Ferro News

June 1997 Quarterly Newsletter for Ferrocement Boat Owners Issue 3

Going Strong

Our third issue, and we haven't run out of things to talk about. You'll notice the marine electrical seminar didn't make this issue. Regrettably we just didn't have the room, but I can assure you it will be back next time. Part three looks at marine batteries.

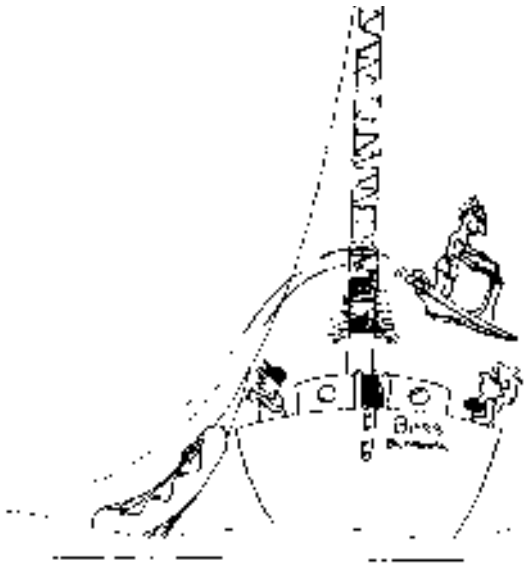
Participation is the key!

Meanwhile I'm looking into printing double sided as a way to grow the content.

Thanks for the all those that returned the subscription and especially to those who saw to provide a donation over and above. However, of our original mailing list of 50, only 25 have returned subscriptions. As this will be the last issue for those that have not subscribed, I encourage you to send in soon or miss out. If you don't feel that the newsletter is interesting enough or it should have a different focus, please write to me with your suggestions if it will keep you on our list. Participation is the key! Once again, don't hesitate to send me information on your recent practical projects and sailing adventures.

This month we introduce a new contributor - Roy Scoon. You may remember Roy built the Hartley South Sea, *Tava* which featured in issue 1 of Ferro News.

Also you'll notice a brochure insert from Maintainence Products Direct. Among other things they sell drill bits that cut both concrete and steel. I haven't tried them myself, but intend to order some soon. Each drill kit or Kwik-Tie sells for $89.00 (ex tax). $7.70 is charged for an overnight bag delivery.



Hello Roy

By Roy Scoon

At last I put pen to paper and contribute my tuppence worth to Ferro-News. I must begin with congratulations to Ian, Trudy and Len for their effort and initiative in getting the magazine launched. All interested readers must realise that a lot of time and effort must go into such a project if it is to succeed, so your support and participation are vital. The subscription fee helps cover costs only so please support the team and send yours in now.

It is my intention to write articles on the more technical aspects of ferro-cement, however I do not consider myself an expert on the subject . I do have a long standing interest in the medium and have had a reasonable amount of hands-on experience. In fact I am currently building myself a small cruising yacht which I will profile in a

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inside...

ABOUT STEERING

By Ian McFarlane "S/V Lilly-Ann"

Last month I received an enquiry regarding hydraulic steering, so I've taken this opportunity to outline my very recent experience of choosing and installing a steering system. Until now "Lilly -Ann", my Hartley South Seas was faithfully steered by tiller. These boats however are really too big to steer with any socialably sized tiller, and after our last trip up the Queensland coast where 12 to 16 hours at the helm was not uncommon, it was unanimously agreed that wheel steering and an inboard autopilot was worth selling the silver for. So here began my quest! First I looked at the different types of steering systems available including: cable, pull-pull conduit, mechanical, and hydraulic. Pull-pull conduit steering while very easy to install, just didn't seem to be up the job of a heavy boat, and I'd never know what was going on inside that conduit. And being used to a tiller system, reliability was number one on my list. Mechanical steering was ruled out because my rudder post lays back at a 20 degree angle, making such an installation very difficult if not impossible with the standard systems available. This left me with cable and hydraulic. Prematurely dismissing hydraulic as too complicated and expensive I purchased the large quadrant for the rudder post and set about planning a cable steering installation. At the same time I talked to other yacht owners and consulted technical notes. Some months past and I had growing concerns with the cable steering system, as most owners who had clocked any sort of miles all recounted stories of cables breaking and other bothers. A double cable system seemed to be the solution, that way if one cable broke, the other would continue to do the job. This effectively doubled the number of sheaves, which were beginning to look very expensive. On the other hand, the hydraulic systems that I had inspected, all claimed to have had a problem free life - to-date anyhow. It also seemed that if a hydraulic system was to fail it wouldn't fail completely, as there may be some oil loss and air would penetrate the system. Consequently steering would become sloppy but not totally disfunctional. With the fitting of lock valves and a bypass system, the helmsman would have the choice of helm "feel" where they could feel the back pressure on the rudder, or "no feel" where no matter what pressure was applied to the rudder, it would not turn or "motor" the helm. I would still be able to use an emergency tiller by opening a short circuit valve. Bill Patterson from Hydrive (Queensland) was a tremendous source of information and answered my endless list of questions and finally sized the components to make up the kit. Now convinced, I placed the order. (Anyone want to buy a quadrant?)

