Oil Spill Response Research & Renewable Energy Test Facility

The Ohmsett Gazette

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Oil Slicks and Emulsions Joint Study

From the sky, the water, and from vessels, remote sensing has changed the way the spill response industry has taken on the challenge of detecting, monitoring and measuring oil slicks. In a recent research project, the National Oceanic Atmospheric Administration (NOAA) and Bureau of Safety and Environmental Enforcement (BSEE) experimented with different methodology and tools to assess oil spills. This included accurately monitoring and measuring thickness of surface oil slicks with various sensors and platforms.

"The purpose of this work is to support the ongoing lessons learned from past spills by providing validation studies for surface oiling characterization efforts pursued under the Natural Resource Damage Assessment," stated George Graettinger of NOAA's Office of Response and Restoration. "It also gives us the opportunity to enhance these techniques for future spill response and related damage assessments."

For two weeks in July, NOAA and BSEE conducted a study using multiple remote sensing systems deployed using different

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What's Inside

Mechanical Recovery of Chemically Treated Oil

Oil spill responders face many challenges during recovery operations. They often face adverse weather conditions while containing and recovering spilled oil. Additionally they may encounter oil that has been treated with low doses of chemical dispersants that has not dispersed and is floating on the surface of the water. There are claims that the presence of dispersant mixed with oil can make traditional containment and recovery less effective. To determine whether undispersed crude oil treated at varying dispersant to oil ratios (DORs) affects mechanical containment and recovery operations, the Bureau of Safety and Environmental Enforcement (BSEE) conducted research at Ohmsett over a three week period in September 2016.

During the first phase of the project, two oleophilic skimmers, one with a smooth drum and the other with aluminum discs, were independently tested in controlled conditions. The objective of this phase was to evaluate the impact dispersant mixed with crude oil has on skimmer performance. Using the ASTM F2709 *Standard Test Method for Determining a Measured Nameplate Recovery Rate of Stationary Oil Skimmer Systems* as a guideline, comparative testing of untreated weathered crude oil and treated weathered crude oil was conducted to deter-

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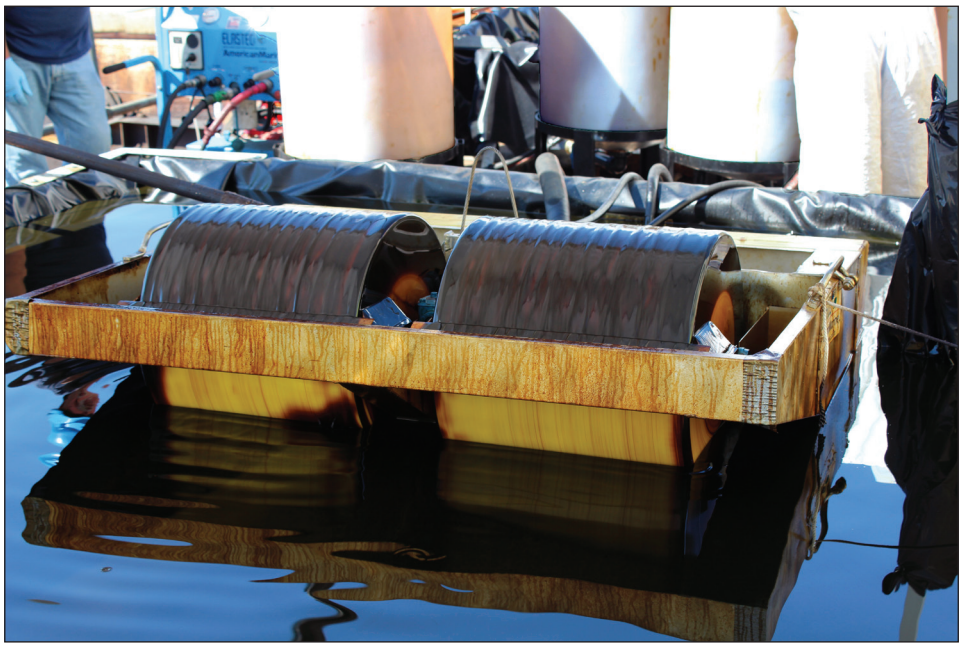

A skimmer was tested in controlled conditions to evaluate the impact dispersant mixed with crude oil has on skimmer performance.

