

Materials Balance on an Oil Washed from a Sandy Substrate Using Shoreline Cleaners

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Abstract

An experiment was conducted at a wave-tank facility, investigating shoreline-cleaner use on oiled sandy substrates. In each tank, a beach was configured, wave/tidal cycles were used, and alongshore currents were simulated through the use of influent/effluent flow ports. The experimental treatments included oiled control, oil-plus-Corexit® 9580, and oil-plus-CytoSol®. Oil was applied to each beach and weathered 24 hours before experimental onset. A cleaner was sprayed onto each respective beach, allowed to soak, and sprayed with seawater. The resulting oil slicks were contained at the tank center using projected airstreams. Samples were taken periodically in all compartments/sinks: water column, beach sediments, tank walls, surface oil slick and tank effluent. At the end of the experiment, the slicks were collected with a surface skimmer. A materials balance of oil was determined for each treatment using oil mass estimates (measured as GC/MS-derived total petroleum hydrocarbons) of each sample within each compartments/sink. Some comparisons between treatments are difficult because of unexpected beach erosion in the oiled-control tank and the CytoSol® tank. Consequently, a reliable quantitative measure of oil remaining in the sediments for these two treatments is hard to establish. Visually, both shoreline cleaners were observed to desorb the oil from the sand and the oil percolated down into the beach substrates. As the waves hit the beach, some oil was flushed from the beach sediments, resulting in floating oil slicks. However, based on the materials balance, both shoreline cleaners treatments still had large percentages of oil remaining in the beach sediments at the end of the experiment. More of the CytoSol®-treated oil was found in the water column and the effluent stream, as compared to the Corexit® 9580-treated oil. This experiment was conducted over a short 10.5-hour period; a longer time period may be required to receive the full benefits of the shoreline cleaners under these experimental protocols.

1.0 Introduction

Texas has 2360 miles of shoreline and two of the country's top 10 ports, Houston and Corpus Christi. These ports handle 50% of nation's crude oil import, while 80% of Corpus Christi's commerce is petroleum related. Oil spill occurrences may result in loss of habitat for economically-important species of fish, other marine animals, and damage to sensitive wetlands. From an economic standpoint, cleanup of minor spills such as the *Buffalo* barge spill can cost over 30 million dollars; the major

spill associated with the Exxon Valdez has exceeded eight billion dollars in cleanup and litigation costs (U.S. News and World Report, 17 May 1999).

Most of the oil spill costs are incurred with coastal cleanup, and unfortunately, oil spills frequently reach shorelines and other environmentally-sensitive areas. Moreover, when oil reaches the shore, it is usually several days old and weathered; it is usually thick, often emulsified, and frequently difficult to remove. Chemical surface washing agents (shoreline cleaners) are formulated to help release stranded oil from rocky shoreline substrates. After applying the cleaner to the oiled substrate and flushing, the released oil coalesces and rises to the water surface. The standard method of oil recovery is by mechanical procedures (booming or skimming). Factors that affect the release of stranded oil from substrate surfaces can include physical and chemical properties of an oil, composition of the shoreline cleaning agent formulation, characteristics of shoreline substrates, method for applying a cleaning agent to stranded oil, characteristics of the flushing or washing method, ratio of cleaning agent-to-oil, temperature, and salinity (Clayton *et al.*, 1993).

Shoreline cleaners have potential use for various shoreline types including rocky shores, man-made structures, gravelly beaches, sandy beaches, wetlands, and mud flats. Although perhaps most appropriate for rocky shores and gravel-dominated beaches (Walker *et al.*, 1993), other studies suggest that vegetated wetland environments may benefit from a low-toxicity shoreline cleaning agent. Pezeshki *et al.* (1995) concluded that using a shoreline cleaner on a *Spartina* marsh grass was beneficial to the plant, no matter the oil type. Shoreline cleaner studies by Teas *et al.* (1993) found similar conclusions with a mangrove study. Bizzell *et al.* (1999) tested a shoreline cleaner in a wetland environment and found no significant benefits in terms of oil removal from the sediments.

