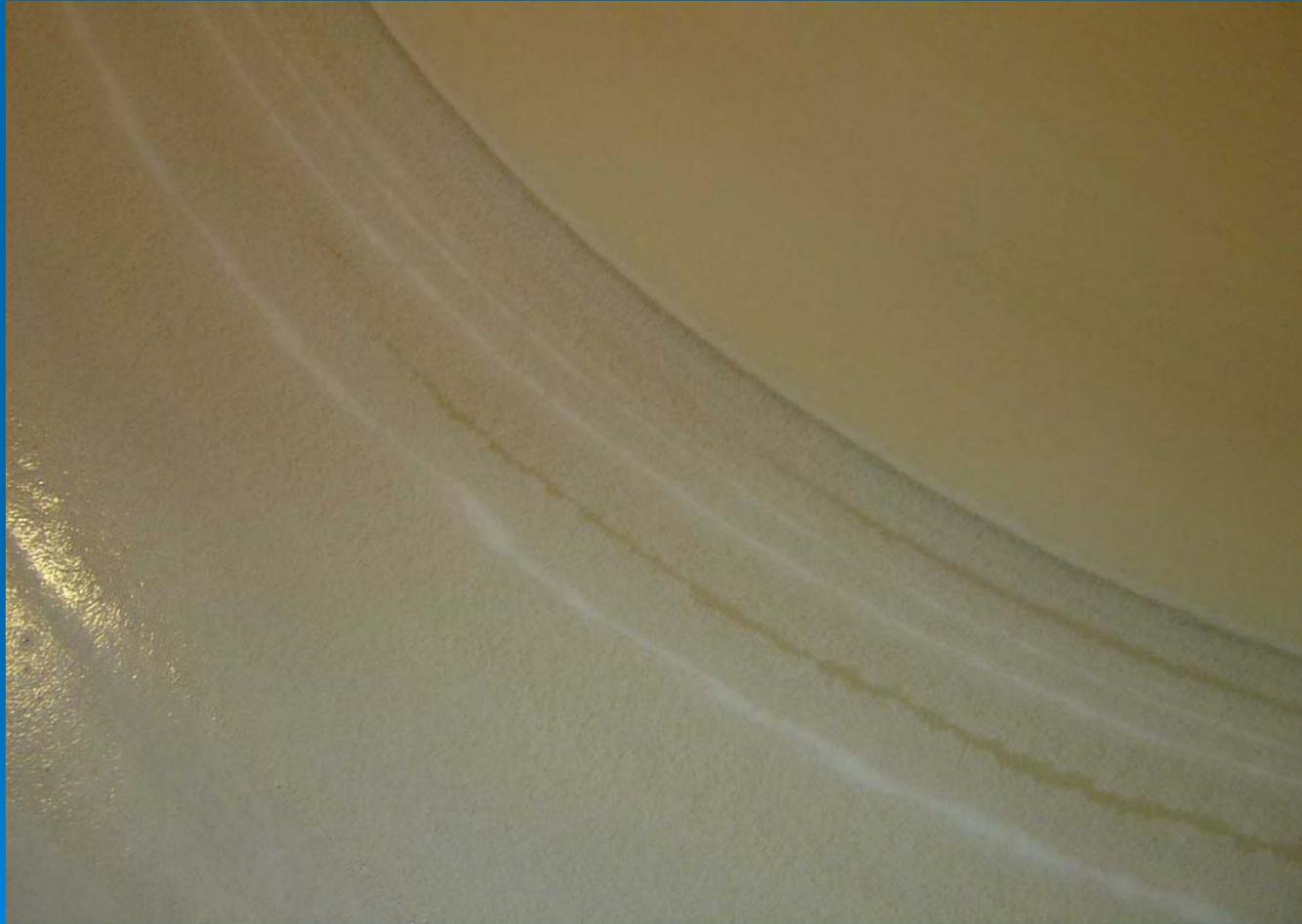
# Endicott (fresh)



