Sacrificial Anodes

A new & unique design approach

Corrosion and Marine Sacrificial Anodes

Background

Salt water is an excellent electrolyte and therefore when any vessel that has underwater metal parts is immersed in water an electrochemical reaction is caused which can rapidly erode underwater fittings, particularly stern gear, sail-drives and propellers.

This electrochemical attack is a significant issue for the majority of marine vessels and structures, with the exception of the smallest craft that are either kept ashore when not in use or without metal hull fixings, fittings or stern gear.

This major and expensive problem affects craft of all construction types whether commercial ships, fishing vessels or leisure sailing yachts and motorboats. In addition all marine structures including, marine buoys, lock gates, piers, jetty's, offshore platforms, pipelines and foundations are similarly affected.

In 1824 to reduce the impact of this destructive electrolytic action on hulls, their fastenings and underwater equipment, the Victorian scientist-engineer Sir Humphrey Davey, developed the first and still most widely used protection system. Davey installed sacrificial anodes made from a more electrically reactive (less Nobel) material attached to the vessel hull and electrically connected to form a cathodic protection circuit.

The significance of the problem is that the vast majority of boats have at least one and typically several anodes all that require regular replacement. Estimating the total number of leisure marine vessels requiring anodes is complex, but it is likely that worldwide there are in excess of 2.5 million such craft, most of which require annual anode replacement. The resultant commercial value of this is evidenced by the sheer quantity and number designs of anodes that are available from chandleries and marine engineers.

Existing Marketplace Products

Many marinas and river moorings, even those in proximity to the sea, are actually composed of brackish or fresh water, where a standard zinc anode soon become ineffective due to build up of zinc oxides and salts that form as a non-reactive surface coating rendering them useless.

Boats that have aluminium components or are kept in fresh water are typically protected using more reactive materials, typically magnesium or an aluminium alloy but magnesium is too active for most boat

Anodes are typically made from Zinc, Aluminium, Magnesium or mixed alloys. Zinc is in widespread use in salt waters, but cannot protect yachts that have either aluminium hulls or with aluminium fittings, such as sail-drive or stern drives units.

Anodes bolted onto the hull inevitably produce drag and turbulence, when the boat is moving through water. Ironically the majority of leisure boats spend less than 5% of their time afloat actually underway.

applications and if used on a boat in salt water, the very low voltage causes the formation of hydrogen bubbles that often results in the paint being stripped from aluminium parts in just a few hours followed by rapid corrosion.

The zinc anode pictured on the left has only been immersed for a few months in brackish water yet has collected a thick non-reactive oxide coating, rendering the anode useless for cathodic protection.

Even more severe corrosion can also be experienced in some locations due to “stray current” from badly installed pontoon AC mains circuits. Mooring in these ““Hot Marinas” typically results in extensive, costly and potential dangerous degradation of most marine grade metal items including bronze, stainless steel and aluminium.

Rather than suffer the notable drag penalty of fixed surface mount anodes many racing boats use heavy over the side hanging “fish” anodes once berthed.

These anodes are also used in an attempt to guard against stray current effects.

But such over the side solutions are fiddly to use and need to be clipped manually to the shaft in order for an electrical bond to be effectively made. Inevitably in use hanging anodes are positioned a long way away from the stern gear that they are trying to protect.

The propeller shown here has suffered catastrophic crevice corrosion in just few months, due to inadequate cathodic protection.

The extent of the corrosion on the shaft demonstrates the need to ensure anodes are sufficient and active.

As a result a replacement new shaft and propeller were required at a cost of over £2000.

Sacrificial anodes continue to be predominately crude castings simply bolted onto hulls with the wiring connection typically made by poorly crimped terminals.

The condition of the anode cannot be monitored whilst afloat without recourse to diving, which is impractical for most craft; therefore the vessel has to be hauled ashore at significant expense for both inspection and replacement.

Shaft anodes can also create problems, either through becoming loosened, resulting in noise and possible damage to both the support bracket and propeller shaft. Even if they do not loosen they can contribute to vibration and excess bearing wear due to the balance of the shaft changing as they erratically erode.

