Protecting your boat's bottom is an expensive business, so it's important to make the right choice. The trouble is, with so many different types on the market and so much complicated technical information about the active ingredients, it's easy to be blinded by science. **Rodger Witt** investigates.

No one in their right mind enjoys buying antifouling. That's why apocryphal tales of cheap and effective home made concoctions are so appealing. There were the jolly West Country (or was it East Coast) fishermen who, legend has it, used a mixture of black varnish (a crude tar-based paint) and Jeyes Fluid (a disinfectant) plus a few dozen egg shells, which, they say, acted as an emulsifier and bound the evil mixture together. To add romance to the story, this simple and inexpensive preparation was mixed in old, washed-up oil drums and heated over driftwood on the beach. Whether they drank cider and sang sea shanties at the same time is unknown, but highly likely.

More recently, it's said that yachtsmen have spiced up conventional products with everything from pesticides and antibiotics, to diesel and, curiously perhaps, chilli powder. Even the manufacturers themselves have experimented. As I recall, there was once something called Hot Bottom, which used cayenne pepper, but I imagine it was the copper in it that really did the business. The real risk of fiddling about on your own, of course, is the potential risk to you, your boat and the environment, so it's probably not such a good idea.

Back in the real world, I'm afraid it's a question of accepting the obvious fact that paint companies have invested huge amounts of money and employed the services of numerous clever chemists to develop their products. We must also acknowledge the unwelcome fact that the materials they use are far from cheap and getting more expensive by the minute. The price of copper, for instance, has increased by about 300 per cent in the last five years.

In the final analysis, whichever way you look at it, fouling is a difficult and costly problem to deal with and there's no easy way out of it. At the heart of the matter is the sheer complexity and nature of the assault on boats' bottoms. Antifouling paint must deter both plant and animal life whose sole purpose it seems is to make a thorough nuisance of itself.

The results of the enemy action are plain for all to see. It causes drag, adds weight and can affect the way a boat handles. Over time it can even attack the basic structure of the boat itself.

It all starts within seconds – as soon as your boat hits the water in fact. There's an immediate accumulation of dissolved organic matter and molecules that quickly settles down, inviting a rapid build up of sticky mucopolysaccharides or slime to you and me. Surprisingly, these primitive forms of low life are far from push overs, partly because, in close up, they consist of tiny interwoven, interlocking filaments. Some varieties are such battle hardened show offs that they apparently shrug off a dose of cuprous oxide and, for all we know, may positively enjoy it.

These microscopic creatures – or vegetables – also provide the ideal foothold for more serious players like the numerous types of weed, some of which are predatory and use their tentacles to trap unsuspecting plankton that might be passing by. Plants of course tend to thrive on sunlight, which is why such fouling is often most evident near the waterline. Animal attachments on the other hand, prefer to operate in the dark, often right down near the keel where they can work without being seen. People who make a study of such things usually differentiate between 'soft' and 'hard' fouling organisms. The soft variety includes a few things you've probably heard of, such as algae and kelp, and others – diatoms, hydrides, hydroids, bryozoans and protozoans etc – that you haven't and sound more like extras in a second »

All the major players conduct rigorous, on-going research in a wide range of different conditions, not just to check the efficiency of new formulations, but also to monitor changing conditions. This is one of SeaJet's many test rigs.

HOW DID IT ALL START?

Antifouling has been around for well over 2,000 years. Back in the early days, a combination of arsenic, sulphur and oil was used to try to stave off the dreaded shipworm, but the first patent was taken out in 1625 when William Beale unleashed a concoction consisting largely of cement, copper and powdered iron.

In the 18th Century, sheets of copper were used to protect ships of the line but elsewhere iron sulphide, powdered zinc and a dollop of arsenic was all the rage, though there were literally hundreds of alternatives in use, none of which had much effect.

In 1863, the aptly named James Tarr, working alongside Augustus Wonson, hit on the idea of using, yes, tar, but mixed in with some copper oxide. The mission even attracted Japanese inventors with equally improbably names, including Zuisho Hotta who, for all we know, may have toyed with using curry powder, but instead settled for lacquer, powdered iron, red lead, persimmon, tannin and other 'unspecified ingredients'.