Although laboratory studies are valuable in testing a shoreline cleaner's effectiveness, the true test of its performance is a full-scale oil spill in the environment. However, these types of tests are costly, difficult to manage, and the results are frequently inconclusive due to lack of experimental control. As a middle ground, meso-scale studies can provide useful knowledge because of greater control, and are usually less expensive than a full-scale study. This mesocosm experiment, conducted at a wave tank facility, studied the effectiveness of two shoreline cleaners (Corexit® 9580 and CytoSol®) on a sandy beach substrate. In this paper, a materials balance on the oil was performed. The major "compartments" for oil transport are assumed to be the water column, the beach sediments, the oil slick (water surface) and the wave tank walls. The primary "sink" is the effluent from the meso-scale tanks. By comparing oil accumulations in these phases, the environmental fate of the oil was determined. Toxicity studies were also conducted during this experiment and the findings are summarized elsewhere in these proceedings (Fuller *et al.*, 2000).

2.0 Methods/Materials

2.1 The Facility

This experiment investigated the effectiveness of two shoreline cleaners in removing oil from a sandy substrate. The experiment was conducted at the Shoreline Environmental Research Facility (SERF), located in Corpus Christi, Texas. This is a meso-scale facility that includes multiple wave tanks, each measuring 33.5 m (length) by 2.1 m (width) by 2.4 m (height). Each tank is equipped with a computer-

controlled wave board that can produce variable wave patterns and feedback circuits to automatically control the tidal range and cycles. More details of the facility are discussed in Kitchen *et al.*, 1997.

2.2 The Beach Profiling, Wave Regime, and Tidal Regime

Each tank was partially filled with fine-grain sand and profiled to establish a beach at one end of the tank (opposite the wave board). A predetermined wave/tidal regime was used throughout the experiment, where high and low tides were attained by varying the influent flow rate and keeping the effluent flow rate constant (200 liters/minute) for the entirety of the 10.5-hour experiment. The water level at high tide was approximately 1.7 m and was close to 1.4 m at low tide. The water salinity averaged 29 parts per thousand during the experiment, and the water temperature was approximately 24° C.

2.3 The Oil

Two oils, Coastal #6 fuel oil and Exxon # 6 fuel oil, were considered for this experiment since spills of these fuel oils are not uncommon in both Texas bays and the Houston Ship Channel. Due to density and viscosity issues, a blend was deemed most appropriate for this experiment. The oil mixture ratio was approximately 3:4 (Exxon oil:Coastal oil, respectively).

2.4 The Treatments

The three treatments included oiled control, oiled and cleaned with Corexit® 9580 shoreline cleaner, and oiled and cleaned with CytoSol® biosolvent cleaner. Corexit® 9580 was developed in response to the Exxon Valdez incident and is "a balanced formulation of selected biodegradable surfactants in a low-toxicity, highly-refined hydrocarbon solvent system" (Fiocco *et al.*, 1991). Several encouraging toxicity and effectiveness studies have been conducted using Corexit 9580 (Fiocco *et al.*, 1991; Teas *et al.*, 1993; Michel and Benngio, 1995; Pezeshki *et al.*, 1995; Shigenaka *et al.*, 1995). CytoSol® has been described by its formulators (CytoCulture International, Inc., Point Richmond, CA, USA) as "a biosolvent formulation, based on vegetable oil methyl esters in combination with bioremediation enhancers. Efficacy studies performed by CytoCulture, both lab-scale and pilot field tests, have demonstrated promising results on various hard, smooth substrates (von Wedel, 1997). Effectiveness tests in removing oil from marsh plants and mussel beds also were successful and demonstrated low toxicity (McGowan *et al.*, 1997).

