RECLAMATION Managing Water in the West

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The Knowledge Stream
Research Update

Coating and Lining Resistance to High-Pressure Jets Used to Remove Invasive Mussels

Ensuring jets can remove mussels while keeping protective coatings and linings intact

Bottom Line

This research helped determine the optimal jet operating criteria to successfully remove mussel colonization without damaging existing and new coatings on hydraulic equipment (e.g., pipelines, trashracks, and gates).

Better, Faster, Cheaper

Water jetting is a valuable tool for removing mussels because it may be used on a variety of hydraulic infrastructure, including inside pipes and in between trashrack bars where removal is difficult. Understanding operation limits could save costs by reducing pumping required for jet flow and avoiding coating damage.

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Collaborators

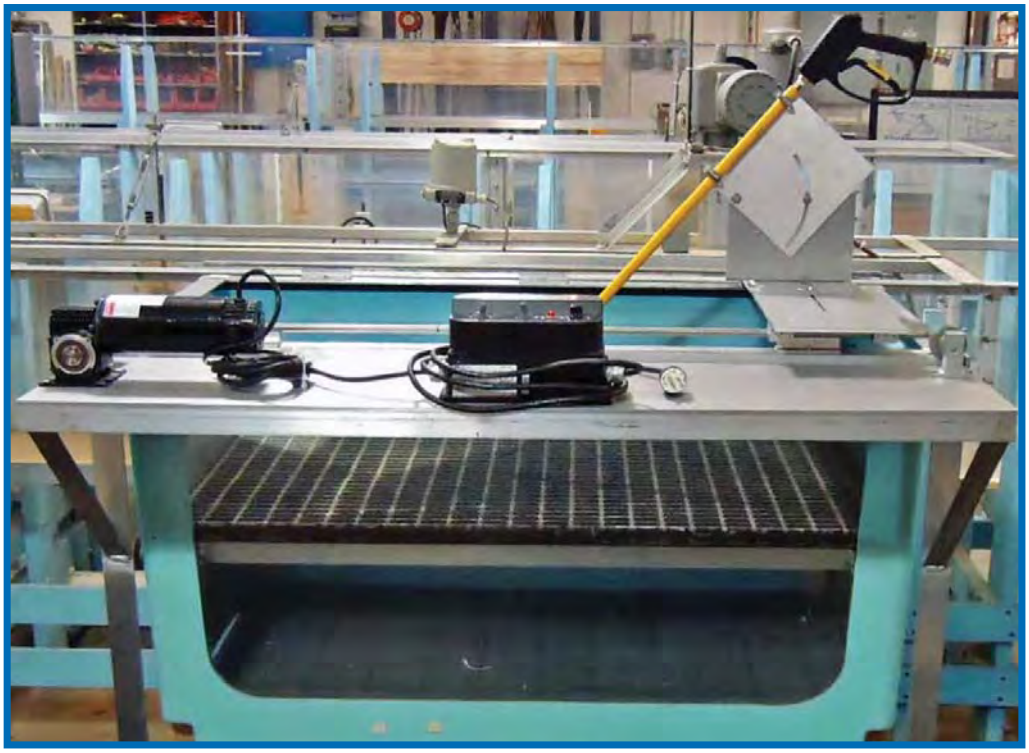
Reclamation

- **Materials Engineering and Research Laboratory in Reclamation's Technical Service Center**
- **Parker Dam, Arizona**

Problem

Invasive mussels pose many problems for Reclamation's infrastructure and operations, degrading facilities, clogging pipes, and fouling water. Developing new technology or using existing technology in new ways is needed to remove mussels. For example, Reclamation researchers recently developed a high-pressure water jetting nozzle that removes mussels that have attached to pipeline walls when operated with 5,000 to 10,000 pounds per square inch pump pressure. However, this much pressure also removes valuable coatings and linings that protect the pipes from corrosion, mussel attachment, and other degradation.

Another method to combat mussels, foul release coatings, deter mussels from attaching by using surface chemistry to significantly weaken the potential chemical bond between the organism and the substrate. However, their durability remains a concern. Using these coatings together with water jetting can enhance their effectiveness, but there is a fine balance between effectiveness and damage. High velocity jets could cause cavitation as eddies form and pressure drops. While submerged water jetting is not new, its effectiveness on, and impacts to, coatings are unknown.



Test apparatus used for coating durability and mussel release testing in both the laboratory and the field.

Solution

This Reclamation Science and Technology Program research project developed a test procedure to determine the pressures needed for a jet to remove attached quagga mussels without damaging the surface coating or material. Fourteen different existing and newly developed coating systems were tested, including recently developed foul release coatings. To determine the optimal operating range for jets to remove mussels from each coating, the coatings were tested in the laboratory for durability and damage, and in the field for live mussel detachment.

As there were high velocities and heavy cavitation associated with water jet cleaning, impact pressure testing was also performed to define the relationship between pressure and jet hydraulics (distance and velocity).

Application and Results

The pressure needed to detach mussels did not vary with the coatings, as the jetting impact pressure did not affect the coating. Rather, the pressure tore the mussels' byssal threads (the threads mussels use to attach to a surface). Byssal threads remained attached to the surface for all tests and could not be completely removed with the jetting system used in the current study. While leaving threads on the coating surface is not desirable, these threads do not protrude enough to significantly change flows or water pressure and, thus, we considered this a successful method to remove invasive mussels.

Test apparatus used for initial mussel removal testing at Parker Dam, Arizona, December 2011.

The jet stream's ability to remove invasive mussels was tested at Parker Dam near Lake Havasu City, Arizona, where live quagga mussels were attached to the coatings. The amount of mussels attached to the experimental plates varied widely—in general, more mussels were attached to bare metal samples or conventional coatings than the foul release coatings. Often, mussels would attach in clumps and would be 2 or 3 mussels thick. While the pressure required to remove mussels did not seem to vary with the amount of attached mussels, plates with fewer mussels were cleaner after jetting.

In every case, the damage impact pressures were higher than the pressures required to remove attached mussels. This gap in pressures allows a range of effective operation without exceeding the jetting durability limits for each specific coating or material. Within this range, measureable hydraulic parameters can be used to design and size a water jetting system that is effective and compatible with multiple coatings.

"Testing in this study has helped determine the operational limits and effectiveness of submerged jetting to remove mussels from coatings without causing damage. We will be looking at developing a hybrid jetting/ coating system initially for trashracks and possibly other hydraulic infrastructure."

Josh Mortensen
Hydraulic Engineer,
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Future Plans

This new test procedure will allow the durability of future coatings and materials to be tested quickly and cheaply. These newly developed design and operating guidelines will be used as coatings are applied to existing infrastructure with the possibility of using a hybrid submerged water jetting system to keep the surface mussel free.

More Information

Reclamation. 2013. *Resistance of Protective Coatings to High Pressure Water Jets for Invasive Mussel Removal.* Hydraulic Laboratory Technical Memorandum PAP-1074.

www.usbr.gov/research/projects/detail.cfm?id=1740