Antifouling – A guide to the use of protective coatings below the waterline.

The battle against marine growth on shipping of all descriptions has been ongoing for many hundreds of years. Attaching a copper sheeting to the hull of sailing vessels, or the use of tar to prevent the growth of both shellfish and aquatic weed has been recorded for hundreds of years, and the earliest recorded attempts to reduce fouling are 2,000 years old.

The formulation of modern antifoulings is a relatively new development that started in the 1800’s with small incremental steps through to the 1930’s.

The driving force to invest in research & development to find a more effective control of marine growth got its first real boost in funding as a consequence of the second World War, and the large fleet of ships in the US Navy that desperately needed protection from marine growth. The onset of war, and the subsequent increase in the navy fleets, along with the rapid growth of merchant shipping after the war all contributed to a sustained investment in research and development.

Antifouling – both the R & D and the manufacturing of commercial products is now a major industry aligned with the marine sector.

The list of key attributes that an antifouling must possess now includes:

- A reduction/elimination of toxic chemicals/introduction of green technology
- Need to reduce fuel costs in the shipping industry
- Overall improvement in performance
- Longer term protection between repaints
- Preventing the introduction of foreign worms, crustaceans or weeds into clean waters

So, what are the primary groups of foulants that plague sea going vessels worldwide? They can simply be categorised into three groups.

Slime: Slime may appear to be the lesser of the fouling challenges, but it is well recognized that slime is often the precursor to both weed growth and establishment of shelled animals. Slime is difficult to control – bacteria and diatoms are everywhere, and infestation is inevitable to some degree.

Many of these bacteria produce mucilaginous materials (proteins in a gel like form – from which agar is derived for example) to which bits of organic detritus adhere. The surfaces may then be colonized by lower forms of algae such as diatoms. The bacteria and their by-products combined with the detritus and algae populations constitute what is commonly referred to as a "slime film".

From there, rampant infestation with both plant and animal fouling is inevitable unless biocides can prevent their establishment.

Shell Growth:

There are thousands of species of shell based foulings – barnacles, molluscs (mussels) and tube worms (a group of animals that reside within a tube-shaped shell) these three are the most common groups, which create the biggest problems for vessels.

Barnacles: Barnacles start off as fertile eggs which, when hatched, spend several months growing until they reach a point in their development where they want to find a location to colonise – that is, a permanent location where they will mature, and in turn, start reproducing.

This is the danger zone for boaties. The cyprid larva is focused solely on finding a suitable spot where it attaches head-first to the surface. Larvae base their selection of a site on the surface texture, the chemistry, and whether there is a biofilm (slime) present.

As the tiny barnacle grows, it builds a hard-calcareous shell, which progressively enlarges with the addition of more layers.

Molluscs: Marine mussels, like their neighbors, the barnacles, will float around in the ocean as they develop. This free floating larval form usually exists for a period of three to four weeks, at which point it reaches what is known as the settlement stage.

Eventually, these floating larvae mature and attach themselves to a suitable growing surface. This could be a coastal rock, a pier, or your boat. Once they have attached, they excrete a material to form the byssal threads. These filaments are incredibly strong and secure the mussel to its new home.

Tube Worms:

Tube worms are an expensive and unwelcome passenger on any boat, they have been known to increase drag on the hull by 60%, which in turn reduces speed – commonly losses of 10% and often greater. These dynamics increase fuel consumption - poorly maintained vessels may use 40% more fuel as a direct result of the drag fouling creates.

The other consideration which tends to be overlooked is the cost to repair damage sustained by excessive marine growth. Barnacles (especially) will damage the hull surface, and this becomes expensive to repair and to reapply a functional antifouling system.

From the above it can be seen that bio fouling is a serious problem which comes in many forms in different waters and can create havoc with all classes of vessels.

Types of Antifouling:

There are two primary types of antifoulings, with opinions on the performance of either type being a hotly debated topic.

The most common type is the ablative or semi-ablative group. This group is designed so that the “binder” (the resinous material that makes the substance of the paint) starts to slowly dissolve over time and therefore releases its biocides from within the film. This process is called ablation.

Generally, most semi/ablative antifoulings use cuprous oxide as the primary biocide, along with co-biocides (secondary biocides) – in the main being various fungicides and/or zinc.

The rate at which the film ablates, and therefore the rate at which biocides are released is a function of:

- The chemistry utilised in the formula – the various brands in the market range from very soft (ablative) to quite hard (semi-ablative)
- The age of the coatings – ablation rates reduce as the film ages and its active ingredients are depleted

- The speed of the vessel
- Frequency of use
- Thickness of the coating
- The water chemistry & temperature.

Any one of these factors, if misjudged or overlooked can severely compromise the performance of any ablative, or semi ablative antifouling.

The second group of antifoulings are the self-polishing co-polymer antifoulings. (SPC).

These coatings are harder than the ablative types, and after a short time in the water they produce a smooth, hard surface which maximises speed and fuel efficiency. These coatings release their biocides at a more controlled rate throughout the season compared to the ablative types.

This group is generally more expensive, as the coatings are using newer technology resins and a greater range of biocides.

Within this group is a relatively new binder – called a silyl acrylate. This binder is proving to be an ideal product for use in the SPC group. Recently newer, patented versions of this material have come onto the market, and they are providing an even more predictable release of biocides and overall performance.

Another group of coatings contain no biocides at all. Known as foul release coatings, they rely on a very smooth "non-stick" surface that prevents foulants from being able to adhere to the surface.

Most of them are made from silicone elastomers, teflon and/or fluoropolymer coatings.

