Ohmsett Newsletter
Fall 2023

# The Ohmsett Gazette

The National Oil Spill Response Research & Renewable Energy Test Facility

## Harvesting Energy from waves

Many countries around the world are switching to renewable energy as they transition away from fossil fuels. To help make the transition, the United States is investing in clean energy research and development, and technology developers are looking at untapped resources such as wave, current, and tidal energy that hold the greatest potential to generate green energy.

To assist developers with harnessing energy from the ocean, the U.S. Department of Energy established the Testing Expertise and Access for Marine

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## API Workshop Attendees Learn about Dispersant Use

Dispersants are one of several response tools that may be considered for use during response operations to minimize the overall environmental impacts of an oil spill. In an ongoing outreach effort to provide an understanding of the benefits and limitations of dispersant use, the American Petroleum Institute (API), in partnership with ExxonMobil, sponsored a dispersant workshop at Ohmsett.

"Dispersants are an essential, but

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*Thirty members from academia, industry, and oil spill responders attended the two-day API/ExxonMobil Dispersant Workshop in June 2023.*

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# Dispersant Workshop

generally misunderstood, oil spill response tool. With recent regulatory updates and continual loss of expertise in the spill response community, API's role of advancing science, engaging with regulators, and educating stakeholders is crucial in this space," commented Tim Steffek, senior policy advisor at API.

The two-day workshop took place June 27-28, 2023, and was attended by 30 members from academia, industry, and oil spill responders. The program included a combination of presentations and demonstrations led by subject matter experts in the industry, as well as scientists and researchers.

Classroom discussions provided an overview of dispersant use, industry perspectives on dispersant use, oil and dispersant toxicity, biodegradation of oil, dispersant aerial application operations, and international use of dispersants.

"It was great to hear from a diverse group of stakeholders who were able to provide different perspectives of dispersants. Presentations covered topics from dispersant history, science, operations, and regulations and approvals," said Steffek.

Out on the Ohmsett test tank, the workshop participants gathered on the main bridge and the side deck for demonstrations where they saw first-hand how dispersant breaks up the oil into droplets small enough to be dispersed into the water column.

During a side-by-side surface dispersant comparison, two frames containing crude oil were placed on the water's surface; a dispersant was applied to one, and the other was untreated. The frames were lifted to release the slicks. As slicks were subjected to wave energy, the slick treated with the dispersant turned brown, an indication of dispersed oil.

Also on the Ohmsett test tank, a subsurface dispersant application was demonstrated. In this exercise, a subsurface crude oil plume was created using metered subsurface injection from the main bridge at approximately one meter below the surface. This untreated plume was extended down the tank through the advancing travel of the main bridge. After a brief amount of time, a dispersant-treated oil plume was introduced to demonstrate the difference between the non-dispersed plume and the dispersed plume.

"The value of holding the workshop at Ohmsett is the unique ability for participants to witness large scale dispersant demonstrations," Steffeck explained. "For many, this may be their first and only opportunity to see an oil slick dispersed. API looks forward to hosting a dispersant workshop at Ohmsett next year."

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# Wave Energy Evaluation

Energy Research program (TEAMER), managed by the Pacific Ocean Energy Trust. Its mission is to accelerate the viability of marine renewables by providing access to the nation's best facilities and expertise. As a member of the TEAMER Network of Facilities, Ohmsett bridges the gap in marine renewable energy development through testing and evaluating wave and current energy systems, as well as technology used for the Blue Economy.

In a recent collaboration with TEAMER and the University College Cork, Ireland, Ohmsett conducted tank testing of OceanEnergy's 1:15 scale floating oscillating water column wave energy converter. While deployed in varying wave conditions, the oscillating water column compresses air within a chamber to spin a turbine capable of generating electric output. As a wave passes by the unit, negative air pressure is created within the chamber to further spin the turbine.

The device has been in development for over a decade and was tested at the Lir National Ocean

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*On the Ohmsett tank, OceanEnergy's 1:15 scale floating oscillating water column wave energy converter was studied for operational and structural performance.*

# Training for Competence and Confidence

What is the best way to prepare personnel for responding to oil spills? By providing hands-on training with real oil! To ensure their personnel and partners are up-to-date on policy and practices, bp provided a comprehensive oil spill response training program that included a dispersant application demonstration at Ohmsett.

According to Scott Neuhauser, bp oil spill manager, the goal was to give industry response leaders exposure to tactical oil spill response requirements. “We prioritized the opportunity Ohmsett provided to give the students hands-on experience working with oil on water. We also brought in presenters from Oil Spill Removal Organizations, technical experts, and researchers to give presentations and demonstrations on existing equipment, best practices, and new products under development.”

