RECLAMATION
Managing Water in the West
U.S. Department of the Interior
Bureau of Reclamation

Western Water and Power Solution Bulletin

Bulletin No. 48
Research and Development Office — Denver, Colorado **September 2011**

Pseudomonas fluorescens: A Dead Bacteria to Control Invasive Mussels

Bacterial-based product shows promise for controlling mussels at impacted water resources facilities

What Is the Problem?

Zebra and quagga mussels are invasive, freshwater, bivalve mollusks that firmly attach to underwater surfaces. The species first appeared in the Eastern United States in the mid 1980s and in Western waters around 2007. Mussel infestations are a growing concern for water resources managers throughout the Western United States. Zebra and quagga mussels can clog intakes, trashracks, strainers, pipes, fire control systems, cooling water systems, fish screens, or virtually any raw-water system exposed to mussels, resulting in costly impacts to water delivery and hydropower facilities.

What Is the Solution?

Pseudomonas fluorescens (Pf) is a bacteria commonly found in soil and water. Researchers at New York State Museum discovered that a specific strain of Pf can, following ingestion, disrupt the digestive system of invasive zebra and quagga mussels causing mortality in adults. Furthermore, it has the potential to kill both adult and larval life stages thereby preventing mussels from colonizing critical raw water systems in hydropower and pumping plants.

Marrone Bio Innovations, Inc. (MBI), via a license agreement with New York State Museum, is commercially developing a product derived from dead Pf under the trade name Zequanox™. Unlike mechanical removal of mussels, following installation of delivery equipment, Zequanox™ may be applied without the need for facilities to shut down. Furthermore, Zequanox™ appears highly selective; at applied doses for invasive mussels, ongoing laboratory ecotoxicity studies have shown that it does not harm native bivalves, fish, and other aquatic organisms that have been tested. Moreover, Zequanox™ does not produce the adverse byproducts common to conventional treatments (e.g., chlorine).

Where Have We Applied This Solution?

Reclamation's Lower Colorado Region – LC Dams Office in collaboration with Reclamation's Research and Development Office and Technical Service Center have been working together with MBI under a Cooperative Research and Development Agreement (CRADA). Small-scale formulation testing involving closed-system field trials have been conducted at Reclamation's Davis Dam which is heavily infested with quagga mussels and results to date are promising.

In 2010, the U.S. Environmental Protection Agency (EPA) granted Reclamation an Emergency Exemption (Section 18 under FIFRA) to use Zequanox™ at Davis Dam and nearby facilities that are currently impacted. Reclamation has completed the National Environmental Policy Act (NEPA) compliance process with outreach to inform the public and other agencies of treatment plans at Davis Dam. The Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) have been released and initial cooling water system treatments are underway.

Quagga mussel infested power plant cooling water pipe.

Who Can Benefit?

Reclamation facilities facing impacts associated with invasive mussels could benefit from the use of Zequanox™ to control mussels in water-related systems. However, MBI's latest product formulations are still undergoing EPA review for FIFRA Section 3 registration as a pesticide. Following successful registration, the product is expected to become commercially available.

Future Development Plans

Reclamation researchers plan to continue working with MBI to improve the applicability of Zequanox™ to specific water conditions at impacted Reclamation facilities in the Western U.S.

More Information

Additional information can be found at Reclamation's Lower Colorado Region website: http://www.usbr.gov/lc/region/g2000/envdocs.html, and MBI's website: http://marronebioinnovations.com/products/zequanox/.

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