US Army Corps of Engineers
Waterways Experiment Station

Zebra Mussel Research Technical Notes

Section 2 — Control Methods | Technical Note ZMR-2-19

January 1998

Comparison of the Component-Level Performance of Anti-Zebra Mussel Coating Systems with Research Coupon Results

Background and purpose

The Paint Lab of the U.S. Army Construction Engineering Research Laboratories is evaluating antifoulant and foul-release coating systems on steel and concrete test coupons. Laboratory measurements of the metal leach rates of copper, zinc, aluminum, and tin containing antifoulant coatings and monoliths are being correlated with zebra mussel population densities on similar coupons immersed in the Black Rock Channel of the Niagara River at the Black Rock Lock facility of the U.S. Army Engineer District, Buffalo, in Buffalo, NY. Population density studies and qualitative adhesion measurements of nontoxic foul-release coating systems are also under way at the same location.

In addition, component-level testing of antifoulant and foul-release coating systems is being conducted at several locations in the Corps' Great Lakes and Ohio River Division (CELRD) and the Mississippi Valley Division (CEMVD).

This technical note summarizes observations of component-level tests of the various coatings. The results are compared to those obtained in the laboratory and on coupon samples at Black Rock Lock.

Additional information

This technical note was written by Mr. Mark A. Kelly, U.S. Army Construction Engineering Research Laboratories (CERL), Champaign IL. For more information, contact Mr. Tim Race, CERL, (217) 373-6769, e-mail *t-race@cecer.army.mil*. The Manager of the Zebra Mussel Research Program is Dr. Ed Theriot, U.S. Army Engineer Waterways Experiment Station, Vicksburg MS, (601) 634-2678.

Louisville District (CELRD)

In September 1993, the middle wall intake manifold screen No. 2 in the 1,200-ft (366-m) lock chamber at Markland Locks and Dam (Ohio River Mile 531.5) was coated with two antifouling coatings. The entire screen was coated with a grey vinyl paint, Corps of Engineers Specification V-766e. The first six vertical screen bars (from downstream to upstream) were coated with IC-531, an inorganic zinc silicate paint; the next six with Devoe ABC No. 3, a

Prepared and published by the Zebra Mussel Research Program, U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

cuprous oxide-pigmented ablative antifoulant paint; and the remaining seven with the V-766e grey vinyl.

When the screen was removed for inspection in August 1995, no zebra mussels were found on either the zinc silicate or cuprous oxide ablative paint-coated screen bars. However, infestations of 1 in. (2.54 cm) or more were present on the flow-shadowed side of the vinyl-coated bars, as well as the vinyl-coated tubular frame and lifting lugs. The ablative coating was reported to be completely eroded away, while the zinc coating had failed in many places, especially at the edges of the bars. Slight failure was observed at the corners of the bars coated with the vinyl paint.

St. Louis District (MVD)

In the summer of 1992, two floating mooring bitts were blast cleaned and primed with V-766e white vinyl paint. One bitt was top-coated with Devoe ABC No. 3, the cuprous oxide-pigmented ablative antifoulant paint; the other was coated with Jotun Valspar 569-R-1, a vinyl antifouling paint conforming to Mil-P-15931. When inspected in October 1995, both bitts were still free of zebra mussels.

Detroit District (CELRD)

In March 1992, the hull of a bay class tug, the *Tawas Bay*, was coated with five coats of Epco Tek 2000, an epoxy/copper antifouling paint. The tug has since been surplussed, but no infestation has been observed.

Buffalo District (CELRD)

The hulls of two tugs operating in Lakes Erie and Ontario were cleaned of zebra mussels and coated with an epoxy primer. Both were top-coated with copper oxide-containing ablative antifouling paints—one with Devoe's ABC No. 3 and the other with Ameron's Amercoat 70ESP. No results have been reported yet.

Nashville District (CELRD)

All surfaces of a water quality monitor housing (steel pipe, 6-in. (15-cm) diameter) at a monitoring site at Mile 30.5 on the Cumberland River just below Barkley Dam were treated with a hot-dip zinc metal-galvanized coating. No mussels have been observed since this monitor was installed, in spring 1995.

Coupon tests

With the exception of the Ameron Amercoat 70ESP, the coatings used in the component-level tests have been evaluated at the coupon scale, both in the laboratory and at Black Rock Lock. Two of the materials employ zinc as the antifoulant, while the others contain a form of copper.

Figure 1 plots the population densities (zebra mussels per square meter) that have infested the test coupons at Black Rock Lock over time. The two copper oxide-containing coatings (Devoe ABC No. 3 and J-V Mil-P-15931) had essentially no zebra mussels during the 3-year test. Infestations on the other coatings seem to have peaked, and are now retreating.

