

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY



ENVIRONMENTALLY-SAFE CONTROL OF ZEBRA MUSSEL FOULING

Background

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\$910,688

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Coal-fired power plants within North America need an effective, economical, and non-polluting technique for managing infestations of zebra mussels within their facilities, particularly in cooling water intake systems. Because zebra mussels attach inside pipes, they have caused millions of dollars of additional expense to raw water users, such as power plants where the colonization of zebra mussels on cooling water intake structures can lead to significant plant outages, often during peak demand times. Other problems caused by zebra mussels include damage of boat motors by shells being drawn into the cooling system, beaches littered with piles of dead mussels, and negative ecological impact caused by zebra mussels out-competing native bivalves.

Due to a lack of options, many facilities have relied on the use of broad-spectrum, chemical biocides for control of these freshwater mussels. However, biocide treatments, such as continuous chlorination for three weeks, are widely regarded as environmentally unacceptable because they can result in the formation of potentially carcinogenic substances. There is growing concern within the power generation industry that such broad-spectrum biocides will be banned by individual states and/or the federal government because of increasingly stringent environmental regulations.



The small zebra mussels densely colonize inside cooling water intake pipes of power plants thus leading to significant power outages and expense.

What Are Zebra Mussels?

Zebra mussels are small, fingernail-sized bivalves that can live in enormous densities in rivers and lakes. Native to Europe, these mussels were first discovered in Lake St. Clair, near Detroit, in 1988 and have since spread as far south as Louisiana and as far west as Oklahoma. They are called zebra mussels because of the striped pattern that often is present on their shells. They can attach to almost any hard surface with their adhesive byssal threads.



PARTNER

New York State Museum
Field Research Laboratory
Cambridge, NY

WEBSITES

www.netl.doe.gov/coal



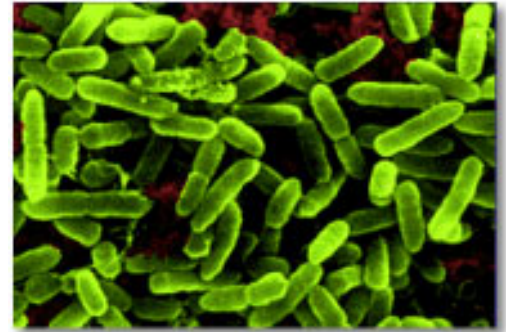
Zebra Mussel Distribution in North America



Examples of the acrylic minipipes used in the tests. The pipe with clear water on left is an untreated control, whereas water in other pipes has a grayish color due to presence of suspended bacteria during treatment. Mussels are visible attached to walls of pipe.

An Environmentally-Safe Method of Control

Progressive research has located a “green technology” to address zebra mussel fouling. A particular strain of a naturally-occurring bacterium called *Pseudomonas fluorescens*, isolated from a North American river, has shown to be toxic to zebra mussels. Zebra mussels naturally filter bacteria from water, and because this bacterium is toxic, zebra mussels die following ingestion of the bacterial cells. All zebra mussels, regardless of size, are susceptible to this bacterium.



The Pseudomonas fluorescens strain of bacterium is toxic to zebra mussels, but benign to non-target organisms such as fish and other bivalves.

Researchers with the New York State Education Department are conducting a three-year study to evaluate this *Pseudomonas fluorescens* strain because not only is it toxic to zebra mussels, but also benign to non-target organisms such as bluegill sunfish, minnows, and brown trout. Rochester Gas & Electric Corporation (RG&E) has offered one of its coal-fired power plants as a test site for a pilot demonstration of this green technology.

Research Goals

The overall research goal of this ongoing three-year project is to conduct experiments at the RG&E plant with the bacterium and to evaluate its technical and economic feasibility to control zebra mussel fouling. Current funding is provided by the Power Systems Advanced Research program of the National Energy Technology Laboratory (NETL) and the Innovations for Existing Plants (IEP) program. The development of an innovative solution to address an environmental challenge with an environmentally-safe biological control technology for zebra mussel management will allow coal-burning plants to reduce or eliminate the use of chlorination as a zebra mussel control method, reducing the risk of chlorine’s potentially harmful effects on aquatic ecosystems.

Plans for the Future

Future plans for the use of this environmentally-safe method of controlling zebra mussels include the following:

- Develop methods to increase bacterial cell toxicity;
- Develop economical methods for bacterial mass production;
- Develop a bacterial cell formulation for long-term storage;
- Conduct additional treatment trials in power plants to demonstrate effectiveness;
- Conduct additional non-target species trials; and
- Establish a commercial partnership.