

Anti-fouling Coatings for Boats

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THE BOTTOM of a ship or boat painted with ordinary paint quickly becomes the home for a variety of organisms, both plant and animal, which, if allowed to remain, seriously slows the vessel and increases fuel consumption. There are hundreds of different kinds of these so-called fouling organisms, mostly classed as barnacles, moss animals, tube-worms, clams, sea squirts, or sea weeds.

It seems possible that fouling could be prevented in two main ways. The simplest would be to coat the surface of the hull with a substance which would be physically unattractive to the small active (larval) stage of the fouling organism when it is looking for a suitable place to settle. One would think that a very smooth or slippery surface might do. Many of the modern plastics, particularly Teflon, appear to have such surfaces. However, an Australian worker recently tested Teflon for its anti-fouling properties and found that many organisms settled actively on it and developed normally. The same is true of other plastics. In fact, a substance with a surface physically unsuitable for fouling organisms to settle and grow on has not yet been found. Most fouling animals and plants possess quite remarkable powers to adhere to surfaces.

The other possible method of preventing fouling would be to make the bottom of the boat poisonous or repellent to fouling organisms so that they cannot settle, or would die almost immediately if they do. All successful anti-fouling coatings are based on this system. The extensively used anti-

fouling paints all contain substances poisonous to fouling organisms.

ANTI-FOULING PAINTS

Most successful anti-fouling paints contain a compound of copper, called cuprous oxide. Cuprous oxide will dissolve only slowly in sea water but is very poisonous to fouling organisms.

There are two basically different types of paint containing cuprous oxide. The first of these is called the "continuous contact" type. Continuous-contact paints rely for their action on a large amount of the poison in the surface layer of the paint. Such paints need only be applied as a thin coat. The second

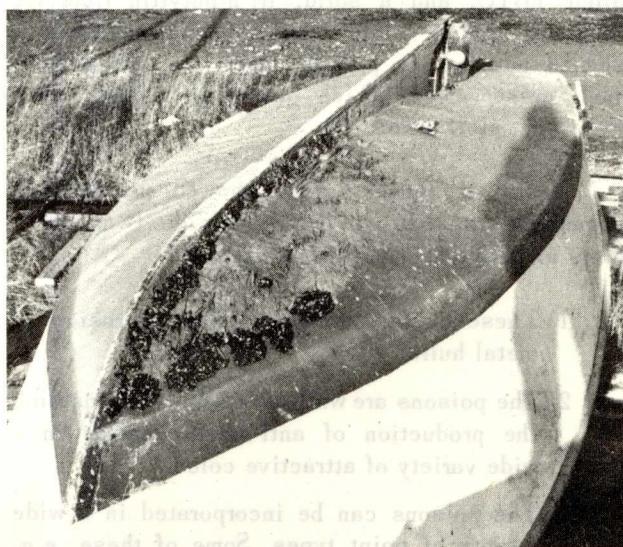


Figure 1. A boat left in the water for the summer at Ellerslie, Prince Edward Island. The side with no fouling was painted with a modern, cuprous-oxide paint, the other with ordinary bottom paint.

type, known as "soluble matrix" paints, contain a lower concentration of the poison but have a porous structure which allows poisons to reach the surface from within the paint. This latter type is applied as a thick coating. The soluble matrix paints are more effective but good examples of either kind will resist fouling for two years.

These commonly used "copper" anti-fouling paints have several serious disadvantages. One of these is that if they are applied directly to metal hulls, they cause considerable corrosion. This disadvantage can be circumvented by pre-painting with a special paint. A second disadvantage is that these paints have quite a soft surface that does not resist wear well. A further fault is that most of these paints must be immersed in sea water before they are dry. If this is not done, the surface of the paint hardens and seals the poison beneath it where it cannot do its job.

NEW ANTI-FOULING PAINTS

It has long been known that metals other than copper, such as mercury and tin, have compounds that are very poisonous to fouling organisms. However, until recently, paints containing them had not been successfully developed.

