Oil Spill Response Research & Renewable Energy Test Facility

The Ohmsett

Leonardo, New Jersey · Testing · Training · Research · Fall/Winter 2013

Lights. Camera. Action!

Discovery Channel Canada sent a film crew to Ohmsett in August to tape a segment for their program *The Daily Planet*. Ohmsett Engineer Paul Meyer was the spokesperson for the day, taking them through the complete process of testing the Elastec TDS118G skimmer to the ASTM F2709-08 Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems.

Filming included an explanation of Elastec/American Marine's skimmer technology, the test setup per ASTM 2709-08, dispensing of oil into the test area, taking

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Ohmsett Engineer Paul Meyer explains the test setup during the filming of the Discovery Channel Daily Planet program.

What's Inside

Testing to the ASTM F2709-08 Standard

Elastec/American Marine of Carmi, Illinois tested their TDS118G Grooved Drum skimmer to the ASTM F2709-08 Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems at Ohmsett on August 6 and 7, 2013. The TDS118G is capable of recovering both light and heavy oils with high recovery efficiency.

This skimmer design incorporates rotating drums with grooves on the surface which enhance the oil recovery rate. The grooved technology is based on research conducted by the University of California, Santa Barbara and extensively tested at Ohmsett.

"We have tested a number of our skimmers at Ohmsett over the years. In 2012 we tested our TDS136G, Magnum 100G and X150 skimmers. With the advent of the new ASTM standard certification program, we feel it's important to test our latest skimmer designs to verify the nameplate capacity, which in turn helps responders and planners by providing a benchmark for spill planning and obtaining OSRO [Oil Spill Response Organization] status with the U.S. Coast Guard," said Stewart Ellis, vice president of Sales and Marketing at Elastec/American Marine.

During the tests, the skimmer was placed in a boomed area within the test basin that was three times the length and width of the skimmer, as required by the ASTM test standard. Samples of the oil dispensed in the test area were taken to determine its properties. For the test, the skimmer was run until the equivalent of one inch of oil was recovered from the test area, with a minimum test time of 30 seconds. Samples of the collected oil were sent to Ohmsett's on-site oil/water lab for analysis, and oil recovery rate and recovery efficiency were calculated. "We are pleased that the performance met and exceeded our advertised recovery rates," said Ellis.

The Elastec grooved drum skimmer was tested to the ASTM Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems.

Dispersants 101: API Interactive Classroom and Field Demonstration Workshop

In an ongoing outreach effort to provide an understanding of the benefits and limitations of dispersant use in response efforts, the American Petroleum Institute (API) hosted an oil spill dispersant workshop at the Ohmsett facility during the week of July 8, 2013. API is a national trade association that represents all aspects of America's oil and natural gas industry; from producers, refiners, suppliers, pipeline operators and marine transporters, to service and supply companies that support all segments of the industry.

"In the last few years, a large number of new research projects have targeted dispersants as an area of scientific interest, and the workshop was designed to educate the current community of academic researchers on dispersant use in near real world conditions," explained Emily Kennedy, policy advisor for Upstream and Industry Operations at API. The workshop was attended by representatives from universities, oil companies, and government agencies.

The API workshop focused on the practical application of dispersants for use in oil spill response. It included both interactive classroom-type discussions where participants learned about dispersants and their use, and practical field demonstrations conducted in the Ohmsett tank where they could observe how dispersants are applied, how they break up the oil into droplets and then disperse it into the water column.

Led by subject matter experts in the industry, as well as scientists and researchers, classroom discussions provided an overview of dispersant use; how they can be applied, the science behind the use, and how biodegradation comes into play. "This is Dispersants 101," said Kennedy. "There are many tools for response. Dispersants are one tool and as with any tool, there are limitations. Industry and government responders use the Net Environment Benefit analysis to assess which tools to use. It helps them determine when dispersants would be the right choice to use during response operations."

Out on the Ohmsett tank, skimmer demonstrations were conducted in a portable tank with both a weir type skimmer, and an oleophilic grooved drum skimmer to show how they are used during spill response efforts. After the demonstrations, the workshop participants gathered on the main bridge where Randy Belore, a dispersant expert with SL Ross Environmental Research, Ltd., conducted a series of tank runs.

