Alaska Business

Oil Spill Cleanup

Industry pushing technology, procedures forward

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Lingering oil found by trained sniffer dog on a beach along the Prince William Sound in May 2016.

Credit: Oil Spill Recovery Institute/PWSSC

The harsh conditions and remote nature of Alaska present formidable obstacles to those protecting the environment from oil spills. Though oil prices have only recently crept above $60 a barrel, companies,

agencies, and academics throughout the state continue to find the necessary funds to develop better, more efficient technology to prevent and clean up spills.

This technology ranges from infrared and satellite imaging techniques and advances in oleophilic skimmers to the use of bomb-sniffing dogs and Alyeska's new fleet of purpose-built ships.

Skimmers and PPR Otter Systems

The primary line of response to water-based oil spills is using mechanical methods, which have seen numerous enhancements over the years as companies attempt to improve their efficiency, lowering the need for temporary storage units and improving their response in remote areas.

"An OSRO [oil spill removal organization] like Chadux is at a disadvantage; we can' get temporary storage out to some of the places we need to go just because of the remoteness of it," Alaska Chadux Corporation General Manager Matt Melton explains. "So, we definitely need higher efficiency in our skimmers, and that kind of goes with any OSRO nowadays because a lot of things are tied up with temporary storage."

One of the more advanced and efficient skimmers in Melton's member-funded, nonprofit OSRO is the Lamor 50 Skimmer—an oil-attracting (oleophilic) brush skimmer.

The Lamor 50, which is capable of picking up persistent oils when the brushes are run one way and non-persistent oils when run the other, was developed after Chadux team members pitched the idea to engineers at Lamor, says Melton.

However, Melton isn't convinced the limitations of efficiency are entirely with the equipment. He explains that an operator's understanding of water conditions and the skimmer being operated plays a significant role in efficiency.

"I think there is still that combo," he says. "I know back East they are working on autonomous vessels that can go and skim oil, and that will never work up here because you don't always have satellites that will be in range all the time to run them."

That said, there is one skimmer project being developed in Alaska that Melton does consider groundbreaking: the PPR Otter Pup. Alaskan Kevin Kennedy, founder of Pacific Petroleum Recovery Alaska (PPR), is working tirelessly to bring his PPR Otter Series skimmer systems to the market.

"They've probably got the newest thing in the world when it comes to cleaning up oil spills," Melton says. "I'm just hoping he can produce a lot of them because right now the price point is too high for me to jump in."

Kennedy began dabbling with oil cleanup after the Exxon Valdez spill in 1989, though he didn't fully dedicate himself to designing his system until the Wendy Schmidt Oil Cleanup X Challenge, which was inspired by the Deepwater Horizon oil spill disaster.

Despite feeling that regulations like the Oil Spill Act of 1990 (a response to the Exxon Valdez spill) stifle innovation, Kennedy has persevered. The self-taught engineer with a background in commercial fishing first applied his understanding of dragging nets to catch fish to the problem of oil spills as he developed PPR Otter systems.

His patented net design creates a high-pressure system on one side of the net and low-pressure system on the other, allowing the equipment to round up oil while moving at a rate of 2 to 3 knots. Once the net stops moving, the oil all comes out, which leads to the second phase of the project: oil removal.

“Why are we trying to lift it out of the water? Why don't we put in a vacuum and suck it out of the water?” Kennedy asked himself, noticing that the oil in the net started spinning in a circle—similar to how water moves after flushing a toilet. It was an ideal situation for vacuuming oil out of the water.

Though this system was efficient, Kennedy was convinced he could do better—and he was right. By emptying the oil-water mixture into a vacuum chamber at a pressure of 26 mercury or higher—the point that water boils, but not oil—he was able to vaporize the water, separating it from the oil.

Last year, the PPR Otter Pup went through an American Society for Testing and Materials (ASTM) testing process, through which the US Coast Guard (USCG) essentially approved the system to be used for oil spill cleanup. The skimmer scored a rating within the margin of error of 100 percent efficiency, Kennedy says. For perspective, many top skimmers in the world have efficiency rates much closer to 20 percent.