Oil Slicks and Emulsions

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A rotocraft equipped with a thermal infrared sensor captured images of emulsified oil to validate the sensor's capabilities during the NOAA and BSEE funded remote sensing test.

mobile platforms at Ohmsett. The study was to compare and determine how well each of the systems detects, monitors, and measures oil slicks and emulsions in the marine environment.

"This first study at Ohmsett was focused on the identification of oil emulsions from aerial and satellite platforms with a variety of sensors while simultaneously collecting in situ physical thickness and oil chemistry measurements in a controlled test environment," said Graettinger.

For the study, the Ohmsett staff had to create a large scale emulsified oil slick under natural but controlled conditions, and maintain it throughout 10 days of evaluations. This was the largest emulsified oil volume and slick ever used at Ohmsett. With 400 gallons of HOOPS oil (Gulf of Mexico pipeline oil) released on the test tank surface, it was left for four days of weathering from saltwater, weather, UV exposure, and evaporation. On the fourth day, waves were started to create shear energy for the emulsification of the oil. Waves were continued throughout the monitoring period of the study and varied in order to maintain the emulsions for the sensor and in situ measurements to be performed during the week.

During the study, the emulsified oil in the tank was viewed from multiple angles and heights with remote sensor systems mounted to the main bridge, an unmanned aerial vehicle, fixed-winged aircraft, and a helicopter. In addition three satellites equipped with a variety of sensors were tasked to fly over the Ohmsett test tank to capture high resolution remote sensing data with the physical sampling in the evaluation of the emulsified oil slick.

According to Graettinger, this initial phase of the study allowed the BSEE/NOAA team to fine tune in situ sampling methods, and gain a better understanding of sensor resolution and the impact of sensor altitude while characterizing surface oil emulsions. "These results will be taken forward this fall for a second phase of experiments where the same techniques will be used in the open waters of the Gulf of Mexico. These studies will provide BSEE and NOAA useful information to judge the most efficient remote sensing technologies and platforms for real-world response and effective damage assessment investigations going forward."

Chemically Treated Undispersed Oil Recovery

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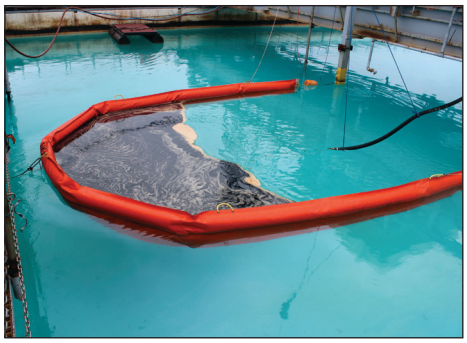
mine oil recovery rate (ORR) and recovery efficiency (RE).

The skimmer tests were performed in a temporary tank located on the Ohmsett north deck. Controlled volumes of untreated and treated weathered crude oil were placed in the tank. Each skimmer's performance was tested with a starting slick thickness of 2 inches. Performance was calculated using the diminishing slick from 2 inches to 1 inch.

"Data is currently under analysis; however, preliminary results do indicate that performance of both skimmer types was affected by the presence of dispersants in the oil," said Kristi McKinney, BSEE's project manager.

The second phase took place in the Ohmsett test basin. The objective of these tests was to compare the ability of a boom to contain crude oil and crude oil mixed with dispersant. Using ASTM F2084 *Standard Guide for Collecting Containment Boom Performance Data in Controlled Environment,* as a guideline, a 50-foot curtain boom was rigged to the main bridge to simulate towing at sea. Oil was preloaded into the apex of the boom which could be monitored in real time using two high definition underwater cameras. The boom was towed at incremental tow speeds to determine when first loss occurred.



Dispersant treated oil was placed in the apex of the boom to assess the ability of a boom to contain undispersed oil.

"Videos from previous boom tests were studied prior to testing to try to ensure consistency as to what was considered first loss. Runs were also conducted at various speeds with the crude and dispersant treated crude to quantify and compare volume of oil lost due to entrainment," said McKinney. "BSEE is currently analyzing the data obtained from these tests, and may conduct further skimmer and/or boom tests to collect additional data."

