Ohmsett Newsletter
Spring 2020

The Ohmsett Gazette

The National Oil Spill Response Research & Renewable Energy Test Facility

Developing a Burner Unit for Spill Response

One of the tools responders have at their disposal for oil spill response operations is in situ burning of the spilled oil. However, wind and wave action on the water changes the properties of the oil, thereby enhancing emulsification. These emulsions can only be effectively ignited for burning if the water content within the emulsions is less than 12-20%. Another drawback of this method is the sooty black plumes created by burning pooled oil.

Since 2012, the Bureau

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What's Inside

AIMing to Improve Oil Recovery in the Arctic

Mechanical recovery of oil can be a challenge even in the best conditions; add ice, slush and debris to the mix and it can hamper a skimmer's ability to efficiently pick up oil. Since 2017 the Bureau of Safety and Environmental Enforcement (BSEE) has collaborated with the Army Corps of Engineers Engineering Research and Development Center's Cold Regions Research and Engineering Laboratory (CRREL) to develop an Active Ice Management System (AIMS). The system is designed to improve oil recovery in drift ice conditions while deployed with a

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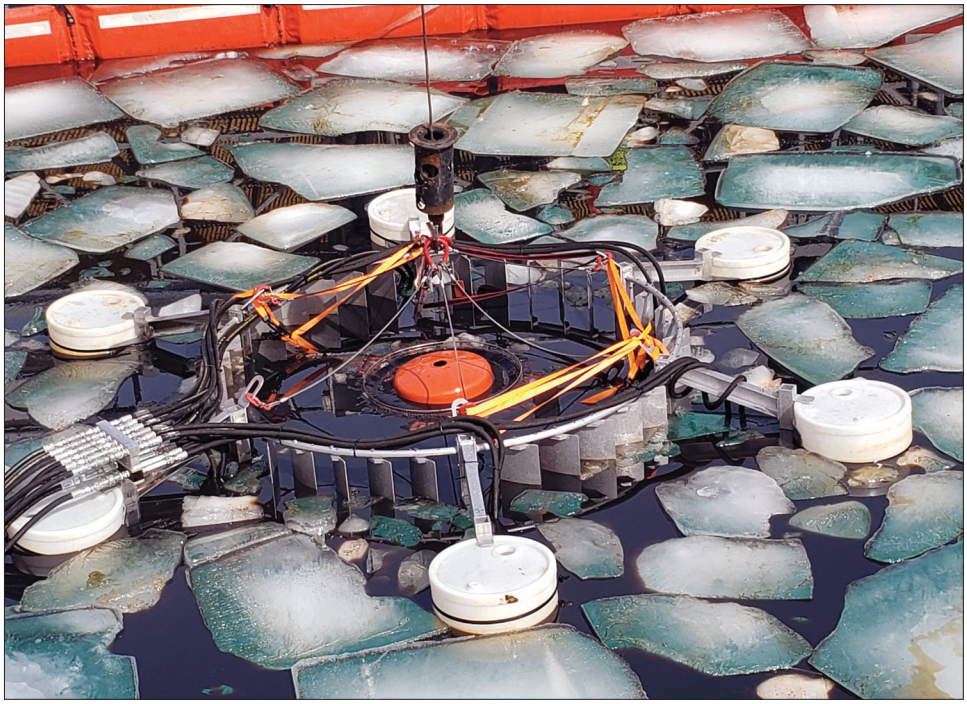

The Active Ice Management System (AIMS) is designed to improve oil recovery in drift ice conditions.