Summary of current product weaknesses

It may be summarised that the anode systems used by leisure marine craft suffer from the following key weaknesses:

- Anodes are fitted on a trial and error basis
- Wear level cannot be monitored afloat without use of a diver or slipping
- Boat requires expensive haul-out for anode replacement
- Anodes cause turbulence and drag
- Propeller and shaft anodes are attached in a rotating and vibrating environment which can result in their premature loss or damage to shaft brackets and stern gear if they become loosened
- Shaft anodes can contribute to propeller shaft imbalance which in high performance craft can lead to excessive vibration and stern gear damage
- Hull anodes are typically fixed using crude through hull bolts and mastic sealant, which can lead to water ingress, if poorly fixed or through hidden corrosion
- Anodes are typically electrically bonded in damp bilge areas where the quality of the electric terminations are difficult to inspect and prone to corrosion and failure, rendering the anode useless
- Anode material cannot be changed when moving the vessel to and from salt water to fresh water environments

What is required?

- An anode system that can be easily fitted either as OEM installation or aftermarket
- An anode system that can be regularly and safely inspected without the vessel being hauled out, or by a diver
- An anode system that can provide a “No-drag” solution for racing and performance craft when underway
- An anode system that can be easily changed when vessel is used in different water salinity types. For example from zinc to magnesium
- An anode that can be cleaned of surface oxide or marine growth whilst still afloat
- An anode where the electric bonding can be reliably made, periodically inspected and tested for electrical continuity
- An anode system that is suitable for all hull types whether; wood, steel, fibreglass, composite or aluminium
- An anode system that can provide protection for fixed, feathering, folding propellers, shaft or sail drive installations, stern drives, bow thrusters and trim tabs
- An anode that is compatible with any existing cathodic protection installation

The Bruntons - Marine Innovation Solution

BRUNTONS IONGUARD©

Multi-function anode system that:

- **Guards your boat from stray metal Ions**
- **Is easy and quick to replace whilst afloat**
- **Simple to retract when racing**
- **Allows corrosion to be monitored**
- **Can be easily changed for fresh or salt water use**

IonGuard is the World's first anode system that is fully retractable through the hull to eliminate drag and to allow simple inspection or replacement.

IonGuard can be safely and easily replaced whilst boat is still afloat

IonGuard allows the anode to be regularly withdrawn flush with the hull without any water ingress whatsoever. This will be of significant interest to racing craft who can simply push or pull the anode into an active moored position or raised into the racing “flush” position.

A separate simple plug is provided to safely seal the aperture during anode replacement

The in-built anode end-fairing piece also provides a simple direct indication of actual amount corrosion that has occurred.

Plastic, stainless steel and bronze skin fitting options, all with proven record for safe through hull installations are available to make ***IonGuard*** suitable for all hull types including wooden, steel, aluminium, ferro, GRP and all new laminate and composite hull types.

Once fitted ***IonGuard*** condition can be checked for erosion wear level whilst the boat is still in the water simply and safely within 1 minute!

If subject to extreme and unusual force (EG rope or net on propeller), ***IonGuard*** has a unique designed shear point that will purposely fail

The unique cone connection design allows use of a low strength nylon screw whilst retaining excellent electrical and mechanical contact.

IonGuard can be periodically cleaned (especially to remove possible zinc oxide build up)

IonGuard can be made from Zinc, Aluminium or Magnesium for different water salinities and can be easily changed, a replacement can be typically undertaken within 2 minutes

IonGuard can be used as a “Reference anode” providing the direct visual ability to monitor general electrochemical activity on hull, so indicating if any additional fixed anodes may also required replacement – this is particularly valuable on steel and aluminium hulls that require multiple anode systems.

IonGuard can be mounted in the engine room close to the propeller and shaft, where electric bonding is simply achieved via hard wiring direct to the engine/gearbox (shaft bonding option available for rubber isolated engine installations)

The electric connections on ***IonGuard*** can be easily inspected and connections circuit tested with a standard multimeter after being lifted out clear of the bilge area.

IonGuard is designed to use a very low resistance high grade 5 mm^2 (10AWG) gauge PVC insulated multi-strand tinned copper marine bonding cable

IonGuard is extremely simple to fit using industry standard proven through hull skin fittings and can be fitted by boat yards or most competent boat owners using a standard 51mm (2”) holesaw tool in 30 minutes.