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**A Field Manual for Breaking Emulsions in Navy Bilge Collection and Treatment Systems.**

10 R. C. LITTLE and DALE TAYLOR  
Surface Chemistry Branch  
Chemistry Division

9 Interim rept.

11 Dec 1977

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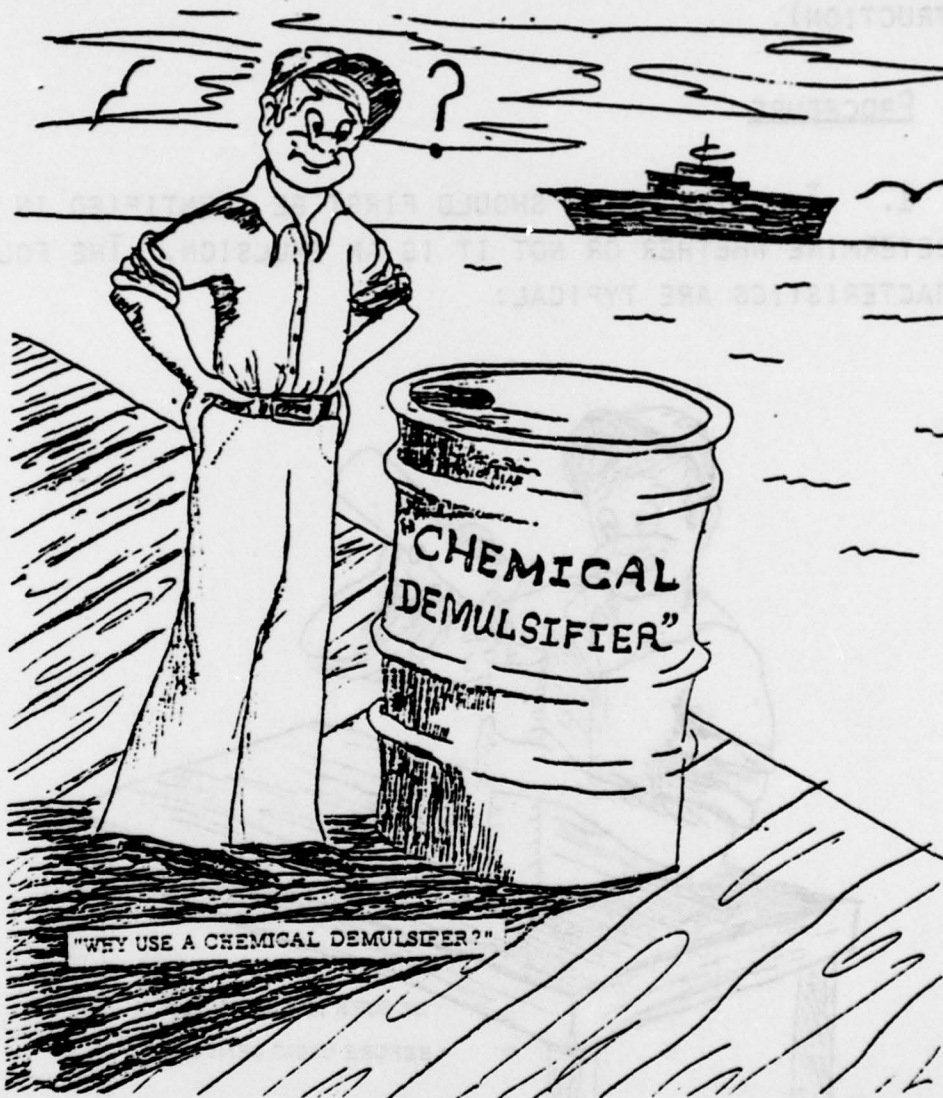
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# A FIELD MANUAL FOR BREAKING EMULSIONS IN NAVY BILGE COLLECTION AND TREATMENT SYSTEMS

## I. NEED FOR CHEMICAL DEMULSIFIERS

THE NEW WASTE OIL RAFT (WOR) WITH ITS MOBILE MODULAR OIL/WATER SEPARATION AND REMOVAL (OWS&R) SUBSYSTEM REPRESENTS A SIGNIFICANT ADVANCE IN THE HANDLING AND TREATMENT



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OF OILY BILGE WASTE WATERS. HOWEVER, OPERATIONAL PROBLEMS IN THE SEPARATION OF OIL AND WATER (EMULSION FORMATION) MAY OCCASIONALLY BE EXPERIENCED ESPECIALLY WHEN SURFACE-ACTIVE MATERIALS (DETERGENTS, SOAPS, CLEANING COMPOUNDS, ETC.) ARE PRESENT IN THE OILY WASTE. THIS INSTRUCTION OUTLINES THE PROCEDURE TO BE USED IN BREAKING EMULSIONS IN THE NEW WOR USING CHEMICAL DEMULSIFIERS (SEE LAST FIGURE FOR DIAGRAM OF DECISION-MAKING PROCESS INVOLVED WITH THIS INSTRUCTION).

