Appendix A—Skimmer Performance Summaries
<table>
<thead>
<tr>
<th>Skimmer Type/Model</th>
<th>Oil Type/Viscosity</th>
<th>Wave Type</th>
<th>Tow Speed, kts</th>
<th>Slick Thickness, mm</th>
<th>Recovery Efficiency (RE), %</th>
<th>Throughput Efficiency (TE), %</th>
<th>Oil Recovery Rate (ORR), bbl/h (m³/h)</th>
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<td>LORI LSC-2 (fine brush)</td>
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## Skimmer Performance Summary—Disc

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<th>Emulsification, %</th>
<th>Oil Recovery Rate (ORR), bbl/h (m³/h)</th>
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<td>Calm Water to 0.4 m</td>
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<td>12 000 cP</td>
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## Skimmer Performance Summary—Drum/Paddle Belt

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<th>Oil Type/Viscosity</th>
<th>Wave Type</th>
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<th>Recovery Efficiency (RE), %</th>
<th>Throughput Efficiency (TE), %</th>
<th>Oil Recovery Rate (ORR), bbl/h (m³/h)</th>
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<td>NR</td>
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## Skimmer Performance Summary—Rope Mop

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<th>Throughput Efficiency (TE), %</th>
<th>Oil Recovery Rate (ORR), bbl/h (m³/h)</th>
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**Skimmer Performance Summary—ZRV Rope Mop/Sorbent Belt**

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<th>Recovery Efficiency (RE), %</th>
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<th>Oil Recovery Rate (ORR), bbl/h (m³/h)</th>
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### Skimmer Performance Summary—Stationary Suction/Air Conveyor

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### Skimmer Performance Summary—Weir/Induced Flow Weir

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<th>Oil Recovery Rate (ORR), bbl/h (m³/h)</th>
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# APPENDIX A—SKIMMER PERFORMANCE SUMMARIES

## Skimmer Performance Summary—Advancing Weir

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<td>RST</td>
<td>383</td>
<td>0.3 m Wave</td>
<td>0.75</td>
<td>NR</td>
<td>94</td>
<td>NR</td>
<td>64 (10.2)</td>
</tr>
</tbody>
</table>
Appendix B—References

REFERENCES

References are listed according to the test facility in which they were performed or by sponsoring agency. Tests performed by or for other agencies in the OHMSETT Facility are listed with OHMSETT reports.

The list of references is followed by an Annotated Bibliography that lists the skimmers that were examined in each test and a brief statement describing the extent of the test program. A second Annotated Bibliography shows references according to the skimmer type tested so that the user can immediately find all the references available for a single skimmer of interest.

OHMSETT TESTS


(O-3) McCracken, W. E., "Performance Testing of Selected Inland Oil Spill Control Equipment," EPA-600/2-77-150, Aug. 1977. (Tests were performed in 1975.)

(O-4) McCracken, W. E. and Schwartz, S. H., "Performance Testing of Spill Control Devices on Floatable Hazardous Materials," EPA-600/2-77-222. (Tests were performed in 1975.)

(O-5) Breslin, M. K., "Performance Testing of Oil Mop Zero Relative Velocity Oil Skimmer," EPA-600/7-78-060, April 1978. (Tests were performed in 1976.)

(O-6) Smith, G. F. and McCracken, W. E., "OHMSETT 'High Seas' Performance Testing: MARCO Class V Oil Skimmer," EPA-600/2-78-093, May 1978. (Tests were performed in 1976.)

(O-7) Lichtie, H. W. and Breslin, M. K., "Performance Testing of Three Offshore Skimming Devices," EPA-600/7-78-082, May 1978. (Tests were performed in 1977.)


ENVIRONMENT CANADA TESTS

Any tests that have an Environment Canada report number are considered to be Environment Canada tests. Reports are listed in order of report date, not the year in which
the test was performed. If the report is not dated, the reference is listed according to the year in which the test was performed.

(E-1) Solsberg, L. B., Ross, C. W., Logan, W. J., and Fingas, M. F., “Field Evaluation of Seven Oil Spill Recovery Devices,” EPS 4-EC-76-3, August 1976. (Tests of the Lockheed Clean Sweep were performed in 1973; the DIP 2001, Oil Mop Mark II-9D, SLURP, and RBH Slickicker, Mark II were performed between December 1974 and April 1975; the Bennett Mark IV and the OSCAR were tested in July 1975.)


(E-4) Beak Consultants Ltd, CanGuard Consulting Ltd, and Associated Engineering Services Ltd, “Field Evaluation of Super Seahawk and MARCO Class V Oil Skimmers,” EPS-4-EC-78-2, May 1978. (Tests were performed in Aug. 1977.)


APPENDIX B—REFERENCES

TEST DATA FROM INTERNATIONAL OIL SPILL CONFERENCES


TEST DATA FROM AMOP CONFERENCES

(Conference Proceedings Reviewed 1980 through 1996)


CANADIAN COAST GUARD TESTS


Sixteenth Arctic Marine Oilspill Program (AMOP) Technical Seminar, 7-9 June 1993, Calgary, Alberta.  


TESTS PERFORMED BY OTHER AGENCIES AND INDUSTRY


ANOTATED BIBLIOGRAPHY

OHMSETT TESTS


Program Note

• Lockheed High Seas Oil Recovery System (HSORS) (Trade name “Cleansweep”)—This very large disc skimmer tested extremely well in thick accumulations of oil, however, was less successful in the field. It was in the Coast Guard inventory at one time, and although there still may be units stored in some locations, it is probably not used. The Cleansweep differs from other disc skimmers in that it has narrow vanes across the discs. Since no other disc skimmer’s have this configuration, it is not possible to compare the performance of this unit with any of the conventional disc skimmer. Because it is an old device, long out of production, probably not in use, and because of the differences in configuration, it does not justify a detailed analysis of test results.

• Ocean Systems Inc. (OSI) Weir-Basin Skimmer—This device is described as consisting of “a series of floating weirs connected by flexible basin material,” probably meaning a containment boom. The report further says that the system has a primary weir which allows oil to flow into the recovery basin, then over a secondary weir and pumped to storage. The report does not show a sketch of this process so it is difficult to compare its operation to other types of weirs. One set of data are available showing high recovery rates but generally low recovery efficiencies. Because this appears to be a prototype device that is not described in detail or produced commercially, these data are not used for analysis.


Program Note

Tests were designed to determine the optimum skimmer settings for recovery and performance based on skimming speed. Performance is noted in terms of Throughout Efficiency. Recovery Efficiency is not noted, probably because the skimmer acts as a simple oil/water separator. Although these tests are old and more recent tests of the DIP skimmer are available, these results will be noted because the USN DIP 3001 is probably still in service in many locations.

(O-3) McCracken, W. E., “Performance Testing of Selected Inland Oil Spill Control Equipment,” EPA-600/2-77-150, Aug. 1977. (Tests were performed in 1975.)

Program Note

Containment Booms—This test series examined the performance of eight containment booms and eight stationary skimmers. Containment booms tested include Clean Water Inc. Harbor Oil Containment Boom, Coastal Services Coastal Oil Boom, Acme Products OK Corral Containment Boom, B. F. Goodrich 18 PFX Permafloat Sea Boom, SLICKBAR Mark VI-A Boom, Kepner Plastics Sea Curtain, PACE Oil Boom, and Whittaker Expandi-Boom. Some versions of these models are still produced. Information about these products is not a part of the skimmers analysis. Skimmers tested include the following:

• SLICKBAR skimmers including the Rigid Manta Ray, Flexible Manta Ray, and Aluminum Skimmer—Each of these tests include only two or three data points.

