US Army Corps
of Engineers
Waterways Experiment
Station

Zebra Mussel Research Technical Notes

Thermal Sprayed Coatings

Purpose This technical note discusses the use of thermally sprayed metallic coatings as deterrents to zebra mussel attachment and subsequent macrofouling at public facilities.

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Definition An antifouling coating is a paint or other coating used to prevent the growth of barnacles and other organisms on the hulls of ships. In addition to ship hulls, antifouling coatings can be used on any stationary structure. These materials typically contain a substance that is toxic to fouling organisms.

Description Several organic compounds and some metal ions are known to be toxic to zebra mussels. A 5-ppm concentration of copper ions maintained for 24 hr was shown to produce 100-percent mortality in an adult zebra mussel population. Zinc ions at 5 ppm for 24 hr yielded 5 percent mortality. Coatings incorporating an organotin pigment are recognized for their antifouling properties. Coatings containing copper and copper compounds have been used extensively to prevent marine fouling of ship hulls. Historically, copper cladding was used for the same purpose. Zinc oxide is frequently added to cuprous oxide antifoulants as a cotoxin. Copper, tin, and zinc are all recognized as toxic to zebra mussels.

Coatings containing metallic zinc, tin, and copper may also be applied by a process known as thermal spray or metallizing in which molten metal is applied to a substrate. The spraying process uses a metal wire which is fed through a melting zone and propelled to the substrate in a stream of compressed air. Melting may be achieved either using an electric arc or an oxygen-acetylene flame. Metals may be applied by thermal spray to virtually any substrate material. Proper surface preparation is important to ensure good coating adhesion.

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TAFA Inc., Concord, NH, has experimented with the use of arc sprayed copper coating as an antifoulant on concrete weir gates in Bridgeham, Norfolk, United Kingdom. After 6 years, copper applied to the crest of a concrete gaging dam was free of fouling except for a slight film of slime. It was concluded that arc sprayed copper behaves essentially the same as solid copper in preventing algal fouling.

Brass is an alloy of zinc and copper. Military specification MIL-W-6712 describes two types of brass metallizing wire. Naval brass has a nominal weight composition of 60 percent copper and 40 percent zinc. Machinable brass metallizing wire contains about 5 percent more copper than naval brass. A brass ship bell that was recovered from an infested section of Lake Erie was noted to be free of fouling.

Bronze metallizing wire is nominally 90 percent copper and 10 percent zinc. Presumably bronze metallizing should have similar antifouling properties as brass.

Zinc wire is the most widely used metallizing material. It has been used as a protective coating for steel since the 1910s. Several state transportation departments are now using zinc metallizing to protect steel bridges from corrosion. The U.S. Army Corps of Engineers has experimented with zinc metallizing to protect steel immersed in fresh water. This work has shown great promise and a draft guide specification has been prepared describing the application and use of this coating. Zinc metallizing has also been applied to concrete structures as part of a cathodic protection system for protecting embedded reinforcing steel. Zinc metallizing immersed in the Ohio River at Belleville Locks and Dam was noted to be free of algal growth after 2 years. Other coatings at this location exhibited algal growth after one season in immersion. Anecdotal information from the U.S. Coast Guard suggests that zinc-galvanized steel is resistant to zebra mussel infestation.

Antifoulants incorporating tributyl tin oxide are banned from use in the United States. These regulations do not apply to metallic tin coatings although presumably they could be expanded to encompass tin metallizing as well as other toxic coatings if they are proven to have a negative impact on native biota. Tin wire is also described in MIL-W-6712.

Several other metallizing materials may also exhibit antifouling properties including aluminum bronze, phosphor bronze, and nickel-copper. Presumably the efficacy of these and other thermal sprayed metallic coatings will be dependent on the availability of the three toxic species, copper, tin, and zinc.

Recommendations

Thermal sprayed copper, tin, brass, bronze, and zinc coatings are recommended for use on a trial basis for abrasive blast-cleaned concrete surfaces which are critical to facility operations and that have been identified as susceptible to zebra mussel infestation. Concrete surfaces metallized with materials other than zinc should not contact other metal surfaces. Metallized coatings, except for zinc, should not be applied to steel substrates. Zinc metallizing may be used on a trial basis on structural steel as well as concrete. On steel the zinc coating will serve as both an antifoulant and protective coating.

As part of the Zebra Mussel Research Program, metallized test panels will be evaluated in field tests from May through October 1992. Further information on the effectiveness of thermal sprayed metal coatings at repelling zebra mussels will be available at the conclusion of this study.

References

McMahon, R. F. 1990. "The Zebra Mussel: U.S. Utility Implications," Electric Power Research Institute Report GS-6995.

TAFA Inc. 1988. "Coating for Underwater AntiFouling Purposes," Publication 2.3.2.5.

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