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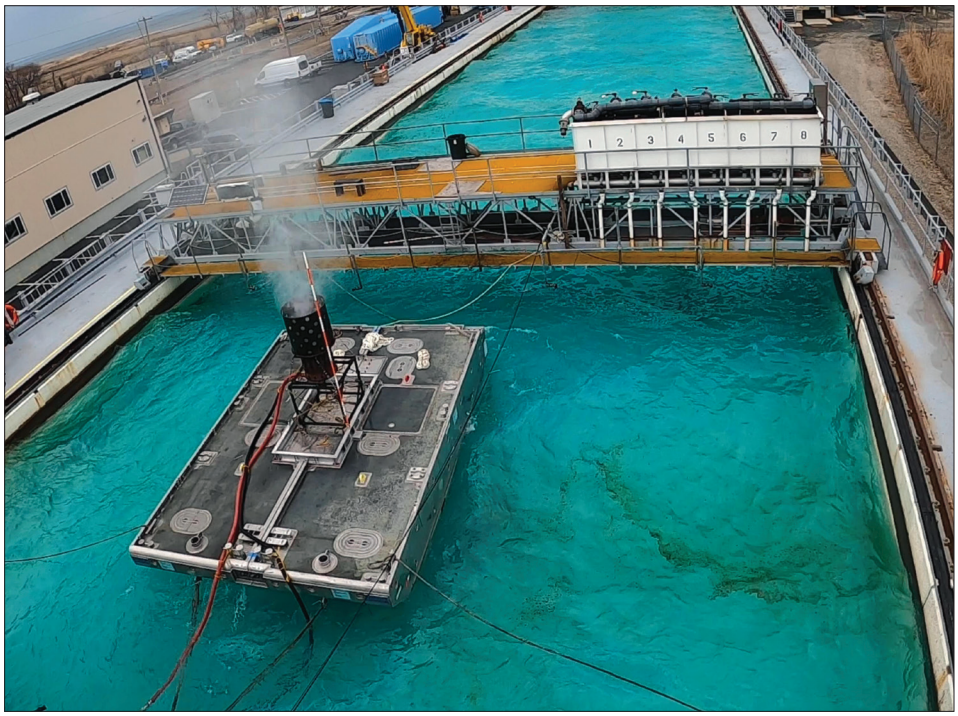
Burner Barge

of Safety and Environmental Enforcement (BSEE) along with the Naval Research Laboratory (NRL) have been developing a low pressure atomizer to efficiently burn emulsions during spill operations. According to Karen Stone, BSEE oil spill response research engineer, by using a spray combustor, crude oil burns completely with less soot and carbon monoxide (CO) emissions than pooled fires. "Air is mixed with the emulsions and once ignited; the spray efficiently burns inside the unit. The two-staged shroud creates eddies, which aid in the burning, as does the heat feedback from the shroud."

With the burner unit maturing to technology readiness level (TRL) 8, the unit was mounted on a barge and went through performance testing at Ohmsett during the week of March 2, 2020. The objective was to determine how the spray from the unit would impinge upon the side of the burner wall (shroud), which could impact the burn efficiency. Additionally, the team studied how the barge and burner would behave in waves. The research team included Stone of BSEE, Dr. Steve Tuttle and Christopher "CJ" Pfutzner of NRL, and Kemp Skudin and Craig Moffatt of the Navy Supervisor of Salvage and Diving (SupSalv).

For testing, Navy SupSalv provided a section of one of their barges, along with the ancillary equipment required to support the burner. The burner and stand were then secured to the top of the barge. "The coupled unit was tested in a series of waves, from a harbor chop to sinusoidal waves, so that the barge would dip up and down; not just ride over the tops of the wave crests," Stone explained. "The Ohmsett staff customized the stroke and wave characteristics to meet our unique needs."

During the test, the team discovered that the wave behavior impacted the water flow in the fuel lines feeding the burner. "The necessary modifications to the fuel lines were made, and the system behaved as expected. We would have never known this had we not tested at Ohmsett," Stone said. "One of the great things about testing at Ohmsett is that it truly tests the entire system."



A low pressure spray combustor (burner unit) was developed to efficiently burn crude oil during spill operations. The burner unit was mounted on a barge and went through performance testing at Ohmsett.

"We tested the burner spray in various wave configurations with great success. While we did not burn or use oil during the Ohmsett tests, we did conclude that the flow rate of the atomized spray is such that the waves do not impact it," Stone noted.

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August 3-5, 2020
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Booth #314
www.cleanwaterwaysevent.org

Clean Gulf 2020
October 20-22, 2020
San Antonio, TX
Booth #415
www.cleangulf.org

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Oil Recovery in Arctic Condititions

skimmer. By redirecting the floating ice away from the system, oil is more easily drawn to the skimmer for recovery. During the week of March 9, 2020, the AIMS was put through seven tests to evaluate its ability to improve the recovery rate and recovery efficiency of a weir skimmer.

