Bacterial spare parts filter antibiotic residue from groundwater

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Researchers at University of Cincinnati have developed and tested a solar-powered nano filter that is able to remove harmful carcinogens and antibiotics from water sources – lakes and rivers – at a significantly higher rate than the currently used filtering technology made of activated carbon. They report their results today at the 113th General Meeting of the American Society for Microbiology.

Vikram Kapoor, environmental engineering doctoral student, and David Wendell, assistant professor of environmental engineering, report on their development and testing of the new filter made of two bacterial proteins that was able to absorb 64 percent of antibiotics in surface waters vs. about 40 percent absorbed by the currently used filtering technology made of activated carbon. One of the more exciting aspects of this filter is the ability to reuse the antibiotics that are captured.

"The presence of antibiotics in surface waters is harmful in that it breeds resistant bacteria and kills helpful microorganisms, which can degrade aquatic environments and food chains. In other words, infectious agents like viruses and illness-causing bacteria become more numerous while the health of streams and lakes degrades," says Kapoor.

The newly developed nano filters, each much smaller in diameter than a human hair, could potentially have a big impact on both human health and on the health of the aquatic environment (since the presence of antibiotics in surface waters can also affect the endocrine systems of fish, birds and other wildlife).

The filter employs one of the very elements that enable drug-resistant bacteria to be so harmful, a protein pump called AcrB.

"These pumps are an amazing product of evolution. They are essentially selective garbage disposals for the bacteria. Our innovation was turning the disposal system around. So, instead of pumping out, we pump the compounds into the proteovesicles," says Kapoor

The operation of the new filtering technology is powered by direct sunlight vs. the energy-intensive needs for the operation of the standard activated carbon filter.

The filtering technology also allows for antibiotic recycling.

"After these new nano filters have absorbed antibiotics from surface waters, the filters could be extracted from the water and processed to release the drugs, allowing them to be reused. On the other hand, carbon filters are regenerated by heating to several hundred degrees, which burns off the antibiotics," says Kapoor.

The new protein filters are highly selective. Currently used activated carbon filters serve as "catch alls," filtering a wide variety of contaminants. That means that they become clogged more quickly with natural organic matter found in rivers and lakes.

"So far, our innovation promises to be an environmentally friendly means for extracting antibiotics from the surface waters that we all rely on. It also has potential to provide for cost-effective antibiotic recovery and reuse," says Kapoor.

The researchers have tested the solar-powered nano filter against activated carbon, the present treatment technology standard outside the lab, in water collected from the Little Miami River. Using only sunlight

as the power source, they were able to selectively remove the antibiotics ampicillin and vancomycin, commonly used human and veterinary antibiotics, and the nucleic acid stain, ethidium bromide, which is a potent carcinogen to humans and aquatic animals.

More information: This research was presented as part of the 2013 General Meeting of the American Society for Microbiology held May 18-21, 2013 in Denver, Colorado.

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