"And being used to a tiller system, reliability was number one on my list."

Trudy getting the feel of the helm during sea trials

The hydraulic components included the ram, which connects to a tiller arm off the rudder post, the helm pump, which the wheel turns and forces oil through the ram, moving the rudder, a set of lock valves, the helm "feedback" bypass valve, and the ram short-circuit ball valve. On top of this I needed a pedestal, a lever to remotely control the feedback valve from the pedestal, a tiller arm for the rudder post, 10 metres of 1/2" copper tubing, a bag full of hydraulic flare fittings, tube bending and flaring tools, a gallon of transmission fluid and oh, a wheel.

The first-mate was getting rather concerned with the growing mound of components and schematics on the kitchen table - not that she hadn't witnessed similar phenomenon on other occasions - but some months had past and she was wondering if I had not surpassed my depth on this occasion and that a new lounge suite wouldn't have been a better choice. Unpeturbed by this lack of faith, I ventured to the next stage.

First, I had to get a tiller arm made for the rudder post, which meant deciding on a length. The length of this arm, along with the capacity of the pump determines how many turns of the wheel will achieve lock to lock. I chose to achieve about 3 turns for a 60 degree movement (30 degrees either side of centre), with a 6.5" arm. All the books tell you that rudder stops

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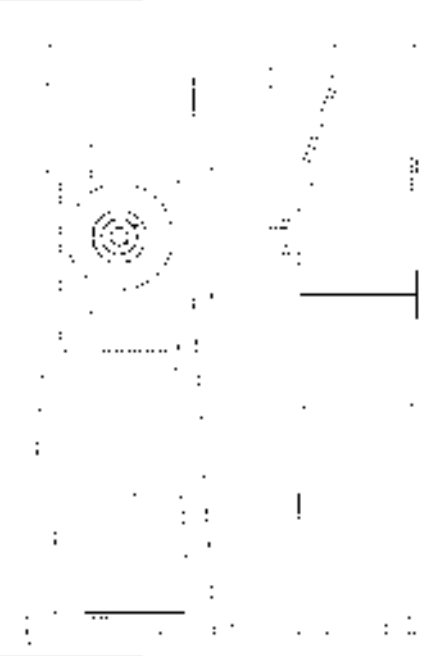
should be placed 30 degrees either side of rudder centre, but us yachties know that when maneuvering in harbors up to 45 degrees can make a difference. David O'Shea from Speed Propulsion Systems set to work making a two piece non-stock tiller arm, so that I could install it without pulling the rudder post. David also has had considerable experience installing Hydride hydraulic steering and had sound advice to offer.



Full drawings including grab bar are available on request.

Next was the pedestal. Now as the wheel bolts right onto to the pump, you must have a pedestal thats going to accommodate this. Standard pedestals can be used if a chain and sprocket system is used with the pump mounted below the cockpit. But I felt this was adding another potential failure point, and so opted to build a pedestal myself. I fiddled about with a number of drawings before I settled on a fairly aesthetic design for one that could be made from ply and fiberglass. And no respectable pedestal would be without a strong grab bar and provision for instrument mounting, so these were incorporated into the design.

I had also decided that most of the hydraulic pipes, fittings, and valves were to be fitted inside the pedestal, so most of the plumbing work could be done at home.
I used 9mm ply which was first cut out according to my pattern and then glued and screwed together forming the basic shape, inspection ports were cut and fitted. Next the whole thing was glassed and faired ready for spray painting. But before then all the internal components were test fitted and the tubing bent and flared. Using a morse control lever, I was able to fashion a lever and rod system to operate the "feedback" valve inside the pedestal.

While I was busy spraying, the polished stainless grab bar was being bent to shape by Peter Devine Marine.
A mounting bracket was made to securely fix the ram to the cockpit bulkhead and to ensure the correct alignment of the ram to the tiller arm.

