Ferro News

September 1997 Quarterly Newsletter for Ferrocement Boat Owners Issue 4

Yes this is the September issue, and its early. As your reading this Trudy and I should be somewhere between Brisbane and the Witsundays in north Queensland on our yacht “Lilly-Ann”. I’m hoping the weather is kinder to us this year, than last. The last several months have been especially busy working down that large list of things to do.

After we return, in time for the December issue of Ferro News, I hope to be able to spend more time developing the newsletter and the group.

I would like to remind readers that articles in this newsletter are not assured from technical errors and that contributors may or may not have qualifications in the area, and should be taken as an expression of opinion or experience, and not as definitive fact. Ferro News is a news letter where all of us can particpate.

Anyhow lets cut the talk and get stuck into this months edition of Ferro News packed full! **Stop-Press:** Post page 12 of this issue at your local marina or yacht club to

RAY’S HELL

By Ray Jones S/V “Ray’sHell”

Many thanks for forwarding my Ferro-News to Carnarvon... Great to hear that we had 25 takers and hopefully this number will grow in the future as other ferro owners hear about us, and realise the obvious worth of this venture.

A little about "Rays Hell". She is a fine example of the Hartley South Seas, built in Perth in 1983 by Alan Ahearn. We purchased her, minus the ketch rig, and proceeded to move her from the Fremantle Sailing Club to the adjacent Fisherman's Harbour, a much more affordable address!

We very carefully berthed her in our pen. At that moment another yacht owner walked over and said G'day and proceeded to inform us that the original rig off "Ray's Hell" was standing up on his boat and it was for sale!. What luck! After some negotiation, we purchased the rig and the excellent sail wardrobe, and, admidst great fanfare we raised the masts in their original positions on "Rays Hell". It is two years later now, and "Ray's Hell is a fully equipped, Australia Registered cruising ketch, home to three human beings and two cats. She is currently lying in anchor in Carnarvon, Western Australia. Once the strong easterley winds have abated, we will sail north along the Ningaloo Reef and around the North-West Cape to the new harbour in Exmouth. Being Keen divers and equipped with a compressor we intend to pause for a year in Exmouth to explore Australia's "other" Barrier Reef, and the myriad of islands along the north-west coast including the Monte Bello Islands, scene of British atomic testing in 1952. After that we are heading on to Darwin, via the Kimberley region, and then to Kopang in Timor, hoefully in company with other ferro-mates. Where are you all!

Just a thought on the side: I agree whole heartedly with Bob of "Rock of Ages". It is great to be out there, doing it! I recently read an article by Alan Lucas, which outlined his perfect boat. My perfect boat is "Ray's Hell" it is mine and it's paid for!

More later .....

Ray, Cindi and Bodhi (& Reebok and Casey!)

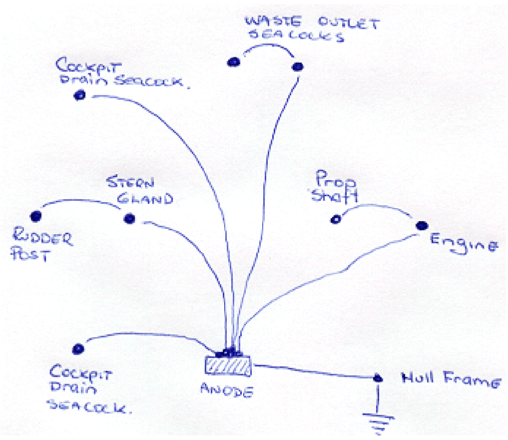
inside...

Ferro and Zinc

By Ian McFarlane "S/V Lilly-Ann"

The practical application of zinc anodes to combat the insideous electrolysis is often misunderstood by boat owners. Electrolysis protection is just as important for ferrocement boats as it is for a steel boats. To provide adequate protection to your hull and fittings, you're not required to have an understanding of the physics and chemistry of the phenomenon known as electrolysis. Its enought to know that without electrically attaching sacrifical amounts of a less noble metal, that is, a more chemically reactive metal immersed in seawater your critical metal components may dangerously errode. Blocks of zinc are used for this purpose. Zinc is a suitably volitile metal, that is more reactive than anything else your likely to have attached as a fitting to your boat. The term anode just describes the part of the electro-chemical system in which it exists and so we can use the terms zincs or anodes interchangably on our boats. Zincs can be purchased from just about any chandlery in a range of sizes and shapes. You must choose a size adequate to protect the number and size of your fittings. The shape has no relevance other than to provide a number of fitting options.

For the anode to protect a fitting it must have a low electrical resistance connection to that fitting, and be immersed in the same electrolyte, in our case the seawater! The seawater is easy, but a bit of investigative work is needed to ensure that every fitting has a low resistance connection. For this you will need an inexpensive multimeter or testmeter. Don' t be scared off by this, they are easy to use and will be handy for many other jobs about your boat or car. Check the inset box on how you can use this device.



A basic wiring diagram for an anode grounding system.

If you have no existing anodes, the first thing to do is find somewhere to fit one. Generally this means drilling 1 or 2 holes through the hull, with which a zinc block can be bolted. A plastic or timber pad should be used for each bolt inside and outside the hull. The blocks often come with a steel strap or predrilled hole to facilitiate this. The zinc can also be drilled with standard metal drill bitts if required. But in the interests of speeding up the replacement each year keep adaptations to a minimum. It is usual to locate this anode somewhere in the aft bilge areas, but not so low that the connecting wires will be subjected to bilge water. Having said that, you need to provide a cable connection to one of the bolts, a large o-ring type connector will do the job, held down by a washer and nut. This cable then needs to be run to a distribution point, from which you'll run a wire to each hull fitting. The most logical point to use is the engine. Avoid daisy chaining connections from one fitting to the next where possible, this increases the number of connections and consequently the resistance. If fittings have already a good low resistance connection to the steel frame within your ferro boat, then a separate connection is not required, so long as you've ensured that the frame is grounded to the anode - as it should be. Many experts advocate isolating every fitting from the frame, although desirable, this is an almost impossible task with a ferro boat, and much harder than making sure all your fittings are properly grounded. On the other hand if an inadequate system is in place, errosion of fittings may be greater than if they were not grounded. For this reason the connections should be tested every year.