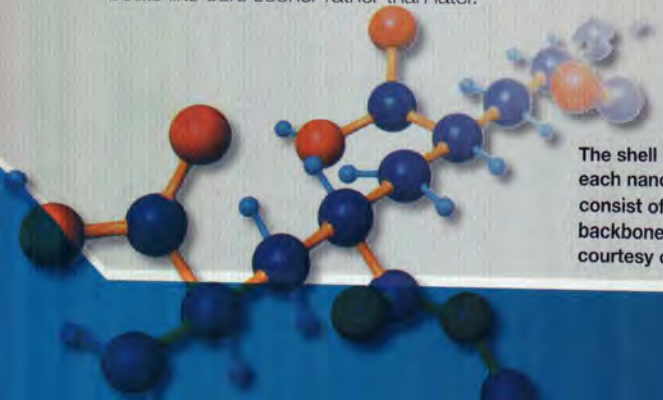
The really big breakthrough came in 1865 when James McInness combined copper sulphate with a metallic soap. A similar treatment had already been developed in Italy using rosin and copper and these techniques were developed and improved upon by the US Navy between 1906 and 1926.

WHAT'S NEXT?

The ultimate objective, of course, has been to produce an effective biocide-free antifouling. The key, it seemed, would be to find something so slippery that virtually nothing would stick to it. The first obvious answer was Teflon, but Teflon is porous, which means that marine organisms can still get a toehold. Then the backroom boys discovered silicone or rather silicone-based elastomeric coatings, which combine smoothness with low surface tension. It certainly seems to work – which is why so many ship owners use it. The latest products reduce both fouling and fuel costs and are designed to last for up to five years. But, before we throw our hats in the air, there's a snag. As things stand, it's only suitable for high-speed vessels. On the other hand, while it won't prevent a build-up on boats that are left on the moorings for any length of time, it does make them easy to clean, so the omens are good and it's easy to imagine some suitable mutation for yachts in the not too distant future.

The other idea in development is nanocapsule technology. This sounds rather like a refined version of the self-polishing antifouling we use already and to some extent that's not so wide of the mark. For a start, it uses a copper oxide biocide, but the difference is the binder, which consists of microscopic capsules that can be fine tuned to control leaching rates. These tiny structures have an acrylate centre – the self-polishing bit – and a shell made of a hydrophobic acrylate polymer, which can be adapted to dissolve in water in an extremely controlled way. The advantage, apart from its effectiveness, is the fact that you don't need such thick layers – with obvious savings.

As before, this paint actually exists and is being used successfully on big ships. The chances are we'll see something similar for small boats like ours sooner rather than later.



The shell and core of each nanocapsule consist of an acrylate backbone. Illustration courtesy of Hempel.

rate, sci-fi horror movie. In the hard camp are tube worms and molluscs – and our old chum the barnacle, which is probably the most insistent of all. The well-known acorn variety, for example, arrives in egg form and attaches itself to unprotected surfaces with the force of a superglue. As a consequence, such is its incredibly tenacity, it can etch its way into paint systems and eventually damage gel coats if allowed to make itself at home. For the same reason, barnacles should also be removed with care and the calcium deposits they leave behind removed before repainting.

In all, according to the experts, there are over 4,000 different types of marine fouling species, which gives you some idea of what we're up against. Or, to be more accurate, what the manufacturers are up against.

TRADITIONAL REMEDIES

For many years the classic approach to the problem, at least for cruising boats, was a soft, relatively straightforward matrix containing cuprous oxide biocide set in rosin gum that slowly dissolved in water and gradually leached out during the course of a season. The most obvious problem here is the fact that, because the reaction leaves a hydrolyzed layer behind, the release rate tends to slow down gradually, so its effectiveness decreases. That's why manufacturers recommend a light rub down (using water and wet or dry paper) every year. Otherwise, after a few seasons, the subsequent build-up of these honeycomb-like residues must be completely removed to provide a sound, even surface for repainting, then the process can start all over again. However, annual pressure washing can go a long way towards reducing if not totally eliminating the build-up problem. Another possible drawback is the necessity to launch shortly after the paint has been applied – and the fact that the release rate is relatively uncontrolled. However, for all that, these well-proven First Generation or traditional, hydration type antifoulings are still available and though far from cutting edge, are relatively inexpensive and particularly popular with fishermen whose boats get plenty of regular use.