In each tank, a known mass (~2.5 kg) of the oil was systematically applied to a 1.8 m x 1.5 m intertidal area of the beach. The oil was allowed to weather for 24 hours before commencement of the experiment. For the shoreline-cleaner tanks, the weathered oil was systematically sprayed with approximately 2.5 kg of the respective cleaner, allowed to soak for 1.5 hours, and then gently sprayed with seawater for about 90 seconds. After the gentle spraying, the wave/tidal cycles commenced. Flushed oil that coalesced on the water surface was forced in the center of the tank using overhead fans situated at either end of each tank. Corraling the slick allowed for better oil-mass estimates for the materials balance, and also permitted easier collection of the slick at the conclusion of the experiment. As outlined in the following paragraphs, samples were taken periodically from the water column, the effluent stream, the beach sediments, the oil slick on the water surface, and the tank

walls. Each tank was monitored for 10.5 hours after wave/tide commencement. At the conclusion of the experiment, a surface skimmer (Surf Cleaner[®], Inovacor, Stockholm, Sweden) was deployed in each tank to collect the free-phase, floating oil. The weight of the collected oil was determined gravimetrically. Details of the device and collection procedure are discussed in another paper in these proceedings (Tissot et al., 2000).

2.5 Sampling

The tanks were sampled at times: pre-oiled baseline, 0.5, 2.5, 6.5, and 10.5 hours for water column, effluent, beach sediments, walls and oil-slick on the water surface (where the start of the waves/tide cycles was designated as time zero). For the water column, three-liter samples were taken from each of two locations in each tank: 1) the "surf zone" (12 meters from the back-beach wall), and 2) the "open water" (29 meters from the back beach wall). The sampling depth was half way between the water surface and the bottom. For the actual sampling, the water-sampling device permitted both the removal and replacement of the sample bottle cap while still underwater. This eliminated the possibility of any inadvertent sampling of floating free-phase oil.

All one-liter effluent samples were taken from a convenient sampling port in the effluent pipeline. All aqueous samples (water column and effluent) were stored in glass amber bottles with teflon-lined lids, acidified to pH 2 using HCl and refrigerated at 4° C until processed.

Beach sediment samples were cored using a 5-cm-diameter coring device.

For each sampling event, three samples were taken from the oiled region on a systematic, randomized sampling grid and then combined to form a representative sample. The three samples were combined according to depth (0-7.5 cm, and 7.5-15 cm) and then homogenized. The samples were stored in glass containers with teflon-lined lids at 4° C until processed.

Sampling of the water surface was conducted to secure a quantitative determination of the floating oil slick/film. A sampling protocol for surface oil slicks was recently developed in our lab. This procedure involved placing a high-performance extraction disk (Empore[™], Filtration Products, St. Paul, MN) on a fritted funnel that was attached to a small pump. A slight vacuum was applied to hold the disk in place while sampling the slick. The disk was carefully placed on the slick, and then removed quickly. For each sampling event, three samples were taken (two from the thicker portion of the full slick and one from the thinner, filmy edge of the slick). Each sample was comprised of three individually-samples SPE disks. The disks were then stored in 4-ounce jars, and refrigerated until processing. The details of this surface-sampling protocol are the topic of another paper in these proceedings (Louchouart et al., 2000)

To permit sampling of the tank walls, 12 strips (approximately 2 cm x 80 cm) of the polymer tank lining were strategically placed along the 33-m walls (6 strips per wall) before onset of the experiment. Two strips were designated as baseline, two were sampled at 0.5 hours and the remaining strips were sampled at the end of the experiment. The strips were extracted immediately, as outlined in the next section.

2.6 Analytical Methods

The water and effluent samples were extracted using a solid-phase extraction (SPE) procedure (EPA SW846, method 3535). Each aqueous sample was passed through a pre-conditioned SPE disk designed to attract hydrophobic compounds. The disk was then extracted with dichloromethane (DCM) to transfer the contaminants into the organic solvent. After extraction, the DCM extracts were condensed by evaporative concentration and reconstituted to a final 5-mL volume.