According to BSEE engineer Kristi McKinney, the US Coast Guard (USCG) led the initial collaborative research project to develop an ice cage in 2015. CRREL engineers then designed the AIMS, a new system informed by the USCG Ice Cage project. "The AIMS incorporates some of the positive USCG Ice Cage features to protect the skimmer from damage due to ice. In addition, it includes an active ice management component to prevent ice from accumulating directly around its perimeter which would prevent oil from reaching the skimmer."

Prior to testing a half-scale model of the AIMS, the Ohmsett staff had to grow blocks of ice that could be placed in the test area of the tank. In January, the engineers and technicians started building the trays and racks in which they grew ice over the next two months. The trays were placed in refrigerated containers to be kept frozen until the test.

The evaluation took place in a boomed area of the Ohmsett tank which provided simulated arctic conditions that included ice and oil. The blocks of ice were cut into various sizes and placed in the boomed area to create an ice field. A one-inch oil slick was then distributed within the ice field. The weir skimmer was placed inside of the AIMS to recover oil, with the AIMS system operational and non-operational. This allowed the team to assess the recovery benefit provided by the active management of the ice.

The Active Ice Management System (AIMS) is designed to redirect the floating ice away from the system so oil can be easily drawn to the skimmer for recovery.

"The tests were based on the new ASTM standard F3350-18 *Standard Guide for Collecting Skimmer Performance Data in Ice Conditions*; however this was a series of tests to evaluate the AIMS rather than the skimmer itself. Therefore, several aspects of the test were changed in order to collect comparative data with the limited number of tests that could be conducted," McKinney said.

"The system performance looks promising from visual inspection and I look forward to further analyzing the recovery efficiency data." said CRREL Principal Investigator, Nathan Lamie. "We're excited about the continued success and progression of the AIMS. The USCG and Ohmsett team have added valuable input and excitement towards this prototype system."

Meeting the Training Needs of Spill Responders

Designing an effective training course capable of meeting the changing needs of a diverse group of spill responders was the most important criteria for Clean Harbors Cooperative's (CHC) recent program. According to Brian Bryant of CHC, the key ingredients are a defined objective, instructors with technical experience, and organizational structure. To round out the course, Bryant included the technical expertise of the Ohmsett staff for hands-on activities in the test basin. "The benefits of the Clean Harbors Cooperative and Ohmsett partnership are the on-site training, strong and consistent leadership, and the coordination and communications."

CHC held their training course at Ohmsett the weeks of October 7 and 21, 2019. Member organizations that participated in the course included staff from Phillips 66, ExxonMobil, Con Edison, U.S. Coast Guard Sector New York, and Applied Research Associates, Inc.

CHC member organizations participated in training activities including selecting equipment based on operational needs and availability.

The classroom curriculum provided crucial information on the fate of oil spilled and recommendations for determining the projected course of the weathered oil as it travels in the environment. Additionally, students were introduced to detailed guidance for protecting the shoreline with the use of pre-determined tactical response plans and use of the ICS-204 form in support of the plan.

Bryant noted the primary emphasis of the course centered on health and safety precautions for those involved

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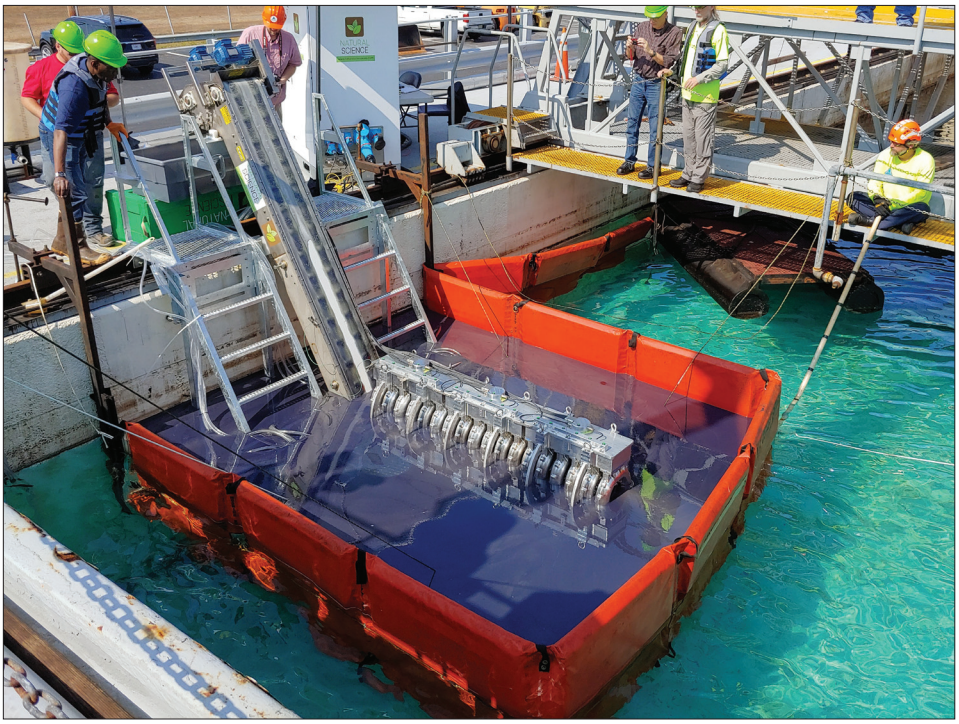
System Magnetically Traps and Removes Oil