At last, the day had come to install it all. Well actually it took 4 days uncomfortably squeezed down the back hatch!. Before the jigsaw was let loose on the cockpit floor the pedestal positioning was checked and rechecked. The connecting pipes from the pedestal to the ram were bent and flared, and short circuit valve tucked safely away, but within reach of the back hatch, and the rudder stop chains were attached. All to do now was to fill the system with oil and bleed the air. The instructions must be followed to the tee here, and three people in my opinion are mandatory, one to play with the bleeder nipples and coordinate the whole operation, the second to maintain the oil level in the bleeding bottle, and the third to spin the wheel - and spin it fast.
After a nervous trial run, one leak was detected at a pipe union, this was tightened and that was that. Further sea trial revealed that it was going to take quite a bit of time to get used to a wheel over tiller steering. You just don't seem to have the same control. It didn't help that we had a couple of uncontrolled jibes during the sea trials due to inadvertently turning the wheel "the wrong way" - well it seems like that after years of tiller steering.

I'm also glad that I can still climb down the back hatch, something that I couldn't have done with a dirty big quadrant in the way.

Next is the hydraulic autopilot.... I think I might just tha

The "feedback/no feed back" control lever clearly visible on the right side.

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later edition.

Having said all that, I now turn my attention to the two topics which seem to be of most interest to readers to date - insurance and paint adhesion. Insurance cover for ferro-cement craft has been a bit of a problem for many owners over recent years. Perhaps this is understandable when one considers some of the disasters that were constructed when ferro-cement was in its hey-day. Yet a well built and maintained ferro-cement hulled craft is no more risk than any other material. The problem it seems, is lack of repair services. This simple fact high-lights the overall lack of ferro-cement expertise available today. For instance does your insurance inspector or marine surveyor **really** know what it is he is looking at when inspecting your hull? Just how much does that marine broker know about ferro when you buy or sell. In fact, what do **you** really know about your own boat! My own research indicates that the majority of ferro boat owners have at best a basic understanding of ferro-cement construction while very few owners have any comprehensive information on the construction and history of their hulls. I'll get back to this point in a moment. The good news, insurance wise, is that, if your craft is up to par you can get insurance cover. NRMA will cover ferro-cement hulled vessels under the same criteria as timber, steel or glass.

"... a well built and maintained ferro-cement hulled craft is no more risk than any other

In speaking with Mr Brian Daunchey I was told that as underwriters his company have nothing against ferro-cement. Their only problem lay with the fact that it is difficult to find a repair service for ferro-cement yachts. In the past they have made full payouts only to find that they are left with a damaged hull that they cannot get repaired.

Anyone wishing to make more direct inquiries may like to call Mr Frank Amatta on freecall 132132.

Now back to that apparent lack of expertise in ferro-cement construction, repair and maintenance. This problem does not seem to exist in countries like U.K or N.Z where construction and repairs are still carried out.Classic Boating magazine #99 features an article covering the ferro-cement sheathing of a 115 year old Harwich Bawley. The same magazine carries the advertisement of A.J Prior and Son who works in wood, GRP, steel and ferro (yes all this in a traditional boating magazine!). I have written to R.J Prior and Sons hoping to gain useful information. More KIWI input later.

In the meantime what to do about the problem here! I have suggested the compilation of a repair and maintenance manual which would be of benefit to all concerned, from owner to broker and insurance company, to surveyor. NRMA and Marine Insurance have already expressed interest. To put such a manual together will take considerable time and effort but must surely be worth while.

This brings me back to my opening paragraph - owner/reader participation! Please send in any contribution you can make, be it your experience with repairs, tools, gadgets, methods or something you have seen or heard about. Diagrams and or photos where appropriate would be appreciated.

The second topic of interest to owners - bottom paint blisters. Next issue I will profile a vessel which should be of interest to all readers as she is still owned and sailed by her builder. His experience with bottom paint blisters and remedy is food for thought. Basically it centres around voids.

Now for some New Zealand thoughts on the problem. Ferro-cement craft are still being built, bought and sold, insured and repaired in New Zealand. However there have been some recommended construction changes:

1) no more tubing used for the stem, keel and transom pieces;
2) overlapping of mesh is restricted to the minimum;
3) increased ratio of water to other ingredients or mortar mix.

You will note that these three changes are all aimed at reducing voids. It has been accepted for a long time now that voids are directly associated with poor paint adhesion. The slightly wetter mortar mix assists in penetration of mesh and rods etc. Restricting mesh layer build up also helps penetration of the mortar and the elimination of hollow tubing for stem keel and transom pieces of course removes one big built-in void in itself (these should be filled with a heavy grout during construction anyway). We are currently carrying out some experiments on an endeavor to formulate a system to detect and eliminate voids. Unfortunately these things take time but hopefully by the next issue I will be able to provide more specific information.