## II. PROCEDURE

1. THE OILY WASTE SHOULD FIRST BE IDENTIFIED IN ORDER TO DETERMINE WHETHER OR NOT IT IS AN EMULSION. THE FOLLOWING CHARACTERISTICS ARE TYPICAL:



APPEARANCE: MILKY WHITE TO DARK BROWNISH CREAM

TEXTURE: WATERY TO CREAMY

NOTE: EMULSION MAY HAVE AN OIL LAYER OF VARIABLE THICKNESS ABOVE IT AND A SEPARATED WATER LAYER BELOW IT.

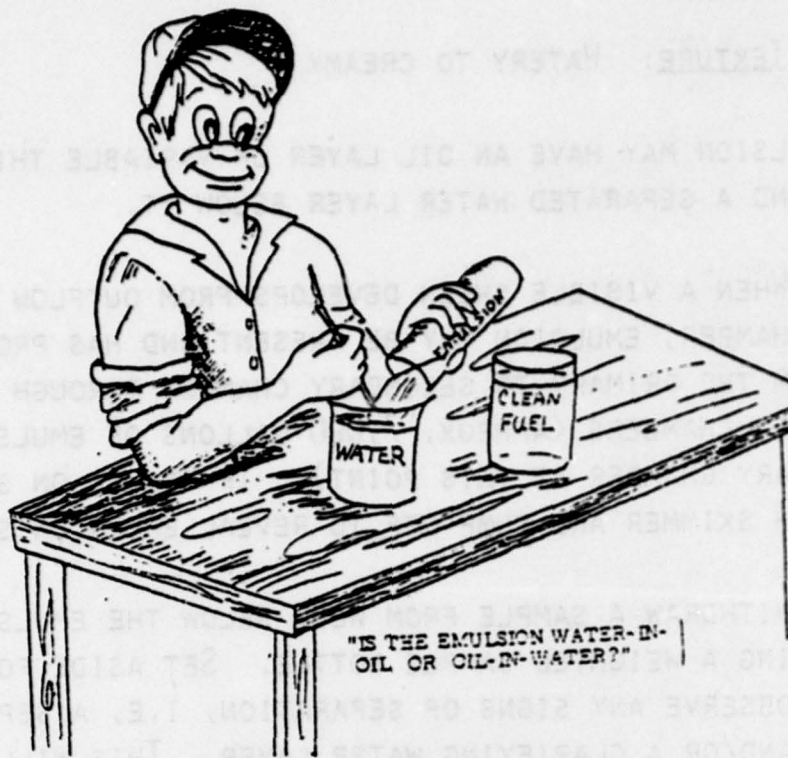
2. WHEN A VISIBLE SHEEN DEVELOPS FROM OUTFLOW OF SECONDARY WOR CHAMBER, EMULSION MAY BE PRESENT AND HAS PROBABLY PASSED FROM THE PRIMARY TO SECONDARY CHAMBER THROUGH CONNECTING PORT BETWEEN CHAMBERS (APPROX. 7,000 GALLONS OF EMULSION WILL BE IN PRIMARY CHAMBER AT THIS POINT). IF OIL IS ON SURFACE REMOVE WITH SKIMMER AND PUMP OFF TO REVEAL EMULSION SURFACE.

3. WITHDRAW A SAMPLE FROM WELL BELOW THE EMULSION SURFACE USING A WEIGHTED SAMPLE BOTTLE. SET ASIDE FOR TWO HOURS AND OBSERVE ANY SIGNS OF SEPARATION, I.E, A SEPARATING OIL LAYER AND/OR A CLARIFYING WATER LAYER. THIS WILL PROVIDE INFORMATION ON WHAT'S HAPPENING IN THE WOR AND ALSO DISTINGUISH BETWEEN MECHANICAL EMULSIONS AND CHEMICALLY-STABILIZED EMULSIONS.