The four-day event took place May 15-19, 2023, where 24 attendees participated in a combination of demonstrations, classroom discussions, practical exercises, and equipment decontamination procedures.

On day one, Ohmsett staff assisted in the introduction to dispersants block of instruction which included the Special Monitoring of Applied Response Technologies (SMART) protocols and a wave dispersant application demonstration. “One of the key benefits of holding the class at Ohmsett is the opportunity for the students to observe the effects of dispersant application on water. Seeing the oil disperse into the water column and the real-time effectiveness of dispersants on oil in the tank environment was an invaluable experience for the students,” explained Neuhauser. “Having Joanne Letson and Tom Coolbaugh run the students through baffled flask dispersibility assessment testing in the lab gave excellent insight into how dispersants interact with hydrocarbons and the impact of energy on the process.”


*Training included equipment demonstrations and hands-on skimming exercises with real oil.*

Days two and three were followed with classroom training, a static equipment demonstration, and hands-on stationery and advancing skimming exercises with real oil in the Ohmsett tank with and without waves. On the final day, students decontaminated the equipment they used during training.

“By rotating student groups through stations covering dispersant application, stationary skimming, advancing skimming, and decontamination, interspersed with classroom, lab, and field demonstrations of equipment setup and operation, they received a solid understanding of the requirements of managing a tactical oil spill response through hands-on experience,” said Neuhauser. “We received very positive feedback on the training and the facility from the students. It was a great learning experience for them that they will take back to their businesses around the world.”

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# Wave Energy

Test Facility at the University College Cork and École Centrale de Nantes in France.

According to University College Cork's Michael O’Shea, the objective of securing TEAMER funding and testing at Ohmsett was to focus on improving tank testing accuracy of the 1:15 scale device in seawater.

The TEAMER project was tested at Ohmsett May 1-12, 2023, to study the operational and structural performance of the wave energy converter. With the device compliantly tethered between the main and the auxiliary bridges, it was subjected to a mix of irregular and regular waves. Through the data acquisition system attached to the device, O’Shea and the Ohmsett staff measured pressure, as well as wave and water movement.

# Non-invasive Technology for Imaging Oil Spills in Ice-infested Waters

When oil is accidentally discharged into Arctic waters, it can be extremely difficult to detect oil that is trapped under and in the ice. To overcome this struggle and provide responders with real-time data on where to direct their clean-up efforts, The Bureau of Safety and Environmental Enforcement (BSEE) funded a project with the American University of Beirut (AUB) to develop a non-invasive sensing technology designed to image the spill area above the surface of the ice.

The Electrical Capacitance Tomography (ECT) prototype sensor has the potential to detect the presence of oil under ice and estimate its depth and thickness. "ECT provides information about the internal structure and/or composition of objects without physically penetrating or damaging them," explained Jay Cho, program manager with BSEE's Oil Spill Preparedness Division. "It involves measuring the capacitance between multiple pairs of electrodes placed on the outer surface of the object or medium under investigation. When an alternating current is applied to these electrodes, the capacitance between each electrode changes based on the dielectric properties (permittivity) of the materials present between them."

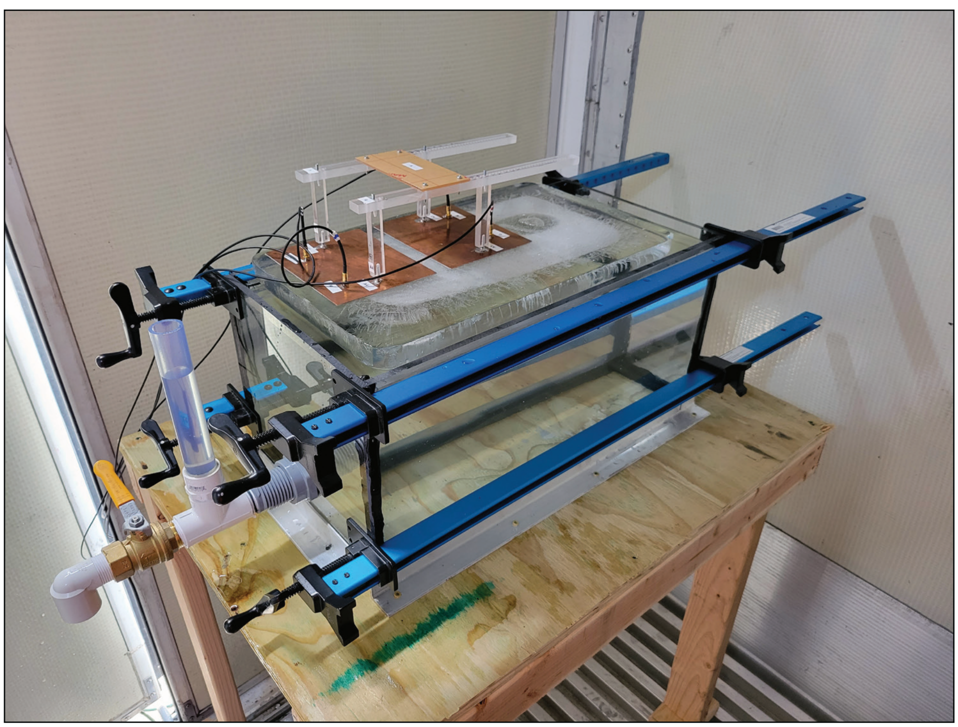
**Electrical Capacitance Tomography provides information about objects without physically penetrating or damaging them**

