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."

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