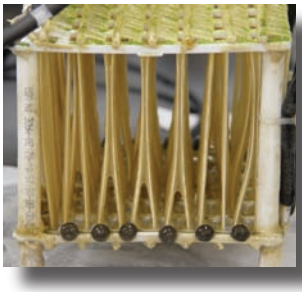
Wastewater Cleanup

Eco-friendly system offers cost-effective removal of nitrogen from wastewater

Challenge

Every summer, a "dead" zone the size of New Jersey develops in the Gulf of Mexico. The result of harmful algal blooms that thrive on the nitrogen– and phosphorus–rich runoff that flows into coastal waters, such dead zones deprive fish and shellfish of the oxygen they need to survive, and can damage coastal ecosystems and the local economies that depend on them. The nutrient pollution that triggers dead zones comes from a variety of sources, including wastewater treatment plants. The challenge for these plants and other industrial facilities is how to remove nitrogen from wastewater while meeting budget requirements, as well as space and time limitations.

Response



A hollow fiber membrane used to retain aerobic bacteria that are key to the nitrification process.

With support from CICEET, investigators from the University of Notre Dame are developing a low-cost, eco-friendly method of removing nitrogen from wastewater. The approach relies on the dual processes of nitrification and denitrification to convert the ammonium in wastewater first into nitrates, and then into harmless nitrogen gas that can be released safely into the atmosphere.

In most wastewater systems, the treatment tanks are too small —and the time allotted for treatment too short—to eliminate nitrogen. The technology developed by these researchers aims to improve nitrogen elimination by equipping treatment tanks with hollow fiber membranes that retain the aerobic, nitrifying bacteria critical to the nitrification process. Since these membranes feed oxygen to the nitrifying bacteria, all of the liquid in the tanks does not need to be aerated. As a result, denitrification and nitrification can take place concurrently.

The goal is a faster treatment process that completely eliminates nitrogen. If successful, these membranes could serve as retrofits for existing wastewater treatment systems—there would be no need to invest in larger tanks. Such retrofits would reduce reliance on the expensive, and sometimes toxic, carbon sources used for treating wastewater, such as acetate or methanol.

Wastewater from treatment plants can contribute to nutrient pollution in coastal waters. This CICEET project is developing an eco-friendly, affordable approach to nitrogen removal that can be retrofitted to existing wastewater treatment systems.

Impact

In bench-scale tests, researchers have demonstrated the effectiveness of the hollow-fiber membrane technology. They are completing construction of a pilot-scale reactor to test the technology further. This prototype will be demonstrated at the Applied Research Facility for Nitrogen Removal (PO-55A) in Brooklyn, New York, in 2007, with support from Metcalf Eddy, a water resources management consulting firm.

The facility maintains an intensive sampling and monitoring program that is equipped to rigorously evaluate this technology's performance, and also provide a better understanding of its capabilities for nutrient removal at a full scale level.

If successful, the hollow-fiber membrane technology to eliminate nitrogen from wastewater could be applied to systems around the world. To date, researchers have presented their findings in the U.S., Canada, China, and the Netherlands.

Learn more

Dr. Robert Nerenberg
University of Notre Dame
Civil Engineering and Geosciences

T: 574.631.4098
E: Nerenberg.1@nd.edu

Prevention Tools to Prevent the Impacts of Pollution