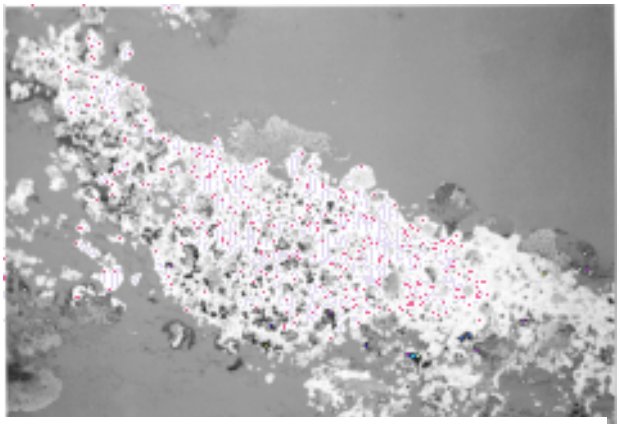
... safe boating

WHY DOES IT FALL OFF?

By Paul Oman

The following article has been prepared by Paul Oman, a coatings consultant with Progressive Products in the USA. Paul has been very helpful over the last year in providing information and samples of their solventless epoxies, in particular a Kevlar fibre reinforced epoxy. I am conducting some tests this year on my own hull, in view of using such a system as a below the waterline paint system. Progressive Products specialise in coating systems for concrete. They have a track record with nuclear power plants, waste treatment facilities, and offshore oil and gas platforms.

If there is a trick for achieving a successful coating job it would be to understand why coatings fail and how proper surface preparation can prevent those failures. It is hardly a minor issue. Premature or immediate coating failure is like throwing large amounts of money away. Removing the failed coating, contractor costs and material costs, as well as down time, can cost tens of thousands of dollars and end business relationships and entire careers. Simply put, coating application is a high stakes game, play smart and the odds are in your favor, cut a few corners and sooner or later you'll regret it Big Time. This report will help get you started on the right track.



Paint blisters on a ferro hull - "S/V Lilly Ann"

I. Why Coatings Don't Stick

There are many reasons coatings fail to stick to their applied surfaces. We'll review them one at a time. Unless otherwise stated, we will assume we are dealing with a concrete floor or loading dock, an area that seems simple, but can be one of the trickiest to coat and one of the most expensive to 'mess-up' with.

Dampness: Moisture is a good starting place for a coating's failure to adhere. Moisture doesn't just mean water droplets, it could include high humidity. Some coatings shouldn't be applied when humidity levels are high. More obvious sources of serious moisture are things like thunderstorms during an outside application job, standing water puddles on a concrete slab, or, even more likely, a damp or even saturated surface. Surface dry doesn't mean really dry. There can be (and often is) a high moisture content hidden just below the surface. The standard test is to tape a four foot by four foot plastic sheet to the concrete and see if visible moisture collects under the plastic. Some of the modern epoxies (like those sold by the author) can be applied to wet or damp surfaces but generally a moisture rich surface means no possibility of coating.

Moisture flow: Migrating moisture, as opposed to simple standing water, creates a more difficult problem. The common sign of this kind of failure is water filled blisters. Just a tiny amount of 'flow' pressure under a still curing coating can ruin the bonding process still taking place. With underwater bonding epoxies the 'trick' is to 'reverse' the pressure, i.e. coat the surface under a column of water (for example, flood the manhole then coat the inside of it). There is no good answer here, but rapid drying/curing coatings have a better chance of working. They can setup and bond before the water and water pressure builds to unacceptable levels under the fresh coating.

Grease/oils/silicons: Few, if any, coatings stick to greasy, oily, waxy surfaces. This includes many kinds of plastic surfaces. Oily surfaces can be tricky, Just feeling the surface is often not good enough. Even on what seems like a non-greasy surface, many coatings will 'bead-up' leaving behind hollow, coatingless circles or voids. Hosing down, high pressure water, and even grit blasting, is no guaranty that greases will be removed, indeed, they will probably stay behind. Greasy, oily surfaces require a degreasing chemical to remove the film. Experts suggest washing down the surfaces using a degreaser and stiff brush. It is wise to make this a standing surface preparation step, wiser still to do at least two degreasing wash-downs. Unfortunately, even simple degreasing or more advanced hot steam and chemical systems may not work completely. Surfaces contaminated with animal fats seem especially difficult to degrease and successfully coat without physically removing/replacing an inch or so of the surface concrete.