In June 2023, AUB brought the prototype remote sensor and computer algorithms to Ohmsett for a proof-of-concept bench-scale test. According to Cho, the objective was to test ECT's capabilities under different scenarios and conditions (e.g., perfect ice, ice with impurities, melting ice, etc.).

To prepare for the test, the Ohmsett staff created a temperature-controlled cold-weather environment inside a refrigerated conex container where they created ice blocks for use during the tests. Additionally, they fabricated a small tank to hold a variable amount of water along with oil and ice. "The test stand was a clear box with an exterior tube and a valve to add and remove oil and water to the setup. The test box was sealed to hold water, oil, and ice and it had the following dimensions: 30.5 cm x 50.8 cm x 17.1 cm," described Cho.

Throughout testing, the small tank and sensors were kept in the refrigerated conex container, while the data acquisition and analysis were positioned outside of the container. Two types of crude oils were used, fresh Alaska North Slope (ANS) and Hoover Offshore Oil Pipeline System (HOOPS). A prepared ice slab was placed on saltwater and oil in the test stand. The coplanar probe was then mounted on the ice slab that contained the test fluids. Tests were repeated for each ice thickness with different oil thicknesses for each oil type. AUB researchers collected, recorded, and analyzed the capacitance data in real time.

Cho stated that the next steps in development will include scaling up the sensor to increase its penetration depth, customizing the acquisition system to be able to read high capacitances resulting from scaling up the sensor, improving the real-time operation of the sensor by automating the motion of the probes, and designing mounting mechanisms for field operation. "The final step will be testing and calibrating the sensor under different conditions such as snow over ice, and ice with bubbles."



*The sensors were tested in a small tank inside a refrigerated conex container. An ice slab, prepared in advance of the test, was placed on saltwater and oil in the test stand. The coplanar probe was then mounted on the ice slab that contained the test fluids.*

# Monitoring Surface Water Droplet Size Distribution

*During testing, sensors were mounted to a metal frame. Oil was treated with dispersant and released within the test area. As a breaking wave hit the slick, the instruments measured the effects.*

The Bureau of Safety and Environmental Enforcement's (BSEE) Response Research Branch, along with scientists from the New Jersey Institute of Technology (NJIT), is working on a project to gain a better understanding of how surface water dispersant monitoring can be practically implemented with current technology, as required by new Environmental Protection Agency (EPA) regulations. The EPA recently finalized the new monitoring requirement under Subpart J of the National Contingency Plan (NCP) for dispersant use during oil discharges and in the navigable waters of the United States and adjoining shorelines.

"In response to the new requirement, this research project is designed to test existing sensors and cameras in surface waters to measure droplet size distribution (DSD) and fluorescence, which are characteristics that can predict and track the transport and fate of oil in water," said Ann Slaughter, BSEE chemical treatments program manager.

The three main goals of the project are to validate the instrument's accuracy in a lab setting at NJIT, deploy the instruments in the Ohmsett tank to test a variety of operational aspects of the instruments, including towing capacity, carriage systems, data processing, etc., and conduct a field evaluation at sea to test the instruments on a ship.

The technology purchased for the project was the Towed Silhouette Camera (Towed SilCam) from SINTEF and the Laser In-situ Scattering and Transmissometry (LISST) Black from Sequoia Scientific. "These instruments measure DSD, fluorescence, depth, and temperature, in both stationary and towed positions," Slaughter explained. "Other existing Ohmsett and NJIT instruments were included in tests to validate the data from the LISST Black and Towed SilCam."