“[USCG approval] now allows people to start listing this and putting these skimmers into their oil response plans; it becomes a usable tool,” Kennedy says. “I am producing it now. So, I developed it, designed it, tested it, and now we're producing it. And, it's all being done in Alaska—start to finish.”

Because of the vacuum chamber, the system is also capable of dealing with some types of ice, making it a viable solution under certain circumstances in the coastal waters along the North Slope and other Arctic regions.

“It's portable, it's efficient... it operates in an icy climate and it's scalable. If you want something that does 1,000 gallons a minute, I can build it for you,” Kennedy says.

Drones and Infrared

Skimmer technology itself may not be advancing by leaps and bounds outside of Kennedy's project; however, there are other innovative approaches to oil spill response. Sarah Moore, a preparedness and response section manager at the Department of Environmental Conservation's Prevention, Preparedness, and Response Program, says that the department is seeing rapid change in the use of unmanned aerial aircraft as well as infrared and optical cameras.

Moore notes that it can be relatively hard to determine the effectiveness of a boom's containment of a spill from the water's surface: a drone is capable of providing a much better view of the situation.

Given the remote nature and dangerous conditions sometimes surrounding an oil spill in Alaska, drones offer the added benefit of risk mitigation—not putting a human life in harm's way as part of the recovery process.

Dr. Ed Owens of Owens Coastal Consultants, which specializes in shoreline cleanup assessment technique (SCAT) surveys among other spill response operations, explains how his company uses drones.

“[We] use drones in remote areas, areas that are difficult to access on foot,” such as mud flats, headlands, and wetlands. “A lot of wetlands you walk for two hours to get to a site, and you get there, and there's no oil... and then you have to walk two hours back. We use drones... to go out and do a reconnaissance,” he says.

Of course, not all unmanned vehicles are airborne. There is also working being done on identifying uses of unmanned waterborne vehicles in the Arctic and sub-Arctic regions.

“I don't believe we've seen [unmanned waterborne vehicles] used in an accident response here in Alaska yet, but it is something that our UAF [University of Alaska Fairbanks] partners are actively researching,” Moore says.

Oil Spill Response Research

And researchers at UAF are not the only ones probing such technology in Alaska. The Oil Spill Recovery Institute (OSRI) explained in its 2017 Fiscal Year Report that it is working to ensure USCG, which is responsible for responding to oil spills in open water and in ice conditions, "is aware of the current state of technology for spill response in ice" by partnering with them to develop and test new equipment capabilities.

Last year, unmanned systems, as well as self-propelled skimmers, were among the response equipment deployed off the icebreaker CGC Healy to evaluate current capabilities and methods. AquaGuard provided the self-propelled skimmer for the USCG-OSRI project. The testing revealed that the self-propelled aspect allowed the skimmer to reach pockets of oil away from the vessel. The skimmer also included a macerator designed to chew up small chunks of ice. However, it tended to climb up on larger ice floes, which were too big for it to grind up, according to OSRI Research Program Manager Scott Pegau.

"One of the biggest things relevant to Alaska waters is that there was a joint-industry program looking at technology for responses to oil spills in ice-covered waters which just got completed in the last couple of years," says Pegau.

Pegau helped coordinate the remote sensing part of the program. They posed a question: Can we detect oil in, on, and under ice?

"The things that were most promising were optics from below," Pegau explains. "It's amazing what you can do with a camera if you're down below the ice."

The primary advantage is that its output is easy to interpret. However, one limitation with the technology is that it only works when there is light penetration. Additionally, as ice grows around oil, it becomes harder and harder to detect.

"From above, radar shows a lot of promise; however, there is a need to provide an interpretative signal," Pegau says, noting that the output of a bunch of squiggly lines is not intuitive for people to identify oil. The ground-penetrating radar worked best when the device was in contact with the ice. "We still need to push harder to get an airborne unit that is demonstrated for detecting through ice."

Infrared technology is also being developed and applied for Alaska. Pegau explains that OSRI research demonstrated that, during spring in the Arctic, it was possible to detect oil with infrared for up to twelve hours after it has been warmed by the sun.

One of the big take-homes from the joint-industry research into sensors was that none worked all the time. Instead, it's necessary to have some combination of sensors that are effective at different times of the year and in different conditions, Pegau explains.