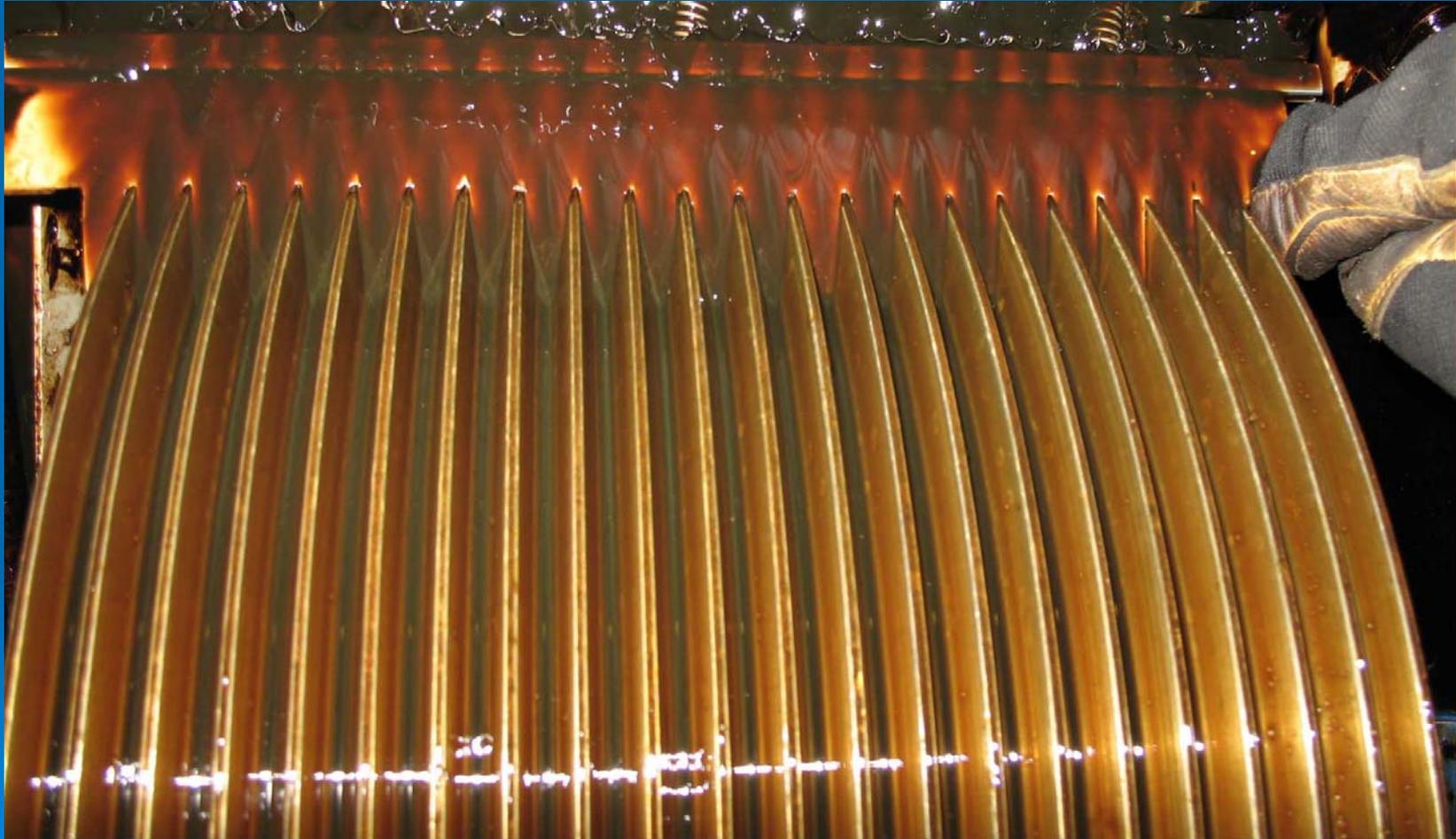
# HydroCal 300



# HydroCal 300



# Diesel

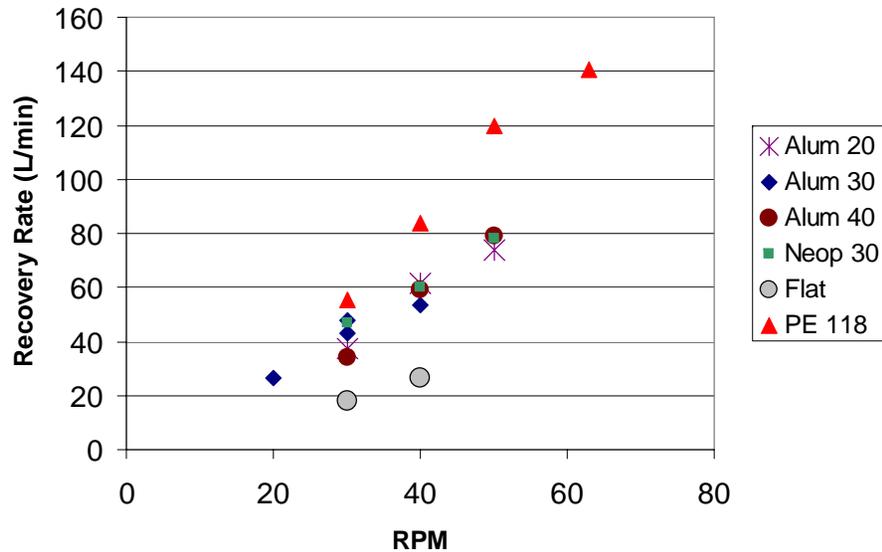


# Flat drums

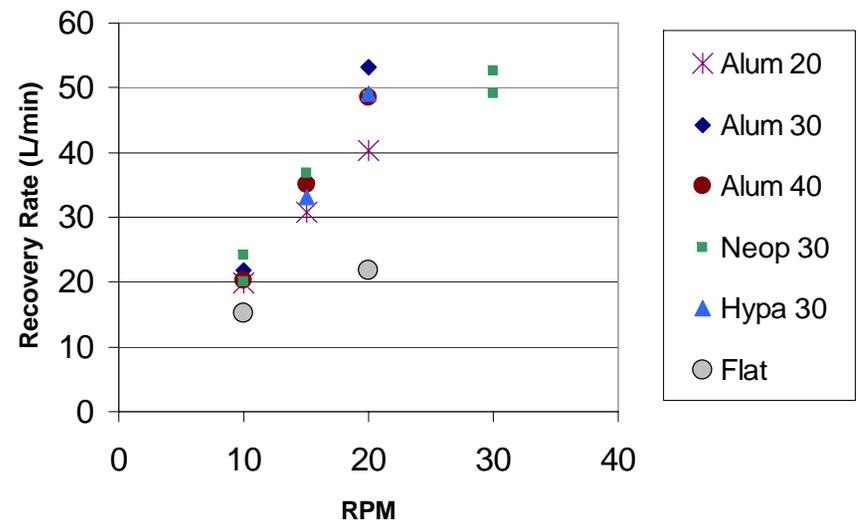


# Oil Recovery w/o Ice

Endicott at -1°C, No Ice



Hydrocal at -1°C, No Ice



# Endicott and 30% ice



# Minimal ice build-up

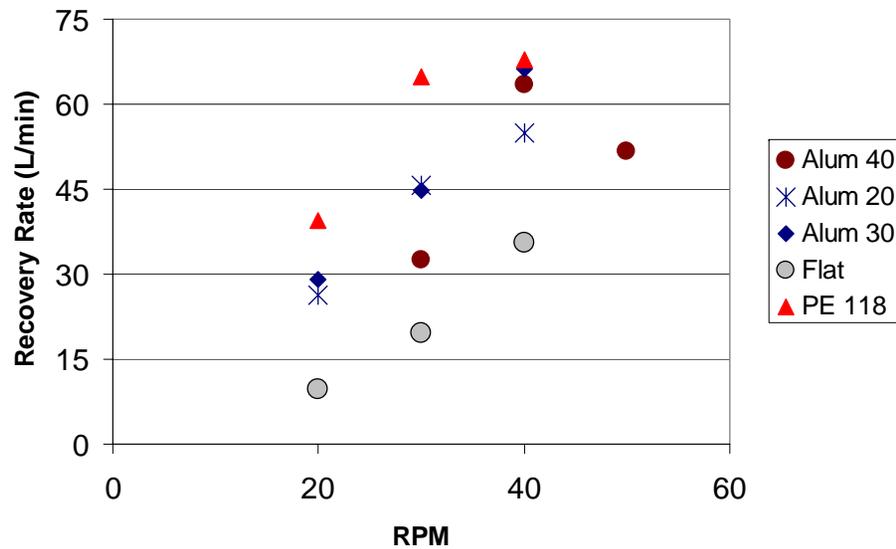