Performance Testing of the SeaHow Skimmers

Leveraging decades of experience in the marine industry including oil spill response, MeriTaito Ltd. of Finland developed the SeaHow brand of skimmers three years ago. In that short period, they created three styles of skimmers, each suitable for different recovery conditions; the Offshore, the MiniBagger, and the MiniSkimmer. For two weeks in October 2016, as part of the development of these new skimmers, MeriTaito came to Ohmsett to perform standardized testing.

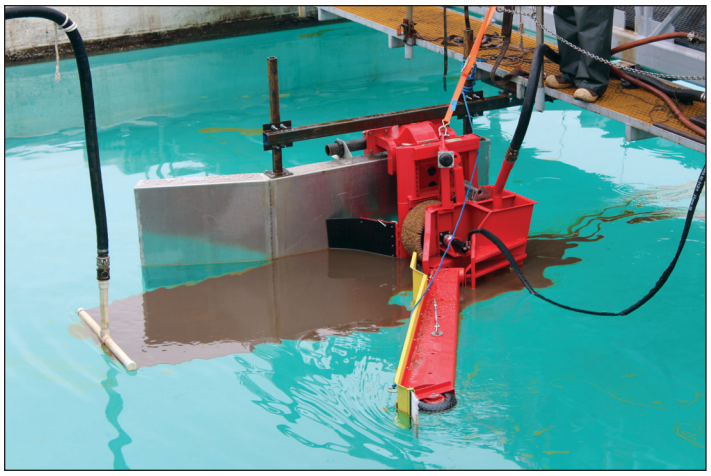
All of the SeaHow products use the same patented brush-comb drum system. What makes this system different from traditional drum skimmers is that the scraper comb plate can be changed to accommodate diesel or heavy oil without changing the brush-drum. In addition, the brushes are made of a new material that is easier to clean with a higher steam temperature of about 160° C without damaging the bristles.

The SeaHow Offshore skimmer is a ruggedly constructed stationary brush skimmer made to endure heavy seas without compromising the oil collection capacity. The skimmer is designed with interchangeable scraper comb plates to perform in varying oil slick thicknesses and viscosities. Prior to its testing in October, several modifications were made to the SeaHow skimmer after its initial testing conducted in June 2016 at Ohmsett.

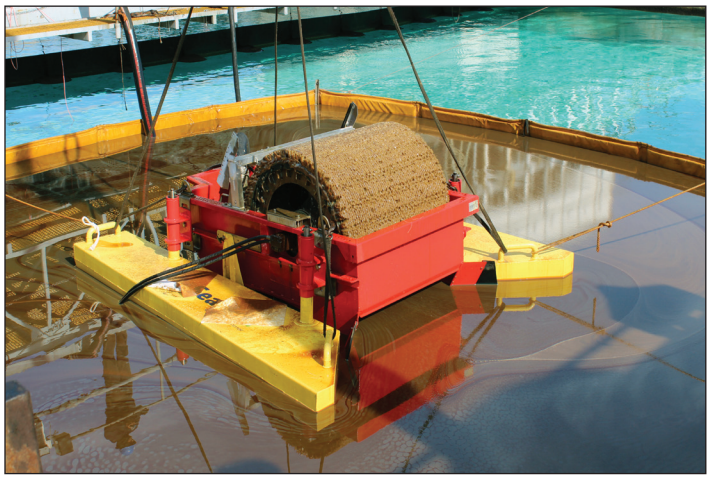
During the series of tests conducted in October, the Offshore skimmer was placed in a boomed area of the test tank. Using the ASTM F2709 *Standard Test Method for Determining a Measured Nameplate Recovery Rate of Stationary Oil Skimmer Systems*, the goal was to gather nameplate recovery rate (NRR) and recovery efficiency (RE) performance data with two different test oils; Calsol and Diesel fuel.