Then the boffins got clever. By using a carefully contrived combination of two resins, only one of which was soluble, they found they could control the reaction to produce a steady and even release rate. These self-polishing copolymers (SPCs) originally contained TBT (tributyltin), which proved incredibly successful in a huge variety of different environments. It could also be used safely on aluminium. There was only one drawback. TBT is highly toxic and had an adverse effect on certain kinds of shellfish.

The result was a Europe-wide ban in 1987 that made its use illegal on boats under 25m.

Even so, TBT has still been available in certain areas of the world, notably parts of the Caribbean, though following recent ratification of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS) Treaty by 27 countries, it will be universally outlawed after September this year.

The European Commission also outlawed TBT on all vessels

> *"It's pretty unlikely that the EC will insist on a total copper ban when it makes its mind up next year"*

using EU ports with effect from 1 January this year.

The trend is undoubtedly towards less toxic alternatives. Even copper, which replaced TBT, is under threat. Both Sweden and Denmark have imposed legal limits in certain areas on leach rates according to the size of boat, for example, but while the pressures are real, based on the evidence presented by ICOMIA at least, it's unlikely that the European Commission will recommend a total ban when it makes its decision towards the end of next year.

Naturally enough though, such moves have focused the minds of the manufacturers. It's also the reason that these days controlled solubility or self-polishing copolymers are the obvious choice. When the outermost layer of paint dissolves, it not only uncovers another film of

Long life, copper-rich systems, which apparently last for several years, have obvious attractions. The only obvious drawback is the fact that you need to get right back to the gel coat. It's also a job best left to the professionals.

biocide underneath, but also carries away any animal or plant life that might have attached itself. This is particularly significant, because it means the paint firms can get away with using less biocide – which is better all round. Also, because they gradually wash away, these paints leave less behind than more traditional treatments and for that reason require less work at the end of the season.

As a bonus, copolymers are generally easier to apply and have greater covering characteristics, so you actually use less of the stuff. Even better, the latest concoctions are probably still more effective than the old and much vaunted TBT.

Most manufacturers offer a choice of copolymer products, typically for low, medium or high fouling areas.

Ablative systems are similar and belong in the same category, but rely more on a reaction with the surrounding water. SPCs and controlled solubility antifoulings on the other hand provide the same kind of measured protection whether the boat is on the mooring or underway.

If this weren't enough, at the same time, manufacturers have been trying to reduce the use of organic solvents like xylene, which can also be harmful. Instead, they've introduced expensive, high performance waterborne antifoulings that package the biocide in an emulsion, which evaporates leaving a hard film behind.

The chemistry is extremely complicated, but revolves around the use of film-forming liquid resins made from polymers and silica-coated copper. The slight downside here is the fact that you can't apply the stuff when it's damp or raining.

Most erodible antifoulings use cuprous oxide, but some rely on cuprous thiocyanate, which is more expensive, but means you can use brighter colours. With the correct preparation and suitable primers this 'milder' form of copper can even be used on aluminium – and is often found in antifouling treatments for propellers and outdrives.

Most if not all copolymers also contain small quantities »

Proof that marine growth loves nothing more than an unprotected propeller.

Inset right: a build up of slime and plant life around the waterline. Far right: animal fouling found nearer the keel.

of booster biocides with such impressive names as zinc pyrithione, dichlofluanid and the awesome-sounding zineb – one even does away with copper altogether and uses the action of hydrogen peroxide.

THE HARD CHOICE

So-called 'hard' antifoulings, the other obvious alternative, is one much favoured by the racing fraternity in search of that extra tenth of a knot, because you can scrub it during the season. Most use the same kind of ingredients as self-polishing varieties, but in different ratios. For instance, there would invariably be more insoluble than soluble resins to maintain a more stable finish. The way their biocides work is generally known as 'contact leaching', which uses a porous film saturated with biocides. As one particle is dissolved, the particle behind it is exposed and takes its place, leaving a hard surface underneath.

WHICH CATEGORY

Having looked at the options, the next job is to decide which type is best for you. As we've seen already, if your boat is made of aluminium, you can't use an antifouling with cuprous oxide (unless you use a 400 micron thick epoxy barrier coat), because the two metals will react in salt water causing electrolysis and corrosion. Steel is another slightly special case and may need a special primer – largely because of the increasing problem with stray currents in marinas. This particular problem, which can throw off epoxies as well as copper antifouling, is often made worse by the amount of electronic equipment people fit these days.

For most GRP boats, however, the most likely choice is a modern self-polishing or controlled release antifouling that's relatively easy to apply – though ideally you do need a reasonably nice day without too much wind.