Dust, slime, loose rust: The author has seen floor

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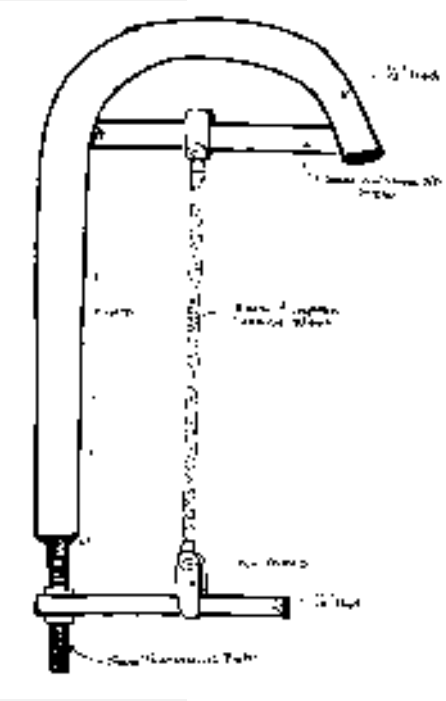
Dougs Tips

By Doug Wallace "S/V Mystery"

The ever enthusiastic Doug Wallace has provided us with more information and tips discovered in the renovation of his yacht "Mystery".



Epoxy Follow Up

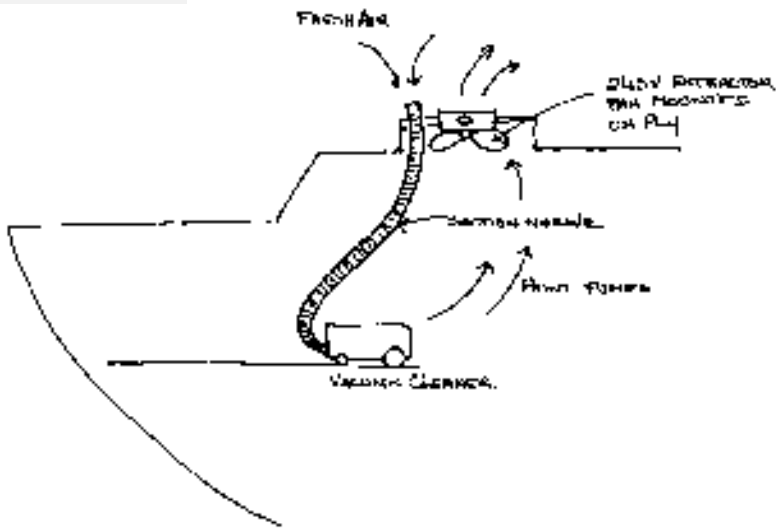
If you remember, in the last issue of Ferro News, Doug performed some tests with various epoxies to bond new cement to old. This month Doug has provided further information in regard to these experiments Doug didn't try a tacky System 3 epoxy/cement bond as the material was no longer available locally. The cured patch of System 3, had already been applied to the test panel some months earlier.

Doug uses RESIMAX, a low viscosity sheathing resin. This is similiar to the System 3 but is mixed 4:1 instead of 3:1. The difference between RESIMAX, BOTECOTE, WEST SYSTEM and SYSTEM 3 and MEGAPOXY is:

1) Megapoxy is hydrophilic (water loving), is compatible with water , that is, . wet cement. It is specifically designed to bond wet to dry cement.

2) Resimax and the other systems are designed to glue fiberglass or wood to dry wood or concrete.

The Megapoxy literature instructs the user to lay the new concrete within 15 minutes of applying the epoxy to ensure good bonding. This would suggest that as Megapoxy cures, the bond will not be any better than any other cured epoxy.



Doug has used *ordinary* epoxy to paint on bare concrete as a primer before painting with epoxy paint (INTERGARD) and to stick fibreglass cloth to concrete and only use MEGAPOXY to bond new cement to old dry cement.

Doug's recent discovery in the epoxy department is RESIMAX epoxy glue adhesive powder. It is a white fluffy powder in a 4 litre drum which is mixed with epoxy resin to make a thick, non-slumping glue. Doug has glued all of Mystery's forepeak locker framing with this mix.

Ventilation

If painting an inside area with 2 part epoxy paint, try ventilating the area with an extractor fan on the forehatch to remove fumes. A vacuum cleaner can be used to supply fresh air and displace the fumes.

Cutting Holes

A hole saw, which can be used to make holes of any diameter in ferro-cement can be made using a tungsten carbide coated rod saw blade. The saw blade can be used as follows:

1. Drill a 9/16" pilot hole
2. Drill 5mm hole at required radius
3. Grease rod, assemble saw in holes
4. Use coarse valve grinding paste if rod saw gets blunt.

Tungsten carbide coated rod saw blades are available in most hardware stores. Doug has used this assembly to cut a 60cm hole in ¾ " foredeck for a winch shaft. It took 2 hours however!