# HydroCal 300 and 30% ice

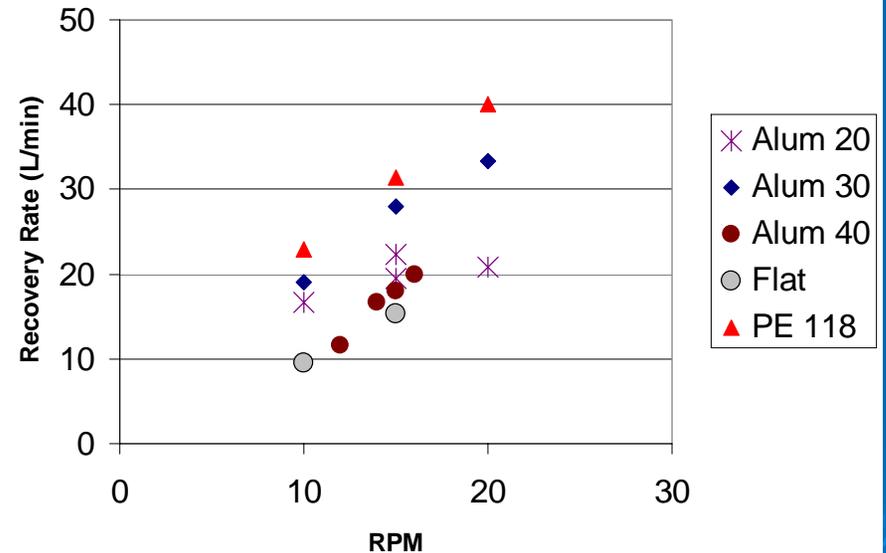


# Oil Recovery with Ice

Endicott at -1°C, With Ice

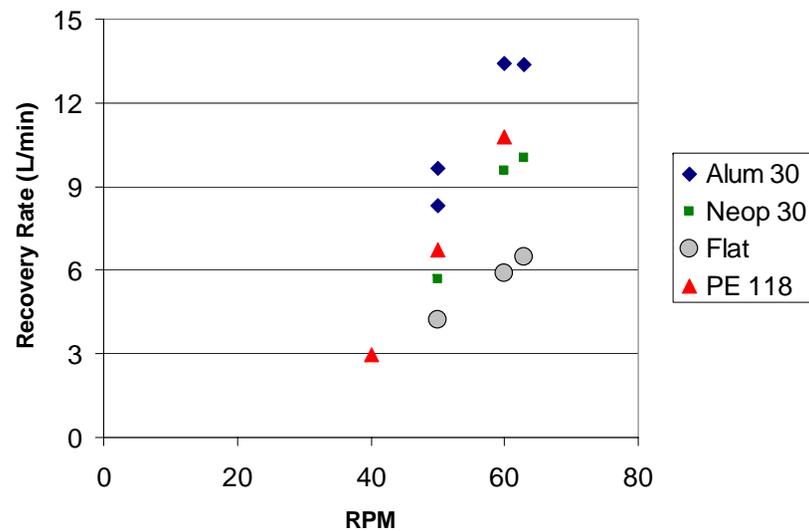


Hydrocal With Ice

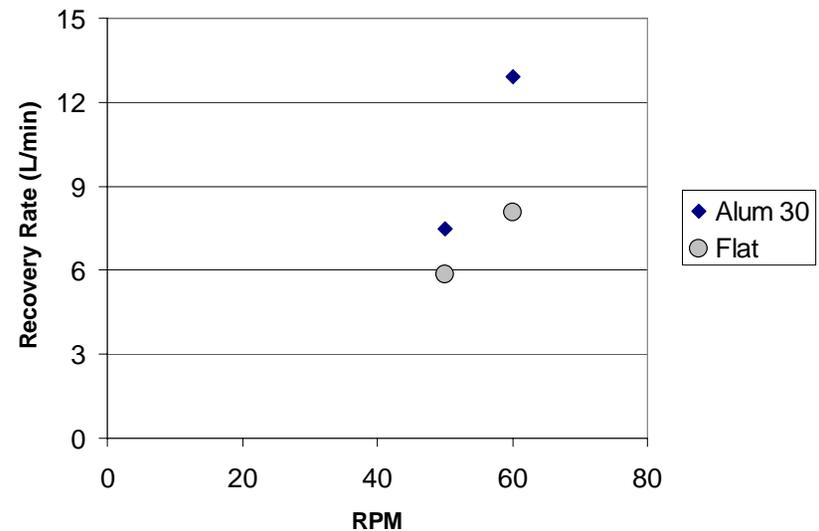


# Diesel recovery

Diesel at -1 °C, No Ice



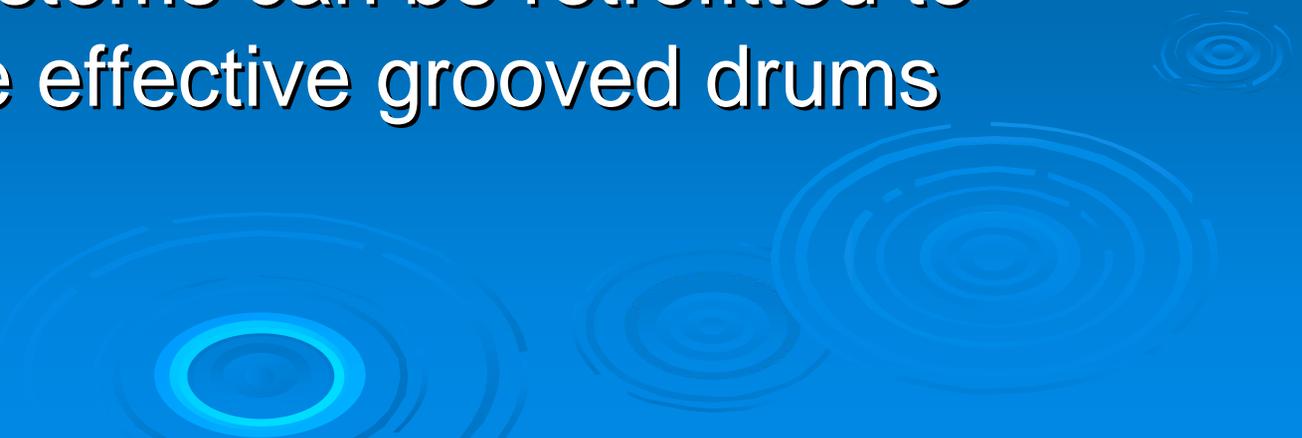
Diesel at -1 °C with Ice



# Conclusions

- High recovery rates for light to viscous oils under cold conditions
- Presence of ice (30% by weight) reduces oil recovery but recovery rate still quite acceptable
- No significant ice build-up behind skimmer for 25 mm slick thickness
- Water recovery was relatively low

# Conclusions

- Groove angle and depth may be optimized for specific conditions
  - Surface materials play secondary role
  - Larger system can recover up to 300 L/min (80 gal/min) of Endicott or HydroCal
  - Existing systems can be retrofitted to much more effective grooved drums
- 

# Acknowledgements

## Projects funded by

U.S. Dept of Interior, Minerals Management Service

Oil Spill Recovery Institute at Prince William Sound Center

University of California Toxic Substances  
Research and Teaching Program

## Support from

Army Corps of Engineers (CRREL Lab)

