

Sacrificial Boat Anodes

Non-Zinc Alternatives and End of Life Management

Introduction

Boatyard managers and boat owners are essential to preserving water quality and healthy marine life. Sacrificial anodes, often referred to as “zincs” in the boating community (nicknamed after their historic main element), counteract galvanic corrosion on exposed adjacent metal components, such as propellers, rudders, and outboards.

To maintain efficiency and functionality, replacement of anodes happens when about half of the anode is lost to corrosion. Frequency of change-out depends on the water, and boat use patterns, but is recommended before the anode has corroded by 50% of its weight. This typically means at least once annually for boats stored in water.



Alternatives to zinc anodes are available in aluminum and magnesium alloys, which have lower toxicity to marine life than the traditional zincs, as well as other potential performance advantages. Aluminum anodes work well in salt and brackish water, while magnesium are for fresh water boating. When switching to a different anode material, note that all the anodes on the boat must be the same material, and recommended to be a different metal than under-water components.

A series of factsheets provided by Pacific Northwest Pollution Prevention Resource Center (PPRC) and the Clean Boating Foundation provide suggestions to help reduce impacts to marine life and water quality from boat hull maintenance and repair activities. This factsheet covers zinc anode alternatives, information about the marine toxicity of zinc, and proper end of life management

The following factsheet and video topics are available [here](#).

- Hull Paint Removal
- Do It Yourself (DIY) Tips to Minimize Antifouling Pollution
- Pressure Washing
- Antifouling Paint Waste Management

Marine Toxicity Concerns with Zinc

While zinc works effectively as an anode material, it can be highly toxic in aquatic environments. Zinc ions, which form when zinc is released from the boat hull to saltwater, can be harmful to some marine animals and plants at very low concentrations (NWGC, 2017). Studies have shown that zinc pollution reduces the ability of fish to reproduce and can lead to increased mortality.



Additionally, zinc anodes often contain trace cadmium, which is a bioaccumulative toxin, harmful to both aquatic life and humans. It can cause deformities in fish, as well as nerve and brain damage.

Zinc-Free Alternatives

Utilizing non-toxic alternatives can provide better protection for boats, while protecting aquatic environments from zinc and cadmium exposure and pollution.

Aluminum Anode Benefits | Salt and Brackish Water

- Low aquatic toxicity
- Excellent function in salt and brackish (with limited life in fresh water)
- Perform at least 5% better than zinc with respect to ampere hours per pound
- Typically lasts longer than traditional zincs, depending on water type
- Weigh 50 percent less than traditional zincs
- Meets US Military Specification
- Cost savings compared with commercial zincs

Tip: Look for products containing virgin aluminum, or recycled high-quality alloys. Some aluminum anode manufacturers utilize recycled aluminum anodes, which reduces their effectiveness against corrosion.

Magnesium Anode Benefits | Freshwater Only

- Low aquatic toxicity
- Very active electro-chemical voltage range giving better protection than zinc or aluminum in fresh water
- Weigh at least 60 to 70 percent less than traditional zincs

DIY Best Management Practices (BMPs) to Minimize Zinc Pollution

- Purchase and install zinc-free anodes.
- If a diver is contracted to change anodes underwater, ask them to attach a bucket underneath the work area to catch anodes during change-out and to ensure spent anodes are recycled.
- Properly dispose of spent anodes at a metal recycler, boatyard, or marine supply store if they offer the service.
- Consider storing the boat in dry storage or on a hoist above the water during the off-season, to preserve anode life and hull paint life.



Best Management Practices (BMPs) For Boatyards to Minimize Zinc Pollution

Relevant Washington State Boatyard General Permit Language:

The Permittee must not dispose of ... sacrificial anodes into waters of the State. The Permittee must store spent zincs in a covered container and properly dispose of them.

- Recommend zinc-free anodes to boatyard clients.
- Offer zinc-free anode options for sale at the retail shop or boatyard office
- If divers are contracted to change anodes underwater, ask them to attach a bucket underneath the work area to catch anodes during change-out and ensure all spent anodes are recycled.
- Offer free collection of spent anodes to the site users and to the public.



Fisheries Supply retail store in Seattle offers free anode recycling.

References

- Washington State Department of Ecology, 2011. [Boatyard General Permit](#)
- Clean Boating Foundation, 2018 [Clean Boatyard Program Checklist & Standards](#)
- Northwest Green Chemistry (NWGC), 2017. [Boat Paint Alternatives Assessment](#)
- Canadian Yachting, 2018. [Time to Sink Zinc](#)
- Martyr Anode. [Why Zinc-Less](#)

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