• Acme Floating Saucer SK-397—Four data points.

• BP Komara Mini Skimmer—Four data points.

• Coastal Services Skup—Ten runs covering two pumps; four with one pump and six with the other.

• Swiss OELA III—Five data points with two pumps.

(O-4) McCracken, W. E. and Schwartz, S. H., “Performance Testing of Spill Control Devices on Floatable Hazardous Materials,” EPA-600/2-77-222. (Tests were performed in 1975.)
Program Note

This report contains results of tests on several skimmers plus other systems:

- **Containment Booms**—U.S. Coast Guard High Seas Barrier, Clean Water Inc. Harbor Oil Containment Boom, and B. F. Goodrich Sea Products 18 PFX Seaboom. None of these products are still available. This information would be interesting to a booms study but is not required for the skimmer analysis.

- **Sorbent System**—This system broadcasts polyurethane cubes onto the surface of the slick, and a conveyor belt device harvests them when saturated with oil. This system is not considered with skimmer analysis.

- **Advancing Skimmers**—DIP-1002 submersion moving plane skimmer. This is a small unit that would presently be considered as a VOSS system.

- **Stationary Skimmers**—Four stationary skimmers were tested.

**SLICKBAR Rigid Manta Ray**—This is a suction skimmer. The Manta Ray is a flat skimming head that is attached to a vacuum hose.

**Swiss OELA III**—This is a floating, circular, adjustable weir skimmer. Although this is a very old model, these skimmers are still in use and probably still produced.

**ORS Skimmer**—This is a weir with a rotation collar that directs the surface oil down into the weir section of the skimmer and into a simple separator in an oil/water collection well. The ORS was a prototype design that was never produced commercially and, therefore, these data are not used for analysis.

**Oil Mop Stationary Rope Mop**—A limited amount of data are available describing the performance of the rope mop skimmer.

(O-5) Breslin, M. K., "Performance Testing of Oil Mop Zero Relative Velocity Oil Skimmer," EPA-600/7-78-060, April 1978. (Tests were performed in 1976.)

Program Note

An early, prototype test of the rope mop ZRV.

(O-6) Smith, G. F. and McCracken, W. E. "OHMSETT 'High Seas' Performance Testing: MARCO Class V Oil Skimmer," EPA-600/2-78-093, May 1978. (Tests were performed in 1976.)

Program Note

This earlier test of the sorbent lifting belt skimmer is less detailed than the test performed in 1977.

(O-7) Lichte, H. W. and Breslin, M. K., "Performance Testing of Three Offshore Skimming Devices," EPA-600/7-78-082, May 1978. (Tests were performed in 1977.)

Program Note

- **Cyclonet 100**—This is a larger version of the Cyclonet 050 vortex skimmer also tested in 1977. Vortex skimmers are not included in the analysis.

- **MARCO Class V Oil Skimmer**—This sorbent lifting belt skimmer has been produced in great quantities and this model, or variations, and in general use today. Although this report is old, it is helpful in evaluating the performance of this skimmer type.

- **U.S. Coast Guard Skimming Barrier**—This weir boom skimmer has not been produced for many years but is still in the inventory and used in some areas.


Program Note

- **Oil Mop ZRV Skimmer**—This is a self-propelled rope mop skimmer that deploys a set of ropes between catamaran hulls. The mops are rotated aft at about the same speed as the forward speed of the vessel so the velocity of the ropes relative to the oiled surface is close to zero. The test report shows detailed numerical results.

- **Cyclonet 050**—This vortex skimmer is produced in France and not widely used in the United States and, therefore, data are not included in the analysis.

- **Clowsor Skimmer**—This conventional paddle belt skimmer manufactured by Anti Pollution Inc. is still produced and used.

- **Bennett Mark 6E**—This is a sorbent submersion belt skimmer. Since it has not been produced for many years, this data is not used for analysis.


Program Note

- **SIRENE Boom Skimmer**—Data covers performance in heavy and medium oil.

- **ZRV Oil Mop Skimmer**—Tests were designed to determine design and performance criteria for a small, remotely operated ZRV type rope mop skimmer to be used in arctic ice conditions.

- **TROIL/DESTROIL Weir Skimmers**—Tests provide good data on the performance of these early versions of hopper weir skimmers.

- **Bennett (Versatile) Arctic Skimmer**—Test data showing the performance of a sorbent submersion belt skimmer. This skimmer is no longer in production and, therefore, these data are not used for analysis.


Program Note

- **Scoop Skimmer**—This device, produced by Offshore Devices, is a boom skimmer with four weir skimming struts. Although this device has not been produced for many years, there could be a few still in service.
• Oil Mop Inc. VOSS—This rope mop skimmer was designed to be used abeam on a vessel-of-opportunity, specifically an oil industry offshore supply vessel. The main mop engine would be located aft. From there the mop would be guided forward along the side of the vessel to an idler pulley and thence outboard along a jib to a forward lead engine, then back to the aft mop engine where the oil would be removed by a wringer. The test configuration consisted of a skimmer as the lead engine and a second trailing skimmer engine with a single idler pulley to extend the mop across the test tank. Several other mop configurations were also used. It is shown to be both a stationary and an advancing rope mop skimmer, but it is basically a stationary type.

• Framo ACW-402—This skimmer combines an overflow weir with rotating discs. It was designed for high volume recovery in thick slicks held inside containment barriers. If the slick is thick enough, recovery rate is only limited by pumping rate. The skimmer is a large, heavy device with an enclosed control cab with levers for controlling skimmer operations. A control arm containing hydraulic lines and a 15 cm (6 in.) diameter oil transfer tube is attached to a floating skimmer head consisting of rotating discs, an overflow weir, and a submerged centrifugal pump. This skimmer has been out of production for many years and, therefore, these data are not used for analysis.

• Water Jet Boom-to-Skimmer Transition System—Water jet devices were mounted on a conventional containment boom deployed in a V configuration with a skimmer. The object was to reduce the width of the slick going to the skimmer. Performance results show the percent reduction of slick width. The performance of the skimmer is not noted. This test would be helpful to a R&D effort to evaluate the effectiveness of water jets, but it will not be useful in evaluating skimmers.

Program Note

Test data on vacuum and air conveyor systems.


Program Note

This provides the only data available on this type of induced flow weir skimmer.


Program Note

• Global Oil Recovery Skimmer (GORS)—This weir skimmer is installed on a dedicated barge. The skimmer has a holding chamber maintained at slightly less than atmospheric pressure to draw oil over the weir. A baffled chamber serves as a simple gravity oil/water separator. Water is continuously pumped overboard and oil is pumped to storage. The GORS used in the tests was a modified version of a model tested earlier. In all cases the modified skimmer performance was not as good as the original version. Buoyancy problems in the weir made it difficult to keep the inlet in a position to receive the incoming oil/water mixture. The report concludes that test problems were minor and could be corrected easily. Further, that the concept showed potential for success. There is no evidence that the system was modified as a result of these tests or that it was ever available commercially. These tests are not used for skimmer analysis.

• Hydrovac Veegarm—This is a sweeping arm weir skimmer that consists of a fixed sweeping boom with a built-in weir and pump. It is a large, heavy system designed for use with a suction dredge or other large support vessel or barge. Although the Hydrovac corporation is no longer in business, the device is available from other sources in its tested form. This report shows test results in graphs, so some data are approximate; however, general results and trends are clear based on the graphs.

• Kebab 600—This is the smallest version of the Vikoma disc skimmers. Although this particular model is no longer offered, the data are significant for the use of this type of skimmer.

