Water Filtration Technique Removes Dangerous Freshwater Algae Toxins

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Microcystis, a type of blue-green algae, has been blooming in freshwater lakes across the United States this summer. It secretes a toxin which causes liver damage in animals including humans. Photo by Tom Bridgeman, University of Toledo, courtesy of Ohio Sea Grant.

A water filtration technique that normally cleans up agricultural chemicals is also effective at removing a toxin secreted by algae found in lakes and rivers, an Ohio State University study has found.

Engineers here determined that the technique greatly outperformed other methods by removing at least 95 percent of a toxin secreted by Microcystis, a blue-green algae.

Some water filtration plants around the country already use the technique, which couples activated carbon with membrane filters, said Hal Walker, associate professor of civil and environmental engineering and geodetic science at Ohio State.

Microcystis is native to freshwater lakes and rivers around the country, and secretes toxins that can cause liver damage in animals including humans. Worsening environmental pollution in Lake Erie during the last decade has caused algal blooms, the most recent of which began this August.

Some 13 million people rely on Lake Erie for their water supply, so Microcystis is a growing concern there, Walker said. But dangerous algal blooms have occurred across the country this summer, from Massachusetts to California.

And while many water filtration plants are beginning to use high-tech ultrafiltration membranes with very fine holes to filter water, Microcystin toxins are small enough to slip through. For example, the toxin used in this study was microcystin-lr, a tiny molecule made up of only seven amino acids.

The study will appear in the journal *Environmental Science & Technology*, and has been published in advance on the journal's Web site.

Rather than invent a new technology for filtering microcystin-lr, Walker and his colleagues decided to test whether combining activated carbon with membrane filters would do the trick. That technology has already proven effective for removing herbicides and pesticides from drinking water.

"This toxin is an organic molecule, and we knew that activated carbon is

good at removing organics," Walker said, "so we coupled the carbon with membranes. Together, they provide a way for water treatment plants to remove the toxin by basically upgrading the membrane system they already have."

Water treatment plants that already had membranes in place could add carbon to their systems without purchasing new equipment, he added.

Activated carbon is a highly porous form of charcoal that sticks to organic molecules. It's often used to filter water and clean up environmental spills, and it's even administered to poison victims to clean toxins from the digestive tract.

The engineers combined the active carbon with three different commercially available membrane filters to remove microcystin-lr from samples of Lake Erie drinking water. Each combination produced good results: one removed 95 percent of the toxin, one removed 97 percent, and the other removed 99 percent. Without the carbon, even the most effective ultrafiltration membrane removed only 78 percent of the toxin.

This is the first time this technique has been used to remove an algal toxin, and Walker cautioned that more research needs to be done before commercial water treatment plants could adopt it wholesale.

"Microcystis secretes a whole range of toxins, and we only looked at the one we thought would be the most important for health reasons," he said. "Then there's a whole host of other toxic algae that secrete their own toxins. And we don't know if there are synergistic effects between the toxins. Still, I suspect this technology would be pretty effective for all these toxins."

He would like to start a pilot project with a water treatment plant that uses membrane filters, ideally to test the system during an algal bloom.

Source: Ohio State University