Two additional skimmers, MiniBagger and the MiniSkimmer, were also tested during the two week period. The MiniBagger, with a sweeping boom arm, deploys from the side of a vessel for near shore clean-up. The skimmer is designed with a universal mounting system enabling it to be mounted to small vessels. Prior to testing, the Ohmsett staff fabricated a simulated hull section constructed out of aluminum and mounted it to the auxiliary bridge. The skimmer was then mounted to the hull section. While towing the skimmer through an oil slick at various speeds in the test tank, recovery rate (RR), RE and throughput efficiency (TE) performance values were calculated. Tests were conducted with both Calsol and Diesel fuel, with nominal viscosities 2000 cPs and 7cPs at 20° C.

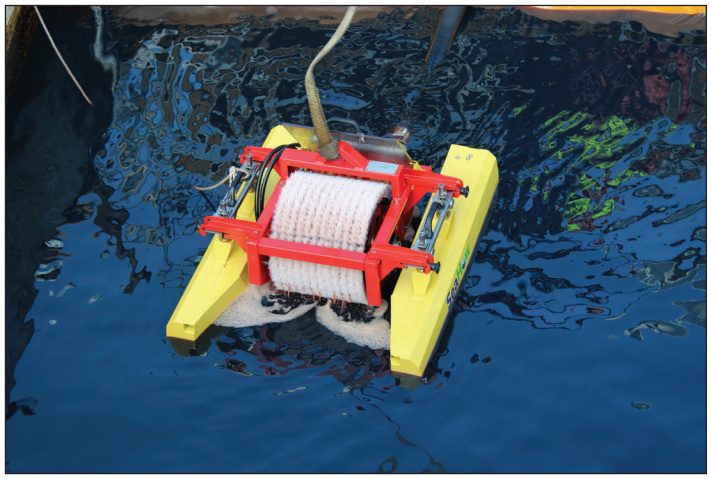
The MiniSkimmer is a floating oil skimmer and tested in accordance with ASTM 2709 using Calsol and Diesel fuel. The skimmer was placed in a boomed area of test protocol defined area and lightly tethered to operate in the center. Oil was preloaded to an initial slick thickness of three inches. Once started and at steady state operation, the recovered fluid was directed to calibrated collection tanks until the equivalent of one inch of the slick was recovered. Post-test fluid measurements were obtained, and NRR with corresponding RE were calculated.



The MiniBagger is designed with a universal mounting system enabling it to be mounted to small vessels.



The SeaHow Offshore skimmer is designed with interchangeable scraper comb plates for varying oil slick viscosities.



The MiniSkimmer, a floating skimmer, was evaluated for nameplate recovery rate and recovery efficiency.

Tracking Oil Movement at Sea

Tracking an oil spill at sea to determine its movement is half the battle when guiding response operations. To track and record the waters' movement at sea, the Consortium for Advanced Research on Transport of Hydrocarbons in the Environment II (CARTHE II) has developed an ocean drifter for use in the Gulf of Mexico. CARTHEII is a multi-university project funded by the Gulf of Mexico Research Initiative led by Dr. Tamay Ozgokman, Professor of Oceanography at the University of Miami, and includes Dr. Michel Boufadel of the New Jersey Institute of Technology (NJIT) as a Co-Principal Investigator.

The ocean drifter is designed to move with the ocean swells, currents and waves to track the movement of water and the transport of an oil spill.

The drifter, developed by Dr. Ozgokman's group, is designed to move in concert with the ocean swells, currents and waves to track the movement of water and, when one occurs, the transport of an oil spill. According to Dr. Boufadel, some drifters are designed to capture the current of only the top two inches of the water. Others have external devices, called drogues that are beneath the surface and enable the drifter to capture the water motion within the top three feet of the water. The CARTHE II drifter can be deployed with or without the drogues, depending on the tracking requirements.

Within the CARTHE II project, researchers from the University of Miami and the New Jersey Institute of Technology conducted studies of oil transport and dispersion in the Ohmsett tank. During the week of April 25 the team of investigators evaluated the performance of the drifter with and without the drogues in various wave conditions. The team observed and measured the drifters' up and down, horizontal transport, and rotational movement in the water.

For the second part of the evaluation, the researchers compared the movement of the drifters (mainly without drogues) in waves to the movement of oil spilled in the Ohmsett tank. "The findings of the Ohmsett study will greatly help interpret the movement of the drifters at sea," says Boufadel. "In particular, the Ohmsett study demonstrated that the drifters (without drogues) very closely reproduce the movement of oil on the water surface."

