Calm Seas Application of Dispersants and Dispersibility of OCS Crude Oils in Non-Breaking Waves at OHMSETT

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Introduction

- This work addresses the first major dispersant decision question, "Will dispersant application be effective under the spill conditions in question?" Issues include:
  - Is the oil dispersible? (Dispersible when fresh? Time window?)
  - Under existing environmental conditions? (mixing energy?)
  - In low or calm sea, if dispersant applied, how long might dispersant remain with oil and stay effective?

    (Hours? Days? Weeks?)

Introduction

- Objectives of these studies:
  - Part 1- How effective can dispersants be in non-breaking waves?
    - How effective will they be?
    - Is there an oil viscosity limit to dispersion?
  - Part 2- If dispersants are applied in the absence of mixing energy, how long will dispersant remain with the oil and continue to be effective?

Part 1- Non- Breaking Waves Methods

- Approach
  - Run standard wave-tank effectiveness tests in non-breaking waves
  - Test OCS oils of different viscosities, Corexit 9500
  - Do preliminary small-scale test to help plan for large-scale Ohmsett tests

Dispersant effectiveness: wave tank tests (a)

Oil Type	Oil Viscosity, cP @ 21° C	Percent Dispersed
Fuel Blend A	620	27
Harmony	500	23.5
IFO 30	200	35.6
Endicott	75	25.5
Alaska North Slope	7	78 100

a. **Wave Tank: 11 m x 1 m x 1 m with wave paddle**

b. **Standard protocol except wave paddle = 31 cpm, test duration = 30 minutes**

Non-Breaking Waves

Ohmsett Tests

Ohmsett :Example – Behavior Control Test

Ohmsett: Example – Effective Dispersant Application

Non-Breaking Waves (a)
Results: Ohmsett Tests

Oil Type	Oil Viscosity(a)	Visual Assessment of Dispersion (Test number)	
		Control	Experimental
Harmony	**1825**		
West Delta 30	**1067**		
Ewing Bank 873	**683**		
Intermediate Fuel Oil 30	**252**		
Galveston 209	**14**		

a. Standard Ohmsett protocol, except 30 cpm waves

b. Measurements = visual, direct measurement, oil conc in water and LISST

Non-Breaking Waves
Results: IFO 30 - No dispersant

Non-Breaking Waves
Results: IFO 30 D0R 1:20

Non-Breaking Waves
Results: Ohmsett Tests

Oil Type	Oil Viscosity(a)	Visual Assessment of Dispersion (a) (Test number)	
		Control	Experimental
Harmony	**1825**	**NVD (15)**	
West Delta 30	**1067**	**NVD (6)**	
Ewing Bank 873	**683**	**NVD (11)**	
Intermediate Fuel Oil 30	**252**	**NVD (1)** **NVD (2)**	
Galveston 209	**14**	**NVD (3)** **NVD (4)**	
a. No Visible Dispersion=NVD			

Non-Breaking Waves
Results: Ohmsett Tests

Oil Type	Oil Viscosity(a)	Visual Assessment of Dispersion (a) (Test number)	
		Control	Experimental
Harmony	1825	NVD (15)	NVD (16), NVD (17)
West Delta 30	1067	NVD (6)	NVD (7) NVD (7)
Ewing Bank 873	683	NVD (11)	NVD (12) NVD (13)
Intermediate Fuel Oil 30	252	NVD (1) NVD (2)	NVD (9) NVD (10)
Galveston 209	14	NVD (3) NVD (4)	NVD (5) NVD (14)

a. No Visible Dispersion=NVD

Non-Breaking Waves
Results: Ohmsett Tests

Oil Type	Oil Viscosity(a)	Percent Dispersed	
		Control	Experimental
Harmony	**1825**	23.3	113.0
West Delta 30	1067	20.2	117.5
Ewing Bank 873	683	18.6	120, 127
IF0 30	252	7.2, 4.1	111, 100
Galveston 209	14	11.2	115.7

Non-Breaking Waves
Results: Ohmsett Tests

- Oil concentrations in the water under slick (LISST) consistently < 5 ppm

Non-Breaking Waves
Conclusions

- Principal observation was that there was no evidence of dispersion (visual, measured, in-water oil concentrations) in non-breaking waves at Ohmsett.
- Effectiveness observed in low viscosity oil in SL Ross wave tank attributable to effects bubble curtain

Introduction

- Objectives of these studies:
  - Part 1- How effective can dispersants be in non-breaking waves?
  - Part 2- If dispersants are applied in the absence of mixing energy, how long will dispersant remain with the oil and continue to be effective?
    - Hours? Days? Weeks?

