

Coatings for Invasive Mussel Control

Evaluating foul-release coatings to protect Reclamation infrastructure

Bottom Line

Researchers at the Technical Service Center in Denver, Colorado, have identified foul-release coatings that prevent attachment of invasive quagga and zebra mussels.

Better Control

Environmentally friendly, prevents mussel attachment, minimizes maintenance. While silicone foul-release coatings can be nearly three times as expensive as conventional epoxy, the long-term preventative maintenance of the foul-release coatings must be considered. Savings in operation and maintenance, safety considerations, and flow may make it more economical to use foul-release coatings to control mussels.

Principal Investigator

Allen Skaja
askaja@usbr.gov
303-445-2396

R&D Office Contact

Miguel Rocha
Science and Technology Program
Coordinator
mrocha@usbr.gov
303-445-2841

Problem

Invasive quagga and zebra mussels have the potential to disrupt water delivery and hydropower generation functions, as well as to create long-term economic impacts. These mussels are capable of attaching to nearly all submerged surfaces and thus can clog pipes, trashracks, and cooling water and fire suppression systems; among other infrastructure. In addition, the mussels build up on gates and gate seats. All of these structures are critical to the reliability of Reclamation's mission of delivering water and generating hydropower.

Historically, mussels have been controlled by chlorinating water systems. This requires discharge permits to release into open waters, and are not practical in all situations. However, foul-release coatings could deter mussel attachment without releasing toxins into the water. These types of coatings do not depend on water chemistry, pH, temperatures, or flow rates. Commercial foul-release products thus far have been marketed for fouling control in the shipping industry. Yet the service environment at Reclamation facilities presents some unique challenges for a fouling control coating.

Solution

This Science and Technology Program research project works with manufacturers to evaluate the performance of a range of commercial coatings to reduce biofouling by mussels. To determine if these coatings could meet Reclamation's needs, we evaluated over 50 coatings and metal alloys in six broad categories:

- Conventional epoxies (which do not have any mussel control)
- Antifouling coatings (which use a biocide to prevent mussel settlement)
- Foul release coatings (which rely on physical properties to make it difficult for mussels to strongly attach)
- Fluorinated powder coatings
- Metallic coatings
- Metal alloys

Prior to this study, Reclamation did not have a strong need for coatings to address biofouling problems.

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Coatings are tested in waters at Reclamation's Parker Dam on the Lower Colorado River, California where mussels reproduce almost year round. We are able to test coatings here in both still and moving water.

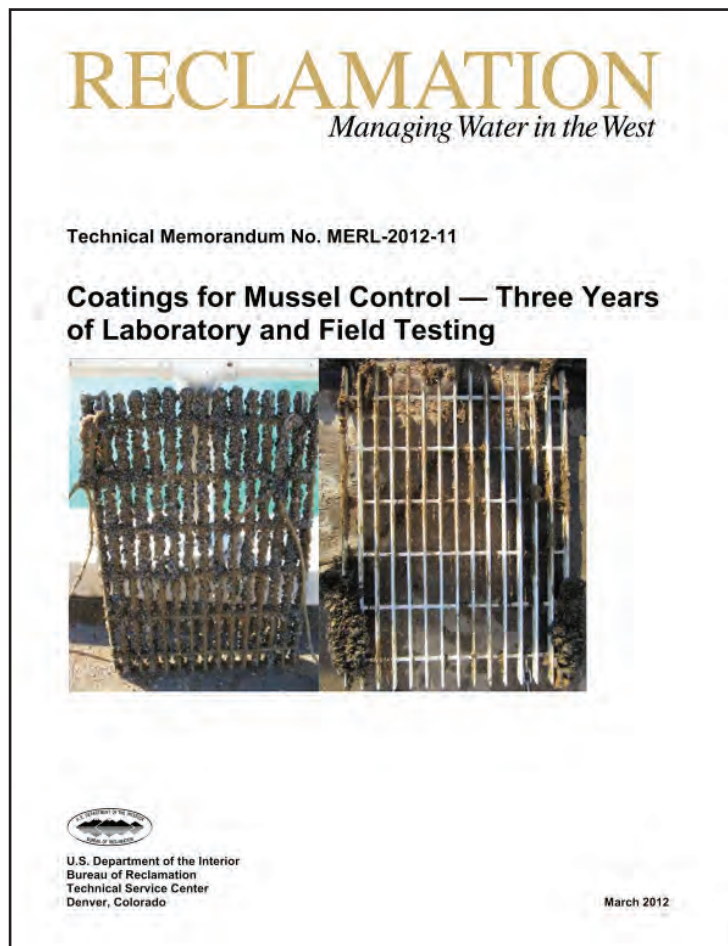
After immersion in the reservoir for several months, the coated metal grates are examined to determine the extent to which mussels have attached, and also the force required to remove the attached mussels. At this time, the data indicate that the silicone foul-release coatings are the most promising at deterring mussel attachment in both static (non-flowing) and dynamic (flowing) conditions. This finding was surprising, because the quagga mussels did not attach to the silicone surfaces at all. This contradicts what manufacturers have found in the shipping industry, that marine fouling organisms attach weakly to silicone surfaces.

Unfortunately, the majority of these coatings are soft and not very resistant to abrasion or gouging. Nevertheless, for conditions that do not expose structures to heavy debris impacts, these coatings may perform well. Surprisingly, although they are soft, the silicone foul release coatings have superior erosion resistance than epoxy coatings for sediment and silt-laden waters and, in this respect, are comparable to abrasion-resistant ceramic epoxies.

Future Plans

Future research is needed to further identify and evaluate new commercially available foul release technologies that will hopefully exhibit desirable abrasion and gouge resistance properties while maintaining foul-release performance. As technology advances, there may eventually be a durable foul-release coating that prevents mussel attachment. Additional research is needed to determine the critical flow rates required for self cleaning of durable foul release, fluorinated powder, and elastomeric coatings.

Reclamation anticipates that its first opportunity to install foul-release coatings will be in fiscal year 2013 at Parker Dam in California as part of the rehabilitation of a trashrack structure.



“The silicone and fluorinated silicone foul release coatings have been successful thus far in preventing or minimizing fouling. The limitations will be when debris is present in the water that will rub, abrade, or gouge the coating. These coating systems should work well on infrastructure that is free of debris.”

Allen Skaja,
Principal Investigator

More Information

Coatings for Mussel Control — Three Years of Laboratory and Field Testing. Technical Memorandum No. MERL-2012-11, Reclamation, 2012.

This report combines all the knowledge gained in the past three years of Reclamation research on coatings for mussel control.