The leach rates of the primary antifouling metal ion, as a function of the time of immersion in flowing water, for the five laboratory-tested coatings are shown in Figure 2. The minimum values of the leach rate estimated for maintaining the antifouling properties in copper- and zinc-bearing coatings are also plotted.

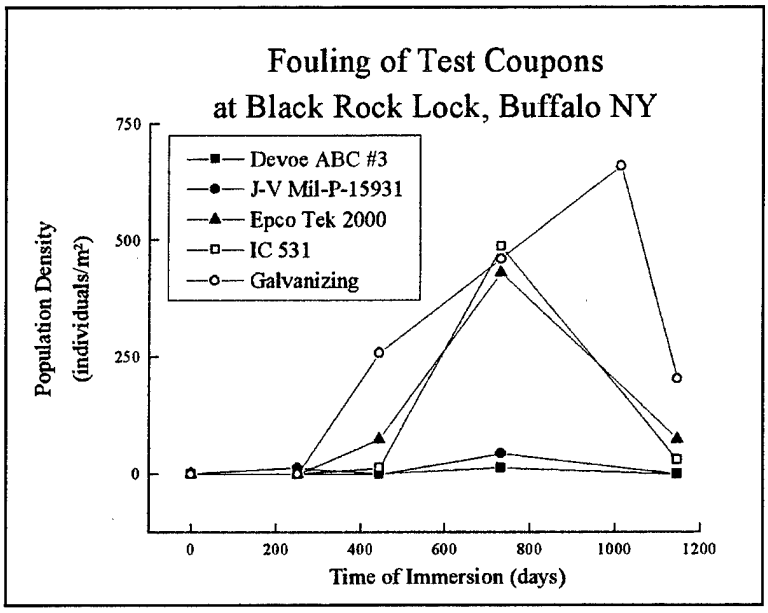

Figure 1. Population density of zebra mussels over time during immersion at Black Rock Lock for copper- and zinc-bearing coatings

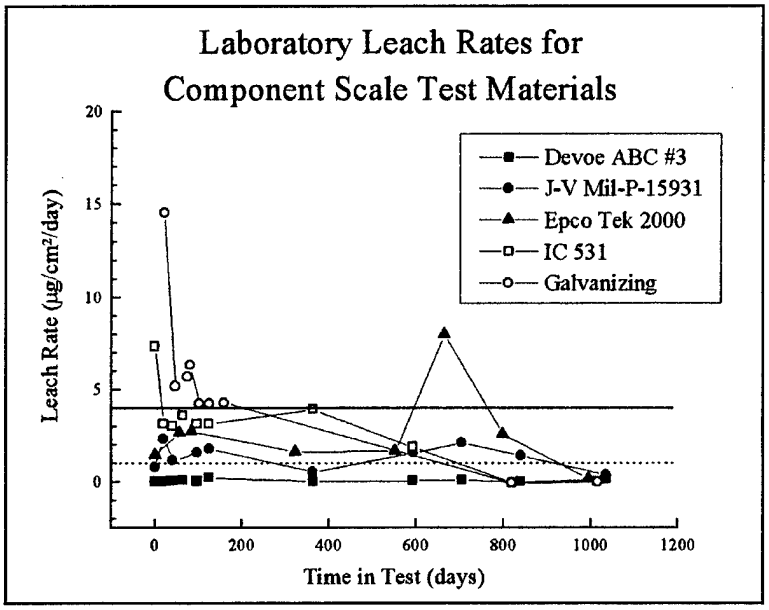

Figure 2. Leach rates of metal ion from copper- and zinc-bearing coatings, measured at intervals over a 3-year period. Horizontal lines indicate the estimated minimum values of leach rate for maintenance of antifouling properties in coatings (dashed line = copper; solid line = zinc-bearing coating)

The copper-containing ablative paints have a short life span because of their nature. Designed to present fresh copper salts to the fouling organism by controlled ablation, they rather quickly disappear from the substrate. The test coupons are not exposed to water flow rates that would cause quick erosion of the surface, and thus retain antifouling properties far longer than the same coatings used in high-flow environments, such as the trash rack at Markland Lock and Dam or the tug hulls on the Great Lakes. The copper-containing epoxy coating, Epco Tek 2000, has exhibited a decreasing leach rate and higher infestation density than the ablative systems. This coating is designed to be reactivated periodically (usually once per year) by light blasting or scraping to

remove the epoxy layer from which copper has been depleted by diffusional leaching. Boat hulls are a good candidate for this class of materials, especially on small boats that are removed from the water every winter.

As laboratory zinc leach rates have fallen, the infestation density has risen at Black Rock Lock. The bars on the trash racks at Markland Lock and Dam have not been coated long enough for the leach rates to have diminished significantly. It is anticipated that the use of thermal-sprayed zinc or zinc alloy materials would work similarly to the inorganic zinc material. These materials might be more abrasion resistant, adhere better, and provide better corrosion inhibition for a longer period.