Calm Seas-Introduction

- **Methods**
  - Pre-mix oil with dispersants
  - Lay down treated slicks and suitable weathering-control slicks on calm water
  - Test oil for dispersibility at regular intervals until slicks no longer disperse.
- **Test at Three Scales**
  - Bench-scale – Aquarium/Labofina Test
  - Middle Scale - SL Ross wave tank
  - Large Scale - Ohmsett

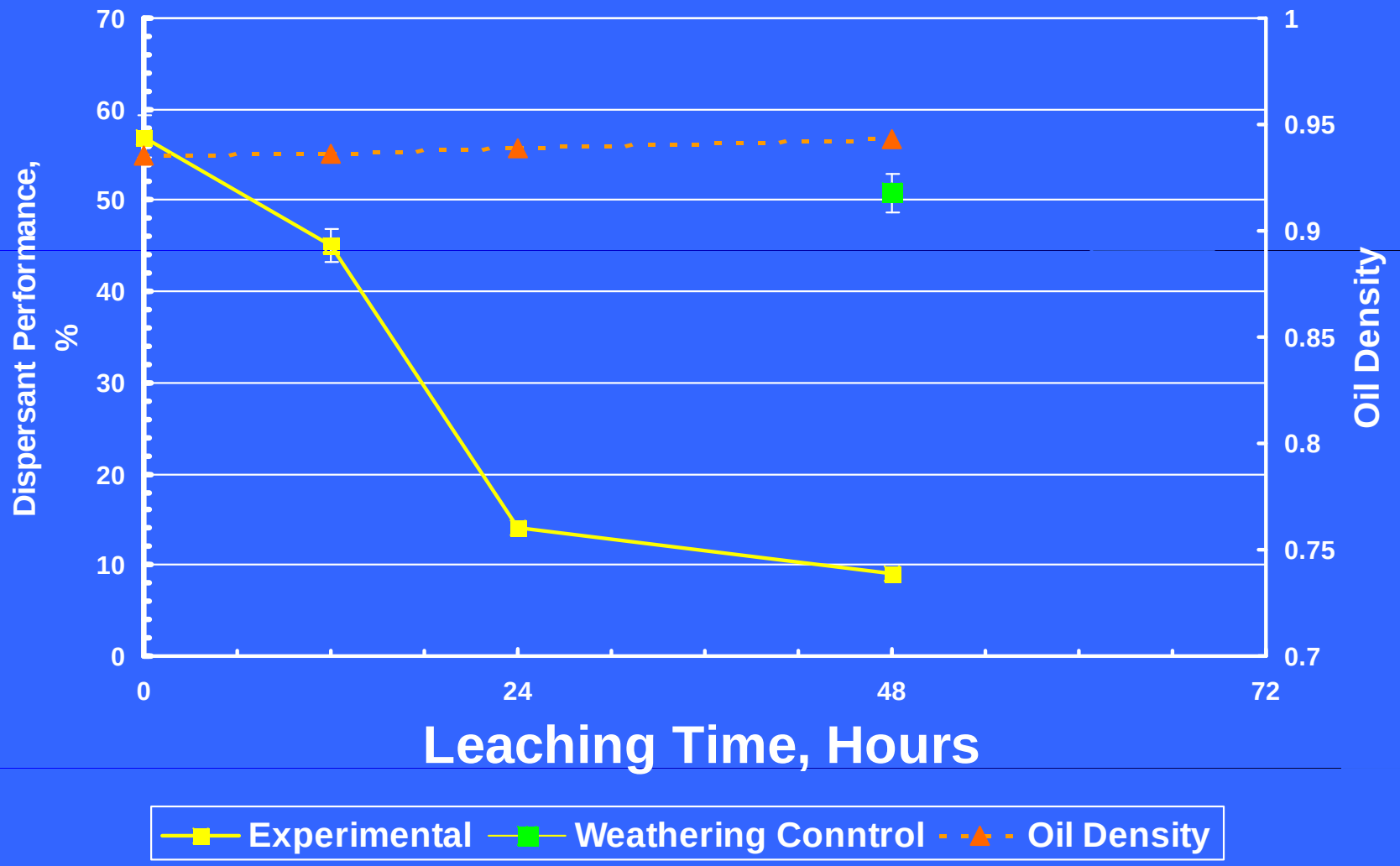
Calm Seas – Bench Scale

- **Bench Scale Tests**
  - obtain preliminary estimate of time frame (hours, days, weeks)
  - assess relative importance of oil weathering and dispersant leaching

- **Method**
  - Corexit 9500, DORs 1:50 to 1:20
  - Oils:
    - ANS (visc 7 cP @ 25° C),
    - IFO 30 (visc 200),
    - Ewing Bank 873 (visc 683)
  - 5-mm thick slicks on calm water
  - effectiveness by Labofina apparatus

Persistence of Dispersion Behavior in Crude Oil

Bench Scale: Ewing Bank 873 Oil x Corexit 9500 (DOR= 1:20)



Calm Seas – SL Ross Wave Tank

- **Wave Tank Tests**
  - Verify estimate of time frame
  - (hours, days, weeks)
  - assess relative importance of oil weathering and dispersant leaching
  - effect of variables: oil type, dispersant dose
- **Method**
  - 5 mm slicks
  - Treated with Corexit 9500, DOR1:50 to 1:10
  - Experimental slick exposed to water
  - Control slick contained in tray
  - Leaching time 15 to 45 hours
  - Oils: (ANS (visc 7 cP @ 25° C), IFO 30 (visc 200), Harmony (visc 1825 cP))
  - Test effectiveness by breaking waves in wave tank

Non-Breaking Waves
Results: SL Ross Wave Tank

Oil	Viscosity	DOR	Leaching Time, h	Percent Dispersed	
				Oil-on-Water	Oil-in-tray
ANS	7	1:10	15	100	100
ANS	7	1:50	24	13	89
IFO 30	252	1:10	17	74	97
IFO 30	252	1:50	24	23	89
Harmony	1825	1:10	18	49	73