Finding an attachement point to each fitting can be tricky so some of the following hints may help.

Seacocks: these are easy if they are the through-bolting type, but the threaded tube variety are somewhat more diffi-

(Continued on page 3)

USING A TEST METER

Read the instruction booklett that comes with your testmeter and generally familarise your self with it, test the voltage of a torch battery, or the resistance of a light globe, for practice. On the front dial you should see a diode symbol (triangle with a bar on top), this will be the meter setting we shall use to test for connections. You will also need a length of electrical wire, say 4 metres long. Attach one large alligator clip by stripping the insulation from one end, and one small alligator clip to the other. This wire will act as an extension lead for your test meter probe. Attach the small clip to the end of one of the test meter's probes. Which does not matter. Now we must find a suitable fitting that connects to the boats frame. The engine bed is a good start. Attach the large alligator clip to a bolt or fitting that you suspect to be in contact with the frame. Then move about with the test meter and by using the other probe systematically test each fitting, if you don't get a **000.00**, one or both fittings are not in contact with the frame. Once you find a **000.00** reading, you've found a suitable point from which to take a wire to the anode. Once you've done this, progressively test each hull fitting. Fittings that don't give a clean **000.00** reading, take a wire from that fitting to the anode or grounding point, and then re-check.

(Continued from page 2)

cult. A copper washer under the bronze nut with a wire soldered to it is one way, a small tap nut into the side of the bronze nut is another. ***Transducers:*** Same as above. ***Rudder Shafts:*** difficult to get a fixed attachment point, but the easiest way is to twist some copper wire around the shaft. But you must test this each year and or renew it. ***Stuffing Boxes:*** These are usually set into the hull with bolts. ***Propellor Shaft:*** If you don t have a flexible coupling, then you don’t have to do anything as it will already be connected to the engine. If you do, put a small jumper cable from one side of the coupling to the other. ***Rudders:*** Due to the large surface area of steel rudders, its recommend to bolt on an anode of its own. Above the water-line alloy fittings are some of the worst, never place aluminum fittings in contact with stainless steel, without using insulating washers or paste. The most common case of this is the mast step and stanchion fastenings.

Correction: Re: NRMA Insurance - Please note that Mr Frank Amatta is no longer with the company. In future please simply call your local NRMA office for inquiries.

The Unavoidable Void

By Roy Scoon

Back to the void ...

Iin the late '70s it was generally accepted that it was virtually impossible to plaster a hull without including voids somewhere in the myriad of little nooks and crannies that existed in any conventionally built armature. To overcome this it was recommended after plastering and curing the hull should be checked for voids. The problem was just how fair did one go with this practice. Did one drill 20 test holes, or 200 or 2000? Many builders didn't bother at all - they would be drilling holes for attachments anyway, besides who wants to build a hull and then drill it full of holes. Some drilled a few holes without detecting voids and concluded there weren't any. Others were very thorough but still had problems later anyway. One way or another, time would tell and did, and still does! If only it was as simple as that but it isn't.

Looking from the outside in.

In our last issue Paul Omans article, “Why Does It Fall Off”, gives a clear insight and explanation of surface conditions that affect surface coating adhesion. It also touched on sub-surface conditions. Now if you add to that the specific medium of ferro-cement and its marine environment and you end up with a real pot-pouri of possibilities. Roughly speaking these are:

- surface conditions;
- presence of chemicals;
- electrolysis;
- corrosion and
- of course, the presence of water, both salt and fresh,

plus a host of others associated with the above. Now include as a specific the presence of voids that were built in during construction plus voids that were perhaps created (over a period of time) by corrosion and/or electrolysis or mechanical stress (Impact damage, wear and tear etc). It all gets to be a bit much. The subject becomes too extensive and technical for the pages of this publication at this stage, so lets move on to looking at what we can do about at least reducing voids and their attendant affects.

A peep from the inside out.

The void its self is simple enough - a pocket of air trapped within the plastered hull. In its self quite harmless in small amounts and in a stable environment. Unfortunately this is not the status quo. A whole range of conditions exist that can cause dramatic (or traumatic) change. These involve electrolysis, corrosion, specific chemicals and mechanical.

Electrolysis - to keep it simple the average hull is a potential battery. Take steel rods, galvanised mesh, a void and just add water!

Corrosion - Simply put - rust. Salt water and a whole range of metals = corrosion = problems. The corrosion wastes away the metal leaving an air space (mini void).

Chemical - again to try to keep it simple, there is the potential for the presence of other chemicals in addition to those involved in the electrolitic and corrosive interactions which again have the potential to create voids.

Mechanical - stress damage in whatever form, can cause physical change - ie. - separation of the plaster from rods and thus an air space or void.

So your innocent looking ferro hull is in fact a chemical laboratory but so are most boats regardless of the material they are built of.

What to do? A Case Study

Andromeda, a Hartley Fijian was launched in Hawkes Bay New Zealand in 1979 after 41/2 years construction by owner/builder Colin Tozer. Construction techniques was by the then conventional Hartley method, meshing being 1/2" hexagonal bird netting (23g), diagonal rods of 10g and 4g longitudionals. Mortor mix was standard with the recommended addition of chromium troxide and the 2 shot method of application was used.

Since launching Colin has lived aboard Andromeda full time and has sailed around the world and enjoyed many other voyages. Colin and wife Vicki are a most sociable and entertaining couple, they are also multi-skilled and practical. This is reflected in Andromeda every where you care to look.

(Continued on page 9)

Marine Electrical Systems

Part III - BATTERIES

By Cameron Clarke "S/V JUPITER"

There are many types of batteries used on a boat, Lead Acid (liquid electrolyte), Gel Cell (immobilized electrolyte), Ni-Cad, and Alkaline. In this part, we discuss the application, usefulness, storage, and charging characteristics of each.