• Wylie Skimmer—This was a hobbyists device constructed with spare parts. Tests showed that the device had no potential as a successful oil skimmer. Results of these tests are not used.

• Skim-Pak Cluster—This device uses six Douglas Engineering SKIM-PAK weir skimmers manifolded together in a cluster. These devices were tested singly earlier.


Program Note

Additional test data describing performance of the ZRV type rope mop in ice.


Program Note

Report describes performance of a small, rope mop device mounted on catamaran hulled platform. This skimmer is in general use in the U.S. Navy.


Program Note

The RST is an self-propelled advancing weir skimmer with two collecting arms extending from the sides of the skimmer, one weir at the end of each arm, and two gravity oil/water separation systems, one operating with each weir. The test is
more of a description of the performance of the separators than the weirs, however, test results describe the performance of this advancing weir system. (Tests were performed in Oct. 1992.)


Program Note
The LORI Stiff-Brush oil recovery system is based on recirculating continuous brush chains. The LSC-2 side-collector has two of these brush chains and a hydraulic drive unit that is fitted to the side of a workboat. A diversion boom directs the spilled oil into the skimming unit. Detailed report on the chain brush skimming system.


Program Note
Basically a boom test but at least two skimmers are also involved. Data are not complete or well identified. These data are not used for analysis.


Program Note
This report presents test data on an early version of the fixed submersion plane skimmer.

ENVIRONMENT CANADA TESTS

Any tests that have an Environment Canada report number are considered to be Environment Canada tests. Reports are listed in order of report date, not the year in which the tests were performed. If the report is not dated, the reference is listed according to the year in which the test was performed.

(E-1) Solsberg, L. B., Ross, C. W., Logan, W. J., and Fingas, M. F., “Field Evaluation of Seven Oil Spill Recovery Devices,” EPS 4-EC-76-3, Aug. 1976. (Tests of the Lockheed Clean Sweep were performed in 1973; the DIP 2001, Oil Mop Mark II-9D, SLURP, and RBH Slicklicker, Mark II were performed between Dec. 1974 and April 1975; the Bennett Mark IV and the OSCAR were tested in July 1975.)

Program Note
This is an early report on a number of devices that were tested in more detail later:

- **JBF DIP 2001**—Data on an early version of a submersion moving plane skimmer.

- **Oil Mop Mark II-9D**—Data for a typical stationary rope mop skimmer. This device has probably not changed much to date.
- **SLURP**—Test of a hydroadjustable weir skimmer.
- **RBH Cybernetics Slicklicker, Mark II**—This sorbent lifting belt skimmer was not produced commercially and is not in use now. Data are not used for analysis.
- **Lockheed Clean Sweep R2002**—This large disc skimmer is different from others in that it has a set of vanes around the perimeter of the discs. This skimmer is no longer produced or used and therefore is not evaluated here.
- **Bennett Mark IV Skimmer**—This sorbent submersion belt skimmer has not been produced for many years and, therefore, these data are not used for analysis.
- **OSCAR Double Drum Skimmer**—This was simply a demonstration in which the test data were taken.


Program Note
This stationary rope mop skimmer was tested with a pre-heat unit to determine performance in highly viscous oils such as Bunker C. The tests showed that the pre-heater did not affect recovery ability but did permit recovery of the heavier oils.


Program Note
Details of skimmers tested follow:

- **Bennett Mark IV**—This sorbent submersion belt skimmer has not been produced for many years and, therefore, these data were not used for analysis.
- **Alsthom Cyclonet 050**—General results of tests of a vortex skimmer are not included in the analysis.
- **MacMillan-Bloedel OS-48-W**—This upward sloping weir skimmer has baffles in its collection area to create a calm area that acts as a simple oil/water separator. The bottom is open so that water can freely flow away. Oil flows from the baffled section over another weir to a trough and is pumped away. There were problems in using this skimmer, and, since there is no evidence that it was ever produced or used, these data are not used for analysis.
- **Bennett Sea Hawk**—This sloping weir skimmer acts more as an in situ oil/water separator than a skimmer. It can be used as a separator with another skimmer. Because of the nature of the device, it is not included in the analysis as a skimmer.
- **Pedco Weir Skimmer**—A hydroadjustable weir in which a trough (sump) is trimmed according to the liquid level inside. As product is pumped out, the trough angle changes to dip more oil, raising the liquid level. This unique weir type skimmer had many problems; therefore, results are not used in analysis.
- **JBF DIP 1001**—This is another, smaller, version of a submersion moving plane skimmer.
- **OELA III Weir**—This is a standard weir skimmer that has been used for a period of many years.
- **Komara Mini-Skimmer**—This small disc skimmer is no longer produced. Only graphical data are shown in the report—no data sheets.
**Program Note**

Good performance data were collected for the MARCO sorbent lifting belt skimmer. Because of problems, data for the Super Seahawk were not collected.


**Program Note**

The following devices were tested:

- **Olsen Oil Reclaimer**—A weir skimmer that had problems in tests and was not produced.
- **Acme Mini Floating Saucer**—A simple weir skimmer.
- **Oil Recovery Systems Scavenger**—Weir skimmer designed for groundwater oil recovery; this will not be used along with other weir skimmers.
- **Alstom Cyclonet S050**—Additional test data on the vortex skimmer.
- **Manta Ray Aluminum Skimmer**—Although this is named as a weir skimmer, it is more properly a suction skimmer and is grouped for analysis with these devices.
- **Manta Ray Flexible Skimmer**—Similar to the aluminum manta ray but fabricated of rubber.
- **Morris 3-Square Skimmer**—Data describe a typical flat disc skimmer.
- **Acme FS400SK 5IT**—A double weir skimmer designed to collect light oil.


**Program Note**

A series of laboratory trials were conducted in the test tank of Arctic Canada Ltd in Kanata, Ontario. Field trials were performed in Annapolis, Maryland. Two pumps were tested, the Roper Rotary Pump and Komline-Sanderson Dualdisc Diaphragm Pump. The pump tests are not pertinent to the skimmer analysis.

Skimmers tested include the following:

- **Morris MI-30 and MI-2**—More than thirty data points are available for each of these disc skimmers.
- **Oil Mop**—This small (4 by 2 ft) remotely controlled catamaran-hull ZRV type skimmer was used in a stationary mode and maneuvering. Since tests were performed in a tank, there was not much room to use a straight ahead velocity, so the unit was maneuvered in figure 8 loops or pivoted in place in a circle. Performance was better maneuvering than straight ahead, but because of problems with the umbilical control cable, maneuvering was difficult. Tests of this prototype skimmer were successful and paved the way for further tests of larger and improved devices. These tests are not used for an analysis of performance because the device was a preliminary design; however, performance analysis of two follow on devices is presented along with ZRV Skimmers.
- **LPI Skimmer**—This fixed submersion plane skimmer was tested in an indoor test tank; however, it was determined that the tank was too small to adequately test the skimmer so these results are not helpful in the skimmer analysis.
- **Scoop Skimmer**—The tests described in this report were conducted in two phases; sea keeping tests performed in Annapolis and oil recovery tests performed in a basin in Ontario. The basin tests only record stationary skimmer pumping rates and, therefore, are not used for analysis.