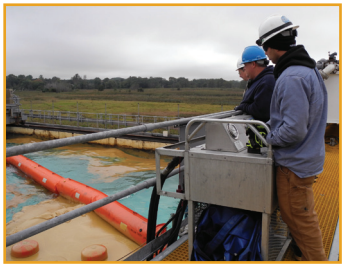
Oil Spill Response Strategies & Tactics Training

May 22-25, 2017

Ohmsett, in partnership with Texas A&M National Spill Control School, offers the hands-on training course you can't afford to miss! You will learn the strategies and tactics for successful spill response operations.

Course Topics:

- Fates & effects of spilled oil
- Oil skimmer & containment boom selection, use & recovery strategies
- Factors affecting oil spill movement
- Incident Command System (ICS)
- Shoreline Characterization (Introduction to SCAT)
- River & tidal inlet strategies
- Responder Safety
- Hands-on skimmer operations
- And More!



When:
May 22-25, 2017
8:00 a.m. - 5:00 p.m.

Where:
Ohmsett
Leonardo, NJ USA

Register Today!
www.ohmsett.com

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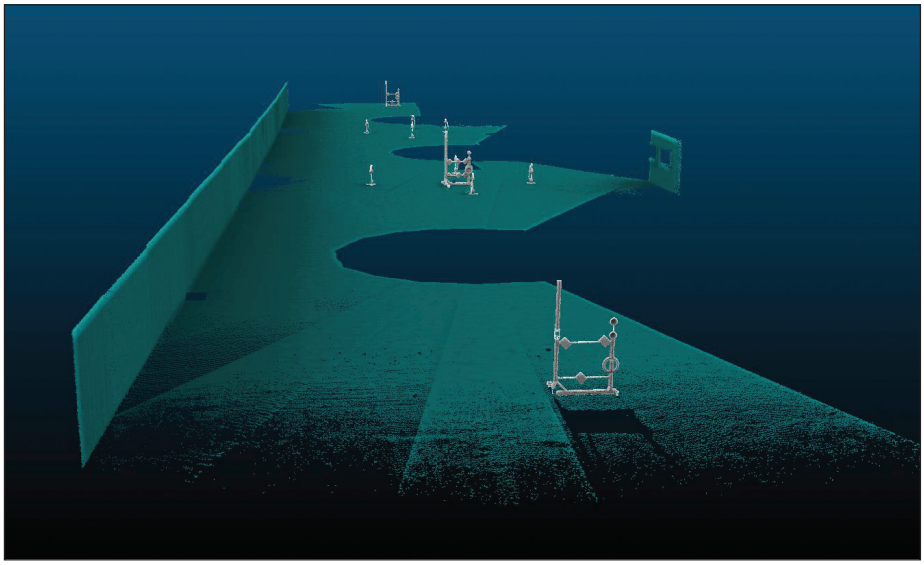
To schedule a testing or training event call 732-866-7283

Underwater Laser Characterization Study

3D at Depth LLC, of Boulder, Colorado returned to Ohmsett the week of August 12 to verify the accuracy of their patented underwater laser scanning technology. Two previous testing programs took place at Ohmsett in which 3D at Depth performed a characterization study of the laser sensor outfitted with a subsurface navigation unit while stationary and while in motion.

During testing, targets were placed at precise locations in the test tank and the stands were surveyed using a local survey company; Maser Consulting. The laser scanner was then placed into the tank, scanned the targets, and the results were compared with the surveyed results. "Early data results confirmed that the underwater scanner's performance and accuracy were comparable with traditional terrestrial laser scanners and provide a unique capability for underwater measurement," commented Mark Hardy, 3D at Depth Co-Founder and Director of Client Services.