Lead Acid or liquid electrolyte type batteries (wet cell) store their energy in a reversible electro-chemical reaction between lead/antimony plates and a sulfuric acid solution. Many books detail the actual reactions that take place, so I will not discuss them here. It is only important you know that a reversible reaction is taking place. One reaction while using the energy, discharging the battery by chemical change of ions (lead and lead oxide) to suspended salts (lead sulfate). The reverse chemical reaction, charging, converts the suspended salts (at least those that did not precipitate out and accumulate on the bottom) back to ions. This is not a perfect reversible chemical reaction, some salts fall out of suspension and become unusable, water is broken down to its elements (oxygen and hydrogen) and partially escapes, some energy is lost through heat, and other things happen which are not that important here either. I feel we can assume a good condition battery to be about 85% efficient, that is for every 100 amp hours we put into it by charging, we can draw out 85. As batteries age, they become even less efficient. You will notice as a battery ages, it will last a shorter period of time. This is true of all batteries, whether wet cell, gel cell, ni-cad, nickel-metal hydride, alkaline, or any other rechargeable type. In a wet cell, the plates become thinner, and fewer ions remain available as the battery ages. This is normal wear.

There are three physical properties that effect the operation of batteries. Batteries exhibit mechanical properties as charged ions, very small particles, in the acid solution must have physical movement within the solution. In order to react with the lead/antimony plates, the ions must physically move into physical contact with the plate. Take a glass of tap water and place it on the sink. No particles can be observed, right? Now let it sit for a few days and notice how the particles have fallen out of suspension and rest on the bottom. If you applied mechanical energy and stirred the water, fewer particles would precipitate. Batteries exhibit electrical properties in that electrons flow in and out of the battery and between interconnected cells. It is this flow of electrons that does the electrical work. Batteries exhibit chemical properties as ions are transformed into salts, releasing available electrons in the process, and visa versa when electrons are absorbed. Each of these differing properties is governed by slightly differing rules. No, we need not be scientists to understand this. We need only understand there are many factors that affect batteries which can be simply explained within the parameters of these three differing properties. Any questions? Remember in Part 2 when discussing Alternator grounds? When electrons move between dissimilar metals, they make little pits in the metal they leave from. Well when electrons migrate from the lead plates into the acid solution to make suspended ions out of suspended salts, a minuscule amount of lead is released from the surface, in essence pitting of the plates occurs during charging. Whoa! What happened here? We had this electrical current flowing into the battery (electrical properties), and as the electron left the lead plate making ions of salts chemical properties) a small bit of lead jumped (physical properties) to the bottom of the battery, never to be useable again. Yes, charging your batteries is harmful to them! But if we do not recharge them after discharge, they would be utterly useless. So we continue to slowly damage them. No wonder they don't last forever! Now lets take a detailed look at what happens when we consume battery power. Go back to our bilge pump circuit in Part 1. The pump is running and 5.4 amps are flowing from the battery, that is 5.4 amps worth of electrons are leaving the negative battery post, travel through our negative side wiring, through the pump motor, then the switch, fuse, etc., until returning to the positive battery post. That's electrical, external to the battery. Inside the battery, suspended ions come into physical contact with the negative plates where a electro-chemical reaction is taking place to make suspended salts and place 5.4 amps worth of electrons into the plates. In order to continue providing 5.4 amps worth of electrons to the negative plate, the suspended salts must physically move away, making room for more charged ions to come into contact with the plate. The battery's positive post is connected to a slightly different metal (lead dioxide) from which the electrons are released into the solution making ions out of salts. This whole process can only continue until all the available ions and salts that can react with the plates come into contact with their respective plates. It takes time to move ions and salts around. For this reason you may notice a weak battery regains a bit of strength after sitting a few minutes. Available ions are slowly making their way to the plates, as the salts fall away. During charging operations, electrons flow into the negative post, and out the positive post, thereby reversing the electro-chemical reactions, only a few salts fell out of suspension, and a bit of metal was removed from the plates in the process. In areas more charged than others, water is split into hydrogen and oxygen gasses and bubbles are released. This is why we must replenish the water. It has escaped in the form of gases. If the plates have more surface area, or we have more acid volume, we increase the amount of ions and salts that can react with the plates in the same period of time. The increased surface area increases battery amp-hour rating, the

(Continued on page 10)

Water-Jetting, An Alternative

By Paul Oman

The issues surrounding the use of pressurized water as a maintenance tool have become more complex over the past several years. Originally used as a cleaning tool, water streams at pressures under 5,000 psi are commonly called pressure washing or water blasting. At these pressures cleaning is still the most common application (see table 1). Waterjetting or hydroblasting, typically utilizing pressures of 5,000 psi to 25,000 psi, is the next step up from water blasting and is a market still expanding in both size and dimension. Much of waterjetting usage is for coating removal and surface preparation. It often competes against sandblasting as a surface preparation option. Ultra-high pressure waterjetting, from approximately 30,000 psi to 60,000 psi, is also a growing market and one that is attempting to build upon the successes of lower pressure waterjetting. With the advent of ultra-high pressure systems, the issue of how much pressure is enough has come to the forefront. These systems can provide more pressure than is needed and perhaps even more pressure than the pumps themselves can structurally handle over time.

Having exceeded the justification for bigger-is-better, the marketplace has been splitting between supporters of high pressures and supporters of ultra-high pressure systems. So how much water pressure is enough and how can you compare a 20,000 psi waterjet system to a 40,000 psi system? And excluding the pressure and water flow variable, doesn't nozzle design and technology add another dimension to the pressure and volume equation? Also at issue is the changing relationship between waterjetting and its primary competitor, sandblasting. If today's modern ships can do waterjet surface preparation while at sea, but sandblasting requires expensive dockside access and large grit containment systems, which method of surface preparation has more to offer? As economic pressures increase and thus promote the use of spot surface preparation instead of blasting a complete surface, shouldn't that also alter the balance between sandblasting and waterjetting? Confused? You should be, it's not so simple anymore. Let's look at the variables one by one.