LONG LIFE ANTIFOULING?

If you want to avoid annual repainting, you might get away with it if you use several coats of a controlled solubility product, but as a rule the manufacturers don't really recommend it.

Instead, they suggest you use a specially formulated multi-season copolymer antifouling with extra biocides designed to last for two years or longer.

Another alternative is one of the copper-rich concoctions, some of which use water-miscible epoxies, combined with spherical copper powder, which sheds itself at a rate of about two microns a year. Given the fact that a standard treatment might contain 250 microns it's understandable that the makers should claim a lifespan of 10 years and claim that some of their clients' boats have survived happily for some 15 years without further treatment.

> *"Hard racing antifoulings that can be scrubbed are also ideal for boats kept in mud berths"*

Others use copper-nickel granules sprayed onto freshly applied resin, which, they claim, produces a hard, long lasting coating without additional booster biocides.

One possible drawback, I suppose, is the huge amount of copper they use, particularly at a time when the move is towards less toxic alternatives. The manufacturers' argument would be that the release is slow and carefully controlled.

SLIPPERY SUBSTITUTES

Alternatively, of course, some preparations use super slippery components such as Teflon. Clearly this doesn't kill off micro-organisms in the same way, which is why most of them also contain biocides, but it will create a really smooth, low friction surface, which can be burnished, that makes their removal considerably easier – as long as you don't leave it too long. A boat that remains on the moorings and never gets used will almost inevitably suffer an increasingly stubborn build-up.

On the subject of hard finishes in general, while we tend to think of them as synonymous with racing, they have other applications too. As a case in point, they make particular sense if your boat dries out at low water. A hard antifouling will stand up to bumps and knocks and general wear, tear and abrasion far better than the softer types. That's why it's also suitable for trailer-sailers or boats that are dry berthed ashore and launched every time the owner goes afloat.

Let's not forget that the kinds of erodible paints we've been talking about also have their limitations. It's best not

	Litres	Price £
1) SOFT – SELF-POLISHING		
International Micron Optima	2	109.99
International Micron Extra	0.75	36.99
International Micron Extra	2.5	104.99
Jotun Mare Nostrum	0.75	19.90
Jotun Mare Nostrum	2.5	59.90
EU45	2.5	47.99
Seajet 033 Shogun	0.75	24.99
Seajet 033 Shogun	2.5	70.49
Seajet 034 Emperor	0.75	26.99
Seajet 034 Emperor	2.5	85.99
Seajet 039 Platinum	2	94.99
Seajet 039 Platinum	4	174.99
Veneziani Raffaello	2.5	87.62
Veneziani Even Extreme 2	2.5	121.37
XM HX 3000	3	39.95
Blakes Ocean Performer	0.75	36.26
Blakes Ocean Performer	2.5	100.5
Nautix Performer	2.5	58.57
Nautix Performer	5	113.30
Clipper	2.5	43.99
2) SOFT – CONTROLLED SOLUBILITY		
Flag Performance	2.5	62.50
Flag Cruising	2.5	32.50
Flag Cruising Extra	2.5	37.95
International Cruiser Uno	0.75	32.99
International Cruiser Uno	3	79.99
International Bottomcoat	2.5	49.99
Jotun Megayacht	2.5	119.50
Jotun Megayacht	5	233.82
HM CX2000	3	43.95
PX4000	3	44.95
Blakes Tiger Xtra	0.75	32.27
Blakes Tiger Xtra	2.5	76.71
Blakes Cruising Performer	2.5	50.45
Blakes Broads	0.75	18.18
Blakes Broads	2.5	46.97
Nautix A3	0.75	32.15
Nautix A3	2.5	96.30
3) SOFT – ABLATIVES		
HMG Slippy Bottom	2.5	59.95
Marclear High Strength	2.5	119.85
Teamac 'D'	1	29.63
Teamac 'D'	2.5	68.36
Teamac 'D'	5	134.07
Awlgrip Gold Label	3.785	160.91

