

This Antifouling Coating Creates a ‘Liquid Surface’

By Kim Kavin

If mussels foul your boat or dock on a regular basis, you might think the mollusk is the enemy. In reality, what you need to stop are the mussels’ byssal threads, or byssus, which the little buggers secrete like Spider-Man webbing when attaching themselves to solid surfaces. Stop the byssal threads from getting a grip, and no more mussels stuck to your hull or dock.

It’s a nifty trick, one that researchers think they’ve finally mastered — and that businessmen say will start appearing in new antifouling paint in early 2018. The magic material that is now advancing from the research phase to commercial use is called SLIPS, or Slippery Liquid-Infused Porous Surfaces. SLIPS is a flexible silicone with a lubricant layer that essentially creates a liquid surface. It feels oily to the touch, and it has a reservoir in the coating’s pores to replace the liquid surface layer when it wears off. The design keeps the coating in a physical state that, to a mussel, seems different from a solid surface.

A recent study in the journal *Science* explains how researchers used SLIPS to confuse mussels enough that they couldn’t, or wouldn’t, attach. In their first experiment, researchers placed Asian green mussels on a checkerboard of sorts, with each square covered in a different antifouling material. The squares with the SLIPS coating confused the creatures. Mussels probed those surfaces longer, didn’t release their byssal threads at all or shot out the threads in a different direction, where a surface they read as solid seemed to be a better choice for attachment.

Wanting to know why the mussels were averse to the coating, the researchers next determined that mussels’ feet contain proteins that sense pressure. Measuring the amount of force that a mussel feels when its foot touches different surfaces led the researchers to realize that the SLIPS coating creates a pulling sensation, as opposed to a solid sensation. Mussels read the pulling as a bad feeling prior to attachment, so they look elsewhere for a better spot.

The coating was also tested in Scituate, Massachusetts, in partnership with the National Oceanic and Atmospheric Administration’s Stellwagen Bank National Marine Sanctuary. Panels covered in the coating were submerged in Scituate Harbor for 16 weeks to see whether

they could resist the local blue mussel population. Again, the coating worked — and kept tunicates (“sea squirts”), hydroids and slime at bay, too.

Armed with this new research and three years’ worth of business development, SLIPS Technologies in Cambridge, Massachusetts — a company that grew out of the Harvard University-based research findings — is now working to commercialize the coating. Because SLIPS can repel more than water, it could have uses far beyond boating. SLIPS Technologies is looking into medical devices that need to resist blood and bacteria; machinery and storage businesses that need to stop sticky liquids, including oil, from glomping onto other materials; and even skyscrapers and airplane wings where ice buildup might be prevented. The SLIPS coating can be applied to plastics, metals, ceramics, glass and concrete, either by spraying, rolling it on or dipping materials into it. Peel-and-stick films have also been developed, along with injection-molded parts.

Company president David Ward told *Soundings* that boaters can expect to see SLIPS-branded antifouling paint in limited quantities by early 2018, with the goal of wider availability in 2019. SLIPS Technologies is now looking for shipyards that want to partner on a limited rollout ahead of the summer 2018 boating season to help gather more real-world data before the antifouling paint becomes widely available.

“We’re not quite at the point where this is over-the-counter yet; we’re not at that phase of scale-up,” Ward says. “We want more field data. We haven’t been through a full season with multiple boats yet. When we launch a commercial-ready product, it has to be perfect.”

Ward says the SLIPS coating can be applied to any type of boat — wood, fiberglass, aluminum or steel. The company has been testing the coating on a handful of boats near Boston for about six months, he says. “We’re a top coat in the normal painting system,” he says. “Whatever surface prep and priming you use for your particular underlying boat material, to get you to a top coat, you do the same stuff and replace the top coat with us.”

The federal government, along with private investors, is betting that boaters and



SLIPS antifouling can be applied to hulls by rolling or spraying.

other consumers will like what they see when SLIPS-branded products start to become widely available. SLIPS Technologies recently announced \$8.6 million in financing that’s expected to go toward product development, testing and commercialization. That money includes a \$2.95 million grant from the U.S. Department of Energy to develop and test SLIPS antifouling paint — not just for recreational boats, but also for military and commercial vessels.

“Barnacles, mussels and algae stick to the hulls of ships and boats, creating extra drag that costs the shipping industry approximately \$20 billion each year in fuel,” the funding announcement stated. “SLIPS provides superior, environmentally friendly solutions to control biofouling and keep ships clean. Traditional paints for ship bottoms rely on copper biocides that leach into water, damaging marine ecosystems and requiring strict regulatory oversight. In contrast, SLIPS marine paints provide a safer alternative while offering enhanced biofouling protection.” ■