4. TEST FOR EMULSION TYPE

THE EMULSION SHOULD NEXT BE TESTED FOR TYPE. A SUGGESTED PROCEDURE IS AS FOLLOWS:

- (A) TAKE TWO CLEAR TUBES OR BOTTLES.
- (B) ADD CLEAN WATER TO ONE TUBE AND CLEAN (PREFERABLY CLEAR) FUEL TO THE OTHER.
- (C) ADD EMULSION TO EACH TUBE AND STIR VERY GENTLY (NO NEED TO SHAKE).



### OBSERVATIONS

(A) IF THE EMULSION EASILY MIXES WITH WATER BUT DOES NOT MIX WITH THE FUEL (I.E. THERE ARE TWO LAYERS) THEN THE EMULSION IS OIL-IN-WATER (O/W).

(B) IF THE EMULSION EASILY MIXES WITH FUEL BUT DOES NOT MIX WITH WATER (TWO LAYERS) THEN THE EMULSION IS WATER-IN-OIL (W/O).

IF EMULSION IS WATER-IN-OIL IT SHOULD BE TRANSPORTED TO A SHORE-BASED OILY WASTE TREATMENT FACILITY. IF OIL-IN-WATER PROCEED TO STEP 5.

## 5. SALINITY TEST

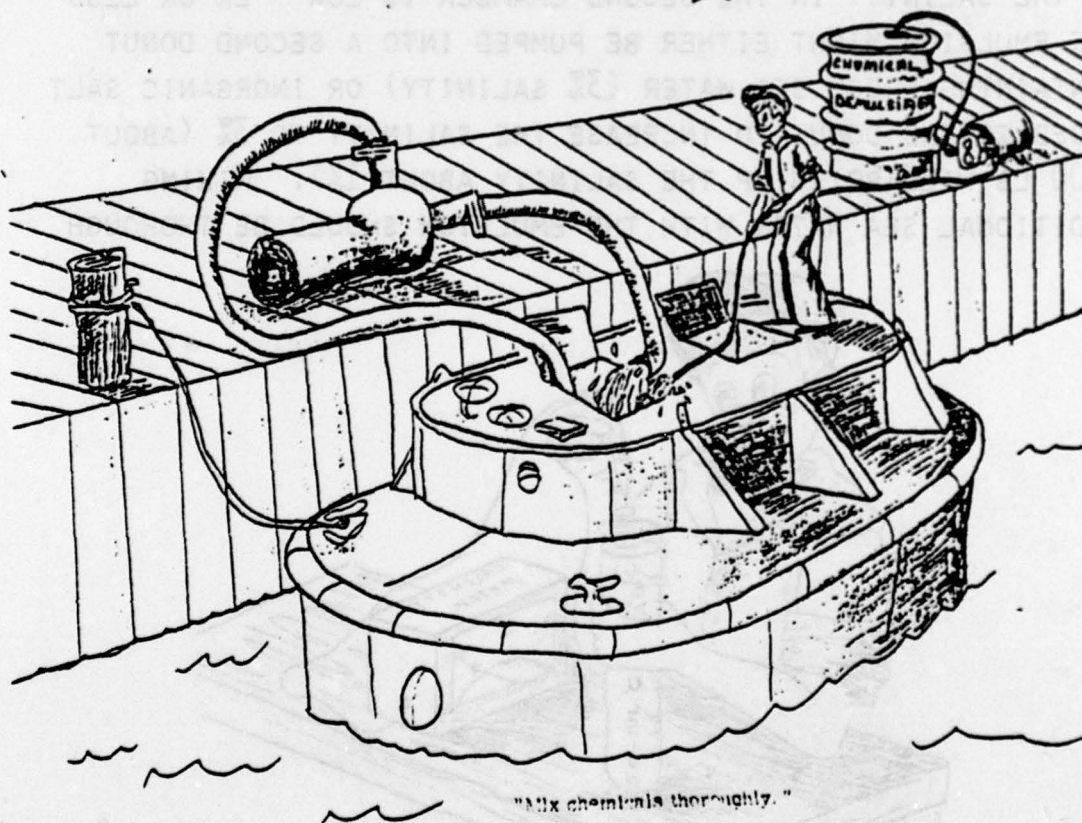
ASSUMING THE SAMPLE IS OIL-IN-WATER A SALINITY TEST SHOULD BE PERFORMED. A CONDUCTIVITY SALINITY METER IS AVAILABLE FROM FISHER SCIENTIFIC Co., MODEL 33 (YSI 33) OR FROM OTHER SOURCES AND IT READS PERCENTAGE OF SALT DIRECTLY. A FRESH WATER EMULSION WOULD READ CLOSE TO 0% AND A SEA WATER EMULSION APPROXIMATELY 3%. CHECK BOTH SIDES OF THE DONUT. IF THE SALINITY OF THE EMULSION IN THE PRIMARY CHAMBER IS 2% OR LESS AND THE SALINITY IN THE SECONDARY CHAMBER IS 3%, PUMPING SEA WATER FROM CHAMBER TWO TO CHAMBER ONE INTO THE EMULSION MAY BE SUFFICIENT TO BREAK IT. IF THE SALINITY IN THE SECOND CHAMBER IS LOW - 2% OR LESS - THE EMULSION MIGHT EITHER BE PUMPED INTO A SECOND DONUT CONTAINING FRESH SEA WATER (3% SALINITY) OR INORGANIC SALT ADDED TO THE DONUT TO INCREASE THE SALINITY TO 3% (ABOUT 2000 LB WILL BRING UP THE SALINITY ABOUT 1%). MIXING ADDITIONAL SEA WATER WITH THE EMULSION SHOULD BE THOROUGH