	Litres	Price £
4) HARD		
Internatonal Interspeed Ultra	0.75	35.00
Internatonal Interspeed Ultra	2.5	108.00
Internatonal VC Offshore with Teflon	0.75	39.99
Internatonal VC Offshore with Teflon	2	79.99
Internatonal VC 17M Extra	0.75	41.00
Internatonal VC 17M Extra	2	89.99
Internatonal Trilux	0.75	34.95
Internatonal Trilux	2.5	96.50
Internatonal Waterways Plus	2.5	48.99
Jotun Super Tropic	2.5	35.99
Seajet 037 Coastal	2.5	44.49
Flag CopperQuick	1	34.95
Flag CopperQuick	2.5	74.95
Flag Performance Extra	2.5	72.95
Blakes Glide Speed	2.5	99.95
Blakes Hard Racing	2.5	90.40
Nautix A4T	0.75	38.61
Nautix A4T	2.5	115.16
5) ANTIFOULING BOOT TOPS		
Flag Performance Extra	0.45	19.95
Internatonal Trilux	0.375	19.52
Blake Boot Top	0.375	17.15
6) PROPELLERS		
Seajet Pellerclean	0.275	42.99
Veneziani Propeller	0.25	14.76
Blakes Mille Drive	0.5	15.15
Internatonal Trilux Prop-O-Drev	0.5	20.50
7) LONG LIFE COPPER RICH		
Coppercoat	1	70.50
Ecosea Cuprotect	PRICE ON APPLICATION	
8) TRADITIONAL		
Skipper Standard Plus	0.75	27.95
Skipper Standard Plus	2.5	76.95
Veneziani Eurosprint	2.5	72.62
Veneziani Eurosprint	5	137.25
Teamac Tropical Killa	1	16.35
Teamac Tropical Killa	2.5	40.59
International Bottomcoat	2.5	49.99
International Nautical	2.5	40.50
9) NON-TOXIC		
Jotun Racing Eco	2.5	88.00
Jotun Non Stop Eco	2.5	93.88
Seajet Shogun-Eco	2.5	54.28
Epifanes Foul Away	0.75	35.81
Epifanes Foul Away	2	94.41

WHICH ONE IS RIGHT FOR YOU?

1. SELF-POLISHING
Top of the range copolymer products with special additives to promote a smooth surface as the biocide is released. Designed to offer maximum protection for cruising boats in a wide range of different conditions, including areas of heavy fouling.

2. CONTROLLED SOLUBILITY
Usually refers to the standard copolymer where, in common with self-polishing types, the biocide is used regularly or not, avoiding a messy build up. Ideal for most cruising boats.

3. ABLATIVES
Antifoulings that rely more on the movement of the hull through the water, so more suited to high speed vessels and motor boats.

4. HARD
Using a process called 'contact leaching', where subsequent layers of biocide-packed particles are exposed to the water, these paints bottoms before a race. Also fine for boats kept on half tide moorings, in mud berths or on shore.

5. ANTIFOULING BOOT TOPS
Formulations vary according to brand, but are usually designed to combat slime and allow occasional scrubbing, though some are simply clear, hard coatings designed to be applied over existing antifouling.

6. PROPELLERS
Most treatments are cuprous thiocyanate rather than cuprous oxide-based to avoid the risk of electrolysis

directly to the gel coat in the form of epoxy. Expensive and needs to be carried out by professionals, but apparently some products will last 10 years or more.

8. TRADITIONAL
Non-copolymer paint made the old fashioned way. The biocide will be released in a less controlled manner and there's always the problem of a build up of layers. Less expensive and used primarily by fishermen and owners of working boats.

9. NON-TOXIC

to use them on boats that regularly travel at 25kn or more, because, as you might imagine, high speeds will hasten the antifouling's demise, which will simply wash away faster than its makers intended.

It's equally important to be aware that different paints are formulated for different parts of the world, so if you're planning to move to the tropics, you might want something designed to work in higher temperatures. The same principle goes for boats kept in fresh rather than salt water. In each case, it's a question of the right coating for the job.

WHICH IS BEST?

Having looked at all the various options, the next job is deciding which product is right for you. As we've seen, and at the risk of repetition, for those of us with GRP hulled boats, unless we decide to opt for a long-life copper-rich treatment, it's largely a question of deciding whether we want a hard or soft antifouling. As we've seen, hard antifoulings are ideal for racers but also for boats that are kept ashore or in mud berths. For the rest of us the basic choice is whether we go for a regular controlled solubility copolymer or a more expensive, high performance, self-polishing alternative. These state-of-the-art products often come in two component form – either with additional booster biocides or special activators.