The sediment samples were processed as follows. Briefly, approximately 20 grams of sediment sample were frozen at -20°C. The frozen samples were then freeze-dried, ground, and homogenized. The dried samples were extracted by pressurized fluid extraction using DCM (EPA SW846, method 3545), concentrated by evaporative concentration, and then reconstituted to a final volume of 5 mL. The SPE pads from the surface-water sampling were extracted by sonicating the pads in a warm DCM bath. The DCM extracts were concentrated by evaporative concentration, and then reconstituted to a final volume of 5 mL. The polymer tank-liner strips were processed by rinsing the strips with DCM and condensing the extract to a final 5-mL volume.

All sample analysis was performed by GC-MS (EPA SW-846, modified method 8270b). A 1-microliter aliquot of the DCM extract was injected into a Hewlett-Packard (HP) 5890 Series II gas chromatograph (GC) interfaced to a HP 5972 mass selective detector (MS) and operated using HP MS Chemstation software (Hewlett-Packard Corporation, Palo Alto, CA). The data analysis was total petroleum hydrocarbons (TPH), which includes the sum of the total resolved peaks (including n-C10 through n-C34) and the unresolved complex mixture.

2.7 Materials Balance Calculations

A mass balance on the oil was determined. The major compartments for oil transport were assumed to be the water column, the beach sediments, the oil slick on the water surface, and the tank walls, while the primary sink was the effluent from the tanks. By comparing oil accumulations in these phases, the fate of the oil was determined.

The oil mass (as TPH) for the beach sediments was determined for the oil-sprayed area. The two depths (0-7.5 cm and 7.5-15 cm) were calculated separately, as TPH values were determined for both depths. The TPH mass for the given volume was determined by multiplying the measured concentration and the volume of the beach section, after accounting for moisture content, porosity, and density of the substrate. For the materials balance calculations, it was assumed that no oil was deposited in the "sub-tidal" (below the low-tide mark) region. An API technical report (1997) states that in many cases, not much oil accumulation occurs in sub-tidal sediments near oiled shorelines. To verify this, after the experiment was concluded, the tanks were drained and replicate sediment samples were taken in three sub-tidal areas. TPH concentrations were at background levels.

The TPH mass for the water column was determined for two sections of the water body, based on the two sampling locations. One section designates the "surf zone" of the tank while the other segment is representative of the "open water". The volumes of water in each control region were estimated (based on the tide height at each sampling event) and then multiplied by the TPH concentrations to calculate the oil mass (as TPH).

The mass for the oil slick was determined by multiplying the TPH concentrations on the sampling SPE disks and the estimated area of the slick. During each sampling event, details on the slick size were noted, providing information to calculate a slick area.

Oil sorbed to the tank walls was estimated as follows. As the tank-liner strips were removed from the tank walls, it was noted what oiled areas of the tank wall were best represented by each liner strip. For each TPH mass calculation, the TPH concentration per strip area was multiplied by the oiled wall area that the strip represented. The masses were summed to give an estimate for the total wall area.

The oil losses due to flushing (via the effluent) were estimated by numerical integration. The specific algorithm used was the "trapezoidal rule with unequal segments" technique outlined in Chappra and Canale, 1988.

3.0 Results and Discussion

3.1 Visual Observations

Due to logistical considerations, the experimental onset for each tank was staggered. Using a random-number generator, it was determined to conduct the "CytoSol" treatment on 10 November 1999, the oiled-control treatment on 11 November 1999, and the "Corexit" treatment on 12 November 1999. During each sampling event, the wave board was turned off, allowing for easier sampling on the beach and on the water surface. The average sampling time was 30 minutes. However, the tidal regime was continuous throughout the 10.5-hour experiment.