Pump Pressure and Flow Rates: If 20,000 psi is a good waterjetting pressure, shouldn't 40,000 psi be even better? Many manufacturers of ultra-high pressure pumps would lead you to think so. But pressure isn't everything. Low pressure fire hoses can literally knock down walls. The fire hose's secret isn't pressure, it is water flow. In fact there is a formula for computing the Impact Force of a waterjet system:

Impact Force = 0.0526 X GPM X square root of PSI

Using this equation, to double the impact force one can either double the water flow or quadruple the pressure. In terms of Impact Force a 20,000 psi waterjet system using 7.2 gallons of water per minute (GPM) packs more punch than a 40,000 psi 5 GPM system. So if a 20,000 psi/7.1 GPM system equals a 40,000 psi/5.0 GPM does it matter which system you have? You bet it does! 40,000 psi pumps are often more than double the price of most 20,000 psi pumps. Their parts also tend to wear out more frequently. Even the steel itself is stressed beyond its limits after a few million 0 - 40,000 psi pump cycles. On the other hand, today's steel can handle an infinite number of 0 - 20,000 psi cycles. In commercial settings a million pump strokes doesn't take that long to accumulate. This is not to say that ultra-high pressure pumps have no value, but rather to illustrate that increasing pressure does not come cheaply and that water flow is a less expensive way in increase impact force.

Despite the importance of water flow nearly everyone still talks and thinks in terms of pressures and assumes that the system being described can provide the water flow necessary to perform the task being considered. Most tasks therefore have a so-called normal pressure at which the work is typically done. Table 2 shows several such tasks and their associated pressures. Note that most fall around 10,000 psi, thereby strengthening the case for not exceeding about 20,000 - 25,000 psi when considering the purchase of a waterjet system.

Nozzles: Waterjetting nozzles are not all created equal. Some nozzles simply project a straight stream of water, others spin the water, move it up and down, or pulsate it. Does it make much of a difference? You bet! Spinning nozzles clean a larger more uniform area than does a straight stream, but the leading edge of the spinning stream is doing most of the work. Pulsating nozzles send the water out in bullets' instead of steady streams which tend to bounce back and collide with incoming water. The patented ShapeJet (tm) nozzles by Houston-based Aqua-Dyne creates a pulsating stream by redesigning the orifice shape from traditional round to triangular or star shaped. These non-normal shapes create an unstable water stream configuration that collapses upon itself and results in discrete, powerful pulses of water. Aqua-Dyne's research shows up to a 40% increase in cleaning efficiency just by switching to ShapeJet nozzles. Expect continued innovation in nozzle technology.

WaterJetting Vs SandBlasting: No discussion of waterjetting is complete without some mention of the surfaces it interacts with. Many new metal surfaces are given what is called a Surface Profile. A profile is a texture consisting of tiny hills and valleys providing a roughness and increased surface area that helps the adhesion of paints and coatings. Traditional and still dominant sandblasting can create surface profiles but waterjetting can only reveal a pre-existing surface profile.

Both waterjetting and sandblasting can strip coatings down to bare or white' metal. Waterjetting can do this starting with units rated at about 10,000 psi.

(Continued on page 8)

Your Say - Q&A

I just received the issues of your newletter you forwarded to me, thank you very much. I am delighted to be able to become the first subscriber in Canada. I will be sending my subscription in presently. After reading your newletter I was struck by the amount of effort spent in trying to maintain the paint systems, are these efforts required to protect the integrity of the material or are they simply cosmetic. My boat has virtually no paint below the water line other than bottom paint and this seems to be the prevailing custom here in British Columbia. As I understand it, as long as the mesh is properly sealed with plaster additional sealing with paints and epoxies is not required. On the topsides many of the boats are simply constantly touched up to cover the salt water sores. The broker who sold me my boat used latex paint on his topsides and just kept touching up as required. Wouldn't corrosion be very evident on a close inspection of the bottom sides? I would think that you would find spalling and / or iron oxide stains.

Bill Brooks, BC

Welcome Bill! It is interesting, and surprising to hear that leaving the ferrocement hulls bare, that is, without a coating system, other than antifouling is a common practice in British Columbia. I have read that this was a common practice, many years ago, but it seems that most sources now advocate a protective coating system. Below I quote from *Pavey, and Hunt.*

A R Pavey - "It has been suggested that adequately plastered ferro-cement hulls need no protection (Jackson and Sutherland, 1969) and it is popularly believed that paint work is for aesthetic reasons. This concept is incorrect. Ferro-cement hulls are a composite body of cement-mortar and steel reinforcing wire and mesh. The strength of this composite depends on the structural integrity of its parts. Any external influence which can lead to the destruction or weakening of either steel or the mortar must be prevented. Typical construction methods involve trowelling cement mortar on to tied wired mesh. This technique is likely to result in areas of steel exposed, or protected only by a vert thin layer of conrete. Thus there are both concrete and steel surfaces exposed or likely to be exposed to sea water. The more severe problem arises from its rapid corrosive attach on exposed steel. If allowed to proceed, serious spalling will occurr from the increased volume of corrosion products compared to that of steel. Even minor corrosion can travel along the mesh inside the hull and severly lower its impact strength."

Pavey goes on to disucss coatings and preparation..

P B Hunt - "It is a mistake to think that a ferro-cement hull can be treated in the same manner as a normal timber one. Massive timber can be left virtually untreated for long periods without deterioration. Massive concrete requires no protection, but ferro-cement needs painting in the same way as does steel and for the same reason - unless protected it will deteriorate. The important difference is, however, that where steel can be chipped, flame de-scaled or sand blasted during subsequent maintenance, the original treatment of a ferro-cement hull should be, as near as possible, for the expected total life. The most durable available finish must be used and from both theoretical and practical points of view epoxy resin compositions should be employed."

