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Project Summary

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms

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Performance tests on three catenary oil containment configurations using sorbent boom sections alone and in conjunction with a conventional containment boom were conducted at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (U.S. EPA OHMSETT). Other test variables included wave condition, tow speed, and oil quantity encountered. Maximum no-oil-loss containment tow speed was determined for each wave and oil quantity tested.

The use of an all sorbent boom with a multilayer sorbent raft at the apex resulted in average increases in the no-oil-loss tow speed of 0.13 m/s over previous results using a single-layer boom in calm water. However, use of a conventional containment boom with a sorbent raft inside the apex increased turbulence and caused oil loss at lower speeds than with the use of the conventional boom alone. Use of the sorbent boom raft at the boom apex also resulted in lower no-oil-loss tow speeds than with previous tests using a single-layer sorbent boom in the 0.3-m harbor chop wave. Loss of speed was due to the increased turbulence that occurred when raft sections struck each other because of the wave action.

Recovery of sorbed fluid and regeneration of the boom sections was unsuccessfully attempted with a commercially available sorbent and wringer.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This report continues the sorbent boom testing previously carried out at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT). The test objectives were to evaluate the use of a sorbent raft at the apex of a catenary oil containment boom and to try to recover oil from saturated sorbent boom sections by squeezing them between two rollers. Rafts made of sorbent boom sections were placed at the apex of conventional and sorbent oil containment booms.

Oil loss generally occurred as oil droplets entrained in the water passing under the boom in Phase A testing and in all harbor chop (HC) tests. Calm water tests in Phases B and C exhibited oil losses as a surface slick. Oil appeared on the downstream side—not as droplets rising to the surface, but as a surface slick passing under the boom sections.

Phase A testing, which used sorbent rafts in conjunction with the B.F. Goodrich PFX-18* containment boom, showed an overall decrease in maximum

*Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Environmental Protection Agency.

no-oil-loss tow speed in both calm water and the HC wave when compared with results for the B.F. Goodrich boom alone. The sorbent raft generated oil drops when it struck the B.F. Goodrich boom. These drops were then swept under the sorbent raft and the B.F. Goodrich boom.

Phase B tests, which used B.F. Goodrich containment boom sides and a sorbent raft at the apex, exhibited increased no-oil-loss tow speeds in calm water and no change in HC waves. Use of a raft of Conwed Corporation heavy duty sorbent boom as the apex section caused an average increase of 0.08 m/s in calm water, and use of 3M Company Type 270 sorbent boom raft resulted in an average increase of 0.03 m/s. Oil loss generally occurred at the points where the sorbent raft apex section was attached to the conventional boom sides. Sorbent boom sections of the raft were overlapped on the aft side of the conventional boom for 3 m, but turbulence from currents near the end of the conventional boom caused oil droplets to be driven down into the water and under the boom.

Tests in Phase C, which used sorbent booms for the sides along with a sorbent raft at the boom apex, showed increased no-oil-loss tow speeds in calm water and decreased speeds in the HC wave. The Conwed heavy duty sorbent boom used in Phase C effected an average increase of 0.13 m/s in calm water, and the 3M Type 270 boom generated an average increase of 0.14 m/s in calm water. In the 0.3-m HC wave, decreases of 0.05 m/s were found with both booms. Oil was lost when the sorbent boom sections of the raft struck each other in the HC wave. Oil drops were squeezed out of the sorbent sections and driven down into the water by the turbulence that occurred when the waves and the boom sections collided.

Tests were performed to determine the effects of changes in the number of rows added to the sorbent raft. Results, which were obtained in Phase C testing using the Conwed sorbent boom, calm water, and 0.97 m^3 of oil, showed that the no-oil-loss tow speed increased only after more than three rows were used to form the raft. Up to five rows were used to form the raft, and the fourth and fifth rows increased the maximum no-oil-loss tow speed by 0.05 m/s for each row.

Regeneration of saturated sorbent boom sections was unsuccessfully attempted using the Petro-Trap wringer with a powered roller designed to squeeze oil from sorbent pads. The rollers were smooth with tension provided by springs on the top roller. Difficulty was encountered in forcing the boom sections between the wringer rollers. No more than 1 m of any boom section could be pulled through the wringer rollers at one time, and then only with several people helping the regenerator motor to pull the boom through the rollers. Samples of the fluid recovered by this operation were analyzed for oil and water content. Conwed sorbent boom sections contained 18.3 kg/m (or 2.03 m^3/m) of fluid containing 84% oil, and the 3M sorbent boom contained 11.2 kg/m (or 1.2 m^3/m) of fluid containing 85% oil. Because of the small amount of sorbent boom squeezed, these results cannot and should not be considered representative of the oil content or total fluid volume of the entire sorbent boom or sorbent raft.

Conclusions

Use of a sorbent raft inside the apex of a catenary, conventional oil containment boom failed to increase the maximum no-oil-loss tow speed. In fact, maximum no-oil-loss tow speed decreased from 0.43 m/s to 0.33 m/s in calm water, and from 0.46 m/s to 0.30 m/s in the 0.3-m HC wave for the B.F. Goodrich PFX-18 boom used.

Maximum no-oil-loss tow speeds increased with the use of sorbent raft apex sections. Conventional boom sides coupled with a sorbent raft apex section increased the no-oil-loss tow speed in calm water and 100% oil capacity from 0.25 m/s for a single-layer totally sorbent boom to 0.29 m/s for a four-layer sorbent raft apex section. Similar tests in the 0.3-m HC wave exhibited a no-oil-loss tow speed increase from 0 m/s to 0.22 m/s. Oil no longer was splashed over the sorbent raft at the apex, as occurred with the single-layer sorbent boom. Loss of oil occurred mainly at the attachment points of the sorbent raft to the conventional boom sides. Vortices formed at these attachment points, causing oil drops to be lost under the sorbent raft.

Tests using an all sorbent boom with a five-layer sorbent raft apex again caused increases in no-oil-loss tow speeds compared with those of a single-layer sorbent boom: 0.33 m/s (as opposed to 0.25 m/s) in calm water, and 0.17 m/s (as opposed to 0 m/s) in the 0.3-m HC wave.

Tests using apex raft sections varying from one to five layers showed little effect until three layers were used in the raft. The no-oil-loss tow speed increased 0.05 m/s for each layer added to the apex raft for layers three, four, and five.

Attempts at boom regeneration were futile. The opening between the squeeze rollers was too small for the boom to pass through easily, and the smooth rollers could not grip the oily boom sufficiently to feed the boom between the rollers. Fluid-saturated boom sections contained 6 to 12 times the dry boom weight of an 85% oil content fluid. Only the medium viscosity, naphthenic oil was used in these tests; different oils would yield different results.

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***John S. Farlow** is the EPA Project Officer (see below).*
The complete report, entitled "Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms," (Order No. PB 82-101 650; Cost: $6.50, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
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