**Program Note**

Five mechanical oil recovery devices and six oil containment booms were evaluated in the vicinity of St. John's, Newfoundland, during March and April of 1980. Testing was conducted in a refinery settling pond, in St. John's Harbor, and in the coastal waters just beyond the harbor entrance. One skimmer was tested in Mulgrave, Nova Scotia, and one of the booms was tested later at OHMSETT. The project was designed to determine the performance of booms and skimmers designed for cold weather and Arctic operations. Containment boom tested included the U.S. Coast Guard boom (B. F. Goodrich), Trollboom (Trelleborg AB), Albany Olifence, Zoom Boom (Versatech Products), Arctic Marine Oilspill Program (AMOP) Boom (McAllister Engineering), and Vikoma Seapack. None of the data on booms will be required for the skimmers analysis.

Skimmers tested include the following:

- **Little Giant**—This submersion paddle belt skimmer is designed to recover Bunker C fuel and other highly viscous
products. It is a modification of a commercially available farm conveyor and uses moving blades to push oil up an inclined tray. Although this device was never produced commercially as an oil spill recovery skimmer, the test results provide insight into likely performance of submersion paddle belt skimmers.

- **DESTROIL**—This is an early version of the "hopper" weir skimmer with an archimedean screw pump, presently called a weir skimmer with an integral pump by ASTM.
- **Slicklicker**—This unit resembles the sorbent lifting belt skimmer except the belt is fabric and not sorbent. (Sorbent lifting belts are often rigged in this way to recover highly viscous oil and sorption is not a factor.) The report provides data on four test runs.
- **SKIM-PAK**—This device is a small, hydroadjustable weir skimmer. "Hydroadjustable" means that the weir lip is hinged so that as pumping rate is increased, it is depressed by the flow and permits more fluid to enter the skimming head. Seven data points are available.
- **Morris MI-80**—This device is a self propelled, double hulled skimmer that combines a hydroadjustable weir that collects the oil and a double row of discs that pick it up. The MI-80 was an experimental device that did not work well in tests and apparently has not been produced. There is no new information on disc skimmer performance.
- **Arctic Skimmer**—This sorbent lifting belt skimmer was designed for use in viscous oil and cold weather conditions. It was to be tested in oil offshore, but because of weather problems and difficulty keeping the test oil in the containment boom, oil recovery tests were not performed. Tests only report on the skimmer's sea keeping and handling characteristics. Because of the test problems and because this skimmer has not been produced for many years, these data were not used for analysis.


**Program Note**

This test program studies the extent to which the performance of particular oil skimmer principles is affected by varying oil viscosity of both nonemulsified and emulsified oils. Data developed in these tests are excellent and will be used for skimmer analysis. The skimmers used in testing include the following:

- **MARCO sidewinder 12 in. filterbelt skimmer.**
- **LORI side collector chain brush skimmer.**
- **Morris MI-30 disc skimmer.**
- **Elastec TDS-118 drum skimmer.**
- **Containment systems VMW-61 suspended rope mop skimmer.**
- **Douglas Engineering SKIM-PAK 18 500 weir skimmer.**


**Program Note**

The skimmer tested was a 1:5 scale of a prototype being operated in Norway. This device is an induced flow weir skimmer using a "snail-house" induction system and an integrated oil/water separator. It uses a planar water jet induction system, called a "snail-house" because of its shape, to draw in the floating oil from the surface of the water. This is a prototype skimmer so data have not been used for analysis.

**CANADIAN COAST GUARD TESTS**


**Program Note**

A series of four offshore skimmers were tested in a large, outdoor wave basin during the fall of 1988. Each skimmer was tested in three oils: IPL Sweet, a conventional crude oil; Terra Nova C-09, a waxy crude oil from the Grand Banks and Bunker C. Tests were very complete and well documented—good information for skimmer analysis. Skimmers tested include:

- **Framo ACW-400 disc/weir**—Skimmer has been out of production for many years and therefore data are not used for analysis.
- **GT-185 weir.**
- **Walosep W-2 weir vortex.**
- **Heavy oil skimmer**—A double, counter-rotating drum. This skimmer did not recover any oil until the skimming enhancer Elastol was added. Test of this double-drum was not successful, and since it has not been produced commercially, results are not used for analysis.


**Program Note**

This is one of the most significant sets of test data available and is a primary source of disc skimmer analysis. Skimmers tested include the following:

- **Morris MI-30 disc.**
- **Ro-disc 15.**
- **Vikoma Komara 30K disc.**
- **Vikoma sea devil heavy oil skimmer (Star Disc skimmer).**
- **Vikoma T-disc skimmer.**
- **Foilex mini skimmer (weir) (no performance data).**
- **Pharos marine harbour mate mini skimmer (weir).**
TEST DATA FROM INTERNATIONAL OIL SPILL CONFERENCES


Program Note
Tests of the SOCK VOSS skimmer designed by Shell Oil Company. This is a covered boom skimmer, probably with a weir at the end. Only five data points with recovery rate, recovery efficiency, and throughput efficiency. This skimmer is no longer available, therefore these data are not used for analysis.


Program Note
This paper describes an early version of the Vikoma boom skimmer. Data cover an at sea test at the IXTOC I blowout in the Gulf of Mexico.


Program Note
This paper reports on the analysis described in a final OHMSETT Report listed as reference O-11. Reference O-11 is, therefore, used for analysis.


Program Note
Tests of the SIRENE 20 boom skimmer, the ESCA weir skimmer, and the STOPOL 3P dual drum skimmer. Only a few data points are available, but these could be used to compare to other test data.


Program Note
This small remotely controlled ZRV type skimmer was also tested earlier by Environment Canada and at OHMSETT. (See Refs E-7 and O-9) The results of this test and a Phase II Test (O-14) are included in the ZRV skimmer analysis.


Program Note
This study investigates the effectiveness of various disc types; T-disc, ribbed disc, T-disc with rim scoop, and plain disc with rim scoop. Results of tests are shown graphically. Excellent analysis of the performance of a single disc.

TEST DATA FROM AMOP CONFERENCES

(Conference Proceedings Reviewed 1980 through 1996)


Program Note
This paper describes tests of the BP (later Vikoma) prototype weir boom. There is a table showing the results of eight test runs.


Program Note
Some data on the FRAMO disc weir system. Since this skimmer has not been produced for many years and is not in general use, these tests are not used for analysis.


Program Note
Tests performed with a disc and rope mop skimmer. About seven data points shown for each.


Program Note
This study investigates the effectiveness of various disc types; T-disc, ribbed disc, T-disc with rim scoop, and plain disc with rim scoop. Results of tests are shown graphically. Excellent analysis of the performance of a single disc.

Program Note
This paper reports on tests of a suspended rope mop skimmer in ice, performed at the Tesoro Refinery near Kenai, Alaska in Dec. 1991.


Program Note
This paper presents excellent test data on the chain brush skimmer system.


Program Note
This paper describes the adhesion of oil to different materials. Although it is not a test of skimmers, this information could be used for background performance information for disc and drum skimmers.


Program Note
This paper mentions tests of a weir vortex skimmer and a disc skimmer, but provides a minimum of details. Background for these skimmers.


Program Note
Tests were performed evaluating the performance of a disc skimmer in oil treated with "low efficiency" dispersants. Data show that the performance in these treated products is not changed. Although these data do not make a major contribution to the analysis, they answer a specific question that is helpful.

TESTS PERFORMED BY OTHER AGENCIES AND INDUSTRY


Program Note
Tests were performed using the Lockheed Clean Sweep disc skimmer, MARCO sorbent lifting belt, and JBF submersion moving plane. More elementary tests were performed using a rope mop skimmer and a weir skimmer. Although some data are available, these will not be directly comparable to other tests because these tests evaluated effectiveness in broken ice fields.


Program Note
This report covers skimmers that already have been subject of many tests; therefore, it was not used for analysis.