Keel Work

Doug has replastered under the keel of Mystery by smashing away the loose concrete and welding in new reinforcing rods and mesh. He then made a mould with two pieces of guttering pop riveted together, and painted the inside of the mould with sump oil. The mould was then positioned under the keel using a scaffold plank and a jack, and cement was poured into the mould and agitated by hitting the mould with a hammer to remove air bubbles. Doug left the mould on and let the cement to cure for 3 weeks.

Dougs now busy working on repairing the timber belting on Mystery.

Keep It Coming Doug!

Your Say - Q&A

Great Stuff!

Q1. What paint is recommended for the bilges and the engine room?
Q2. An article on sacrificial anodes would be appreciated, what is recommended for a metal rudder?
Q3. Hydraulic steering information would be appreciated as well?

Barry, State of Bahrain S/V " Barquientine"

Thanks for your subscription and your comments and questions. In response to your questions, I have included an article on hydraulic steering in this issue of Ferro News, although it is rather brief. But if their are some specific hydraulic questions you need to know, please ask, and I'll see how I can help.

Painting the bilges draws a number of contradictory lines of advice from the range of experts. My belief is that the bilges should be thoroughly sealed with 2 part epoxy. Assuming a dry and clean surface (see this months article on coatings), apply a sealing resin (eg EPIGLASS HT9000), followed by an epoxy primer, then finally a couple of coats of gloss white epoxy (never black - you can't see a damn thing). I advocate this treatment, as I believe it is important to keep the spilt oils, grease, fuel, and battery acid
from absorbing into the concrete - which will result in rather insidious paint system problems. Those that appose this system, argue that the hull can't breath being sealed both sides in this manner, and blistering on either side may result. They may be right but such evidence is not conclusive in my mind.
Sacrificial anodes and electrolysis again is a subject with many different opinions. In short I believe, that all hull fittings should be connected electrically by a decent sized wire (say rated at 25 amps) including: all through-hulls, prop shaft, rudder/rudder shaft, hull frame, engine bed, and engine. These connections should be tested with a multimeter to ensure low resistance. This all then should be connected to 1 or 2 very healthy zinc anodes outside the hull and below the water line. Very large metal fittings like a rudder should have their own anode. Replace them every year, Don't be tempted to reuse them, because an oxide coating builds up rendering them ineffective. If they are not significantly eroding each year, something is wrong! A warning: if you have manganese bronze bolts fastening your through hulls, replace them immediately with stainless. Manganese bronze contains zinc - and acts like an anode. I intend to expand this in an article next issue. **Ian, S/V "Lilly Ann"**

... I was really surprised and appreciated Ferro News including extensive details, photo etc of "Rock of Ages" for sale in issue 2, thanks ...

... Although I've been into ferro for over 20 years, I consider myself definitely not an expert, and yet to meet somebody who is, and can guarantee, for example . a paint system under the water, so really I can't offer any expert advice to contribute to your newsletter. I've tried different advice, products and find that some seem to work for one boat and not another, but this has never worried me, still enjoying being afloat in a "floating footpath", rubbing shoulders with millionaires with their expensive yachts, and just doing it!
Bob, S/V "Rock of Ages"

None of us are experts in ferrocement, and I agree with you that such experts either are very thin on the ground or don't exist. I favour the latter theory. It is however through such a forum as this newsletter that we can hope to share fruitful and not so fruitful experiences like those you have inevitably faced over the past 20 years to raise the collective expertise of ferrocement boat owners, ensuring our vessels live well into the next century and perhaps win back some lost respect.

QUICK TIP *by Trudy*

There are very few things you can get for free these days. A useful item to have in your tool trolley are laminate sample chips. These are available free from the hardware or home products centre and are good for putty or epoxy scrapers, shims or wedges. The larger lamipanel samples make good cutting boards, or are useful for scraping hard scum off the water line. I'm sure you will find many more uses for these items. Just don't take too many!!