Oil Spill Canines

Another major project OSRI spearheaded was an innovative method to identify lingering oil buried in the beaches along the Prince William Sound. While dogs are by no means "new technology," Pegau thought it was important to test the abilities of professionally trained canines and handlers to identify oil in places where other methods of monitoring for hydrocarbons were failing.

The idea of testing the dogs in the sound came after Pegau heard OCC's Owens speak at a conference about his use of oil-sniffing dogs. Owens had been developing the idea over the last few years after being inspired by the work of a Norwegian chemist who trained his own dogs to identify oil.

OSRI was able to put together the funds for Owens to test the dog's capabilities at Prince William Sound in May 2016.

“The testing went better than expected,” Pegau says. There was uncertainty about how the dogs would perform because the oil was not in good communication with the atmosphere or ocean, which was also why it was not naturally breaking down.

“I do shoreline assessments surveys for oil spills. One of the troubles/difficulties/challenges we have is finding subsurface oil,” Owens says. “Dogs are a new tool; they streamline the process. They really help us go quicker... We took someone else's idea and ran with it.”

The people Owens works with have been training dogs for years to detect mines and other unexploded ordnance, supplying the US Military with such canines. The dogs' noses are so sensitive that they are able to distinguish between oils, allowing SCAT survey teams to hone in on exactly what they are looking for.

Through double-blind testing, research conducted with OSRI, and even in real response efforts in Canada, the dogs have proved their value.

“Apart from finding oil, one of their valuable attributes is to clear areas that don't have oil. When we do surveys, we spend 50 or more percent of our efforts on making sure there is no oil,” Owens says, noting that while a traditional SCAT team does spot sampling for sub-surface oil, the dogs are able to do 100 percent searches and still be significantly faster. “It's like a lot of things we have: they're one of our survey tools, just like a drone.”

Edison Chouest Offshore Gearing Up

Though the dogs’ ability to sniff out oil in the Prince William Sound is an exciting development, the biggest news floating into the Sound comes in the form of fourteen custom-built ships operated by Edison Chouest Offshore (ECO) destined to take over for an existing fleet that provides services to Alyeska Pipeline Service Co. late this summer.

The new fleet will be comprised of four general purpose tugs, five escort tugs, one utility tug already in the ECO fleet, and four oil spill response barges.

Each oil spill response tug will be equipped with two 100-disc Crucial skimming systems. The metal discs, covered with a fuzzy, oleophilic material, will efficiently pick up oil before it is squeegeed into temporary holding tanks.

“We believe they are the biggest disc skimmers in the world,” says Alyeska’s Valdez Communications Manager Kate Dugan. “Our current skimming system is about 20 percent efficient... With Crucial skimmers, they really pick up two or three times that amount of oil. So they double, if not triple, our efficiency.”

Barges began arriving in Alaska this year as Louisiana-based ECO prepares to take over the Alyeska contract previously held by Crowley Marine. The change of guard for the Sound started in late 2013 when Alyeska Pipeline Service Company, owned by Alaska's major oil producers, determined to look at various partnership opportunities as the sun started to set on the Crowley contract.

“ECO just has the best package in terms of a brand new fleet, all their modern technology. They had the best safety record of any of the bidders. It just made sense for us to make the change,” Dugan says.

Dugan describes the realization that they would be designing purpose-built barges (their current fleet is retrofitted) as getting hold of a pie-in-the-sky moment.

“We got to start from scratch with twenty years of experience, of lessons learned, of people doing this work,” she says. “The people that are working on it have decades of experience with SERVS [ship escort/response vessel system] in Prince William Sound.”

Another major improvement to the fleet comes in the form of the escort tugs, which are seeing a 20 percent increase in horsepower. This extra power will allow them to better control tankers—slowing them down, stopping them, and guiding them away from danger. Additionally, two of the escort tugs will be equipped with dispersant systems.

“Escort tugs are a key part of oil spill prevention. We can have all the response equipment in the world, but we never want to never have to use it. We want to prevent an oil spill,” says Dugan.

All of the new ships will come with state-of-the-art oil detection equipment, including forward-looking infrared cameras and oil radars.

“We are just so excited to bring this technology to Princes William Sound... It's our backyard and protecting it is incredibly important to our lives and our livelihood. And, the vessels are a significant improvement over our current fleet, which is already best in the world,” she says.

Oil Dispersants

Though there doesn't appear to be a great deal of advancement in what is being used as dispersants (a mixture of emulsifiers and solvents that work to break down oil into small droplets, which then disperse more easily through a body of water and may be more readily biodegradable) in Alaska, OSRI pushed last year to better understand how certain products on the market work in Alaska waters.

“Chemical dispersants are receiving increased research attention, but there has not yet been a thorough scientific evaluation of the heavily marketed bioremediation product Oil Spill Eater II (OSEII) in any marine environment, including in Alaska,” OSRI's 2017 report states.

To that end, last year, OSRI launched a three-year project to evaluate the effectiveness of OSEII on crude oil and marine diesel degradation and detoxification in Arctic and sub-Arctic seawater, determine its modes of action, and compare its efficacy to that of chemical dispersants (Corexit 9500A), as well as to assess effects on indigenous microbial communities.

Though researchers continue to look into the impacts of dispersants in Alaska waters, the biggest advancement in the use of dispersants in the state comes from a push to streamline the approval process for dispersants and ensure the safeguarding of resources and stakeholders.

“It's more how and where, those are the biggest changes,” explains Dr. Richard R. Bernhardt, a scientific support unit manager for the Prevention, Preparedness, and Response Program.

These big changes came in the form of updating the “Dispersant Use Plan for Alaska” for the first time since 1989.

In many ways, dispersants are considered a last resort or an alternative countermeasure.

“The primary response technique would be mechanical response, and that's getting booms and skimmers out there in the field, trying to corral and collect the oil. And so, in our obligatory plan, it specifically states that... non-mechanical response techniques never replace mechanical response techniques as long as they are effective,” Bernhardt says.

If mechanical measures are ill-suited for a situation, dispersants became an essential tool. However, USCG can only expect actors in the industry to have dispersants in the theater if there is a preauthorization plan in the region.

“The time frame that dispersants can be effective is limited already. If dispersants are going to be a viable option, you have to have a streamlined process to get that approval,” Bernhardt says. Thus representatives of the Alaska Regional Response Team (which provides federal, state, and local government agencies with the means to respond to spills and other pollution incidents), along with representatives from the Department of Environmental Conservation, USCG, Environmental Protection Agency, Department of Commerce, and the Department of Interior, began an effort to update the “Dispersant Use Plan for Alaska.”

“Preauthorization is not the same as preapproval,” Bernhardt notes. “We don't have anywhere in Alaska where dispersants are preapproved to be used.”

Preauthorization gives federal coordinators the ability to make independent decisions in certain areas, though it is always in their best interest to get as much input from as many stakeholders as possible before doing so, Bernhardt says. The one caveat is that a coordinator is allowed to make an independent decision in any area if human life is at risk.

The updated preauthorization plan was signed in January 2016, which opened a two-year window to identify avoidance areas within these zones. These are areas where dispersant use should be considered on a case-by-case basis.

The avoidance zones, established earlier this year, were created after extensive outreach was done in various communities and with numerous stakeholders, as well as through sourcing information from experts in fields such as oceanography and marine mammals. Biologically important areas, fishing grounds, and intense mixing zones were also considered when establishing the zones.

“Our plan improved drastically. We didn't just hear them; we incorporated a lot of the information we heard, and the plan was strengthened significantly because of that effort,” Bernhardt says.

Alaska has taken a different, conservative approach with preauthorization areas. Every other state with a preauthorization policy begins the zones either one mile offshore or three miles offshore. In Alaska, they are no less than twenty-four miles offshore and even further in some cases, Bernhardt says.

Though the future of the oil industry in the state is unknown and the remoteness and harsh conditions faced daunting, there is no doubt that Alaskans are working hard to develop new technology and methods to prevent and clean up spills. In doing so, they are protecting the environment as well as the oil and gas industry.

“Because we are remote and it's a relatively small group of industry [members] and responders, we have pretty good partnerships that bring together research, R&D, and experience so we can all learn from and expand on those ideas,” Moore says.