Ian McFarlane S/V “Lilly Ann”

How pleasant it is to be in touch with like minded people through you newsletter "Ferro-News" for which $10.00 is enclosed to secure a years subscription. I have found the first two issues very interest and most enjoyable and congratulate to you both for your fine efforts. It must be obvious Michell and myself are the proud and happy owners of an 18 metre LOA stays'l schooner cann TARA-IPO (Polynesian, I believe, means canoe of the gods). We call her TARA and as per custom refuse to change her name officially. She carries six sails, weighs around 50 tonnes and was once an Australian Registered ship displacing 38.8 tonnes, with a six inch round steel pipe for masts and a bowsprit 4 metres long!. She is a big lump of a boat!

TARA cruises happily around 4 knots under power and i've touched on 7 knots with all canvas up.

We purchased her for a song because of her condition and the fact that she is ferro. In purchasing TARA I fulfilled an adolescent dream of living in a boat and cruising for a life-style. TARA certainly is a rough diamond but for the last 3 years she has been Michelle's and my home and we are content (at present) to limit our travel to Pittwater (where we are based) and Broken Bay, Port Jackson and Port Stephens NSW.

We were not sure whether TARA could be restored so our first priority was to make her functional with all the basic safety equipment so we can use her while we refit her. I'm sure you'll hear more about that as time passes. I can relate some funny stories about our adventure thus far.

My Michelle, bless her heart, insisted that although she wanted to live aboard, whe would only do so on a vessel that could move under it's own power by sail and motor. TARA has faithfully done this since we purchased her. Three years on and no after seeing Doug Wallace "mystery", together with a dose of enthusaism regularly in Ferro-News, I am confident TARA will see many, many more years yet. Which brings us to business at hand the repair and maintenance of concrete. I've noticed Doug is doing

(Continued on page 7)

(Continued from page 6)

major repairs to Mystery's hull on the hard stand and he uses epoxy additives in his cement for bonding. My question concerns moisture content of the cement in the original hull. In my inquiries and practice this question of moisture content of the cement - especially in the early stages of cure - an ongoing process, is a major part in whether repair to the cement will be successful or not. Because of the difficulty of this vessel hauling out, and being on the hard stand is an expensive exercise. While it is a regular expense, our journeys up the slipway are kept as short as possible. Hence most of the work to the boat is done in the water. I have tried a variety of epoxies and epoxy cement and have been less than pleased with the results whenever there is any moisture in the cement.

This limits my use of epoxy so fare to being successful only on the deck. I have also tested, on another part of my topsides, waterproof patching cement with Bondcretes SILASEC additive and achieved a remarkable bond that can be feathered to a fair finish. I have a couple of places where the dekc meets the topside that will require the same work of surgery Doug Wallace is attempting and have been testing and researching the repair of concrete with fascination as the subject is very interesting. Whever I expose steel reinforcing that has corroded I have always cleaned and treated the rust before repairing. I have had success with a product call X-TROLL and PENETROL. How do others treat corrosion in reinforcement?

This brings me to a question for Mr Cameron Clarke whose electrical series will have us all eagerley awaiting each issue. Recently repairs have been underway to the concrete in a waterfront apartment block that has had a history of spalling concrete. In fact this building has long been considered by the locals as a hopeless case! The engineers doing major repairs on this site are seeing me often for they are always freely giving information of their products and mehtods. Is there madness in their method - each offending piece of reinforcement rod is being cleaned of old concrete and rust then an electric wire is attached and then replastered. The plan I'm told is to monitor the electolysis via gauges in the basement and if there is any differing electrical potentials the offending reinforcement receives a compensating dose of electiricity! Is this someway related to bonding that we do afloat?

While looking for references I have found the Cement and Concrete Association of Australia helpfull and also a wealth of information on the internet. Calcium Nitrate is an admix for cement that supposedly inhibits rust in steel. Has anyone heard of this and if so do they know of a product name we can try. Yes, well, I hope you two realise what you're in for!!

Crewmates in Cement

Ps. When on a leisurely cruise and people yell starboard at you, yell back conrete. It works wonders!

Wayne and Michelle S/V “Tara”

Thanks for yet another interesting and informative Ferro news. The multi purpose drill info was interesting. Recently I bought a set of Tectron universal drill bits from a mail order catalogue, cobalt wolfram tipped to drill concrete granite, brick, steel, ceramic, tile, plastic, glass(!) wood etc. Made in U.K. , 4,5,6,8,10mm for $49.95. The literature with them was very explicit that when drilling ferro-cement, the hammer mode must be disengaged immediatly if steel is encountered and rotary drilling used. I also found in the dictionary that wolfram is just another name for tungsten. I have succesfully sharpened ordinary masonry bits with a diamond disc in an angle grinder to drill ceramic tiles which are almost as hard as glass.

I have a friend who has hydraulic steering on his 50ft steel yacht. The rotary electric autopilot drives a sprocket and chain to a sprocket mounted on the shaft between wheel and pump. His only complaint is the electric motor (or more likely planetry reduction gearing is annoyingly noisy in the wheelhouse.

Anodes on metal rudders..... my original rudder was solid reinforced concrete and very heavy, far too small in area, and only had a 1" shaft diameter (solid stainless) I intend building a bigger one on a 50mm heavy wall s/s tubing shaft from 3 or 4 laminations of 3/4" ply and 1/4" fibreglass sheathing. I will weld a row of heavy s/s flat bars on the shaft and mortise and epoxy the ply laminations around them.

Painting bilges..... Mystery has a suspiciously dark patch on the hull right under the engine bay bilge. I am wondering if 20 years of diesel drips under the engine has resulted in the hull becoming permeated right through. I don't want the expensive copper poxy antifouling falling off in sheets, so I will ruthlessly attack the area with repeated scrubbing with boiling hot strong detergenty water followed by acid etching, more detergent to neutralise the acid, lots of hot fresh water rinsing and drying with hot air gun before painting with epoxy resin. On the inside of the hull I will do the same.