Ian, "S/V Lilly Ann"

DEBUT

By Russell and Sue Streckfuss "S/V Homer"

Our boat is a Maurice Griffith 38 Barrier reef. She is about 12' wide and 5'8" draft. She is unusual in that the previous owner built a large deck level coach house which is extremely practical if not overly attractive. We bought her a year ago and have spent this time refitting her. Our first sail last weekend we thought to be well planned and with crew (Sue) briefed on rope handling, cast off. Unfortunately nothing happened when I slotted her into gear, other than a slow drift to leeward. This was a little bewildering ,worrying and frustrating as when I raced around the stern there was a prop wash so we should have been moving. Anyway, once tied up again I resolved to take a closer look at the prop (now with an audience of any and everyone) with snorkel and mask. After 10 months of only being run fortnightly for 1/2 in gear and tied up (just to keep thing moving), a layer of barnacles had grown onto both sides of the prop where the antifoul had worn off. This growth had been enough to reduce the efficiency of the prop to such a degree that the yacht could be pulled backwards against full throttle by a single line!! We were glad of two things. Firstly, it was a quick fix with the use of a mask and a paint scraper and secondly, that we were not on a mooring or piles where recovery may have been hopeless. We learnt another valuable lesson in preparation. Isn't it amazing how many stupid suggestions there are at the time and experts there are in hindsight who "knew that". However sifting through all the advice, the best seemed to be from a neighbouring American woman who told us to do as the fisherman do when on the slips, sand and polish your bronze prop, heat it a little with an oxy torch and rub in as much lanolin as you physically can. The barnacles will stay away for a year I'm told and the efficiency of the prop will be the best achievable.

The delay of an hour was worth it. The wind had picked up to 15kn and the pleasure of finally being under sail for the morning for the both of us was huge.

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Speed Propulsion Systems (David O'Shea) 189 Molle Rd, Gumdale, Q 4154 07-3245-1303

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coating samples collected from peeling floors that were dirtier on their underside than on their top surface. The coatings stuck, but to the dust and dirt on the floor instead of to the floor itself. Hosing down the surface to remove the loose materials works somewhat, but also leaves a lot behind. Ditto for sweeping. The best approach is probably hosing down with as high a flow of water as possible, followed by compressed air blowing to both dry the surface and remove any remaining wet/sticky dust. A quick, last minute broom sweep wouldn't hurt either. Simply sweeping is at the other end of the spectrum. The applicator will need to decide how much time and effort to put into surface dust removal. Contaminants, including salts discussed below, can stick to your floor well enough to not be removed with a hose or brush, yet mysteriously 'pop off' after painting.

Salts: Salts and/or minerals either deposited out on the surface from the curing of fresh concrete, or from the evaporation of seawater on concrete or steel can quickly ruin a coating. For starters the salts work like dust and other contaminants getting between the coating and the surface. New garage floors for example, have a weak top layer of concrete and concrete salt/minerals that causes even epoxy floor paints to peel off easily, despite what appears to be a clean, nicely profiled surface.

Without moisture, salts tend to form crystals, which can interfere with bonding. Experts claim these salts actually perform in a chemical sense more like a grease, damaging or destroying bonding. Unfortunately it gets worse. Salts tend to attract water both from the concrete and through the coating. The result can be a water filled blister that spreads and grows mechanically, destroying the coating-to-surface bond.

"... that often coatings fail from the inside out. This is certainly the case with

II. Why Coatings Fail

Simply not sticking to the surface is one of the more obvious coating failures and has been discussed above. Other reasons include:

UV: Ultra-violet radiation from the sun, UV, will breakdown most coatings. Epoxies tend to yellow and chalk, other coatings, such as plastics, get brittle and crack. After too much UV the coatings will fail.

Porosity: Coatings are not as hard nor as solid as you might think. Some coatings tend to be quite porous, permitting moisture, chemicals, etc. to invade the coating and attack both the coating and it's bonding interface. Some epoxies are more porous than other kinds of epoxies. One common 'fix' used by manufactures of porous brands of epoxy is to add 'glass flakes' (usually mica) to slow the migration of water or chemicals through the coating by physical means.

Pinholes: A single layer of any coating runs the risk of including tiny pinhole areas of non-coatings. These 'leaks' permit chemicals to attack the unprotected surface as well as the bonding interface. In harsh environments it is common to apply two coats of paint/epoxy. Each coat is a contrasting color to aid in spotting thin or missing spots.

Brittleness: Simply put, some coatings are more brittle than others and overly brittle coatings are more likely to crack or chip with impact or expansion/contraction. Older epoxy formulations were generally more brittle than many of their modern counterparts.

Abrasion: Different coatings handle abrasion and wear better than others. Some of the more wear resistant epoxies now available contain Kelvar (TM) microfibers. These fibers, in addition to improving wear resistance also seem to work like rebar does in concrete, localizing any damage to the coating.

Chemicals: Chemical resistance varies between different coatings. Strong acids, for example, will quickly destroy many coatings.

Movement: Paint over an expansion joint and you can count on a coating failure. The slabs will move and the coating over the joint will crack and probably disbonding big chunks of coating in the process. Don't paint over expansion joints. There are other methods for dealing with them.