The objective of the tank runs was to first demonstrate the characteristics of an oil spill interacting with water and waves prior to the application of dispersant. Then, after the application of dispersant, an oil slick was observed as wave energy passed through it. This provided a visual demonstration of oil being broken up into droplets small enough to be dispersed into the water column. Finally, several passes were made to demonstrate the use of subsurface in situ instrumentation to monitor the progress of the dispersed oil plume.

Further down the tank, the participants were able to observe the use of acoustic techniques for measuring the oil droplet size for subsurface releases of crude oil and dispersants in the presence of gas. The demonstration of the research funded by the Bureau of Safety and Environmental Enforcement (BSEE), was conducted by Paul Panetta of Applied Research Associates, Inc. and a team of researchers from Virginia Institute of Marine Science and College of William & Mary.

The measurement tools used during the demonstration included acoustic droplet sizing equipment and a suite of commercial equipment. The instruments, along with oil and dispersant nozzles and a gas bubbler, were installed onto a subsurface oil release frame. The instruments were connected to computers for data collection, and the frame was placed in the Ohmsett tank. Subsurface oil, gas, and dispersant were released, and oil droplet measurements were taken. The demonstration was conducted with and without waves.

"Our acoustic instruments provide the full acoustic wave form which we are using to

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At left: Fresh crude oil was applied to the water surface in the Ohmsett test tank. To the right: A few minutes after dispersant was applied, the brown color is a visual indication of dispersed oil.

Analyzing Volatile Organic Compounds of Dispersed Crude Oil

During the Deepwater Horizon oil spill response efforts, there were concerns raised over the possible impact of the release of volatile organic complounds (VOCs) on air quality as a result of the use of dispersants during surface operations. VOCs are emitted as gases from certain solids or liquids (e.g. crude oils) and may pose short- and long-term adverse health effects. These concerns prompted the Bureau of Safety and Environmental Enforcement (BSEE) to fund research, led by Louisiana State University (LSU) Department of Environmental Sciences, to develop real-time and passive monitoring protocols to determine the impact of dispersant use on VOC release. Ohmsett tank studies were conducted July 22-26, 2013 to analyze VOCs in the water and air after crude oil was chemically dispersed into the water column.

"The study was designed to look at the VOC hazards response workers may encounter while responding to an oil spill," said Scott Miles, environmental engineer at LSU. "The equipment we use is a real-time air and water monitoring system that can analyze the VOC emission levels before and after dispersants have been applied to oil. Dr. Edward Overton at LSU has developed this system over the last 15 years and [it] has been used at multiple spills by NOAA's Emergency Response Division."

The VOC detection system is a portable micro gas chromatograph with flame ionization detector (GC/FID) that analyzes organic substances containing hydrocarbons and VOCs. Gas chromatography is an analytical separation technique used to analyze volatile substances in the gas phase. "In gas chromatography, the components of an air sample are separated by distributing the sample between two phases: a stationary phase and a mobile phase. The mobile phase is a chemically inert gas that serves to carry the molecules of the analyte through a long, heated tubular column (stationary phase). The FID detects analytes by measuring an electrical current generated by electrons from burning carbon compounds in the sample. The flame ionization detector (FID) is a non-selective detector used in conjunction with gas chromatography. The FID detects all carbon containing compounds and has an extremely wide linear dynamic range," explained Miles.

Using the standard dispersant protocol in the Ohmsett tank, multiple test runs were conducted with controls (just oil) and dispersed oil treatments. For the first series of runs, oil was dispensed on the water and waves were initiated. With the GC/FID sample collection equipment mounted on the main bridge, the system was passed over the top of the oil to record and take samples of the oil emissions in the air and water.

During the next series of runs, oil was dispensed on the water, dispersant was applied on the oil, and waves were initiated. Again, the GC/FID system passed over the dispersed oil to determine individual VOC components within the air and water. The team also used passive air absorption tubes to collect air samples over the spilled oil. The passive air sample tubes were stored and taken back to the LSU lab for analysis. "We were trying to get a correlation between the in-situ and passive sampling techniques while monitoring the volatiles that were coming off the oils," said Miles. "In addition, we monitored the oil in the water using a LISST [Laser in Situ Scattering and Transmissometry] and in-situ fluorometer to determine the particle size distribution and oil dispersion effectiveness within the water column. This is similar to the [SMART] protocol used by the U.S. Coast Guard during oil spill incidents to monitor dispersant operations."

Once the data is analyzed, the team will provide their recommendations to BSEE. "We would like to further our studies with some counter measure applications that would absorb the VOCs in the water," said Miles. "The technology we have been testing has been used for ground water applications, and feel it could be valuable for use during oil spill response operations."