Program Note
Test data on the stationary rope mop skimmer.


Program Note
Tests were performed on a dual-drum skimmer in a test basin in a variety of waves, currents, and slick thicknesses. Data report oil recovery rate but not recovery efficiency.

REFERENCES ACCORDING TO SKIMMER TYPE

BOOM SKIMMERS

(O-7) Lichte, H. W. and Breslin, M. K., “Performance Testing of Three Offshore Skimming Devices,” EPA-600/7-78-082, May 1978. (Tests were performed in 1977.)

Program Note
U.S. Coast Guard Skimming Barrier—This weir boom skimmer has not been produced for many years but is still in the inventory and used in some areas.

(O-9) Lichte, H. W., Breslin, M. K., Smith, G. F., Graham, D. J., and Urban, R. W., "Performance Testing of Four Skim-
OIL SPILL RESPONSE PERFORMANCE REVIEW OF SKIMMERS

Program Note

Sirene Boom Skimmer—Data cover performance in heavy and medium oil.

Program Note

Scoop Skimmer—This device, produced by Offshore Devices, is a boom skimmer with four weir skimming struts. Although this device has not been produced for many years, there could be a few still in service.

Program Note

Scoop Skimmer—The tests described in this report were conducted in two phases; sea keeping tests performed in Annapolis and oil recovery tests performed in a basin in Ontario. The basin tests only record stationary skimmer pumping rates and therefore are not used for analysis.

Program Note

This paper describes an early version of the Vikoma boom skimmer. Data cover an at sea test at the IXTOC I blowout in the Gulf of Mexico.

Program Note

Tests of the Sirene 20 boom skimmer. Only a few data points are available, but these can be used to compare to other test data.

Program Note

This paper describes tests of the BP (later Vikoma) prototype weir boom. There is a table showing the results of eight test runs.

BRUSH SKIMMERS

These devices consist of drum brush skimmers and chain brush skimmers.

Program Note

Detailed report on the chain brush skimming system.

Program Note

This test program studies the extent to which the performance of particular oil skimmer principles is affected by varying oil viscosity of both nonemulsified and emulsified oils. The LORI Side Collector chain brush skimmer was tested.

Program Note

This paper presents test data on the chain brush skimmer system.

DISC SKIMMERS

Program Note

Framo ACW-402—This skimmer combines an overflow weir with rotating discs. Test results show performance of both combined weir and disc operation plus performance of the discs alone in thinner slicks. Since this skimmer has not been produced in many years, these data are not included in the analysis.

Program Note
Kebab 600—This is the smallest version of the Vikoma disc skimmers. Although this particular model is no longer offered, the data are significant for the use of this type of skimmer.


Program Note
Komara Mini Skimmer—This small disc skimmer is no longer produced. Only graphical analysis is shown in the report, no data sheets.


Program Note
Morris 3-Square Skimmer—Data describe a typical flat disc skimmer.


Program Note
Morris MI-30 and MI-2—More than thirty data points are available for each of these disc skimmers.


Program Note
Morris MI-30 Disc Skimmer—This test program studies the extent to which the performance of oil skimmers is affected by varying oil viscosity of both nonemulsified and emulsified oils.


Program Note
A series of four offshore skimmers were tested in a large, outdoor wave basin during the fall of 1988. The Framo ACW-400 disc/weir was tested. Since this skimmer has not been produced for many years and is not in general use, these tests are not used for analysis.


Program Note
A significant sets of test data available and is a primary source of disc skimmer analysis.

Morris MI-30 disc.
Ro-Disc 15.
Vikoma Komara 30K disc.
Vikoma sea devil heavy oil skimmer (Star Disc skimmer). Vikoma T-disc skimmer.

(S-6) Christodoulou, M. S. and Turner, J. T., "Experimental Study and Improvement of the Rotating Disc Skimmer," Proceedings of the 1987 Oil Spill Conference, 6–9 April 1987, Baltimore, Maryland.

Program Note
This study investigates the effectiveness of various disc types; T-disc, ribbed disc, T-disc with rim scoop, and plain disc with rim scoop. Results of tests are shown graphically. Excellent analysis of the performance of a single disc.


Program Note
Some data on the FRAMO disc weir system. Since this skimmer has not been produced for many years and is not in general use, these tests are not used for analysis.


Program Note
Seven data points describe disc skimmer performance.


Program Note
This paper describes the adhesion of oil to different materials, some of which may be used for skimmer discs.

Program Note
Background material on a disc skimmer performance.


Program Note
Tests were performed evaluating the performance of a disc skimmer in oil treated with "low efficiency" dispersants.


Program Note
Tests were performed using the Lockheed Clean Sweep disc skimmer. Although some data are available, these are not directly comparable to other tests because these tests evaluated effectiveness in broken ice fields. The Lockheed Clean Sweep is no longer produced or used.

DRUM SKIMMERS


Program Note
A double drum skimmer that could be used with drums rotating inward or outward, but drums are not positioned close together to produce pumping action. Oil adheres to the drums, is scraped off into a sump and stored or pumped away. The manufacturer claims that the speed of the drums and the distance between them can serve to pump the oil off the surface as well as recover it by adhering to the drums. This study did not find any pumping action to occur, but there are many data points and the analysis is excellent. This skimmer was not produced for many years, but it is again active and there are some more recent test data on a more recent system.


Program Note
This test program studies the extent to which the performance of particular oil skimmer principles is affected by varying oil viscosity of both nonemulsified and emulsified oils. The ELASTEC TDS-118 Drum Skimmer was tested.


Program Note
Heavy Oil Skimmer—A double, counter-rotating drum. Test of this double-drum was not successful, and since it has not been produced commercially, results are not used for analysis.


Program Note
Tests of the STOPOL 3P dual drum skimmer. Only a few data points are available.

(PADDLE BELT SKIMMERS)


Program Note
Tests on a dual-drum skimmer in a test basin in a variety of waves, currents, and slick thicknesses. Data report Oil Recovery Rate but not Recovery Efficiency.

Clowsor Skimmer—This conventional paddle belt skimmer manufactured by Anti Pollution Inc. is still produced and used.

Program Note

Little Giant—Designed for Bunker C fuel and other highly viscous products.

STATIONARY ROPE MOP SKIMMERS

(O-4) McCracken, W. E. and Schwartz, S. H., "Performance Testing of Spill Control Devices on Floatable Hazardous Materials," EPA-600/2-77-222. (Tests were performed in 1975.)

Program Note

Oil Mop Stationary Rope Mop—A limited amount of data are available describing the performance of the rope mop skimmer.


Program Note

Oil Mop Inc. VOSS—This rope mop skimmer was designed to be used abeam on a vessel-of-opportunity, specifically an oil industry offshore supply vessel. It is shown to be both a stationary and an advancing rope mop skimmer, but it is basically a stationary type.


Program Note

Report describes performance of a small, rope mop device mounted on catamaran hulled platform. This skimmer is in general use in the U.S. Navy.

(E-1) Solsberg, L. B., Ross, C. W., Logan, W. J., and Fingas, M. F., "Field Evaluation of Seven Oil Spill Recovery Devices," EPS 4-EC-76-3, Aug. 1976. (Tests of the Lockheed Clean Sweep were performed in 1973; the DIP 2001, Oil Mop Mark II-9D, SLURP, and RBH Slicklicker, Mark II were performed between Dec. 1974 and April 1975; the Bennett Mark IV and the OSCAR were tested in July 1975.)

Program Note

Oil Mop Mark II-9D—Data for a typical stationary rope mop skimmer.