A few years ago a group of organic compounds of tin were shown to be especially effective as anti-fouling agents. Two compounds, a liquid technically known as bis(*tri-n*-butyltin)oxide and commonly called TBTO, and a solid, *tri-n*-butyltin fluoride, commonly called TBTF, have been successfully used in anti-fouling paints. TBTO is also a good wood preservative which prevents marine borer (shipworm, etc.) attack.

Tests of these paints showed performance comparable to that of cuprous oxide ("copper") paints and several important advantages:

- 1) These paints do not cause corrosion of metal hulls.
- 2) The poisons are white or colourless, enabling the production of anti-fouling paints in a wide variety of attractive colours.
- 3) The poisons can be incorporated in a wide variety of paint types. Some of these, e.g. vinyl-base paints, have a relatively hard, smooth surface.
- 4) Paints containing this material do not lose their effectiveness on drying. Consequently,

boats do not need to be launched immediately after painting and may be repeatedly hauled without destroying the properties of the paint.

TBTO has also been incorporated in solid plastics, porous stainless steel, etc., and such preparations have pointed to an important added advantage. It has been shown that areas close to a TBTO-treated substance may also be protected. This "fringe benefit" means that a small gouge or scrape in paint would not immediately become fouled and also that unpaintable objects may be protected by surrounding them with TBTO paint, plastic, or impregnated metal. An interesting application of this property is the use of a ring of treated plastic to protect the lenses of continuously immersed underwater TV cameras used in research.

Paints with a vinyl base and containing TBTO or TBTF have been especially effective and possess a hard, smooth surface which, in itself, provides some protection. Recently "copper" paints have also been produced in a vinyl base and found to be as effective as the old-type paints. However, such "copper" paints still cause corrosion on metal hulls.

TESTS OF NEW PAINTS

With fouling a constant problem in eastern Canadian waters, and as there were recent developments in anti-fouling paints, it was decided to test several new paints at Ellerslie. Tests included paints using cuprous oxide, TBTO or TBTF as the poisonous agent. The following main types were tested:

- 1) Standard, modern, cuprous-oxide, continuous-contact paint.
- 2) Vinyl-base, cuprous-oxide, continuous-contact paint.
- 3) Vinyl-base TBTO and TBTF paints.
- 4) Epoxy-resin, TBTO paint.
- 5) Standard, continuous-contact, TBTO paint.

Our tests showed type (1) to be outstanding in preventing fouling in this area. Figure 1 shows the appearance of a boat hull, one side of which was painted with a good paint of this type, and the other side with an ordinary bottom paint. However, several of the type (3) paints were almost as good as type (1), and showed advantages of hardness, smoothness, and durability which make them the best choice for most

uses. Other types tested did not show such distinct advantages but most gave good protection.

Our tests were confined to wooden hulls and panels.

RECOMMENDATIONS

Recommendations for anti-fouling paints for wooden hulls -

(1) Routine use on previously painted hulls: Use a modern, cuprous-oxide paint of proven performance (a good index of quality is the weight of the paint - a heavy paint contains plenty of cuprous oxide). One coat per year should suffice where the bottom is not abraded. Care must be taken to launch the boat within the manufacturer's specified time, and the boat should not be hauled without repainting.

(2) New hulls - not previously painted - ship-worm not a serious problem: Apply two coats of vinyl-base paint containing 5% or more of TBTO or

TBTF. One treatment like this should last two years.

(3) New hulls - not previously painted - ship-worm problem areas: Apply one coat of a wood preservative containing 2% TBTO, followed by two coats of modern, cuprous-oxide, TBTO or TBTF paints. (Note: Some of the preservatives may leave an oily film which may prevent the adhesion of vinyl-base paints. Test on a piece of wood before using.) Durability will depend on the paint used. A vinyl-base TBTO or TBTF paint will last two years.

The new paints mentioned above are often not readily available. If they are available, they may not be easily recognized. Read the label carefully - it will often give information on the type of paint. In particular, look for TBTO or TBTF content. Enquire at your paint dealer's about the types mentioned. He should be able to get the type you need quite easily. Once people start to use these new paints, they will become more readily available.

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