Clearing the Air

LSU professors using concrete hemispheres to battle ‘greenhouse gases’

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Three LSU professors are experimenting with ways to use Mother Nature to combat “greenhouse gases.”

The earth is believed to be warming up because of excessive greenhouse gases such as carbon dioxide. Carbon dioxide is created from burning oil or other fossil fuels. The professors are testing specially designed concrete hemispheres dubbed “reef balls” to create artificial reefs. The reef balls resemble an upside-down bowl.

The project stems from separate work LSU chemical engineering professors Carl Knopf and Kerry Dooley are doing to make an explosive-proof concrete for the U.S. Department of Defense.

The professors were kicking around ideas for pH-neutral concrete (pH neutral means neither acidic nor alkaline), when the Department of Energy asked for research ideas on how to remove carbon dioxide from the environment. Dooley and Knopf brought in Bob Gambrell, a wetlands biogeochemist.

The reef balls are designed to attract microalgae that in turn would draw carbon dioxide from the water. As the balls draw carbon dioxide out of the water, the ocean can absorb more from the atmosphere.

The key to making the reef balls work is to make concrete pH-neutral, they said. Additionally, the reef ball surfaces are pitted with holes like a sponge to create more surface for microalgae to growth.

By lowering the normal pH of concrete, polymers such as plastics and nylons can be mixed in, making it stronger and more resilient.

This summer, the trio began taking their ideas from proposal to testing. Knopf explains the concept like this:

While the cement is being mixed, carbon dioxide would be pumped into the mixture. Normal concrete has a pH of 13 — strongly alkaline — and is composed of calcium hydroxides and other components.

By pumping carbon dioxide at high-pressure — 60 to 150 times that of the atmosphere — into the cement mixture, the calcium hydroxide becomes calcium carbonate, basically limestone. The mixture makes it pH neutral.

A neutral pH would attract the microalgae. Gambrell said microalgae would absorb carbon dioxide and create organic matter, such as their tissue.

Fish would eat the algae and turn it into other carbon-based matter, such as fecal pellets.

While some of the carbon dioxide would be re-released through decomposition, most of it would be trapped and buried in the sea. Such carbon deposition created the oil reserves tapped for today’s petroleum products.

The proposed process is a natural one that “is going on now and what we’re talking about is enhancing it,” Gambrell said.

Knopf said that what the trio is proposing is “not a silly idea. If you are going to remove a million tons (of carbon dioxide) from the atmosphere, where are you going to put it?”

Dooley said some of the ideas tossed around were such things as injecting the carbon dioxide into deep wells or rock formations underground.

Each reef ball would be covered with algae and trap about one ton of carbon dioxide a year.

Part of the project is creating different mixtures for the reef-balls.

Dooley is also trying a mixture with fly ash, the waste created by incineration. If the hemispheres could be made with fly ash, then another waste problem could be alleviated, Dooley said.

Dooley said they sent their ideas to the Department of Energy in January and received a $50,000 grant to get started. That’s all the funding that has been promised.

Phase 2 funding will be determined by what happens in the early experiments.

Dooley has created small mock-ups of various combinations and they have been placed in an aquarium.

Over time the researchers will measure the amount of microalgae that attach to the reef balls. They will then determine which concrete mixtures are best.

Then, they will create some larger models and test them in the Gulf of Mexico, Dooley said.

Knopf said one reason the proposal was funded was “what we’re doing is a pretty common-sense kind of thing.”

On the Internet

This sampling of related Internet sites was compiled by the Louisiana Energy and Environmental Resource and Information Center (LEERIC). A more complete list may be obtained by calling LEERIC at LSU (504) 388-4600 or 1-800-256-ERIC, or by accessing the LEERIC Home Page http://www.leeric.lsu.edu


> Carbon Cycle: Ocean/Sedimentation http://elmhesc.elmhweb.edu/~clm/accountId/chm100/outline/chm100/outline_sedimentation.html

> Biogeochemical Cycling http://www.npm.ac.uk/pml/sep44.html


Research Associate Bronson Guilbeau holds a miniature “reef-ball,” a small concrete structure that LSU scientists are testing as a mechanism to remove carbon dioxide from the atmosphere, helping reduce the greenhouse gases blamed for global warming.