The week-long tank deployment phase of the project took place at Ohmsett June 12-16, 2023, where NJIT researchers tested the deployment, tow configuration, and real-time data processing of the instruments below a slick of Hibernia crude oil in untreated (oil-only) and treated (oil and Corexit 9500 dispersant) conditions. Initially, dry runs were conducted to determine the location for a breaking wave to target the instruments and oil containment boom locations. "The wave conditions place a breaking wave directly on the slick to generate a realistic at-sea mixing energy," said Slaughter.

For static tests, the Ohmsett staff attached the instruments to a metal frame and secured the frame to the bottom of the tank near the breaking waves. Once the breaking wave location was determined and the instruments were in place, untreated crude oil was poured and confined within a containment square and released before the breaking wave reached the target. For the treated oil, the oil slick was sprayed with dispersant using a hand-held portable pressurized sprayer prior to the breaking wave. "This setup allowed the instruments to measure the effects of the breaking wave on the oil in the water approximately one meter below the surface," Slaughter commented.

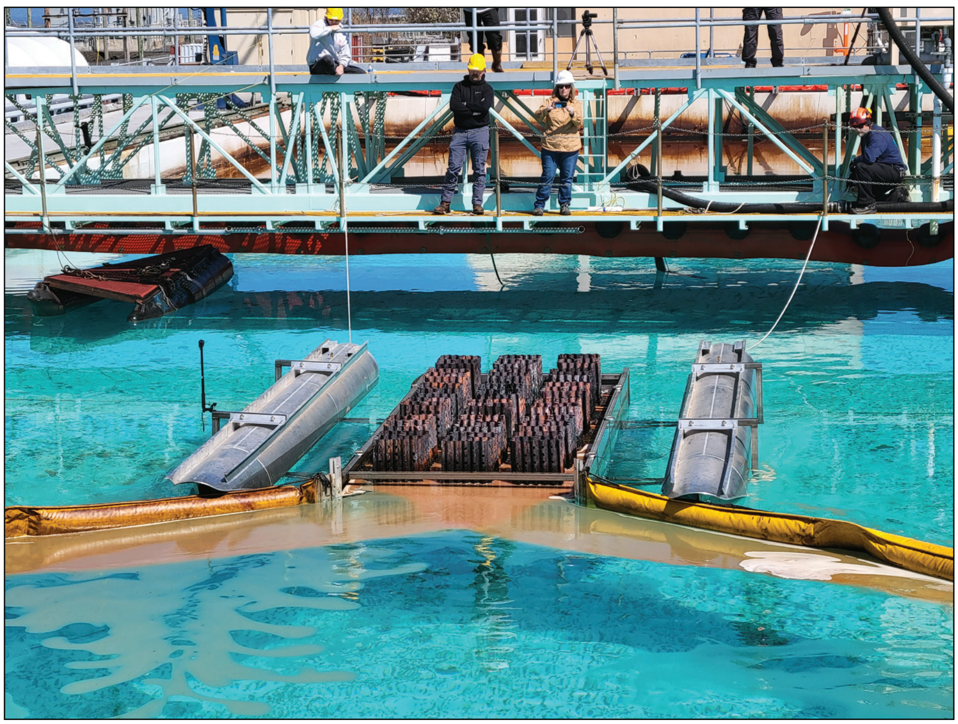
For dynamic tests, the Towed SilCam was secured to the main bridge to simulate towing as the bridge moved up the tank.

*Tethered to the main bridge, the SilCam was towed through the tank during dynamic tests.*

The researchers are processing and analyzing the data from the Ohmsett tests and continuing the laboratory validation phase at NJIT. Another test at Ohmsett is planned for November 2023, and the field test phase is in the planning stage for 2024.

# Reducing Emissions and Burn Residue

In situ burning is an oil spill response technique that involves the controlled ignition and burning of oil on the surface of the water at or near the spill site. This technique can be effective during large-scale spill incidents to remove the oil before it can settle into the water column and harm the environment. However, it creates thick black plumes of smoke and leaves behind harmful residue. Continuing their decades-long research on effective technologies for in-situ burn, BSEE funded the Worcester Polytechnic Institute (WPI) to develop the Flame Refluxer™ technology that could potentially burn off spilled oil quickly while lowering levels of harmful pollutants.