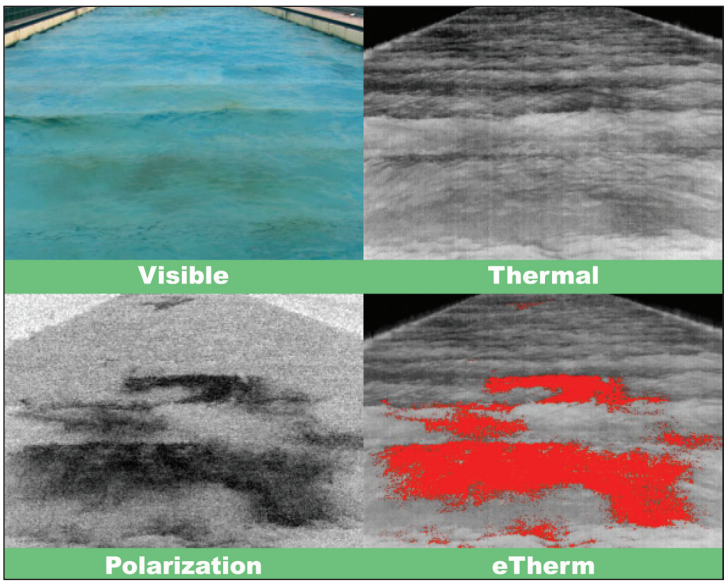
Targets were placed in precise locations in the Ohmsett test basin. The 3D at Depth underwater laser scanning technology scanned the targets to create the above image.

Long Wave Infrared Imaging Camera Oil Spill Detection

Polaris Sensor Technologies, Inc., a developer of imaging polarimetric sensors across the optical spectrum, has designed a new Long Wave Infrared (LWIR) Imaging camera to detect oil spills and leaks. The small, easy to use Pyxis® LWIR 640 can measure polarization and conventional thermal intensity information simultaneously.

During the week of August 1, 2016, Polaris brought the Pyxis® to Ohmsett to test its capabilities in a simulated marine environment. The first series of tests were conducted with a number of controlled spills containing known quantities of oil placed in a temporary test tank. The objective was to study the Pyxis® data collection during various times of the day as oil signatures and temperatures changed, as well as changes in oil thickness.

The second series of tests took place where two crude oils and diesel were allowed to freely disperse in the test basin. With the sensor mounted above the water on the main bridge crow's nest, the bridge was accelerated from 0 to 5 knots as it passed over the spill. The sensor captured thermal, eTherm and polarization images, and monitored the movement of oil in both calm water and waves.



Thermal, eTherm and polarization comparison data shows the improvement in detection of oil on the waters' surface using the Pyxis® LWIR.

"The Pyxis consistently showed superior detection across all conditions tested and regularly detected oil and diesel in both flat water and breaking waves," said David Chenault, Polaris Sensor Technologies, Inc. President. "A time lapse, overnight test showed the detection performance of the polarization imagery from a factor of 3 to more than 50 times better contrast than standard thermal imaging."

With the data collected at Ohmsett, Polaris plans future controlled testing with additional types of oil and the effects of aging.

One Step Closer to the Skimmer of the Future

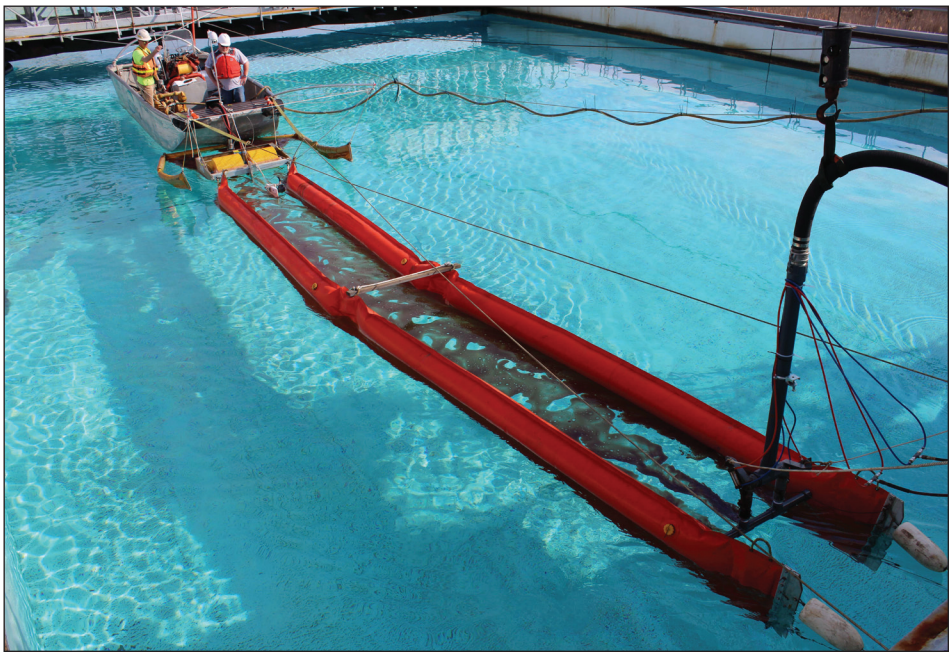
A skimmer is deployed and intuitively maneuvers independently as it automatically tracks and skims oil. This vision is closer to becoming a reality as the Bureau of Safety and Environmental Enforcement (BSEE) funded project, Development of Smart Skimming Technologies, progresses to the final phase of development.