Modules of solenoidal coil-shaped magnets, form an electromagnetic-boom (E-Mop) structure. The E-Mop, with its pulsed magnetic force field, directs the oil towards the magnetic ramp and separator for recovery.

Revolutionary technology is often sparked by an event that generates ideas on how to solve a problem. That was exactly the inspiration behind the development of Natural Science, LLC's Electromagnetic Remediation System for cleaning up oil spills.

The concept behind the technology was developed in 2010 during the Deep Water Horizon oil spill in the Gulf of Mexico. Natural Science founding partner Arden Warner recognized that electromagnetic remediation mimics nature in solving the problem of preventing oil and water from mixing during spill operations. With the first patents for the cleanup technology granted in 2014, "We decided to form Natural Science and build a device to tackle such issues to recover oil from water." Soon after in December of 2017, the Electromagnetic Remediation System prototype design and engineering development began.

The system uses electromagnetic forces that prevent oil and water from mixing. It consists of solenoidal coil-shaped magnets, coupled together in groups of six to form a module. Several modules are connected together to form an electromagnetic-boom (E-Mop) structure. Other components include a magnetic ramp and separator.

"Magnetization of oil is not a new concept, but we realized that the phenomena that allows oil and magnetizable particles to bond at the molecular level, also prevents oil and water from mixing. This was not being exploited to recover oil from water. Standard booms are passive devices, and skimmers rely primarily on surface tension effects to work and are inefficient," Warner explained.

To demonstrate oil spill remediation and recovery with the magnetic ramp and boom system, it was tested the week of September 30, 2019 at Ohmsett. With the prototype placed in a 12 foot x 12 foot boomed area of the tank, test oil was seeded with metal oxide. The mixture formed a loose colloidal suspension that floated on the water. The E-Mop, with its pulsed magnetic force field, directed the oil towards the magnetic ramp for recovery. In the field a dispersive nozzle can seed the oil with oxide (less than 0.5% by volume.

Additionally, the Magnetized Absorbent Technology (MATTM) was tested for its ability to magnetically trap and remove oil. The absorbent was placed in a 4 foot x 4 foot boomed area filled with a known quantity of test oil. A magnetic dip pole was used to remove the material from the test area and samples were sent to the on-site lab for analysis.

"Our team wanted independent verification of the technology. We wanted to show that the technology works and is practical to deploy and use to mitigate oil spills," Warner said. "Above all, we wanted to demonstrate the extremely high efficiency of separating oil from water that we had accomplished with this technology in our lab. We know how to scale it and increase volumetric uptake, but we wanted to have Ohmsett verify that we are not collecting more than trace amounts of water in the process."

The objective of performance testing in a simulated marine environment is to obtain qualitative data prior to deployment in the field. According to Warner, the Natural Science team was able to identify improvements in the E-Mop system and MATTM technology, and is making the necessary engineering changes to address them. "We are very excited by the results. We think that electromagnetic remediation establishes a new paradigm in oil, water and microplastic remediation, as well as other applications," Warner said. "The next step is to make it readily available for deployment."