AND COMPLETE. AFTER MIXING, WITHDRAW SAMPLES FROM BOTH SIDES OF DONUT (AT LEAST 1 FT. BELOW SURFACE) AND OBSERVE SIGNS OF SEPARATION OVER A 2 HR. PERIOD AS IN STEP 3. IF OIL SEPARATES PUMP TO OIL STORAGE FACILITY. IF WATER LAYER IS CLEAR IRRIGATE DONUT; IF CLOUDY PROCEED TO STEP 6.

6. CHEMICAL TREATMENT PROCEDURE: THE FOLLOWING PROCEDURE APPLIES:

PUMP ALL SEPARATED OIL FROM BOTH PRIMARY AND SECONDARY SIDES OF DONUT IF ANY REMAINS ON SURFACE.



(A) START MIXING THE PRIMARY SIDE OF DONUT WITH A 300 GPM OR LARGER PUMP USING A HOSE TO PUMP NEAR THE BOTTOM OF DONUT AND AN OUTLET HOSE AT THE SURFACE.

(B) ADD 1/2 DRUM OF DEMULSIFIER TO EACH CHAMBER OF DONUT AT A RATE OF ABOUT 3-5 GPM WITH EMULSION STREAMING FROM THE MIXING PUMP.

(C) CONTINUE MIXING 60 MINUTES AFTER DEMULSIFIER HAS BEEN ADDED.

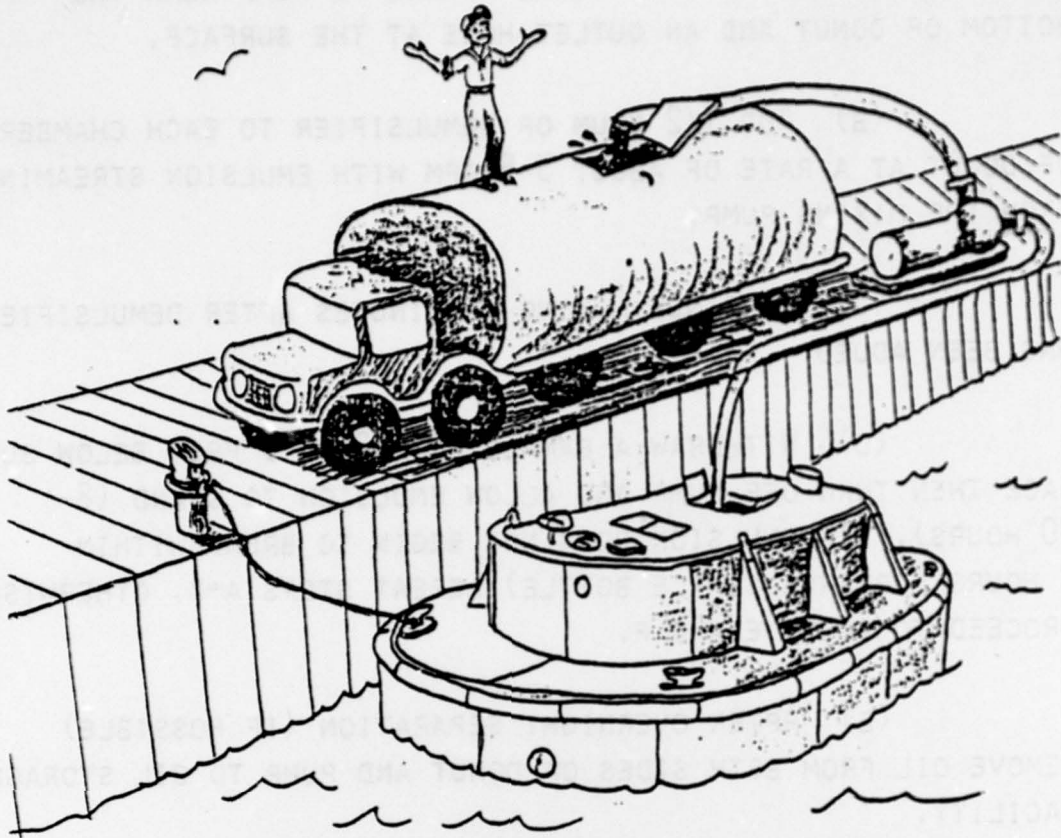
(D) WITHDRAW A SAMPLE FROM 2 OR 3 FEET BELOW SURFACE THEN TURN OFF PUMP AND ALLOW EMULSION TO STAND (8-20 HOURS). IF EMULSION DOES NOT BEGIN TO BREAK WITHIN 2 HOURS (OBSERVE SAMPLE BOTTLE) REPEAT STEPS A-D, OTHERWISE PROCEED TO STEPS E AND F.