Salts: Salts were already covered above. Besides possibly reacting like a surface contaminant, as well as acting something like a grease, they also attract moisture through both the coating and concrete, forming water filled blisters. Note that often coatings fail from the inside out. This is certainly the case with blistering.

III. Surface Preparation

How much surface preparation is necessary can be a tough call. Someone has to take the responsibility, balancing effort and success against time and money. A pre-step is to insure the strength and integrity of the concrete. Crumbling concrete is a poor or impossible surface to bond with. There are several repair or replace options, including 'sealing' the surface with a thin, penetrating epoxy or some other compatible product. Once that is done real surface preparation can begin. The process of surface preparation involves at least five steps:

1) getting rid of greases, oils, etc.; **2)** providing a surface profile or texture; **3)** removing dust and contaminants; **4)** removal of salts; **5)** removal of moisture. Thanks to exposure to the elements, outside concrete slabs are often more ready to accept a coating than interior concrete surfaces (with the possible exception of sea water salt deposits in

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marine settings). New concrete usually has a thin veneer or crust of very weak concrete and salts that absolutely must be removed prior to coating.
In a perfect world surfaces would probably be prepared as follows:

1) Two wash-downs with a degreasing chemical.

2) The use of a 'Blastrac' (TM) type machine that performs concrete surface 'grinding' to remove weak surface layers and give the concrete floor an enhanced profile to bond with. Special grinder machines also work, as does an acid treatment (muriatic acid) known as 'acidizing'. Acidizing is any easy and inexpensive option. Muriatic acid is sold to clean concrete and bricks and is available in concentrations of 20-40%. Dilute the acid to 10-20% (add the acid to water, don't add water to the acid). If the concrete/acid solution fizzes a lot and the acid releases strong fumes, dilute the acid some more. New concrete will fizz more than old concrete. In any event, sweep the floor twice with a thin layer of muriatic acid. Rinse off the acid washed surface well. Check local disposal rules regarding this 'nasty' waste liquid.

3) Ideally, the next step would be a high pressure waterjet cleaning, hopefully at pressures of about 3,500 psi (at pressures over about 5,000 psi waterjetting will actually begin removing concrete, and could be an alternative to #2 above - we'll talk more about that next issue). After waterjetting wet vac dry, sucking up all the remaining water and dirt. Sweep well just before coating. Often this step gets reduced to simple sweeping and air drying of the surface. In most cases, that's probably OK, but every shortcut raises the chances of future problems.

"each coating situation is unique, sometimes cutting a few corners causes no

4) The concern about all the bad things various salts can do to about-to-be coated surfaces is growing as their affects become better understood. On steel surface these salts form ions and corrosion cells that are easy to spot because of the rust. Concrete may have a bigger problem than steel. It is porous and it contains minerals to start with. Several chemicals and/or processes have been developed or proposed to deal with these salts. Seriously consider using/testing these chemicals. Some applicators now include desalting treatment as a standard step in their surface preparation. Often the recommended method of application is with a waterjet unit, however, some can also be brush/roller applied.

Of course we don't live in an ideal world so surface preparation almost always has a few corners cut. Based upon personal field experience I would require, at a minimum, high pressure waterjetting of exterior concrete and 'blastrac' conditioning of interior concrete. Steel surfaces constructed from new steel must be abrasive blasted (largely to produce a surface profile), all other steel surfaces require high pressure waterjetting or dry abrasive blasting.

IV. What About Pre-Existing Coatings?

Most surface tolerant, modern, solvent-free coatings can be applied over well adhered traces of a pre-existing coating. 'If it ain't broken, don't fix it,' could be a completely valid strategy. On the other hand, complete stripping and total surface preparation would be the absolute proper approach to take.

V. Vertical Surfaces

Vertical concrete surfaces are less likely to have a grease film or thick layers of contaminants than floor surfaces. They often also have a pre-existing rougher surface, negating the need for 'blasting' a profile into the concrete. Salts and loose/crumbling surfaces, pre-existing coatings, or moisture are probably the major problems with coating vertical surfaces.

VI. Conclusions

Coatings fail for many reasons, and frequently manifest that failure by becoming 'unstuck'. Proper surface preparation can often prevent coating failure. Unfortunately proper surface preparation is often given short shrift to save costs, time, or materials.

Because each coating situation is unique, sometimes cutting a few corners causes no problem. It is a gamble played out every day between contractors/end users and the coatings they use. It is one thing to gamble and lose and quite another to fail out of ignorance.

FOR SALE

1) 12" Alloy Steering Quadrant for cable steering. Bored and keyed to 1.5" shaft. Un used $300.00

2) Anchor - 35lb Danforth $75.00

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