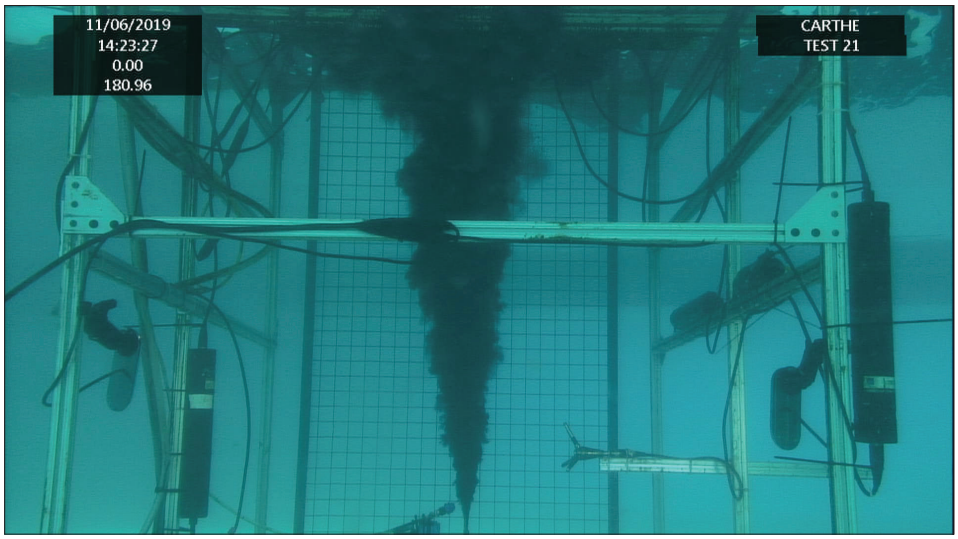
Dispersant Impacts on Oil Droplets and Gas Bubbles During a Blowout

In October 2019, the Boufadel group from the New Jersey Institute of Technology (NJIT) came to Ohmsett to conduct follow-on research to evaluate the oil droplet and gas bubble size distribution with and without dispersant during a simulated oil well blowout. They were joined by researchers from the University of Miami (the Ozgokmen group), and scientists from the Department of Fisheries and Oceans Canada. The study was funded both by the Gulf of Mexico Research Initiative (GOMRI) and the Multipartner Research Initiative (MPRI) from Canada.

Previous studies conducted in 2018 at the facility used a vertical pipe with a diameter of 25 mm (one-inch) for underwater oil discharge, and the pipe apparatus with instrumentation was towed to allow the oil to move in a crossflow direction. This method poses a challenge in determining the full droplet size distribution of the plume.

During the current research, to create the underwater discharge of oil, the NJIT team used a fixed vertical pipe (no towing) with two different diameter nozzles where premixed oil and air were released from the pipe. For the test, 1000 gallons of Thunderhorse crude oil and 10 gallons of COREXIT 9500 dispersant were used. With the system stationary, the discharge was released and dispersant was applied to the discharge. "The droplet and bubble size were measured at 1.4-meter vertical distance from the orifice using shadowgraph camera and LISST-200X. Three Acoustic Doppler Velocimeters (ADVs) and two fluorometers were placed at different locations in the water column to acquire velocity and dissolved oil concentration, respectively," explained Cosan Daskiran, NJIT senior engineer and postdoctoral research associate.

According to Michel Boufadel, principal investigator for NJIT, the preliminary findings indicated the increase in the flow rate decreased the droplet size as the dispersant reduced the size of bubbles. "We believe a fraction of the dispersant was used up by the bubbles. The results will be also used to validate numerical simulations and models to allow prediction of oil droplets from various releases."



A simulated oil well blowout was created in the Ohmsett test tank to study oil droplet size distribution and gas bubble size distribution with and without dispersant.

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Training Spill Responders

in responding to an oil spill. "The classroom portion of the training included two separate case studies, which proved to be beneficial to all those involved in the discussions."

As the students rotated from the classroom discussions to the tank, they were able to participate in the hands-on portion of the course. The tank exercises provided them with the opportunity to operate various skimmers in different types of oils and wave conditions. "We discussed recovery rates, safe operation, selecting the different skimmers based on operational needs and availability, and a few different physical herding applications."

After three days of classroom instruction and tank exercises, Bryant brought the students to the Arthur Kill Waterway where they were able to conduct on-water operations using the CHC self-contained skimming barge platform, along with CHC boom deployment vessels and boom tending boats. "Booming strategies from the tactical response plans were tested, skimming vessel operations were demonstrated, and boom was deployed and anchored in accordance with the New York/New Jersey Area Contingency Plan."