Program Note

This stationary rope mop skimmer was tested with a preheat unit to determine performance in highly viscous oils such as Bunker C. The tests showed that the pre-heater did not affect recovery ability but did permit recovery of the heavier oils.


Program Note

Oil Mop—This small (4 by 2 ft) remotely controlled catamaran-hull ZRV type skimmer was used in a stationary mode and maneuvering. Since tests were performed in a tank, there was not much room to use a straight ahead velocity, so the unit was maneuvered in figure 8 loops or pivoted in place in a circle. Performance was better maneuvering than straight ahead, but because of problems with the umbilical control cable, maneuvering was difficult. Tests of this prototype skimmer were successful and paved the way for further tests of larger and improved devices. These tests are not used for an analysis of performance because the device was a preliminary design; however, performance analysis of two follow on devices is presented along with ZRV Skimmers.


Program Note

A brief report with some data points.


Program Note

Test data on the stationary rope mop skimmer.


Program Note

About seven data points shown for a rope mop skimmer.


Program Note

Elementary tests were performed using a rope mop skimmer. Although data are available, these are not directly comparable to other tests because these tests evaluated effectiveness in broken ice fields.
SUSPENDED ROPE MOP SKIMMERS


Program Note
This test program studies the extent to which the performance of particular oil skimmer principles is affected by varying oil viscosity of both nonemulsified and emulsified oils. Tests report performance of Containment Systems VMW-61 Suspended Rope Mop Skimmer.


Program Note

ZERO RELATIVE VELOCITY SKIMMERS
(ROPE MOP)

(O-5) Breslin, M. K., "Performance Testing of Oil Mop Zero Relative Velocity Oil Skimmer," EPA-600/7-78-060, April 1978. (Tests were performed in 1976.)

Program Note
An early, prototype test of the rope mop ZRV.

(O-7) Urban, R. W., Graham, D. J., and Schwartz, S. H., "Performance Tests of Four Selected Oil Spill Skimmers," EPA-600/2-78-204, Sept. 1978. (Tests were performed in 1977.)

Program Note
Oil Mop ZRV Skimmer—This is a self-propelled rope mop skimmer that deploys a set of ropes between catamaran hulls. The test report shows detailed numerical results.


Program Note
Oil Mop ZRV Skimmer—Tests were designed to determine design and performance criteria for a small, remotely operated ZRV type rope mop skimmer to be used in arctic ice conditions.


Program Note
This small remotely controlled ZRV type skimmer was also tested earlier by Environment Canada and at OHMSETT. (See Refs E-7 and O-9.)


Program Note
Additional test data describing performance of the ZRV type rope mop in ice.

SORBENT LIFTING BELT SKIMMERS

(O-6) Smith, G. F. and McCracken, W. E., “OHMSETT 'High Seas' Performance Testing: MARCO Class V Oil Skimmer,” EPA-600/2-78-093, May 1978. (Tests were performed in 1976.)

Program Note
This early test of the sorbent lifting belt skimmer is less detailed than the test performed in 1977.

(O-7) Lichte, H. W. and Breslin, M. K., "Performance Testing of Three Offshore Skimming Devices," EPA-600/7-78-082, May 1978. (Tests were performed in 1977.)

Program Note
MARCO Class V Oil Skimmer—This sorbent lifting belt skimmer has been produced in great quantities and this model, or variations, and in general use today.

(E-4) Beak Consultants Ltd, CanGuard Consulting Ltd, and Associated Engineering Services Ltd, "Field Evaluation of Super Seahawk and MARCO Class V Oil Skimmers," EPS-4-EC-78-2, May 1978. (Tests were performed in Aug. 1977.)

Program Note
Good performance data were collected for the MARCO sorbent lifting belt skimmer. Because of problems, data for the Super Seahawk were not collected.


Program Note
Slicklicker—This unit resembles the sorbent lifting belt skimmer except the belt is fabric and not sorbent. (Sorbent lifting
APPENDIX B—REFERENCES

belts are often rigged in this way to recover highly viscous oil and sorption is not a factor.) The report provides data on four test runs.


Program Note
Test program studies the extent to which the performance of particular oil skimmer principles is affected by varying oil viscosity of both nonemulsified and emulsified oils. (MARCO Sidewinder 12 in. Filterbelt Skimmer.)


Program Note
Tests were performed using the MARCO sorbent lifting belt. Although good data are available, these will not be directly comparable to other tests because these tests evaluated effectiveness in broken ice fields.

FIXED SUBMERSION PLANE SKIMMERS


Program Note
LPI Skimmer—This fixed submersion plane skimmer was tested in an indoor test tank; however, it was determined that the tank was too small to adequately test the skimmer.


Program Note
This report presents test data on an early version of the fixed submersion plane skimmer.

SUBMERSION MOVING PLANE SKIMMERS


Program Note
Tests were designed to determine the optimum skimmer settings for recovery and performance based on skimming speed. Performance is noted in terms of Throughout Efficiency. Recovery Efficiency is not noted, probably because the skimmer acts as a simple oil/water separator.

(O-4) McCracken, W. E. and Schwartz, S. H., "Performance Testing of Spill Control Devices on Floatable Hazardous Materials," EPA-600/2-77-222. (Tests were performed in 1975.)

Program Note
Advancing Skimmers—DIP-1002 submersion moving plane skimmer. This is a small unit that would presently be considered as a VOSS system.


Program Note
Bennett Mark 6E—This is a sorbent submersion belt skimmer. Since it has not been produced for many years, this data was not used for analysis.


Program Note
Bennett (Versatile) Arctic Skimmer—Test data showing the performance of a sorbent submersion belt skimmer. This skimmer is no longer in production and, therefore, these data were not used for analysis.

(E-1) Solsberg, L. B., Ross, C. W., Logan, W. J., and Fingas, M. F., "Field Evaluation of Seven Oil Spill Recovery Devices," EPS 4-EC-76-3, Aug. 1976. (Tests of the Lockheed Clean Sweep were performed in 1973; the DIP 2001, Oil Mop Mark II-9D, SLURF, and RBH Slicklicker, Mark II were performed between Dec. 1974 and April 1975; the Bennett Mark IV and the OSCAR were tested in July 1975.)

Program Note
JBF DIP-2001—Data on an early version of a submersion moving plane skimmer.

Bennett Mark IV—This skimmer is no longer in production and, therefore, these data were not used for analysis.


Program Note
JBF DIP 1001—This is another, smaller, version of a submersion moving plane skimmer.
OIL SPILL RESPONSE PERFORMANCE REVIEW OF SKIMMERS


Program Note
Test data points are limited. The VEP Arctic Skimmer is no longer in production and therefore these data were not used for analysis.


Program Note
Tests were performed using the JBF submersion moving plane. These data are not directly comparable to other tests because these tests evaluated effectiveness in broken ice fields.

SUCTION SKIMMERS

(O-3) McCracken, W. E., "Performance Testing of Selected Inland Oil Spill Control Equipment," EPA-600/2-77-150, Aug. 1977. (Tests were performed in 1975.)

Program Note
SLICKBAR Skimmers Including the Rigid Manta Ray, Flexible Manta Ray, and Aluminum Skimmer—Each of these tests include only two or three data points.

(O-4) McCracken, W. E. and Schwartz, S. H., "Performance Testing of Spill Control Devices on Floatable Hazardous Materials," EPA-600/2-77-222. (Tests were performed in 1975.)

Program Note
SLICKBAR Rigid Manta Ray—The Manta Ray is a flat skimming head that is attached to a vacuum hose.


Program Note
Test data on vacuum and air conveyor systems.