Rubbing lanoline into a heated bronze propeller! What a strange and exciting thing to try. I suppose the grease fills the billions of microscopic pits in the surface of the metal. I wonder if the lanolin could be doped up with some poisonous chemical or hot chilli powder that marine growth would find distasteful? Here is an oportunity for experimentation, each blade treated with a different concoction for comparison.

I've been flat out at work but have managed to get the dodger framing glued and shaped and some of the 12mm ply fitted. The whole thing will be sheathed in epoxy and fibreglass cloth so I used cheap interpine construction grade ply. To lay the glass cloth on the large areas without getting wrinkles, bubbles and wavy weave I am trying a new approach. I will cut the sections of cloth using the ply panels as templates before I glue and screw them on to the framing. I will draw a vertical felt pen line up the middle of each panel and up the middle of the cloth then roll the cloth sections up on pieces of dowel with neat little string ties each end. The ties will be bows like shoe laces with a tail that can be pulled undone with my teeth while holding each end of the dowel in my sticky rubber gloved hands. It is amazing how you only develop the most effective tecniques when the job is nearly complete.

Doug. Wallace S/V “Mystery”

Thank-You for all your informative mail!

(Continued from page 5)

Such units can also remove the coatings layer by layer, a level of control not found in sandblasting. In terms of appearance a waterjetted surface will not look like its equally prepared sandblasted surface. While the two may be equal, the waterjetted surface with be dull in color while the sandblasted surface will be shiny. Unfortunately visual surface inspection standards have traditionally been based upon the appearances of sandblasted, rather than hydroblasted surfaces. This has slowed acceptance of waterjetting at commercial work sites. Expect this to begin changing. Appearances aside, which surface is cleaner and better prepared for coating, the hydroblasted or sandblasted surface? It is now almost universally accepted that the waterjetted surface is the better prepared surface. Most bare metal surfaces contain clusters of salts and ions that quickly become destructive corrosion sites. Waterjetting removes theses salts and their ions, sandblasting leaves them behind. Sandblasting also appears to leave behind abrasive subparticles that reduce the coating's surface contact area and coating adhesion.

TYPE	PRESSURE
Water blasting used for cleaning	to about 5,000 psi
Water-jetting/ hydroblasting	5,000 - 25,000 psi
ultra high pressure - cutting, specialist function	30,000 psi and higher

Hydroblasting Characteristics: Immediately after waterjetting most steel surfaces develop a thin layer of flash rust'. Special rust inhibitors have been developed to delay flash rusting and future corrosion. Inhibitor additives, however, have fallen out of favor and the consensus is that flash rust' can be painted over without problem. Still, waterjetting would be more widely excepted if wet steel didn't flash rust.

Sandblasting creates tons of spent grit to clean up and dispose, but waterjetting has its own special needs to overcome too. A source of clean water (several gallons per minute) is required as well as a method of collecting and disposing of this water after separating out the paint chips or other debris from the spent water. While waterjetting has much less solid waste matter than sandblasting, the waste mater (usually paint chips) is more concentrated.

The volume of water required by a waterjet system is often linked to pressure. For the same amount of impact force higher pressure waterjetting systems use less water per minute than lower pressure waterjet systems. Is the trade-off worth it? No studies have been done on the economics of using a higher pressure, lower water volume waterjet system vs. a smaller waterjet system and a bigger water recovery system. It is likely that the extra waste water would not be much of an issue in terms of extra cost or effort.

There is an obvious link between the surface preparation tools and the coatings for which the surfaces were prepared. A new generation of coatings are being developed to take advantage of waterjetted (and even sandblasted) surfaces. In an effort to save time, money, effort, and the environment, state-of-the-art coatings are tolerant of less than ideal surface conditions and high humidities (or even wet/ damp surfaces). They are frequently single coat systems that don't need primer coats and are solvent-free. Solvent-free coatings don't release hazardous vapors into the atmosphere and provide a coating where wet thickness equals dry thickness. Advances in both coatings and surface preparations methods go hand in hand to the mutual benefit of both. Fiber-reinforced epoxies, such as those distributed by Progressive Products can actually be applied to wet surfaces, yet can be sprayer applied at single coat thicknesses of 20 mils.

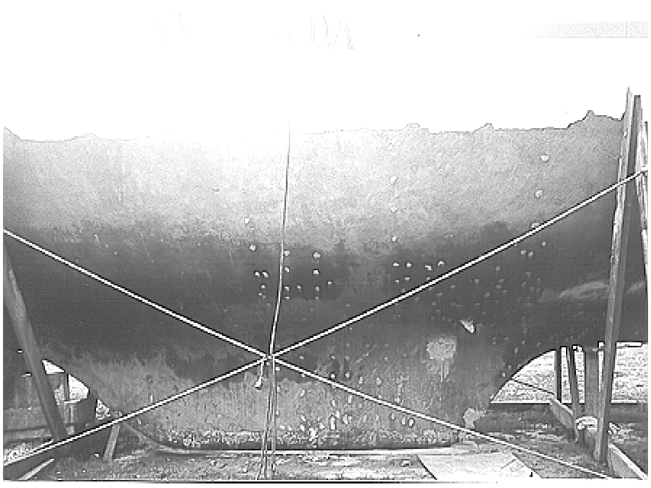
Spot Blasting: Most waterjetting vs. sandblasting comparisons assume coating removal across an entire surface. With today's more pressing economic conditions, spot blasting, either by dry abrasive or water, is replacing complete surface preparation. This alters a number of the waterjet vs. sandblasting comparisons. For example, most experts agree that sandblasting is faster than waterjetting although the extra time and effort required for setting up and removing containment systems and for cleaning up the ubiquitous spent abrasive often negates much of the productivity differences. However, when only performing spot surface preparation, gross speed is not the primary issue. The ease and transition of moving from one spot' to another spot' and the ability to quickly move to different work areas without a lot of related preparations makes waterjetting more attractive. The main deterrent to a major shift away from sandblasting and toward waterjetting for most types of applications is simply the historical acceptance of sandblasting and the lack of knowledge regarding waterjetting. As more educated end-users request waterjetted surface preparation, contractors, shipyards, and maintenance professions will quickly lean the advantages of waterjetting over sandblasting.