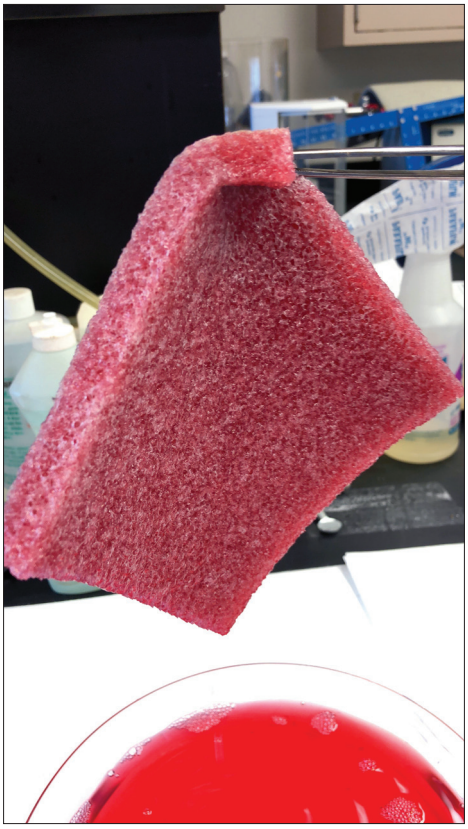
The well-rounded, hands-on training program provided the benefit of networking with various members of the response community, helping to build strong port partnerships. "Four different companies attending the course were able to train and work side-by-side with USCG pollution response regulators; strengthening and building relationships for future endeavors in the response community,"

Sustainable Sorbent Products to Protect Waterways

Since 2014 when AquaFlex Holdings, LLC first came to Ohmsett to test their reusable Open-Cell foam sorbent for oil spill recovery, they have been eagerly working to perfect their technology. The AquaFlex® products are built on its founder Scott Smith's technology for the detection and removal of oil from water. "AquaFlex technology is based on an Open-Cell foam membrane that traps water contaminants that may otherwise remain undetected," says Smith. "Like a sponge, the flexible elastomeric foam acts like a capillary network similar to the alveoli of the human lungs; the Open-Cell foam absorbs contamination and exhales clear water."

Armed with the successful testing results from 2014 and continued development of the technology, AquaFlex entered into a partnership with the multinational company, Palziv, in 2017 for the development of continuous Open-Cell roll foams. Their efforts came to realization in 2019 with the commercialization of AquaPal®.

In August 2019, these new Open-Cell foam rolls and AquaFlex sorbents were brought to Ohmsett for independent testing using the recently developed field-scale sorbent test protocol. During the study, 11 Open-Cell foam sorbents were compared to each other, and to commercially available polypropylene and polyurethane sorbents representative of industry standard products. "We wanted to conduct a full test of all Open-Cell products in order to compare the new roll-based Open-Cell foam sorbents," said Smith.



AquaFlex sorbent products were tested using the newly developed sorbent protocol.

As a part of the evaluation, a total of 27 field tests were performed, in addition to 46 tests using the ASTM F726 *Standard Test Method for Sorbent Performance of Adsorbents for use on Crude Oil and Related Spills.* The testing method included a number of variables; sorbent types, oil viscosity, as well as static and mixing energy scenarios. The four test oils used for the study were light, medium, heavy, and weathered.

According to Smith, using Ohmsett as a third party, independent testing facility is important to verify the performance of sorbents under the current ASTM F 726. "In addition to ASTM F726, the development of an additional industry standard test method at Ohmsett better reflects the real-world conditions, such as oil mixed with water, moving water, wind, rough seas, etc. during oil spills."

Measurements collected during the tests included: Sorbent Maximum Oil Capacity Tests, Sorbent Water Uptake Tests with Oil, Buoyancy, and Manual Oil Recovery. Also noted during testing was the ability to recover oil from a saturated sample using a manual roller to squeeze the sorbent samples to recover and measure a portion of the oil adsorbed during the saturation tests.

"With the newly proposed standards developed by Ohmsett, the tests have helped us optimize our Open-Cell foams for both efficiency and sustainability. Additionally, under the ASTM F726 various formulations of our Open-Cell foam sorbents were able to absorb 22-35 times their weight in oil," Smith said. "Clearly, the independent testing conducted by Ohmsett has helped us to not only better serve the market and our customers; but better protect and preserve the waterways and the environment with our commitment to sustainability."