The GC/FID sample collection equipment passes over the top of an oil slick to record and take samples of the oil emissions in the air and water.

Performance Testing of the Improved Oiltrawl Boom System

Since early 2012, NorLense AS of Norway has tested the Oiltrawl Fast Current Boom System several times at Ohmsett. From these previous tests, ideas were generated to improve the system's performance for testing in the Ohmsett test basin. The Oiltrawl is a fast water system designed to recover patches of oil as well as thin oil slicks over large areas. It incorporates a guiding boom, oil/water splitter, and a collection bag to collect the recovered oil. The collection bag is designed for rapid interchangeability and contains an internal baffle to prevent loss of collected fluid.

The improved Oiltrawl system encounters a slick of oil during performance testing at Ohmsett.

During the weeks of May 28 and June 3, 2013 NorLense returned to Ohmsett with a new design that now includes elongated boom legs that allows air to escape from vents preventing damage when compressed, and will then re-expand to return to its original buoyancy. "Also the splitter that divides the floating oil from the water was improved before the June testing," commented Hugo Svendsen, NorLense R&D Manager. "These design modifications showed to be very efficient."

Throughout the performance testing, the Oiltrawl was rigged between the main bridge and the auxiliary bridge. The system encountered a consistent slick of medium and heavy test oils at varying speeds in calm and wave conditions to determine the recovery throughput efficiency values. "The average throughput efficiency that was attained is a result we find very satisfying," stated Svendsen. "The documentation from Ohmsett is a very important document to show our potential customers around the world as we take the Oiltrawl to the markets."

Dispersants 101

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measure the frequency response of the scattering from the gas and oil," said Panetta. "It is critical to obtain the complete wave form and the frequency response to separate out gas from air and provide a droplet size."

The two acoustic droplet sizing instruments included low frequency acoustics to excite the resonances of the gas bubbles and to help isolate the acoustic response from oil and gas, and high frequency acoustics to measure the response from both the oil and the gas.

The commercial instruments used to support the acoustic instruments were: the LISST, to measure the oil droplet size and gas bubble size; the imaging sonar, to provide acoustic images of the oil plume and to determine if it is compatible with the measurements being developed for easy technology transfer and; the acoustic doppler velocimeter, to determine if it is compatible with the measurements being developed for easy technology transfer.

"The workshop provided an opportunity for academic researchers, government responders, and industry to see the Ohmsett test facility first hand," commented Kennedy. "They gained experience in the specifics of dispersants use and its practical applications, and gained a broader understanding of the extent of research & development that has been carried out on dispersants."

During the demonstration, the acoustic measurement instruments, were installed onto a subsurface oil release frame, then placed in the Ohmsett tank.

Generating Renewable Power from the Water's Vibrations

Vortex Hydro Energy (VHE), a Michigan-based company, has designed a device nicknamed VIVACE (VIVACE: Vortex Induced Vibrations for Aquatic Clean Energy) that takes the phenomenon of vortex induced vibrations to extract useful energy from ocean, river, tidal, and other water currents. VHE has the exclusive license to commercialize this University of Michigan patented, hydrokinetic power generating device.