All protocols (oil application, cleaner application, sampling, oil skimming) in the CytoSol® tank were executed successfully. After commencement of the wave/tidal cycles, the sand appeared to be much cleaner. However, beach erosion was observed shortly after the wave action began, and this may account for some of the oil loss in this compartment. During most of experiment, the oil slick on the water surface appeared homogeneous. It was assumed that the slick was an oil/CytoSol® mixture, as suggested by the manufacturer. When the slick was collected with the Surf Cleaner®, some water and biological particles were also collected with the oil.

In the oiled-control tank, all protocols were again executed without incident. After the 90-second water flush, the wave generator was started. There was obvious physical flushing of the sand surface layer from the beach into the water. By the 0.5-hour sampling event, much of the sampling-grid area has been physically eroded. At the conclusion of the experiment, the slick was collected with the Surf Cleaner®. The slick developed a mousse-like consistency and contained numerous small pebbles and sand particles. For details see Tissot et al. in these proceedings.

In the Corexit® tank, all protocols were again executed successfully. During the flushing step, the oil removal from the sand surface appeared dramatic. Visually, Corexit® 9580 appeared to more effectively remove the oil than the CytoSol®. The beach was not eroded, as seen in the other tanks. The slick was slow in forming as compared to the other treatments. The resulting slick did not have the filmy sheen at the edges as seen in the other tanks. It was patchy and not well coalesced. In general, the slick was much less evident as compared to the other tanks. It is assumed that much of the Corexit® product evaporated and that the slick was composed mainly of oil, with little cleaner associated with it. At the end of the experiment, the

recovered slick resembled more of a sheen, as compared to the CytoSol® and oiled-control slicks.

3.2 GC-MS analyses

Oil concentrations in the sediments, water column, oil slick, tank walls and effluent were determined by GC-MS. Subsequent paragraphs briefly summarize the TPH concentration comparisons made between the treatments for these compartments/sink. These summaries are followed by a discussion of the materials balance on the oil for the three oil treatments. Determining the distribution of oil (i.e., a materials balance) can be helpful in understanding the fate of spilled oil in a coastal environment.

Sediment TPH concentrations in all treatments were compared for the two different depths. For the oiled control and CytoSol® treatments, the oil concentrations were dramatically reduced by more than 95% in the upper 7.5 cm of the beach, while the concentrations were halved in the Corexit® treatment. Visual observations suggest that in the oiled treatment, the oil was removed as the top sand layer of the beach was physically eroded away by wave action. In the CytoSol® tank, the oil percolated down into the sand before being flushed out via wave action. Also, there was some physical erosion of the top sand layer, thus removing some of the oil. In the Corexit® tank, again the oil percolated down, and a portion of it was removed by the flushing action of the waves. Little beach erosion was observed in this tank. In the lower sand layer (7.5-15 cm), some oil percolated down to this depth, particularly in the CytoSol® tank. By the end of the experiment, the oil concentrations were similar in both layers for this treatment.

For the water column ("surf" zone and "open-water" zone), the oil concentrations were compared for all treatments. At all sampling times and for both water zones, the TPH concentrations in the CytoSol® treatment were consistently the highest, followed by the oiled-control treatment, and then the Corexit® treatment. In the surf zone, a dramatic increase in TPH concentrations in all treatments occurred after the beaches were water flushed and the oil began coalescing on the water surface. These concentrations were 4X-7X higher than those in the open-water zone. This difference was attributed to the increased physical dispersion in the surf zone. For all treatments, concentrations in the open-water zone gradually increased during the experiment. By the end of the experiment, an equilibrium was reached and the concentrations in both zones for each treatment were very similar (within 0.5 mg/L).

When comparing the oil slicks in the different tanks, the oiled-control slick yielded higher TPH concentrations than either cleaner treatment (except for the 4-hour sampling when the CytoSol-treated slick had a higher TPH concentration). The Corexit-treated slick had the lowest TPH concentrations overall; moreover, the TPH concentration for this slick progressively decreased with time (from 66 mg/sample area to 18 mg/sample area).