Results from this group are variable – its only real advantage is that it is biocide free, which makes it attractive to some consumers.

Coating Systems:

There are some very well-established protocols and standards around the application of coatings for marine immersion.

Typically, most pleasure craft constructed from fibreglass, gelcoat etc will have a minimum of a primer and an Epoxy High Build coating before the antifouling is applied. The primer's key role is adhesion to and protection of the substrate. The Epoxy High Build is designed to create a barrier between the antifouling & marine environment and the substrate. These two coatings would have a combined thickness in the range of 150 – 200 microns.

With aluminium hulls, an additional 50 – 100 microns of coating is advised to ensure that no aluminium "needles" protrude through the film (barbs created via aggressive grinding).

Steel hulls require an even thicker barrier to avoid corrosion, usually a total of 350 microns minimum. Thinner films may be applied, but overall performance will be compromised.

The other aspect that needs to be considered is avoiding the use of a Copper based antifouling around the stern drive/outboard/other aluminium fittings on the stern. Copper will attack the aluminium and cause pitting, leading to early failure of the aluminium part/s.

In all instances, aluminium hulls, stern drives etc require an antifouling that is cuprous oxide free. AY&B's Petit Vivid® Antifouling is designed for use on all aluminium craft as well as fittings below the waterline. Vivid® is providing 24 months protection from two coats applied by roller.

Although single pack coatings are perfectly acceptable for below water systems, the majority of coatings used are two component epoxies. This technology is well proven over many years and the robust nature of them means they should require less maintenance.

The key to success with two component epoxies is that the last coat of epoxy, and the first coat of antifouling should both be applied the same day. Generally, the epoxy should be left long enough to ensure that it is "tack free" before the antifouling is applied. The Thumb print test is a good way to check. You should be able to leave a thumb print in the epoxy coating, but have no paint stick to your thumb before you apply the antifouling.

As a rule, most epoxy coatings applied in the morning are ready for application of the first coat of antifouling by early afternoon. Do not be tempted to leave it until early the next day as this will result in poor adhesion and likely failure. If you are unable to apply the antifouling due to a change in weather for instance, you will need to apply another, thin epoxy coat prior to applying the antifouling. Sanding the epoxy is not an acceptable practice to "refresh" the epoxy, it simply does not work.

Repaints:

Repainting the hull below the waterline is a routine that most boaties face every two years or so. Many owners prefer to paint their own boats as part of their pre-season preparation. Understanding a few key points will ensure success with the new paint job providing a clean hull for the next two seasons.

When the boat is lifted onto the hardstand, the first job is to waterblast the hull. Most facilities provide a waterblaster capable of 2,000 to 3,500 psi. Although this is sufficient pressure to remove the bulk of the slime, weed and some shell, it is not adequate to fully clean the surface ready for repainting.

Once the waterblasting is completed, the surface needs to be wet sanded, using 80 grit sandpaper on a pole sander. This process will allow you to remove any lose, damaged or overbuilt coatings and it will remove the last residues of slime along with the topmost layer of hydrolysed antifouling (the layer that is fully saturated and has depleted levels of biocides). This process, and the subsequent rinsing to remove the sanding residues will also remove the last traces of salts.

Wet sanding also has the advantage of being more efficient at removing aged coatings, and, equally important, it eliminates the risk of inhaling sanding dust.

Some Councils / Local Bodies are introducing new rules which do not allow wet sanding to be undertaken at marine facilities, and are insisting on dry sanding with vacuum sanders. Although this may sound ideal, it does tend to reduce the quality of the preparation work, and the increased risk of exposure to sanding dust is a concern. We encourage all workers in these environments to wear suitable protective clothing, face masks and gloves to minimise their exposure to toxic materials.

It is important to prevent an excessive build-up of aged coatings on the hull. Multiple layers become increasingly brittle and the surface will end up being rough and difficult to paint.

Once dry, the surface should be smooth and evenly coloured, and if you run your hand over the surface your hand should be free of dry dust residues. If there are still cracked and overbuilt coatings evident, then it is advisable to scrape the excess off and sand again to ensure the surface is sound and smooth.

New antifouling will adhere to old, clean antifouling, but it will not adhere to aged epoxy primers, aged single pack primers, nor gelcoat, fibreglass etc. These surfaces need to be spot primed with Altex Prima~Shield Antifouling Sealer or Multipurpose Primer before the fresh antifouling is applied.

One of the most common mistakes made with antifouling application is the amount of product required to achieve the durability wanted. Many people assume that they can base the amount of product required on the length of the vessel.

In fact, the only accurate way to determine volumes required is to measure the number of square metres of surface area that needs painting. Product Data Sheets provide a spreading rate – the number of square metres that a litre of paint will cover when applied at the correct thickness. From this information you can calculate the number of litres required per coat.

Failure to apply at the recommended rate will result in a reduction in the length of time the antifouling will perform.

The Danger Zone:

When a boat is launched again after a new coat of antifouling has been applied, the antifouling is dry, and will take time to hydrate and start to work – that is, it will take time to start releasing the biocides. Typically, this is around a month or so.

During that initial four-week period, the boat hull has no protection from marine organisms. At this stage it is very vulnerable to “attack”.

It has been noted in Northland (warmer) waters especially, that the barnacle Amphibalanus Amphitrite has been “seeding” at very high levels and that many boats are being attacked by the baby barnacle (cyprid stage) which are attaching themselves to the hull before the biocides can work. This has been evident now for two seasons and is a problem irrespective of product used.

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