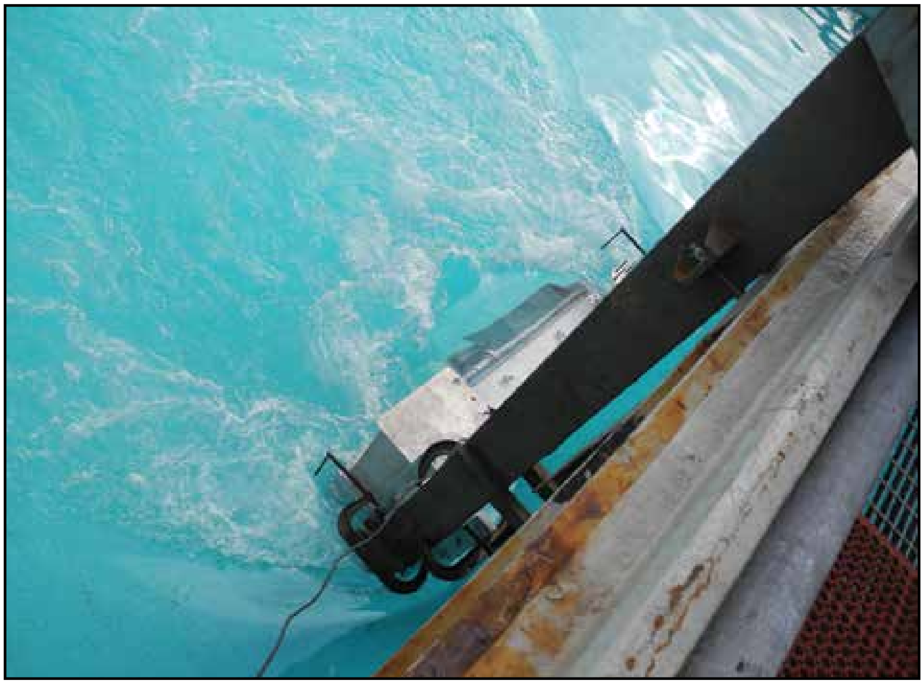
Research into creating VIVACE began in 2005 when Professor Michael Bernitsas, of the Department of Naval Architecture and Marine Engineering at the University of Michigan - Ann Arbor, turned his research 180 degrees from what he and others had been working toward. "He looked for ways to maximize the effects of VIV and control its power rather than suppress its effects. His work resulted in the development of a device that is capable of harnessing the destructive power of VIV in a controllable manner, resulting in generation of clean and renewable electric power in an environmentally compatible way," said Rebecca Alter, Project Engineer for Vortex Hydro Energy.

According to Alter, the VIVACE can be placed in a river or ocean current to extract energy from moving water. Since the device does not use turbines, propellers, or dams, it is non-obtrusive, environmentally friendly, and has an extremely high energy density compared to other renewable technologies.

The major goal of the company is to decrease the Levelized Cost of Energy (LCOE $/kWh) of the VIVACE device. During the week of May 13, 2013, Vortex Hydro Energy performed testing at Ohmsett to measure the change of power generation in the VIVACE device from previous prototypes, to the most current version to improve this metric.

While rigged to the main bridge in the Ohmsett test tank, the VIVACE prototype was placed in an upright position facing the direction of the current flow. In order to produce a driving current, a series of towed test runs were conducted with the prototype in the water. In order to document performance, the data for several variables were collected including: current speed (tow speed), mass damping, spring rate (loading and damping), and electrical loading.

"We were able to increase the power generation efficiency of the VIVACE converter and prove these improvements during testing at Ohmsett," stated Alter, "From here VHE will continue to make strategic changes to the VIVACE device to further reduce the LCOE of the device."



During a series of tow tests, the VIVACE prototype was rigged to the main bridge and placed in an upright position facing the direction of the current flow.

Discovery Channel Filming

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samples of the oil, skimming the oil, collecting the oil in the collection tanks, taking measurements, collecting samples of the recovered fluid, decanting of the fluid, and analysis of the recovered fluid in Ohmsett's oil/water lab.

"This was a wonderful opportunity to show how testing is conducted here at Ohmsett," commented Meyer. "We were able to highlight the importance of a skimmer system's recovery rate by conducting a performance test to the ASTM 2709-08 standard."

After filming the test process, the crew conducted an interview on the main bridge overlooking the test area. Mr. Meyer described the facility and the type of testing, training, and research conducted here.

Following the interview, the crew went to Ohmsett's on-site oil/water lab to film what happens with the fluid samples that were collected during the test. There, Technician Allen Cannone and Engineer Alan Guarino walked them through the analysis process of determining the properties of the oil that was dispensed into the test area as well as determining the water content of the oil that was recovered by the skimmer. "These values are used to determine a skimmer's oil recovery rate as well as its oil recovery efficiency," explained Meyer.

To view the program, go to http://watch.discoverychannel.ca/daily-planet/september-2013/daily-planet---september-9th-2013/#clip1000146. The Ohmsett segment starts around the 4:28 mark.

Wave Energy Harvesting Technology Tested

In the quest for a simple and economically feasible wave energy device, Seattle-based Oscilla Power, Inc. (OPI) is in the developmental stages of a patented wave energy harvester. The technology associated with the power take-off (PTO) of the energy harvester has no moving parts and is known as reverse magnetostriction (converting mechanical energy into electrical energy).