Program Note
SLICKBAR Flexible Manta Ray—Similar to the aluminum manta ray but fabricated of rubber.

WEIR SKIMMERS WITH EXTERNAL PUMPS

(O-3) McCracken, W. E., "Performance Testing of Selected Inland Oil Spill Control Equipment," EPA-600/2-77-150, Aug. 1977. (Tests were performed in 1975.)

Program Note
Acme Floating Saucer SK-39T—Four data points.
Coastal Services SLURP—Ten runs covering two pumps; four with one pump and six with the other.
Swiss OELA III—Five data points with two pumps.

(O-4) McCracken, W. E. and Schwartz, S. H. "Performance Testing of Spill Control Devices on Floatable Hazardous Materials," EPA-600/2-77-222. (Tests were performed in 1975.)

Program Note
Swiss OELA III—Floating, circular, adjustable weir skimmer. Although this is a very old model, these skimmers are still in use and probably still produced.
ORS Skimmer—Weir with a flotation collar that directs the surface oil down into the weir section of the skimmer and into a simple separator in an oil/water collection well. The ORS was a prototype design that was never produced commercially and therefore these data are not used for analysis.


Program Note
SKIM-PAK cluster—This device uses six Douglas Engineering SKIM-PAK weir skimmers manifolded together in a cluster. These devices were tested singly earlier.

(E-1) Solsberg, L. B., Ross, C. W., Logan, W. J., and Fingas, M. F., "Field Evaluation of Seven Oil Spill Recovery Devices," EPS 4-EC-76-3, Aug. 1976. (Tests of the Lockheed Clean Sweep were performed in 1973; the DIP 2001, Oil Mop Mark II-9D, SLURP, and RBH Slicklicker, Mark II were performed between Dec. 1974 and April 1975; the Bennett Mark IV and the OSCAR were tested in July 1975.)

Program Note
SLURP—Test of a hydro adjustable weir skimmer.

Program Note

OEILA III Weir—This is a standard weir skimmer that has been used for a period of many years.


Program Note

Acme Mini Floating Saucer—A simple weir skimmer.
Acme FS400SK 51T—A double weir skimmer designed to collect light oil.


Program Note

SKIM-PAK—Small, hydroadjustable weir skimmer; seven data points.


Program Note

Douglas Engineering SKIM-PAK 18 500 Weir Skimmer.


Program Note

• Foilex mini skimmer (weir) (no performance data).
• Pharos marine harbor mate mini skimmer (weir).


Program Note

ESCA weir skimmer is mounted between catamaran hulls 4 m long and 3 m wide (13 by 10 ft). It is used with a jib and boom collector from a small tanker or other vessel of opportunity. Only one data point is reported for the test of this skimmer, and this is reported to have limited precision because of difficulties emptying the flexible storage tank. These data were not used for analysis.


Program Note

Elementary tests were performed using a weir skimmer. Very limited data are available and not comparable to other tests because these tests evaluated effectiveness in broken ice fields.

WEIR SKIMMERS WITH INTEGRAL PUMPS


Program Note

TROIUDESTROIL Weir Skimmers—Tests provide data on the performance of these early versions of hopper weir skimmers.


Program Note

DESTROIL—This is an early version of the “hopper” weir skimmer with an archimedean screw pump, presently called a weir skimmer with an integral pump by ASTM.


Program Note

GT-185 weir.

INDUCED FLOW WEIR SKIMMERS

This includes two types: weir vortex skimmers, that use a rotor or propeller to draw the oil into the skimming head; and skimmers that use a series of water jets positioned just below the water surface to draw oil into the skimmer.

Program Note

This provides the only data available on this type of induced flow weir skimmer.


Program Note

This device is an induced flow weir skimmer using a "snail-house" induction system and an integrated oil/water separator. This is a prototype skimmer so data are not used in the analysis at this time.


Program Note

Walosep W-2 weir vortex.


Program Note

Tests of a weir vortex skimmer, but provides a very minimum of details. Not used for skimmer analysis.

ADVANCING WEIR SKIMMERS


Program Note

Hydrovac Veegarm—This is a sweeping arm weir skimmer that consists of a fixed sweeping boom with a built-in weir and pump.


Program Note

The RST is an self-propelled advancing weir skimmer with two collecting arms extending from the sides of the skimmer. The test is more of a description of the performance of the separators than the weirs; however, test results describe the performance of this advancing weir system.

VORTEX SKIMMERS

These skimmers are not in general use and therefore these reports were not used for analysis.

(O-7) Lichte, H. W. and Breslin, M. K., "Performance Testing of Three Offshore Skimming Devices," EPA-600/7-78-082, May 1978. (Tests were performed in 1977.)

Program Note

Cyclonet 100—This is a larger version of the Cyclonet 050 vortex skimmer also tested in 1977.


Program Note

Cyclonet 050—This vortex skimmer is produced in France and not widely used in the United States.


Program Note

Alsthom Cyclonet 050—General results of tests of a vortex skimmer.


Program Note

Alsthom Cyclonet S050—Test data on the vortex skimmer.
Appendix C—The OHMSETT Facility (O-16)

The Minerals Management Service of the U.S. Department of the Interior operates the National Oil Spill Responses Test Facility, known as OHMSETT (Oil and Hazardous Materials Simulated Environmental Test Tank), located on the U.S. Naval Weapons Handling Station, Earle, in Leonardo, New Jersey. OHMSETT is used for the testing and development of devices and techniques for the control and cleanup of oil spills. Figure C.1 shows the layout of the facility.

The primary feature of the facility is a pile-supported concrete tank with a water surface 203 m (666 ft) long, 20 m (66 ft) wide, and with a water depth of 2.4 m (8 ft). The tank is filled with brackish water from Sandy Hood Bay, and the water is maintained at a salinity of approximately 17 parts per thousand.

The tank is spanned by three movable carriages. The towing carriage, referred to as the "main bridge," is capable of exerting a force of 151 000 N (34 000 lbs force) while towing floating equipment at speeds up to 3.3 m/s (6.5 knots or 11 ft/s) for at least 40 s; tests of longer duration can be conducted at lower speeds. (At 3 knots, test time is 1 min and 26 s; at 2 knots it is 2 min and 10 s and at 1 knot it is 4 min and 20 s.)

The main bridge is equipped with an oil distribution system capable of laying oil slicks on the surface several meters ahead of the device being tested.

A second carriage, the auxiliary bridge, moves with the main bridge and provides storage for recovered fluids. A removable video bridge (not shown in Fig. C.1) spans the space between the main and auxiliary bridges and provides support for underwater and above-water video cameras.

The third carriage is the vacuum bridge which is stored at the south end of the tank and is used for cleaning the tank bottom; it is not shown in Fig. C.1.

The principal systems of the tank include a flap-type wave generator at the south end and a wave-absorbing beach at the north end which can be lowered to the bottom of the tank to allow waves to reflect from the north wall. The wave generator can produce regular (unidirectional sinusoidal) waves up to 61 cm (2 ft) high and up to 45 m (150 ft) long. With the beach lowered, a confused condition resembling a Harbor Chop can be produced, with heights of 70 cm (2.3 ft).

The basin water is filtered by recirculation through a 270 m³/h (9 500 ft³/h) diatomaceous earth filter system, which produces sufficient water clarity to allow extensive use of underwater video photography to record testing. The main bridge has a built-in oil barrier boom which can be lowered to skim oil to the north end of the tank for cleanup.