Conclusions

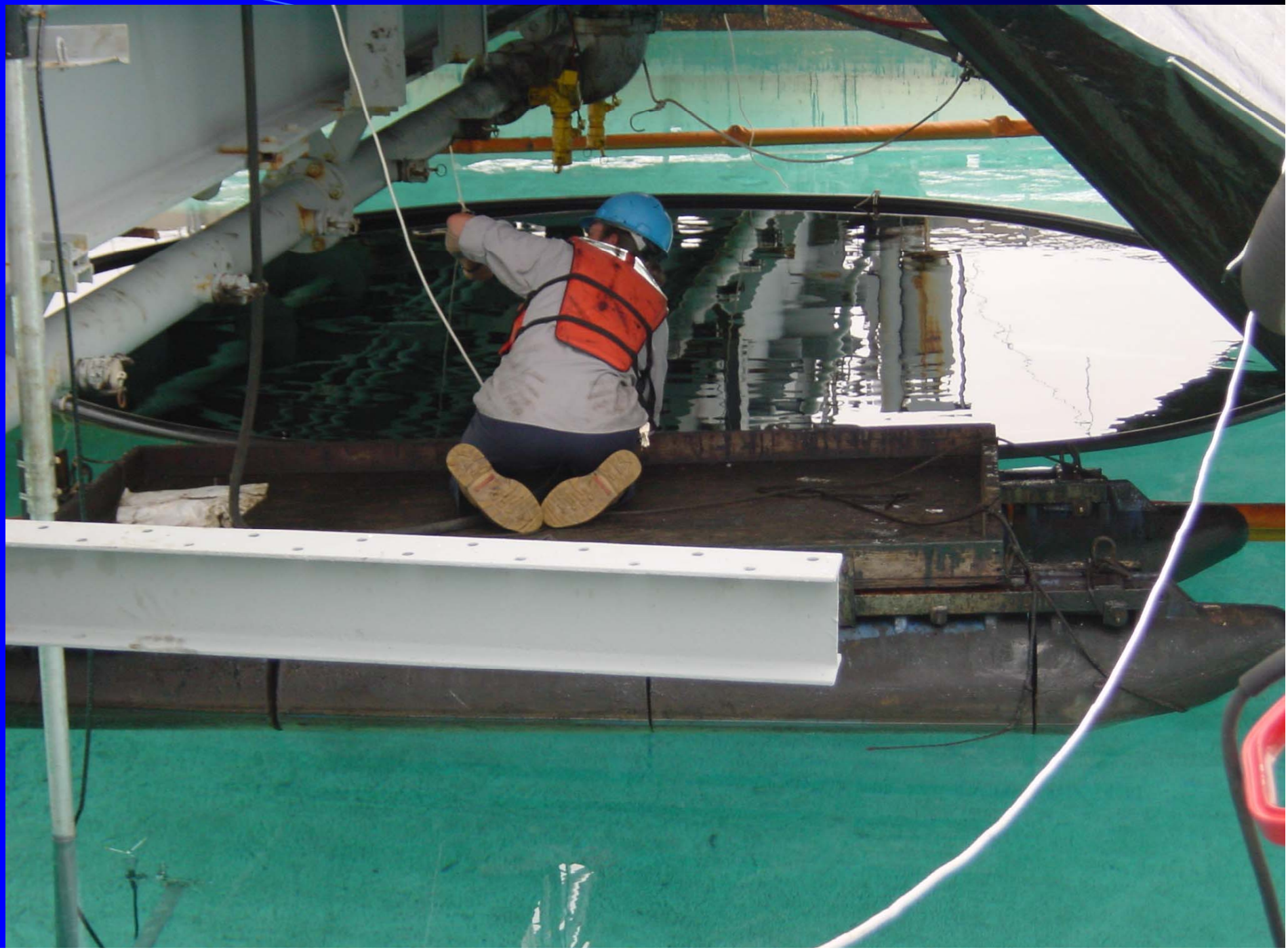
- Bench scale tests – visible decline in dispersant performance in <24 hours
- Wave tank scale tests –
  - Significant decline in performance in < 24 hours,
  - Apparent influence of DOR and oil viscosity

