US Army Corps
of Engineers
Waterways Experiment
Station

Zebra Mussel Research Technical Notes

Susceptibility of Different Ages of Concrete to Zebra Mussel Infestation

Background and purpose

Portland-cement concrete is a common construction material for hydraulic structures in navigable waterways. Some of these hydraulic structures will become infested with zebra mussels and physical removal will be required. The purpose of this technical note is to describe the effects of zebra mussels removal methods on the integrity of concrete. It now appears that environmental factors that favor zebra mussels are also conditions where concrete is most stable. When portland-cement concrete is placed in water, calcium hydroxide ($Ca(OH)_2$) slowly is leached from the surface, producing high pH and salt concentrations approaching that of hard water. Low pH and soft water are not favorable for zebra mussels.

Additional information

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Old concrete

Concrete surfaces gradually deteriorate because of normal weathering. This normal weathering erodes the portland-cement matrix, leaving the aggregate standing in relief. Observations have indicated that zebra mussels are most likely to colonize on these roughened surfaces.

It appears that zebra mussels first colonize along discontinuities such as construction joints, monolith joints, and cracks in monoliths. These areas also tend to contain deteriorated concrete caused by normal weathering.

The compressive strength of concrete in large structures is likely to be greater than 27,600 kPa (4,000 psi), but concrete in areas described above may have incipient fractures and lower compressive strength. Thus, zebra mussel removal techniques may dislodge concrete in these weakened areas. Water jetting to remove normal concrete requires pressures in excess of 117,200 kPa (17,000 psi). Zebra mussels and their byssal threads can be removed from concrete surfaces with water pressures of 68,900 kPa (10,000 psi).

New concrete

Zebra mussels adhere to most surfaces and do not seem to have difficulty attaching to concrete, either to the paste portion (matrix) or the aggregate portion. As described above, zebra mussels first colonize areas with joints or discontinuities. This would suggest that concrete with no discontinuities is more suitable for reducing zebra mussel infestations.

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

PRINTED ON RECYCLED PAPER

Structures of dense concrete with flat surfaces should minimize zebra mussel colonization and make postcolonization cleaning easier.

The American Concrete Institute *Manual of Concrete Practice* in its chapter on admixtures for concrete describes the use of fungicidal, germicidal, and insecticidal admixture for concrete to prevent growth of organisms. All compounds with these admixtures tend to be temporarily effective depending on the environment. Although future research may identify an effective antifouling compound that can be incorporated into concrete, none is currently available for zebra mussel control.

Posttreatment

Chemicals are being use to control zebra mussel infestation. Chemicals should be used cautiously and sparingly. Acids generally cause disintegration of concrete. This can range from slow disintegration (acetic acid) to rapid disintegration (muriatic acid). Acid treatments should not be used to kill zebra mussels. Care should be taken in selecting compounds that are useful to control zebra mussels but remain innocuous to concrete.

Some common compounds and their effects on concrete are listed below:

Chlorides of	Effects on Concrete
Calcium	None
Potassium	None
Sodium	None
Strontium	None
Ammonia	Disintegrates slowly
Copper	Disintegrates slowly
Zinc	Disintegrates slowly

Nitrates of	Effects on Concrete
Ammonium	Disintegrates
Calcium	None
Potassium	None
Sodium	None
Potassium permanganate	None

Hydroxides of	Effects of Concrete
Ammonia	None
Calcium	None
Potassium	none
Sodium	None

References

American Concrete Institute Manual of Concrete Practice, Detroit, MI, yearly update.

Woods, H. 1968. *Durability of Concrete Construction,* ACI Monograph No. 4, Detroit, MI.

March 1992