For the tank-wall compartment, liner samples from the oiled-control tank produced higher TPH concentrations than the two cleaner treatments. For all tanks, the strips situated near the cross-sectional center of the walls had higher oil concentrations, due to the proximity of the slicks.

When comparing the effluents from the three treatments, the TPH concentrations in the CytoSol-treated effluent were 2X-3X higher than the concentrations in the other effluents.

The fate of the oil in each treatment can be compared after the concentration values are converted to mass values for each compartment/sink. All TPH concentrations were converted to TPH masses as outlined in Section 2.7; the relative mass values in each compartment/sink were calculated and then compared. This comparison was made for the four sampling events (0.5, 2.5, 6.5, 10.5 hours), and expressed as percentages for the sediments, water column, oil slick, tank walls and cumulative effluent. Only the results from the end-of-experiment sampling (10.5 hours) are presented in this paper. These results are depicted in Figure 1. Any unaccounted oil is not represented in the pie charts for this figure. When unexplained oil losses exist in data sets, it can be difficult to make direct comparisons between treatments. However, comparing oil accumulations in the various compartments within a given tank is reasonable under this circumstance. In the oiled-control tank (Figure 1a), a high percentage of the oil was either part of the slick (48%) or sorbed to the tank walls (36%). Minimal oil was found in the water column or as "lost" via the effluent. The percentage of oil accumulations in the sediments (0%) is deceiving since the top sand layer was eroded by wave action. In the CytoSol[®] tank (Figure 1b), the largest accumulations of oil appear to be in the slick (17%) and sediments (41%), with 30% lost via the effluent. In contrast, the vast majority of the oil in the Corexit[®] tank (Figure 1c) remained in the sandy sediments (70%) with the remainder of the oil distributed in the other compartments/sink.

As suggested in the previous paragraph, the materials balance determinations indicated that some of the oil was unaccountable. The pie charts in Figure 2 include this "unaccounted-for" oil. With this fraction of the oil included in the charts, direct comparisons between treatments are more legitimate. This is especially true when comparing the two cleaner treatments (Figures 2b and 2c), since the "unaccountable oil" fractions are of comparable size. The most significant differences occur in the sediments, slick, and effluent compartments/sink. Comparing the sediments, the Corexit[®] tank had much more residual oil (52%), as compared to the CytoSol[®] tank (37%). However, some of the oil loss in the CytoSol tank was due to beach erosion. In the slick compartment, the CytoSol[®]-treated slick had higher relative oil accumulations (16% vs 3%), while the effluent carried away 27% of the oil in the CytoSol[®] tank and only 3% in the Corexit[®] tank. So, the behavior of the treated oil varied significantly with the two shoreline cleaners. The CytoSol[®] was able to desorb more of the oil from the sandy substrate and let the water flush the mobilized oil from the beach. The oil appeared well-coalesced as a homogenous slick on the water surface, allowing for mechanical recovery at the end of the experiment. However, a surprisingly large portion of the oil (27%) was removed with the effluent, which was an unexpected phenomenon. The Corexit[®] 9580 was able to desorb the oil from the sand particles, as evidenced by the oil percolating into the beach. However, it appears that the oil stranded in the sandy layer, as indicated by the high percentage that remained in the sediment compartment (52%). The carrier solvent for Corexit[®] 9580 is primarily composed of lower-molecular-weight hydrocarbons (n-C10 through n-C14). It is possible that much of the Corexit[®] solvent evaporated during the 1.5-hour soaking period, and the oil re-stranded in the sandy sediments.