"This multiple phase project investigates the development of technology packages to aid in the automation and optimization of oil skimmer recovery operations," stated Kristi Mckinney, BSEE's project manager. "The intention of these technologies is to ultimately replace the skimmer operator's decisions entirely with real time spill data obtained from the surface."

The autonomous skimmer system (AOS), developed by Alion Science and Technology of Connecticut, consists of an oleophilic skimmer placed in the apex of a sweeping/collection boom that is mounted to the bow of a vessel. The system is outfitted with a high precision navigation package, a custom computer algorithm, oil slick detection sensors and an oil/water discharge sensor. The system relies on input from an oil slick thickness sensor in order to detect and identify areas of the thickest oil concentration.

First evaluated at Ohmsett in March 2015 (See Ohmsett Gazette Spring/Summer 2015), Alion refined the sensors and tested the computer control of a full-scale autonomous system without oil in Connecticut September 2015. "We assessed the performance of the oil spill tracking algorithms in a realistic environment," says Dr. Gregory Johnson, Alion program manager. "A simulated oil slick was used to drive the operation of the system. The system worked as planned and the test gave us some experience in how the skimmer vessel handled. We used that experience to improve the algorithms to better match real-world vessel dynamics."

In March 2016, Alion returned to Ohmsett to evaluate their proof of concept in realistic oil spill and wave conditions. The test scenario was divided into two segments: evaluation of the oil thickness sensors' performance; and evaluation of the oil/water cargo-line discharge sensor.



The autonomous skimmer, outfitted with oil thickness sensors, undergoes performance evaluations in the Ohmsett test basin.

During the first segment of testing, a skimmer was positioned in the apex of a boom that was mounted to the bow of a boat and tethered between the auxiliary and main bridges. The oil thickness sensors were positioned in front of the advancing skimmer and towed through patches of oil. Ohmsett staff controlled the thickness of the oil slicks, as well as the wave conditions to evaluate performance at varying tow speeds.

"Two different sensors were tested and both worked well in calm water and long period waves to identify oil vs. water and relative oil thicknesses," says Johnson. "Performance dropped off in short period waves, and neither sensor is calibrated to provide an absolute thickness measurement."

The second test segment evaluated the performance of the oil-in-water percentage sensor during an oil recovery scenario. For this test a stationary skimmer system was placed in an oil slick within a boomed area of the Ohmsett tank. Recovered fluid (oil/water mix) was off loaded through a discharge hose in which the oil/water sensor was installed. The oil-in-water sensor data was collected to correlate raw sensor output with actual water content in the fluid stream.

With testing completed, the concept has been shown to be feasible. Currently, BSEE is anticipating further research on improved oil thickness and oil recovery efficiency sensors. "The next step for the AOS concept would be to expand the capability to use larger skimmer-vessels and incorporate sensing of the oil thickness over a wider area to provide better look-ahead capability to the tracking algorithm," says Johnson.