(E) AFTER OVERNIGHT SEPARATION (IF POSSIBLE) REMOVE OIL FROM BOTH SIDES OF DONUT AND PUMP TO OIL STORAGE FACILITY.

(F) IF TWO BARRELS DO NOT BREAK EMULSION IT SHOULD BE PUMPED OR TRANSPORTED TO OILY WASTE TREATMENT PLANT. NOTE THAT IN COLDER CLIMATES WHERE WATER TEMPERATURE MAY BE AS LOW AS 32°F A THIRD BARREL MAY BE REQUIRED.

## 7. TREATMENT OF SEPARATED WATER

IF WATER LAYER IS CLEAN (TAKE SAMPLE WITH SAMPLE BOTTLE) CAUTIOUSLY PUMP SEA WATER 2' TO 3' BELOW THE SURFACE OF THE PRIMARY CHAMBER, FIRST CLOSING OFF SEA WATER INTAKE VALVE IN SECONDARY CHAMBER AND OPENING OUTFLOW VALVE TO OBSERVATION. IF SHEEN DEVELOPS IN WELL, CEASE PUMPING IMMEDIATELY. THE WATER SHOULD BE ADDITIONALLY TREATED



"When all else fails, transport the waste to the oily waste plant."

WITH OTHER CHEMICAL AGENTS OR MECHANICAL SEPARATORS  
(PARALLEL PLATE UNITS, FILTER COALESCERS ETC.) TO  
REMOVE LAST TRACES OF UNDISSOLVED OIL.

8. SCHEMATIC OF OVERALL TREATMENT PROCEDURE

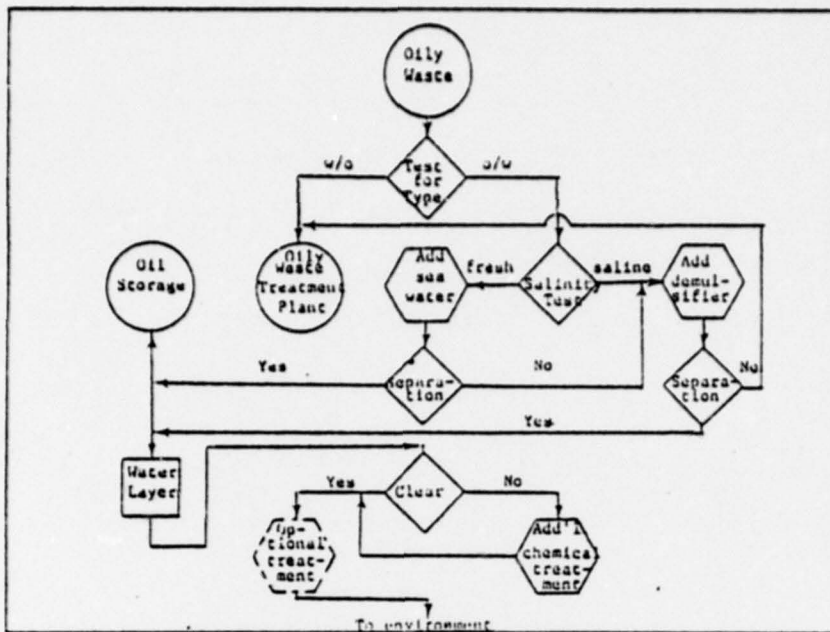


Fig. 7 — Logic diagram for handling and treatment of oily waste upon arrival in a waste oil raft