4.0 Conclusions

Some comparisons between treatments are difficult. In the oiled-control tank, three-fourths of the oil cannot be accounted for in the materials balance; this is partially due to beach erosion. The final destination of these oil-coated sand particles is unclear. The CytoSol tank also experienced beach erosion to a similar degree, but most of the oil was accounted for in the materials balance. It is possible that much of the desorbed oil was able to re-coalesce into a slick, even as the beach was eroding. Using the protocols outlined in this experiment, the CytoSol[®] shoreline cleaner appeared to be more effective than the Corexit[®] 9580 cleaner. CytoSol[®] mobilized and removed a higher percentage of the oil from the sandy substrate, with the aid of the high-energy waves. Although not evident in the figures presented, the oil remaining in the sediments of the Corexit tank was 2X as high as that in the CytoSol tank. The Corexit[®] 9580 initially desorbed the oil from the sand, but re-adsorption may have occurred, and the wave action was not able to flush the oil from the beach satisfactorily. The CytoSol[®]-treated slick was more manageable and easier to collect at the end of the experiment. The CytoSol[®]-treated oil was subject to entrainment in the water column, as evidenced by the higher oil losses in the effluent. This experiment was conducted over a short 10.5-hour period; a longer time period may be required to receive the full benefits of the shoreline cleaners under these experimental protocols.

5.0 Acknowledgements

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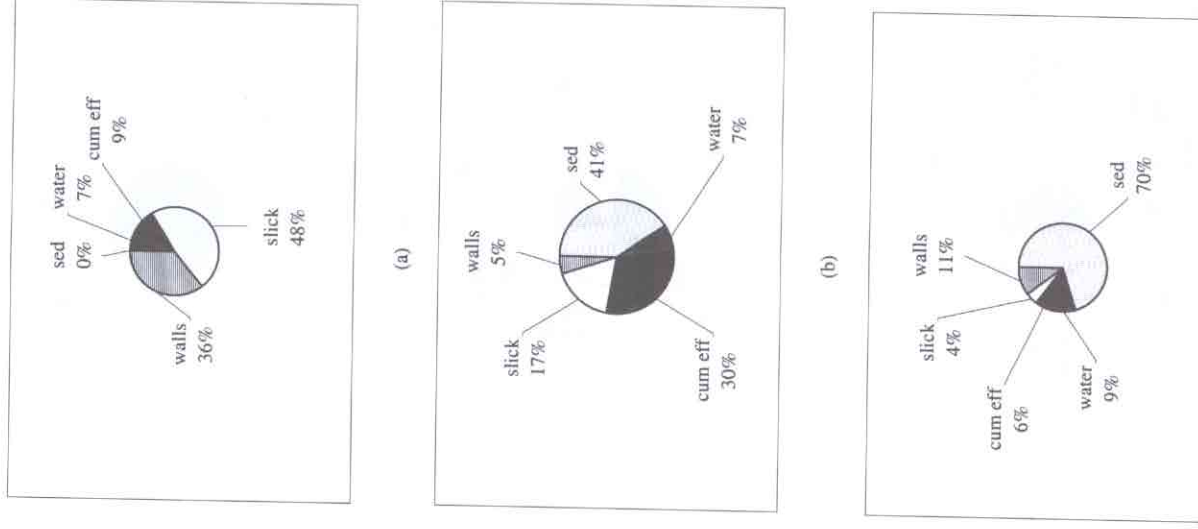


Figure 1. TPH materials balance (excluding unaccounted oil) for the (a) oiled control treatment (b) CytoSol treatment and (c) Corexit treatment at end of experiment.