An added plus for waterjetting is that in many situations spot blasting with water can be done on-the-fly' instead of waiting to dock or arrive at a maintenance facility. Many ships and/or work sites have the ability to produce or obtain suitable quantities of fresh water needed for waterjetting. Sandblasting, on the other hand, requires tons of abrasives and containment/clean-up systems that simply aren't available or a llowed outside of actual maintenance sites. This is one reason why waterjetting is gaining popularity with companies that are actively seeking cost savings and increased efficiency.

The Future: The use of high pressure water as a replacement for sandblasting is gaining acceptance. ⚐

(Continued from page 3)

Two years after launching the hull began displaying bottom paint problems in the form of small blisters. These gradually worsened over the years increasing in size and number and typically followed the normal pattern of appearing around the keel and ballast areas and reaching out to the deadwood and fore foot. The first remedial appraoch was to try sand blasting and experimenting with various paint systems to no avail. This will sound familiar to many readers. Finally in 1993/94 Andromeda was hauled out, shored up and sand blasted in preparation for an all out attack on the problem.



Battle Stations.

Colin had decided that the problem lay in the presence of voids. Here is the procedure that he and Vicki adopted.

1. After sandblasting damp patches in the hull were marked.

2. Then beginning at the bottom of the keel 1/4" holes were drilled on approximately 4" centres to a depth of 1/2 hull thickness (#/8" - 1/2" deep) and as deep as practical in all solid areas. A vertical line of holes were drilled up each frame station.

3. Each hole was then thoroughly flushed with fresh water and allowed to dry for two weeks. Preparation completed they were now ready to grout. Colin hired a hydro testing hand pump to which he fitted a suitable rubber seal nozzle. The nozzle was simpley pressed over the hole to be filled with hand pressure. The grout consisted of portland cement, clean water, Intraplast A (Intraplast A expands on curing and so makes up for shrinkage on curing)

Armed with a good supply of suitably sized wooden plugs grouting began from the bottom up. Insert nozzle and pump until grout blows back at nozzle or exits from adjacent hole. Plug insert and exit hole until cured. Repeat process and slowly work upward. (The grout could be heard gurgling it's way along some voids!) After 1 week of curing the wooden plugs were removed and the holes plugged. For this hydrapoxy filler was used mixed with fine silica sand.

Surface Preparation and Paint

Well that was the grouting completed, Colin and Vicki now turned their attention to the hull surface detail in preparation for repainting. Colin reasoned that every little indent in the full surfact its self was another potential mini void that could threaten good paid adhesion. Their procedures was to very carefully treat the hull with their hydrapoxy mix thouroughly working the mix into the surface with a nail brush! After curing they proceeded with 3 coats of epoxy resin followed by 2 coats of primer and 3 coats of antifouling.

Four years later,

Was all the time, effort and cost worth it? Colin and Vicki claim it has reduced their problem by about 90%. The remaining 10% indicate to them areas that were missed or not quite completed. Their strategy is to treat these areas as and when appropriate and hopefully finally eliminate the problem altogether, or at least to an acceptable level.

Additional Protection

An interesting addition was made to Andromeda's keel as part of the project. This was done to afford further protection against the ingress of water and bottom abrasion. Colin fabricated a stainless steel keel shoe which looked rather like a simple canoe conforming to the shape of the lower part of the hull. Adromeda was raised on jacks the shoe positioned under the keel and filled with grout. The vessel was then lowered/ dropped into the shoe. (The dropped part was unplanned but fortunate as the shoe proved to be a snug fit.) The top edge of the shoe was then faired into the keel with an epoxy grout steel pins were fitted throught the shoe and into solid areas of keel and finally the whole lot glassed over. Now adromeda and her crew can rest be assured of maximum protection against future hard encounters.

Summary

Adromeda's history is quite unique in that she has voyaged over 100 thousand sea miles over a period of 18 years under the care of her original owner/builder so her compete history is known. Colin has carried out all work on Andromeda along with more than capable assistance of Vicki. Their competence care and experience is reflected in their vessel in every way. So it is with much interest that I will be following their progress and the success of their grouting program. Their cofidence in Adromeda and her ferro construction can best be summed up by Colons simple works "I wouldn't change a thing...."

The system they devised and followed has I believe achieved an excellent outcome, reducing future costs in paint systems and haul out time, protected the integrity of their hull, safe guarded their investment and given them peace of mind.

The cost of the whole project (as described) would vary from boat to boat but one would need a healthy budget. However it is a reasonably straight forward undertaking and could be carried out piecemeal if necessary.

I would like to thank Colin and Vicki for their time and hospitality not to mention the cups of coffee Vicki kept me supplied

(Continued from page 4)