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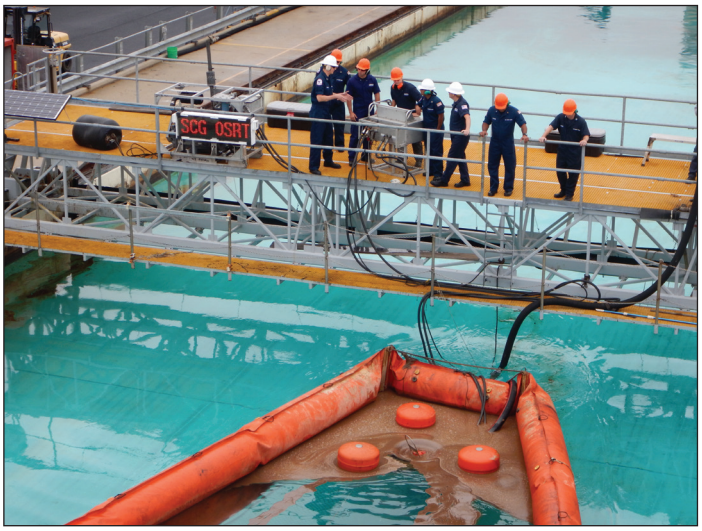
News Briefs

USCG Trains Responders

Every year, the U.S. Coast Guard holds a five-day entry level Oil Spill Response Training course at Ohmsett provides the unique experience of classroom and hands-on training. The OSRT Course is considered an entry-level course based on the National Strike Force Qualification Program's practical factors that deal with Vessel of Opportunity Skimming System (VOSS) and Spilled Oil Response System (SORS) equipment systems. During the course, personnel receive training using oil spill response equipment systems onboard JUNIPER Class WLBs SORS, District Response Advisory Team, and National Strike Team VOSS equipment.

This year, the Coast Guard held two separate sessions during the weeks of May 16 and August 27 with 48 students in attendance. The classroom curriculum focused on Coast Guard oil spill response fundamentals, safety, and specific VOSS and SORS response equipment. The students also participated in hands-on practical training where they were divided into three groups of eight personnel and rotated through five equipment stations: Half Hull Rigging, Pumping/Skimming Station, Boom Deployment, Temporary Storage Device, and Skimming Exercises.



U.S. Coast Guard personnel participating in Oil Spill Response Training skimming exercise.

Hands-on training in the Ohmsett tank provided the students the opportunity to experience realistic oil spill recovery operations using USCG SORS and VOSS equipment. During the skimming exercises the students practiced recovering real oil in conditions that simulate an actual oil spill. The exercises took on a competitive nature as the students tried to out-perform each other for the most oil recovered; earning them bragging rights while demonstrating Esprit de Corps.

The Ohmsett Gazette is published biannually by Ohmsett -The National Oil Spill Response Research & Renewable Energy Test Facility to update our readers on activities at the facility.

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Preparedness and Proficiency Comes with Practice

Over the past 19 years, in partnership with Texas A&M University National Spill Control School (NSCS), Ohmsett has offered hands-on oil spill response training. The training is designed to impart the skills necessary for response personnel to make quick and informed decisions during an oil spill incident. NSCS trainers provide the classroom curriculum and instruction, while the Ohmsett staff provides professional training services to support the hands-on portion of training.

The 3-1/2 day Ohmsett/NSCS Oil Spill Response Strategies and Tactics course was held three times this year during the weeks of May 23, August 17, and August 29. The students started out with classroom instruction which provided a detailed review of oil spill fundamentals and actual implementation of proven best practices during spill response efforts. Topics included a review of the application of all types of skimmers, booming strategies, National Incident Management System (NIMS), contingency planning, and a review of the behavior of oil on water.

Following classroom instruction, students were able to build their confidence and competence during the hands-on training in the Ohmsett test tank. There students practiced recovery operations using equipment and techniques in conditions that simulated an actual oil spill.

"This unique course includes discussions of recent developments in the response industry, a review of the history and science of oil spills, and allows all of the attendees to spend an optimal amount of time with recovery systems on the Ohmsett tank," said Tony Wood, director of the National Spill Control School.

The opinions, findings, conclusions, or recommendations expressed in this report are those of the authors, and do not necessarily reflect the views or policies of the Bureau of Safety and Environmental Enforcement (BSEE). Mention of trade names or commercial products does not constitute endorsement or recommendation for use. This document has been technically reviewed by the BSEE according to contractual specifications.

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