Ohmsett Welcomes Field & Lab Chemistry Technician to the Team

We are pleased to announce the addition of Joanne Letson, field and lab technician, to the Ohmsett team. Joanne comes to us with more than 30 years of experience as a research lab team lead and technologist. Most recently she was a research coordinator in a pharmaceuticals trial participating in the study planning, preparation execution verification, monitoring work flow and procedures, processing samples, labelling, and documentation.

As the Field and Lab Technician, Joanne will perform precision measurements of physical properties in Ohmsett's oil and water chemistry laboratory, assist engineers with preparations for test and research programs, and assist in deploying instrumentation and test equipment.

Meet Our STEM Intern Sophie Zhang

Ohmsett is proud to participate in the High Technology High School's Student Mentorship program. High Technology High School, located in Lincroft, New Jersey is a nationally recognized Blue Ribbon specialized school concentrating in math, science, and technology. In the mentorship program, a senior from High Tech High elects to intern at a company of their choice, where he or she receives high school credit for work done during that time.

According to Emily Lagrotteria Petrillo, High Tech High Mentorship Coordinator, the program is a mandatory component for seniors. "The process begins during their junior year. The students work with me to define their areas of interest and find a relevant placement. They are expected to develop a professional resume, set up and go on a professional interview to discuss what their experience will be like, and communicate with their mentor once placed and in progress."

At the end of the program, the students develop a presentation that includes information about their placement, the project(s) they worked on, and how it will guide their future study and/or career choices. "We have worked extensively over the years with AT&T, Alcatel-Lucent, Commvault, and Yorktel as some of our technology partners. They report that our students are more competent and serious of purpose than the graduate students that have interned with them," stated Petrillo.

This winter Sophie Zhang chose Ohmsett for her mentorship since it closely aligned with her interest in chemistry and environmental science. In her own words, Sophie describes her experience.

"Working at Ohmsett during my senior year was an immensely fulfilling experience. I initially chose this mentorship opportunity because it married my interests in chemical engineering and environmental science. In the past, I've done some research concerning water purification, and I was excited to broaden my experience in this field. As I'm preparing to leave high school and begin the next stage of my academic career, I'm grateful to Ohmsett for giving me a glimpse of an incredible potential career.

Over the past few weeks, I've been primarily working in the lab. My personal project is carrying out a small-scale simulation of emulsion formation following oil spills. In addition to learning techniques and instruments for characterizing fluids, my interactions with my mentor and other technicians have deepened my understanding of the overarching challenges encountered in the oil-spill response community. Occasionally during breaks, I'd walk outside (after bundling up in layers of clothing!) and check out some of the ongoing projects; the preparation for testing oil recovery from ice has been especially exciting. Overall, this experience has reinforced my love for hands-on investigation and shown me research is far more versatile than I previously imagined."

Ohmsett
Oil Spill Response Research & Renewable Energy Facility

The Ohmsett Gazette is published biannually to update our readers on testing, training, and research activities at the facility.

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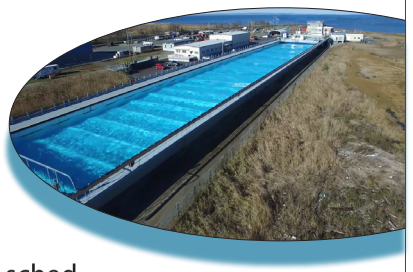

Now is the perfect time to evaluate new designs, prototypes, or to test the efficiency of your oil spill equipment against a wide range of controlled conditions in a marine environment.

ARA will be preparing Ohmsett for a scheduled refurbishment project during the Summer of 2021 when the tank will be drained for maintenance tasks.

Schedule your project now before the tank goes offline. Contact Jane Delgado at 908-601-7082 or jdelgado@ohmsett.com.

Facility Capabilities:

- ◊ Independent and objective testing
- ◊ Measurable & repeatable test parameters
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- ◊ Marine debris recovery systems
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- ◊ Testing of Underwater Autonomous Vehicles (UAV)
- ◊ Evaluation of security barriers
- ◊ ASTM Standards testing
- ◊ Chemical treating agents and dispersant effectiveness
- ◊ Evaluation of remote sensing systems for oil and non-oil surfaces
- ◊ Emulsion formation
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