rate the battery can deliver electrons. The increased acid volume increases the total battery capacity, the total number of amps that can be delivered. If the plates are made thicker, they will last a longer period of time. One electron, one bit of metal. The more total metal the more bits can be sacrificed. If we discharge a battery all the way, then the concentration of suspended salts will be high and some salts will precipitate out. The higher the discharge ratio, the more salts precipitate forming a layer on the bottom of the battery. Sometimes this layer gets so deep, it comes into contact with the positive and negative metal plates and "shorts out" a cell. If we do not discharge a battery all the way, then the concentration of suspended salts will be lower and few salts will precipitate out. The battery will last longer. Yet, if we use only a small amount of the battery's capacity before recharge and subject it to many charge/discharge cycles, then we lose a bit more metal than if we use more capacity before recharge. There is an optimum cost/performance ratio for lead/acid batteries. If we use very little of the available energy, we subject the battery to many recharge cycles. If we drain it to near exhaustion, we destroy the plates and acid solution quickly. Using about half the capacity before recharge is optimum. It is the point where the battery will last longer and deliver more amp-hours over its total lifetime. For those with the diagrams, refer to the graph of energy cost as a function of battery usage. Use less than 30 percent or more than 70 percent of the capacity and the cost per amp-hour increases dramatically. For these reasons, there are differences in the physical makeup of engine "start" batteries and "deep cycle" types. There are differences in marine, vs. automotive, vs. electric vehicle, vs. airplane batteries. It only makes sense to tailor the properties to best match the application needs. One battery can only be rated better than another by considering the application. To complicate matters a bit, there are many different way "marine" batteries are used, and the demands placed upon them. Which battery is best? Well that depends upon your needs and intended usage. A small power boat needs enough "cranking amps" to start the engine (also consider the effects of temperature when deciding) and accept a "float" charge while the engine is running. Very few other needs are required, running lights, bilge pump, radio, etc. This battery can be small, light weight, with many thin plates and a small amount of acid capacity as only a small amount of total capacity is used during the brief moments of starting. A house battery for a cruising sailboat with electric refrigeration needs to have a "deep cycle" type to provide a long term, consistent current drain between charges. For this type the plates may be fewer in quantity, but much thicker for durability (it takes a longer time to make a thicker plate look like cheesecloth due to pitting) and increased acid volume (more ions available). Reverse these two applications and both users will be unhappy. Gel Cell, or immobilized electrolyte batteries are really lead acid batteries, with a small difference. The acid (electrolyte) is made into a jelly. It is not a free flowing solution like the wet cell types. The same chemical reactions, the same metals in the plates, are employed. But remember I said batteries exhibit mechanical properties, in that the suspended ions must come into physical contact with the plates? Ok imagine trying to swim in a pool of jelly. You would swim slow! That is what happens in Gel Cell batteries. The ions migrate much more slowly than liquid types. However, the salts tend to stay in suspension and not precipitate out, so they can last longer due to inhibited precipitation of salts. This gives the Gel Cell battery a great advantage, and disadvantage. First, as the salts tend to stay in suspended state, they do not collect on the bottom to short out plates. That means a Gel Cell can be stored in a discharged state for quite some time and later brought back to very near if not full capacity. Try this with a liquid type battery and you will permanently lose some capacity. On the other hand, ion movement is slowed considerably. In other words, the rate of exchange of available ions and salts is slowed, reducing the amp-hour capacity. Remember the amp-hour capacity is a measure of the quantity of electron flow (amperes) in a given period of time (hours). Slowing the movement means fewer ions can react with the plates in a given period of time, reduced amp-hour capacity. Why doesn't a gel cell have less amp-hour capacity than an equivalent sized wet cell? Well they would, if it were not for the fact that gel cells have more plate surface area and less space between plates. By using many more, but thinner plates, the surface area is increased, allowing more jelly (more ions) to physically contact more plate surface area, compensating for the slower moving ions. So what? Well because of the slower movement, a longer period of time is needed for the ions concentration to become uniform, that is the electrolyte at the plate surface would have a lower concentration of ions during discharge (battery under load) than between the plates. During battery charge, the ion concentration would be higher at the surface of the plates. It would take longer to charge a Gel Cell, if it did not have more plate surface area and less space between plates, which compensates to the slower ion movement in the jelly. Try this. Charge an out of circuit battery and monitor the battery voltage. When it reaches say 14.0 volts remove the charger. With no load applied, what happens to the battery voltage? It starts to drop, 13.9 volts, 13.8 volts, 13.75 volts.....until at some time, perhaps 20 to 24 hours later it measures 12.75 or so volts. Did the battery discharge itself over that period of time? No. At the time the charger was removed there was a high concentration of ions at the plate surfaces. Consequently, a higher than normal voltage was observed on your voltmeter. Over time, the ions moved and became uniformly distributed within the acid between and at the plate surfaces. Ah, ha! Yes, we would then expect a Gel Cell to take a considerably longer period of time to reach a state whereby the ions were uniformly distributed within the jelly. Right!

A typical time for a wet cell to reach this stabilized point is about 20 to 24 hours. A Gel Cell takes at least twice that long. What that means, is it takes about 48 hours with the Gel Cell out of circuit (no loads) to reach a point of uniform ion distribution (stabilized condition) so that the voltage measurement is a valid indication of the battery's state of

(Continued on page 11)

(Continued from page 10)

charge! In a wet cell, figure 24 hours (Gel, 48).

Joe Boater asks, "I charge my batteries up to 14 volts, but they don't seem to last very long as they drop to 12.2 volts in a few hours. Are my batteries shot?" My reply is "Are you sure you have fully charged your batteries? Did you remove the battery from the circuit and wait a full day to determine the state of charge?"

Are we getting the point here? There is ABSOLUTELY NO WAY to tell the state of charge of a battery unless the acid is STABILIZED, period! However, once the acid is stabilized, the table (centre) can be useful. Notice the table has a temperature of the battery associated with it. Slightly different numbers apply to different temperatures. Also notice Rested 24 or 48 hours. That means "out of circuit" with no charging current and no loads applied. If anything is connected to the battery, the ion distribution will not become uniform. If the ions are not uniformly distributed, the reading is meaningless. For those of you with my diagrams, refer to the graph of Voltage vs Capacity, the temperature compensation table, and 4 Cycles to Battery Charging. I will get to the 4 cycles of battery charging in Part 5. What would happen if Joe Boater above were to charge and then remove his battery from circuit for 24 hours, assuming a wet cell? If the voltage dropped to somewhere between 12.5 and 12.7 volts, I would say he did not complete a full charge. If the voltage dropped to less than 12.2 volts, then his battery is definitely shot. A dissection would reveal salts laying in the bottom, perhaps even partially shorting the plates. The point here is, we can make an intelligent determination of the condition of the battery by measuring it only AFTER STABILIZED (rested). It is important to note the values in the table above cannot be taken as absolute values. Many other factors apply, like age of battery and its specific gravity. