Sopping up sunblock from oceans to save coral reefs

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Coral reefs can't seem to catch a break. Not only are rising temperatures wreaking havoc with their environment, but emerging evidence suggests that a certain sunblock component in many lotions that may help protect humans from developing skin cancer is a coral killer. Now, researchers have developed a biodegradable bead that can soak up the sunblock ingredient, oxybenzone, like a thirsty sea sponge. They hope to use the agent to clean up seawater at beaches.

The researchers are presenting their work today at the 254th National Meeting & Exposition of the American Chemical Society (ACS). ACS, the world's largest scientific society, is holding the meeting here through Thursday. It features nearly 9,400 presentations on a wide range of science topics.

"Coral bleaching by oxybenzone is a difficult problem, but not an impossible one," says Felix R. Roman, Ph.D. "Our magnetite nanoparticles are magnetic, and we can make them specific to a particular pollutant—in this case oxybenzone—by altering the surface chemistry of these particles. But you don't want to release loose nanoparticles into the environment, so we encapsulate them in a matrix that is environmentally friendly and cheap. The idea is that if you dump it in water, you can pull it out with a magnet." By controlling the alginate/chitosan ratio, he says they can make these magnetic nanobiocomposites float or sink for added flexibility in the removal of contaminants.

The beads' matrix consists of materials that are familiar to the ocean: alginate, which is derived from algae, and chitosan, which is a waste product of fish. Inside this gelatinous matrix are the magnetic nanoparticles. The magnetic core of the nanoparticles is made from iron oxide and is coated with sodium oleate. To come up with a strategy to increase the nanoparticles' affinity for oxybenzone, the researchers, who are at the University of Puerto Rico, Mayaguez, analyzed the molecule's chemical properties. "Oxybenzone is soluble in water and is capable of hydrogen bonding, so it's going to have good interactions with hydroxyl functional groups," says Roman. "So we wanted to increase hydroxyl functional groups on the surface of the nanoparticle." To do that, the researchers oxidized the sodium oleate.

Then came the fun part: The researchers headed to a local beach to test the beads. An undergraduate student in Roman's laboratory, Ana Zapata, slathered herself in oxybenzone -containing sunblock and stepped into the ocean. "You could see the sunblock leaching into the water, so I collected that water for analysis back in the lab," she says. There, Zapata ran chromatography experiments on the sample and found an oxybenzone concentration of 1.3 parts per million (ppm) within 10 minutes of the exposure. "That's very high," she says, because concentrations of only parts per billion may be enough to negatively impact coral.

Next, the researchers added their beads to the sample. "We collected seawater samples and spiked them with oxybenzone at 30 ppm, and within an hour, we removed 95 percent of the compound," says Roman. "It's a fairly fast process." Control experiments showed no change in oxybenzone concentrations without beads present.

In their next set of experiments, Roman's team—which also includes graduate student Victor Fernandez, undergraduate student Gabriela Cruet and collaborator Oscar Perales-Perez—will be heading to a saltwater swimming pool. The group intends to have a bunch of volunteers coat themselves in sunblock and swim around for a bit. Then, the researchers will add beads and see how long it takes to remove oxybenzone from the pool. "We may have to run the experiment a number of times with different amounts of beads," Roman says. He adds that, someday in the future, people would likely drag a net full of these magnetic nanobiocomposite beads with a boat to help remove target contaminants, especially in areas near vulnerable [coral reefs](https://phys.org/tags/coral+reefs/).

Provided by American Chemical Society

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