> *"To complicate matters, what works in one area one year, may be far less effective the next"*

Judging by anecdotal reports from owners, there's no question that you get what you pay for, but, bearing in mind the big difference in price, it's still worth asking around, because in some areas a controlled solubility product may work just as well as the more expensive self polishing alternative. You might even get away with one coat – though I've absolutely no doubt at all that the manufacturers would vehemently disagree.

On the other hand, you might think that the best antifouling paint would simply be the one with the most copper in it – which in turn means the one with the highest specific gravity – and to be honest, some overseas manufacturers encourage customers to think that way. That's why they flag up the copper percentage so boldly. If you go along with that, it's a case of the heavier the paint the better, but not everyone agrees. For a start, many mid-range products contain roughly similar amounts of copper and the drive now is towards producing the most effective combination of biocides and co-biocides (or boosters) and even reducing them, so, arguably, it's more a question of matching a particular blend of ingredients to a particular set of circumstances.

The snag is that what works in one area one year may be less effective the next. Among other things, it depends on the temperature of the sea, its salinity and even the amount of pollution. Even so, it's still worth comparing notes with owners of similar boats in your area to see what seems to work best.

TOUGH TIMES

As I said at the beginning, we all complain about the cost of antifouling, but it's worth remembering that the manufacturers are trying to conduct an almost impossible balancing act. While we, the consumers, want the most powerful product at the cheapest possible price, environmentalists are demanding ever tighter legislation on the use of anything that might conceivably have the slightest detrimental effect on marine habitats.

In Europe, the Biocidal Products Directive (BPD), which came into force eight years ago, requires two regulatory submissions before a biocidal product can be marketed, each of which needs a separate dossier for every product, containing information on its biocidal efficacy, toxicological and ecotoxicological properties.

So, to put it bluntly, everything the manufacturers do is subject to the closest scrutiny.

Whatever you think about the paint companies, trying to keep everyone happy is a difficult trick to pull off.

MID RANGE
XM's PX4000 is a controlled solubility copolymer.

BURNISHABLE
Blakes Hard Racing Copper can be scrubbed to reduce resistance.

ALUMINIUM COMPATIBLE
International Trilux is ideal for outdrives and propellers.

HIGH END
Platinum 039, SeaJet's top of the range self-polishing copolymer.

UNWELCOME GUEST
Tubeworm, which hails from warmer climes, is an increasing problem in some areas and yet another challenge for the antifouling manufacturers.

WWW.AWLGRIP.COM
WWW.BLAKESPAINTS.COM
WWW.COPPERCOAT.COM
WWW.FLAGFINISHES.CO.UK
WWW.YACHTPAINT.COM
WWW.MARCLEAR.COM
WWW.SEAJETPAINT.COM
WWW.SKIPPERSPAINTS.CO.UK
WWW.JOTUN.CO.UK
WWW.EU45ANTIFOUL.COM
WWW.XM-YACHTING.CO.UK
WWW.EXO-SEA.CO.UK
WWW.VENEZIANIYACHT.IT
WWW.HMGPAINT.COM
WWW.NAUTIX.COM
WWW.INTERNATIONALPAINT.COM
WWW.ANTIFOULDIRECT.COM
WWW.TEAMAC.CO.UK
WWW.EPIFANES.COM

HOW WAS IT FOR YOU?

To help all of us find out which antifoulings work best, we want to hear from readers like you with a view to publishing a round up of information in future issues.

If you could let us know what brand and type you used, when and how you applied it, what systems you've tried before, what kind of sailing you do, where you keep your boat – and how well the treatment performed over the course of a season – we'd very much appreciate it.

Details and feedback, please, to letters@sailingtoday.co.uk

DID YOU KNOW?

1. White antifouling may look pretty, but because it's unlikely to contain as much copper as darker colours, it probably won't be quite as effective.

2. Most antifouling takes time to be fully active, but fouling itself starts immediately your boat gets wet. The solution is to take her for a spin before there's any appreciable build up.

3. Contrary to popular belief, it's better to coat the propeller with an antifouling than leave it unprotected – but never use a cuprous oxide based paint.

4. Some manufacturers make paints containing cuprous thiocyanate that can be used for boot tops as well as propellers. Alternatively, hard racing copper is ideal for boot tops, because you can scrub it.

NEXT MONTH:

ANTIFOULING WITH THE EXPERTS. HOW TO GET THE BEST FROM YOUR BOTTOM PAINT.