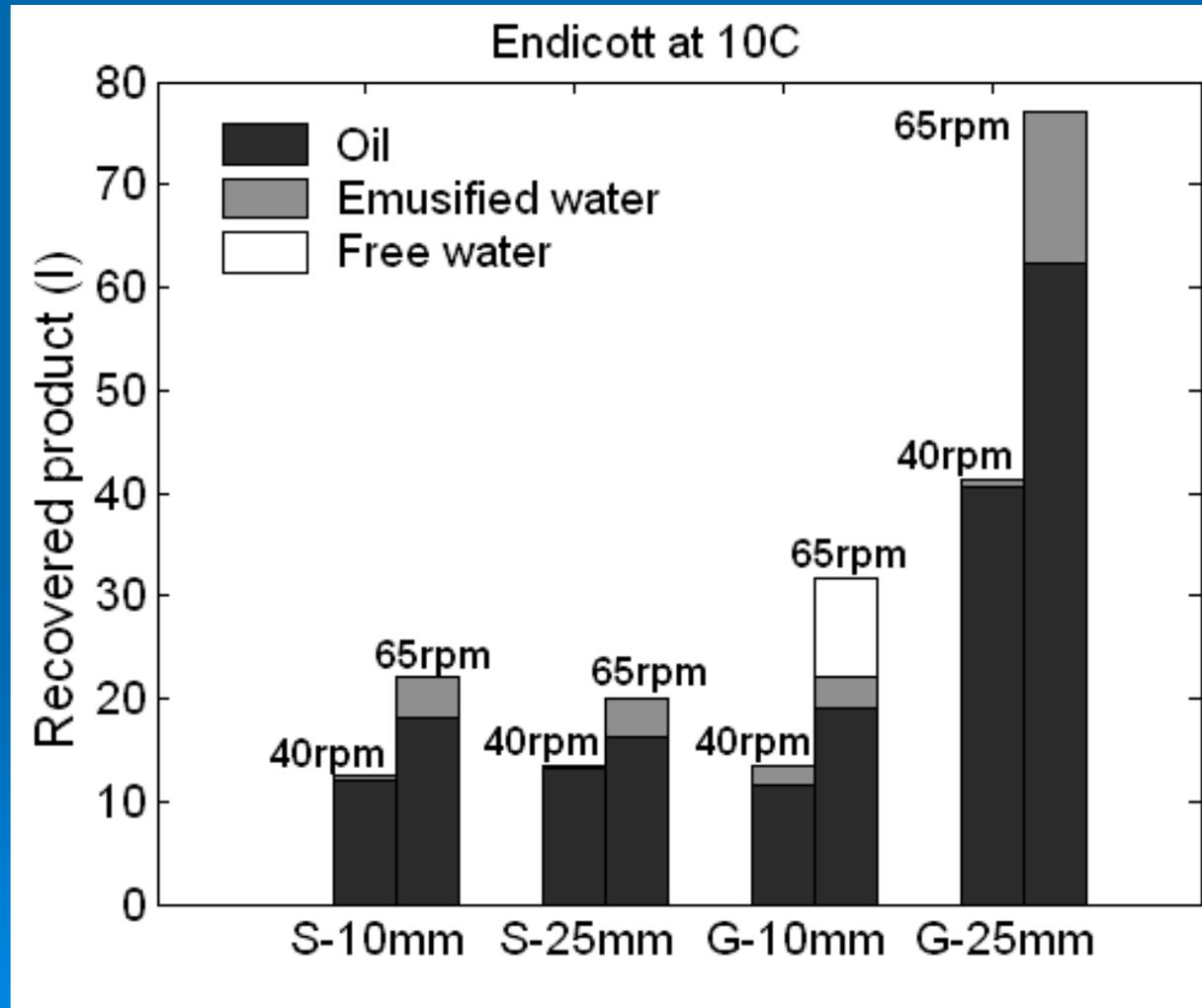
Ohmsett Facility & Mar Inc.

American Elastec, Inc.