Testing at the facility is served from the multilevel control tower building, which houses the bridge and wavemaker controls, the data acquisition system and computer systems, and offices. A 650 m² (7 000 ft²) building adjacent to the tank houses offices, a machine shop, and an equipment preparation area. A separate self-contained chemistry laboratory provides test facilities for analyzing samples of water, oil, and mixtures.

MAR, Inc., the operating contractor, provides a permanent on-site staff of eight, along with a number of additional specialized engineering, scientific, and quality assurance personnel as needed. Chapman, Inc., a subcontractor, provides a permanent staff of four.

![FIG. C.1—The OHMSETT facility.](image-url)
Appendix D—Notes for Preparation of Test Reports

There is a great diversity of test requirements for skimmers and consequently a similar diversity in the way reports of these tests are prepared. There are, however, basic requirements that test reports should fulfill which would be true for any test program. These requirements are likely to be more evident to the researcher using the reports than to the persons writing the report. Based on this assumption, the following comments are offered based on many months of work reviewing 52 reports covering at least two or three times that many skimmers. It is hoped that these comments will be helpful to persons writing test reports and will result in reports that are more functional for the user.

1. Group All Information on a Single Skimmer Together—Many test programs involve the examination of several skimmers. The report of these tests should group all information on a single skimmer in one place. Although the researcher may be interested in the performance of several skimmers, he must gather information on one at a time. Some early test reports begin by listing all skimmers tested, then present a description of each skimmer, followed by test procedures for each skimmer, and so forth. This means that the user must go through several sections of the report, or perhaps even all sections, to gather information on a single skimmer. This can be extremely frustrating and time consuming, with the result that there may be doubt that all the information on a single skimmer has been found.

2. Test Parameters—Each skimmer report should begin with a list of test parameters that are significant to the performance of that skimmer. If some of these parameters are not to be measured in the tests, reasons should be given. For example, the area of the wetted surface for disc skimmers is a significant test parameter that affects performance, but it is rarely reported. If it is not reported, reasons should be given.

3. Skimmer Description—The skimmer tested should be described completely at the beginning of the individual test section, not in an appendix. This description should include the commercial name and model number, size, weight, draft, sweep width, or size of the skimming area, pump type and capacity, plus any other information that would be helpful in understanding how the skimmer works.

4. Report Slick Thickness—Slick thickness is an important performance parameter for the test of any skimmer so it should be reported prominently and clearly. The way in which slick thickness was determined should also be recorded. In static tests, slick thickness is often determined by adding a measured volume of oil to enclosed area. In this case the slick thickness is determined by dividing the volume by the area. Sometimes thickness is measured by taking samples at the oil/water interface, or a continuously reading measuring device may be in place. In all cases it is important to know what the slick thickness was, how it was measured, and the estimated accuracy of the measurement. It is also vitally important to know if the slick thickness was decreasing during the test or if it was maintained constant. This may change the expected performance by a factor of two, three, or even more. In some towed skimmer tests, oil is discharged immediately ahead of the skimmer so slick thickness is not measured. This is an acceptable alternative, but the way in which this process was carried out should be described.

5. Volume of Oil Used in Testing—The volume of oil used in individual tests should be reported to give the user appreciation of the extent of the test and the amount of oil that was available for recovery.

6. Test Time—The amount of time taken in each test cycle is significant but rarely reported. Results of tests run over a period of hours may be more significant than a test that is performed in a few minutes. Test times are typically short, which leaves the question of whether the skimmer achieved a steady state recovery condition and whether the skimmer was performing at near its maximum capacity. Most towed tests of advancing skimmers are very short, even in a large test tank. In these cases test time may be 1 to 3 min, and may be even less. The period of time that the skimmer achieves a steady state skimming condition may be less than a minute. In these cases it is most important that test time be recorded and a remark made to indicate if a steady state skimming rate was established and for what period of time.

7. Graphs—Graphs are useful in visualizing what happened but graphs should not be the only source of data. There are several reasons for this. First, graphs can generally only show two or three test parameters at once. Other important test parameters are left in doubt or are not reported. Second, data taken from graphs are generally only approximate. Actual recorded test data may be much more accurate. Finally, if graphs are used to supplement
data sheets, they should contain enough data so that specific test runs can be identified.

8. **Data Sheets**—Usually data are arranged according to test oil viscosity, but within that category, data should be arranged according to some other controlling test parameter, such as tow speed, slick thickness or other controlling parameter, not the order in which the tests were performed. Most test reports record data in the order that tests were performed. In many cases, tests are repeated at a selected slick thickness or for advancing skimmers, at a selected tow speed. This means that the user must begin the analysis by making up a new data sheet in which runs with similar test parameters are grouped together. This, of course, is a time consuming job. If the testing agency wants to include raw data, that is, information that shows how results such as Oil Recovery Rate and Recovery Efficiency were computed, this can be shown in an appendix and these data could be in the order in which the tests were performed.

9. **Executive Summaries**—Summaries are helpful, particularly in comparing the performance of several skimmers, but these summaries should repeat information that is available in the individual skimmer report sections and not present new information that is not available elsewhere. The user should be certain that all of the information available from a single skimmer test is presented in that skimmer’s section of the report.

10. **Measurement Procedures and Accuracy**—Each skimmer section should contain a general description of how test measurements were made and the estimated accuracy of each. Problems in achieving the desired accuracy of test parameters could also be discussed. A detailed description of how each measurement was made, devices used in measuring, ASTM Standards used in making measurements, can be included in an appendix.

11. **Units of Measurement**—Units used for reporting data should be standardized as much as possible. The user could use this Review as a standard, since the units used here represent standard ASTM and industry practice. In this Review, a wide variety of units were all converted to a single standard.

12. **Report Format**—Reports should follow a uniform format if possible. The order in which things are presented in this Review could be used as a model. This format was developed in the course of reading a great many reports and seems to serve all requirements well.

13. **Throughput Efficiency**—This is an important measure of skimmer effectiveness, but it is not always well measured in tests. Throughput Efficiency (TE) is the percent oil presented to the skimmer that is recovered, or conversely, the percent of the oil that is lost behind the skimmer, which is also significant. In many cases, TE is a function of the containment boom being used with a skimmer rather than the performance of the skimmer itself. In some cases, a skimmer may be tested without containment boom so the TE either isn’t measured or is shown as a very low value. If TE is not recorded in tests, reasons should be explained. If TE is recorded but the skimmer is used without containment boom, or with non-standard boom because of test constraints, this should also be explained.

14. **Maximum Performance Values**—Some early tests only record maximum performance values. This is misleading because the user has no idea of what the spread of recorded values was or what a likely or typical value may be. This practice is also misleading because maximum values of the various test parameters rarely occur together. That is, the maximum values for Oil Recovery Rate almost never occur at the maximum Recovery Efficiency. Showing maximum values of test parameters together should be avoided, even in test summaries.

15. **Speed of Recovery Mechanism**—Skimmers that have moving recovery elements, such as discs, brushes, drums, and moving planes, are generally tested at a variety of recovery element speeds. This may be either a linear speed of a moving plane or revolutions per minute of rotating elements. In most cases, testing begins by varying the speed of the moving element to determine a spread of performance values and to determine the optimum performance value. Often when the optimum performance value is determined, that element speed is used in remaining tests. At this point element speed is no longer a test variable. The process of finding the optimum skimming element speed should be discussed in the report and some information should be presented about how the optimum speed would be determined in the field or considerations for selecting a desired skimmer element speed.

Writing a good test report is a complicated process, far more complicated than is suggested by these notes. While these notes are not intended to be a complete guide to report writing, it is hoped that they will help in the development of reports that are clear and easy to use.