ZEQUANOX®
Invasive Mussel Control

For Enclosed Water Systems: Bio-Based Invasive Mussel Control

Need for Invasive Mussel Control

Since their introduction to the United States Great Lakes region in the 1980s, invasive zebra and quagga mussels have caused immense environmental and economic damage. Their unique free-floating veliger stage has allowed them to quickly expand in their adopted territory. As invasive mussels continue to spread throughout water bodies in the United States, they continue to invade not only open, but also enclosed water systems. Facilities are increasingly being fouled by zebra and quagga mussels, which clog piping and restrict water intake and flow in addition to severely damaging infrastructure and equipment. Unlike chemical treatments, which are harmful to the environment, damaging to equipment, and require complicated regulatory procedures, Zequanox® molluscicide offers a safe and easy solution for invasive mussel control.

Zequanox Molluscicide: Leveraging the Power of Nature

Zequanox molluscicide—a naturally derived aquatic biopesticide—has proven to be effective in controlling invasive zebra and quagga mussels and offers an environmentally responsible solution to this daunting ecological challenge.

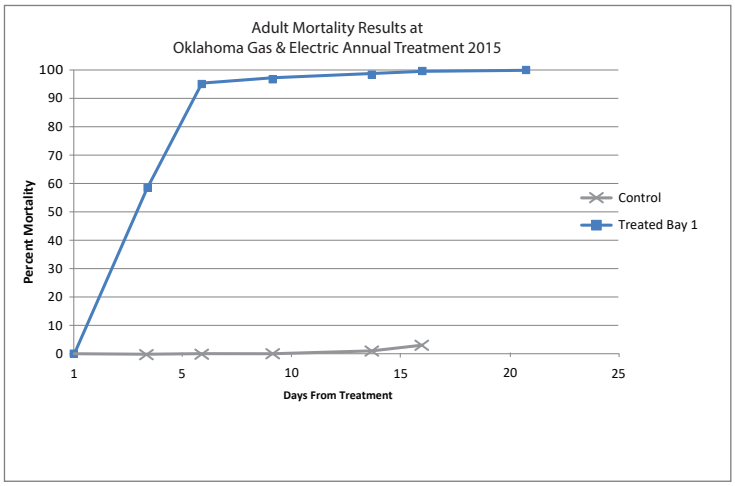
How Does Zequanox Molluscicide Work?

Zequanox molluscicide is composed of dead cells from a naturally occurring strain of the bacteria *Pseudomonas fluorescens*. Zebra and quagga mussels perceive Zequanox molluscicide as a nonthreatening food source and readily consume the product along with their normal diet. Once ingested, Zequanox molluscicide causes their digestive lining to deteriorate, resulting in death.

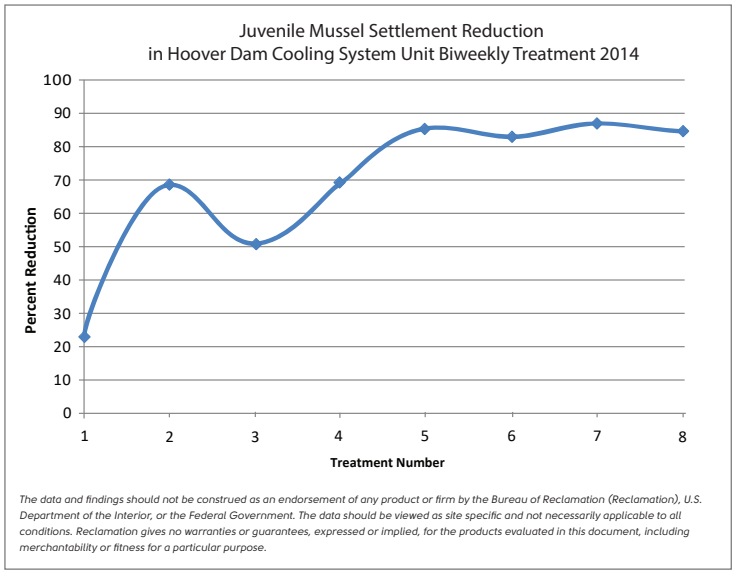
Mussel mortality begins within a couple of days of treatment and continues for several weeks following exposure to Zequanox molluscicide. The rate of mortality varies with mussel metabolic (or biological) activity and water temperature. This mode of action prevents a quick mass kill, reducing the risk of causing a large debris slug.