*Questions ?*

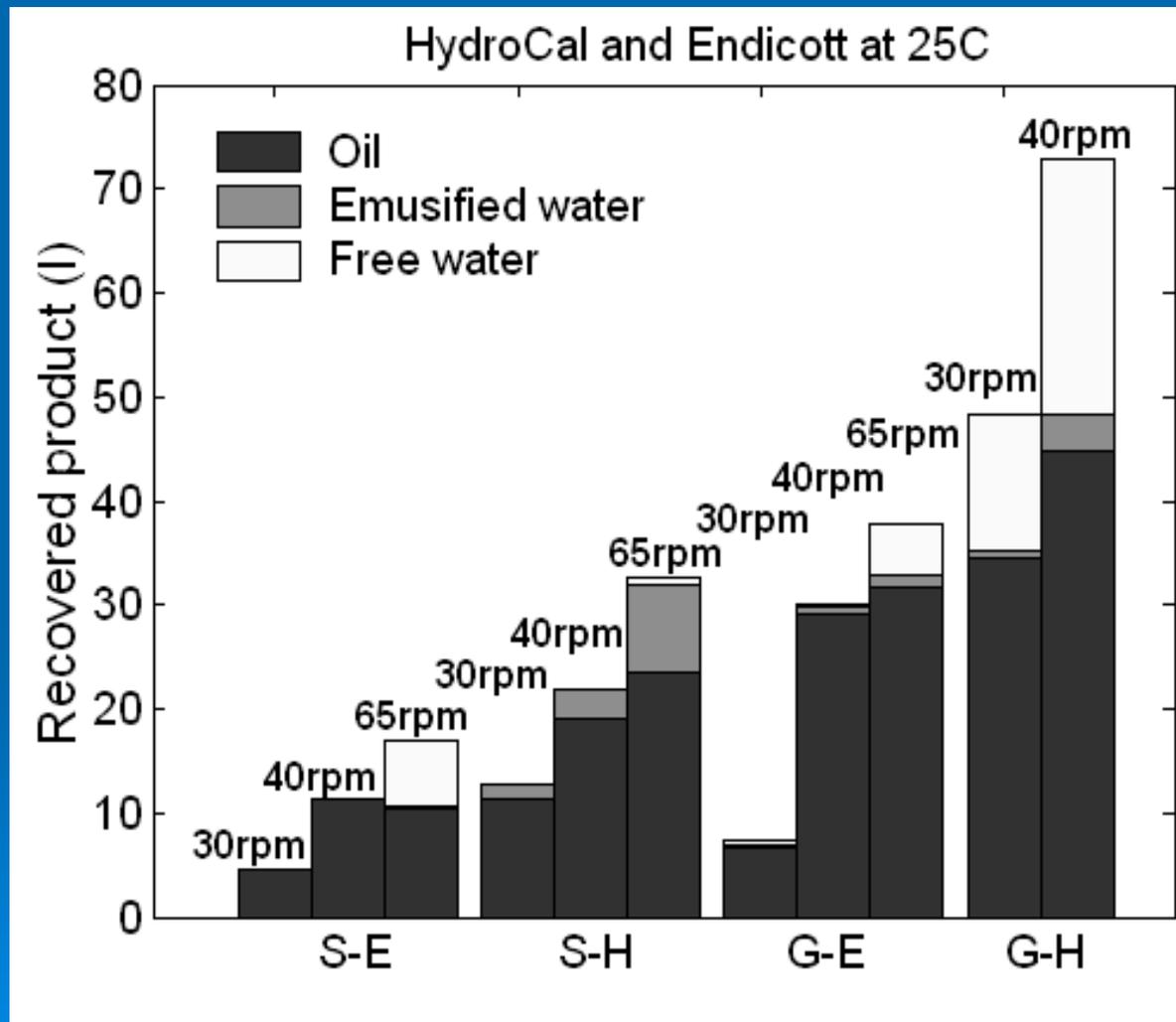


# Sample test results at 10 °C



Recovery in liters/min 3.785 L/min = 1 gal/min

# Sample test results at 25 °C



Recovery in liters/min 3.785 L/min = 1 gal/min