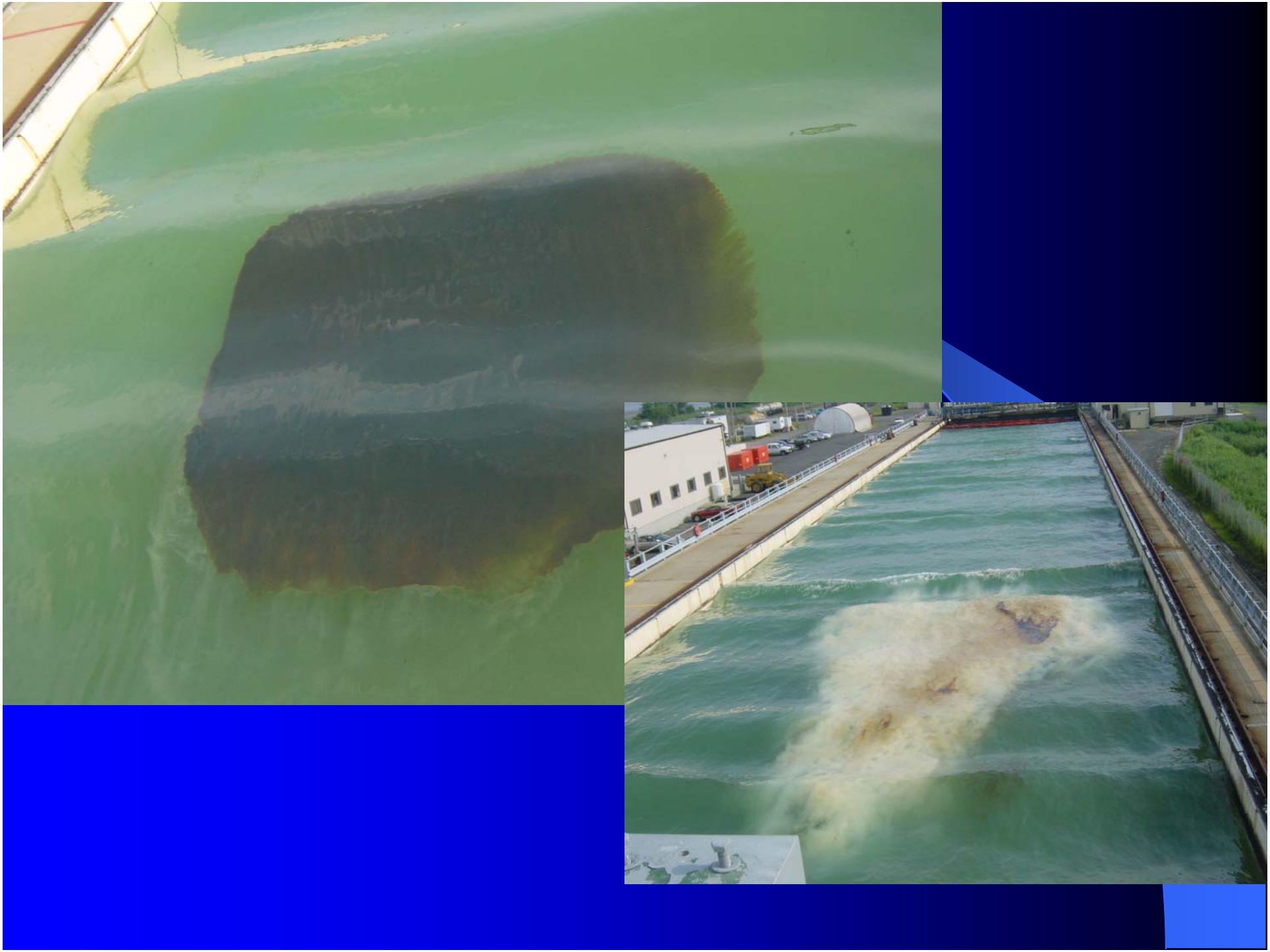
Calm Seas – Ohmsett

- **Ohmsett Tests**
  - Verify estimate of time frame on large scale with breaking waves
  - effect of variables: oil type
- **Method**
  - 5mm slicks
  - Treated with Corexit 9500, DOR = 1:10
  - Experimental slick exposed to water
  - Control slick contained in tray
  - Leaching time 18 to 149 hours (6 days)
  - Oils: (Galveston 209 (visc=14 cP, (IFO 30 (visc=200 cP), Ewing Bank 873 (visc 683 cP);)
  - Test effectiveness by breaking waves in wave tank

Oil containment ring on Ohmsett

Oil & dispersant pre-mixed is added to ring





Ohmsett: IFO 30 Weathering Control

Non-Breaking Waves
Results: SL Ross Wave Tank

Oil	Slick Thickness, mm	DOR	Leaching Time, h	Dispersion performance (DE)
Galveston 209	3.8	1:10	15	Dispersed Totally (100)
IFO 30	5.0	Control	0	No dispersion (27)
IFO 30	5.0	1:20	70	Dispersed totally (96)
IFO 30	5.0	1:20	149 (6.2d)	Dispersed totally (85)
IFO 30	5.0	1:20 Weathering Control	Weathered 70h Leached 0 h	Dispersed totally (95)
Ewing Bank 873	2.5	Control	0	No dispersion (59)
Ewing Bank 873	5.0	1:20	74	Dispersed totally (n.d.)
Ewing Bank 873	5.0	1:20 Weathering Control	Weathered 70h Leached 0 h	Dispersed totally (82)

Conclusions

- Bench scale tests
  - Visible decline in dispersant performance in <24 hours, most lost in <48h
  - Some effect of weathering, but most may be due to loss of dispersants
- Wave tank scale tests
  - Verify significant decline in dispersant performance in < 24 hours
  - Apparent influence of DOR and oil type

Conclusions

- Ohmsett tests
  - Oils disperse totally and rapidly in spilling breakers even after standing on calm waters for up to 6 days, contrary to bench- and wave tank scales


END