Customizable Treatments

Zequanox molluscicide treatment programs are customizable based on the desired control of a facility. Annual, 6 hour high dose treatments can occur up to four times per year and target control of existing adult mussels. These are best for facilities with a high level of invasive mussel colonization.



Biweekly, 2 hour low dose treatments occur every two weeks when water temperatures are above 15˚C (~60˚F). This treatment option is designed for facilities newly infested with mussels, or facilities who want to gradually control existing adult mussels and limit new mussel settlement.



Enclosed Uses

Zequanox molluscicide can be applied to control invasive mussels in enclosed water systems, such as cooling water or fire suppression systems. Some examples are included below.

- Hydropower facilities
- Coal-fired power facilities
- Nuclear power facilities
- Drinking water and water treatment plants
- Metals processing and mining
- Pulp and paper facilities
- Chemical manufacturing facilities
- Oil, gas, and petrochemical facilities
- Process water systems
- Other industrial facilities

Zequanox molluscicide and Other Species

Zequanox molluscicide has been shown to be highly selective toward zebra and quagga mussels. Extensive studies have been completed on numerous species of fish, native mussels, plants, algae, crustaceans and insects, as well as mallard ducks, with no indication of any harmful effects on any other species at treatment concentrations.

Highlights/Key Characteristics

- Noncorrosive to equipment or infrastructure
- Does not disrupt normal facility operations
- Not subject to regulatory restrictions on usage and carries minimal permit requirements
- Highly effective in a broad range of temperatures and conditions
- Controls invasive mussels in all life stages
- Does not require detoxification before water discharge
- No significant effect on water quality or non-target organisms
- Minimal PPE required for application

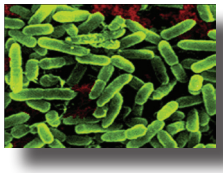
Customer Service

Marrone Bio Innovations, Inc. has formed an exclusive partnership with Solenis LLC, a global supplier of water treatment and process chemistries, to offer full service for enclosed industrial system Zequanox molluscicide treatment programs in the U.S. and Canada. Service includes:

- Consultation and treatment design unique to each facility.
- Free treatment proposal including cost estimate.
- On-site application and treatment monitoring.
- Ongoing consultation and support from expert invasive mussel and application scientists, technicians, and dedicated sales teams.

The Discovery

Zequanox molluscicide was discovered by New York State Museum (NYSM) scientists in search of an environmentally responsible solution to the zebra and quagga mussel problem. After screening more than 700 strains of bacteria, the scientists discovered that a specific strain of *Pseudomonas fluorescens* (CL145A), found in a river soil sample in the northeastern United States, was lethal to zebra and quagga mussels. Marrone Bio Innovations, Inc. holds the commercial license for Zequanox molluscicide and was responsible for the commercial development of the product.



Pseudomonas fluorescens species have been used in many applications, including pharmaceutical production, snow making, frost protection for strawberries, and disease protection for apples. It has also been designated as "Biosafety Level 1" by the American Type Culture Collection and the American Biological Safety Association, defining *Pseudomonas fluorescens* as "having no known potential to cause disease in humans or animals." U.S. and international health and safety regulators consider *Pseudomonas fluorescens* species to be of the lowest possible risk to human health and the environment.

ZEQUANOX®

For More Information

Call 1-530-750-2800 • Email zequanox@marronebio.com • Visit www.zequanox.com

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