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Winner of \$1 Million X-CHALLENGE Has Roots at UCSB's Bren School

An innovative piece of oil-spill recovery equipment -- evolved from a design created at UC Santa Barbara's Bren School of Environmental Science & Management in 2006 by Victoria Broje, who was a graduate student working in the research group of Bren professor Arturo Keller -- has won the \$1 million top prize in the 2011 Wendy Schmidt Oil Cleanup X CHALLENGE.

The winning prototype in the X CHALLENGE was entered by Elastec/American Marine and incorporates technology developed at the Bren School. For her Ph.D. dissertation, Broje redesigned the standard drum oil skimmer, which is a cylinder coated with an oil-adhering material, typically polyethylene or polypropylene. The rotating drum is mounted in a rack and moved through the water on its side, lifting a thin film of oil as it goes. The oil is then scraped from the drum and collected.

In her substantially higher-performing skimmer, Broje introduced a "stickier" surface coating. But the real breakthrough came when she enhanced the drum by adding v-shaped grooves running in the direction of rotation. The grooves add surface area, enhance oil adhesion, and can be cleaned thoroughly with a scraper that fits precisely into them, eliminating the need for brushes.

The design was patented, and a few months before Broje received her Ph.D., UCSB officials completed negotiations to license the patent for the technology to Elastec/American Marine, the largest maker of oil-spill recovery equipment in the

United States. Having made her mark on the technology, Broje accepted a position after graduation as an oil-spill response expert for Shell Oil, which keeps her busy traveling the world to improve oil-spill preparedness and response.

For the X CHALLENGE, five years after licensing Broje's skimmer, Elastec introduced another revolutionary skimmer that took the grooved design to a new level. Rather than a single grooved drum, the new skimmer incorporates 16 rotating discs spaced evenly along an axle. The discs have concentric grooves on both sides to capture the oil, giving each disc surface an area equivalent to that of a single drum skimmer. The entire set-up includes four of the cylindrically shaped 16-disc units, arranged one behind the other, so that the skimmer has an oil-recovery capacity equal to that of 64 drums.

The X CHALLENGE was the idea of Wendy Schmidt, spouse of Google CEO Eric Schmidt. While following the oil-recovery effort in the wake of the Deepwater Horizon spill in the Gulf of Mexico, she realized the inadequacy of existing technology, and funded the X CHALLENGE as an incentive to advance the technology.

Numerous X CHALLENGE competitions have been held by the X PRIZE Foundation, which raises money for cash prizes that are large enough to stimulate competition and innovation in four main areas: energy and the environment, life sciences, exploration, and education and global development. X PRIZES have been awarded for the first sub-orbital space flight and the first 100-mile-per-gallon car.

Schmidt's challenge attracted applications from 350 teams, of which 10 were selected to test their technologies at OHMSETT, the National Oil Spill Response Research & Renewable Energy Test Facility in New Jersey, and home to the largest saltwater wave pool in the world. The set-up, pre-event testing, and competition took 12 weeks.

Every X CHALLENGE sets performance standards well beyond what is considered possible at the time the challenge is issued. The industry standard for oil recovery on the ocean surface, for instance, is about 1,100 gallons per minute; for the X CHALLENGE, the minimum prize-worthy recovery level was set at 2,500 gallons per minute with a 70 percent efficiency rate, meaning that the recovered liquid could contain no more than 30 percent water.

Elastec/American Marine's winning entry shattered that "impossible" standard. The new grooved-disc skimmer recovered a phenomenal 4,670 gallons per minute, nearly double the X CHALLENGE goal and more than three times the industry's previous best oil recovery rate in controlled conditions, with unprecedented 89.5 percent efficiency.

The skimmer discs were mounted in a specially designed frame that could remain intact while being towed through waves at a minimum speed of one knot, another rigorous X CHALLENGE element, since, according to Elastec CEO Donnie Wilson, "A skimmer in a containment boom usually fails when being towed at three-quarters of a knot."

Inside the frame, the discs were gulping oil, thanks to their grooved design.

"In our tests of this skimmer, a grooved disc was four times more efficient than a smooth one, so the grooved design that was developed at the Bren School for use in a drum skimmer was instrumental in our success," Wilson said.

While Broje was not involved in designing Elastec's new skimmer, she was pleased to see the grooved technology on which it is based evolving and making a difference.

"I'm happy that my Ph.D. research resulted in a fundamental change in approach, which significantly improved oil-spill recovery efficiency, and allows many people to benefit from it," said the Russian-born physicist-turned-oil-spill-expert.

"When you give a very bright and innovative graduate student like Victoria Broje an important problem to work on, new technology is often the result," said Michael Witherell, UCSB's vice chancellor for research. "In this case, we were able to get that technology into the hands of a company that knew exactly how to turn it into a commercial product. It is a great story of success."

Keller, Broje's Bren School faculty advisor and the principal investigator on the skimmer project, was thrilled to have seen the grooved design grow from a topic of discussion to a transformational technology.

"It's super cool to see how this technology went from some conversations with my Ph.D. student years ago, to the design and execution of some very successful lab and field experiments, to publication in the world's leading environmental science

and technology publication, to commercialization and use in the response to the Gulf of Mexico oil spill," Keller said. "And now, this million-dollar challenge has proven that the grooved technology is indeed best for recovering oil from the ocean."

Keller also credited the UC Santa Barbara Office of Technology & Industry Alliances for its work in commercializing the technology.

"The success of the grooved-skimmer technology also came about in part because the Office of Technology & Industry Alliances did such a great job of finding a commercial partner, American Elastec, which saw the value of this innovation and took it to the next level to win the X CHALLENGE," he said. "They made a tremendous difference."

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