OPI began developing the wave energy harvester technology in 2009 following its invention by its co-founder and Chief Technology Officer Dr. Balakrishnan Nair, a metallurgist and materials scientist. OPI has advanced the technology they have termed iMEC™ to convert mechanical load changes into electricity. These loads are produced by the movement of one or more buoys, partially submerged and anchored by taut tethers that respond to hydrodynamic forces caused by surface waves.

OPI's development efforts have been supported by private investors as well as Small Business Innovative Research (SBIR) grants awarded by the Department of Energy, National Oceanic & Atmospheric Administration, and the National Science Foundation.

OPI has developed the iMEC technology to convert wave energy into electricity.

Earlier this year OPI partnered with the University of Washington's Applied Physics Laboratory to test its 1:4 scale power take-off (PTO) in Lake Washington. During the week of May 20, 2013 OPI brought the wave energy harvester to Ohmsett for tank testing. "Similar to the Lake Washington testing, the purpose of the tank tests was to validate that the iMEC-enabled PTO of the system performed in a predictable fashion," said Rahul Shendure, OPI's Chief Executive Officer. "While the Lake Washington testing was subject to the whims of the late winter weather, our objective at Ohmsett was to subject the PTO to a wide range of specific wave conditions over a concentrated period of time."

During the week-long test, the hydrokinetic wave energy harvesting system was placed in the Ohmsett test tank using a specially designed and fabricated test jig that situated the system in a stable operating position in the water. According to Ohmsett Senior Test Engineer Alan Guarino, spatial considerations were critical in positioning the iMEC PTO in relation to the large wave-following buoy on the water's surface so that the loads produced by the buoy could be efficiently transferred to the PTO.

Testing consisted of subjecting the energy harvesting system to waves of various energies, wavelengths, and periods. During the test runs, recorded information included wave data, electrical current output, accelerometer data, and tether load forces. "Our testing at Ohmsett proved successful, with a correlation between the predicted and measured output of the PTO across a wide range of wave conditions," stated Shendure.

Based on this success, OPI will partner with the University of New Hampshire's Center for Ocean Renewable Energy to deploy the 1:4 scale PTO in an open ocean test site in July. In addition, open ocean testing of 1:2 scale and full scale PTOs are planned for 2014.

News Briefs

U.S. Coast Guard NSF & SMART Training

The U.S. Coast Guard conducted a five-day training program that provides Coast Guard personnel with both classroom and hands-on training using oil spill response equipment systems onboard the U.S. Coast Guard Cutter JUNIPER class buoy tenders, the Spilled Oil Recovery System (SORS), and the District Response Advisory Team (DRAT)/NSF Strike Team Vessel of Opportunity Skimming System (VOSS) equipment.

During the training, participants moved through equipment stations that included: A half-hull that mimics the ship's starboard side; Hydraulic Prime Mover and Weir Skimmer; Boom Reel operation; Temporary Storage Device/inflatable oil barge; and concluded with on-tank exercises where students recovered spilled oil in calm conditions and in harbor chop conditions.

In addition, they received Special Monitoring of Applied Response Technologies (SMART) protocol training. The SMART protocol is a monitoring program for use with dispersants and in-situ burning and relies on small, mobile teams that collect real-time data using portable instruments.

The Ohmsett Gazette is published bi-annually 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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Alaska Clean Seas Trains Responders

For more than 10 years, Alaska Clean Seas (ACS) has come to Ohmsett for their annual advanced oil spill response training. In September and October, ACS instructors held two one-week sessions for their experienced oil spill responders from member companies.

The training curriculum incorporated classroom topics, tank exercises, equipment deployment, and a field deployment. The objective was to give experienced oil spill responders hands-on practice with oil spill equipment specifications, set-up, operation, maintenance and decontamination. The spill equipment used during the training was from the ACS inventory and other vendors.

Officials from Turkey Tour Ohmsett

Visitors from all over the world come to Ohmsett to tour the facility, many of whom become customers. In August 2013, Peter Lane of Desmi-AFTI brought a representative of Remar Marine and members of the Republic of Turkey Transport Maritime Affairs and Communications to Ohmsett to show them where Desmi-AFTI conducts performance testing of their equipment. From left: Peter Lane, Desmi-AFTI; Ahmed Numan Nasuhioglu, Remar Marine; Cemalettin Selvi, General Director, Directorate General For Regulation of Maritime and Inland Waters; Suat Hayri Aka, Deputy Undersecretary, Ministry of Transport Maritime Affairs and Communications; Okay Kilic, Head of Marine Environment and Tourism Department.

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