*The Flame refluxer is designed to increase combustion efficiency and reduce emissions and burn residue. It was evaluated at Ohmsett for buoyancy and behavior in waves.*

"BSEE has been working with WPI to advance the maturity of their Flame Refluxer™ Technology for a decade. Through many research phases, WPI has advanced the proof-of-concept to a robust prototype," commented BSEE Response Research Branch Chief, Karen Stone.

The Flame Refluxer™ is a floating heat feedback device that consists of metal coil modules attached to a blanket made from copper wool sandwiched between two layers of copper mesh. Designed to increase combustion efficiency and reduce emissions and burn residue, it was previously tested at the former Joint Maritime Testing Facility (JMTF) operated by the U.S. Coast Guard and Naval Research Lab, and the Cold Regions Research and Engineering Laboratory facility (CRREL) with a simulated oil flow into the system and ignited.

According to Stone, in preparation for the series of tests at Ohmsett, discussions between WPI scientists and Ohmsett engineers resulted in a system alteration. "It was decided that the float would benefit from several modifications to the unit's buoyancy systems. This insight from Ohmsett's combined decades of experience of testing oil spill response equipment in realistic conditions provides invaluable data and information needed to advance oil spill response technology."

The modified prototype was brought to Ohmsett the week of April 3, 2023, to evaluate its buoyancy and behavior in waves under tow and to determine the timing and location of future ignitions. There were no ignition or burns conducted at Ohmsett. "WPI worked with the Ohmsett test engineers to develop a robust testing regime to ensure the Flame Refluxer™ technology is ready for operation the open ocean," said Stone.

Using a crane, the 4000 lb. system was carefully lowered into the Ohmsett test tank and securely rigged between the main and auxiliary bridges. The project team developed the appropriate oil flow profile and velocities and used the oil distribution tank to deposit Hydrocal within the system's boom arms. As the system was towed through the water, the oil was corralled by the boom arms and migrated into the refluxer modules.

During the buoyancy and behavior tests, WPI researchers monitored the oil behavior while measuring the oil-slick thicknesses as oil migrated into the float at various tow speeds and wave conditions. The team also noted oil entrainment above and below the boom system to determine optimal tow speeds.

The data collected from the tests and observations will be used to prepare the Flame Refluxer™ for open water demonstrations during Canada's Multi-Partner Research Initiative (MPRI) Offshore Burn Experiments in 2025. "After testing at Ohmsett, I'm confident that the technology is ready for operations on the open water during oil spills," said Stone.

# From the Classroom to the Tank

In an era where oil spill prevention efforts are working well, there have been fewer opportunities for responders to learn on the job. Organizations can minimize safety risks by providing team members with dynamic training, in and out of the classroom.

To achieve a state of readiness to respond to oil spills, the U.S. Coast Guard provides its personnel with a hands-on Oil Spill Recovery Technician (OSRT) course twice a year at the Ohmsett facility. Incorporating both classroom and hands-on exercises with real oil in a marine environment, the USCG held two sessions during the weeks of April 24 and August 7, 2023.

The curriculum is based on the National Strike Force (NSF) qualification requirements. Personnel received training on spill recovery equipment, pumping and transfer operations, Special Monitoring of Applied Response Technologies (SMART), a side-by-side dispersant demonstration, and equipment decontamination.

Each five-day training session included classroom instruction, after which, the students were divided into groups rotating through a series of equipment stations. The stations increased their knowledge of setting up oil spill recovery equipment, dispersant application, and monitoring systems using the Ohmsett tank.

Through 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.

"Having the ability to conduct training at this one-of-a-kind facility is immensely important to the development of the NSFs responders," said Angie Vallier, PREP/Readiness Specialist at the NSF Coordination Center. "The real-world atmosphere that the tank can provide and the hands on concepts of the course provide responders the opportunity to hone their skills in a controlled environment."

*During skimming exercises, the students practiced recovering real oil in conditions that simulate an actual oil spill.*


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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# Think Tank. Think Answers.
# Think Ohmsett!

Prototyping is an important step in new product development for oil spill technology, marine energy systems, and blue technology. Whether it is to explore new designs or refine existing technologies, Ohmsett can assist in testing for maximum results in performance, survivability, autonomous operation, maneuverability, and sensor integration.

In the relatively controlled and repeatable test environment of the outdoor wave tank, developers have access to expertise and tools for scaling new technology and validating engineering expectations under varying flow, position, and load conditions.

- Full-scale testing with oil
- Skimming systems
- Containment boom & barriers
- Sensors
- Wave energy converters
- Protocol development
- Controlled marine environment
- Accurate and reliable results

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