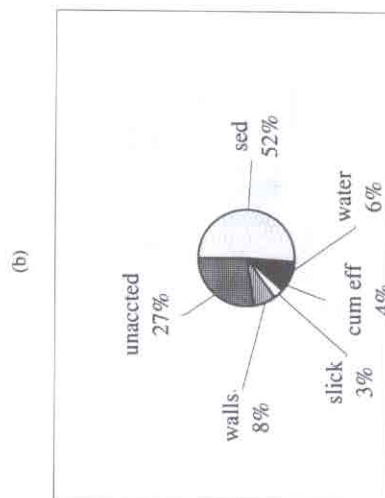
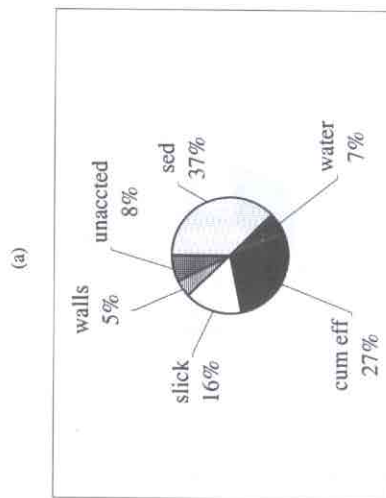
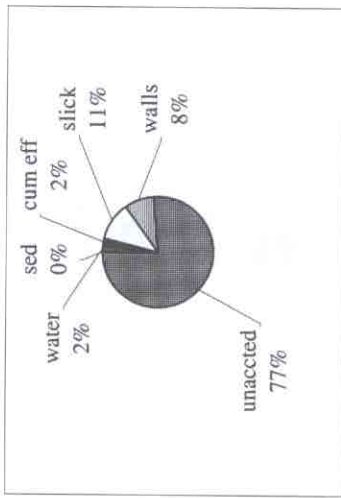


Figure 2. TPH materials balance (including unaccounted oil) for the (a) oiled control treatment (b) CytoSol treatment and (c) Corexit treatment at end of experiment.

Feasibility of Using Ohmsett for Dispersant Testing and Research

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Abstract

The Minerals Management Service operates a wave tank facility in Leonardo, New Jersey, known as Ohmsett, which is used primarily for the testing of oil spill equipment. The objective of this study was to examine the feasibility of performing dispersant effectiveness testing at the facility. The study included (1) interfacial tension laboratory tests; (2) turbidity tests; (3) laboratory tests to determine efficacy of the current filtering material used at Ohmsett and alternative filtering materials for removing dispersant and chemically dispersed oil; and (4) full-scale testing at Ohmsett.

The study showed that (1) the presence of dispersant in Ohmsett water following dispersant tests will strongly affect the interfacial tension of oils used in subsequent boom or skimmer tests at Ohmsett, so that the tank will have to be thoroughly cleaned following a dispersant testing program; (2) dispersant concentrations in the water can reach at least 400 ppm before having a noticeable effect on the dispersion of floating oil, so that many experiments could be done consecutively without concern that residual dispersant is in the tank; (3) a number of experiments per day could be run in sequence before having to filter the body of water to remove dispersed oil; (4) underwater viewing of dispersant testing will only be possible for the first test in a series; (5) it is possible to remove most dispersed oil from Ohmsett tank water using cellulose as the filter aid; (6) activated carbon is likely to remove dissolved dispersant with a high degree of effectiveness; and (7) overall, dispersant testing at Ohmsett could be done with good success if the testing program is carefully designed and implemented with regard for the limitations noted above.

1.0 Introduction

One difficulty in using oil spill dispersants in the field is predicting and measuring the effectiveness of the dispersant over a range of conditions. The main variables include oil type and weathered state, dispersant type, dispersant-to-oil ratio, application method, slick thickness, and sea state. Dispersant testing in small-scale laboratory tests has been shown to be of limited value in predicting dispersant effectiveness in actual spill situations. Dispersant testing in ocean field trials has yielded useful results, but these are only valid for the narrow range of conditions that were experienced in the trials. Testing a wide range of variables at sea in many trials is possible, but would be expensive and also difficult to get approved by regulators. The situation remains that little quantitative information is available on dispersant effectiveness under real spill conditions. What is needed is a facility that can be used to test a wide range of dispersant-use variables under conditions that simulate actual conditions much better than existing laboratory tests do. Ohmsett may be such a facility.

The problem is that Ohmsett may not be currently equipped to do dispersant testing. The main concerns are that: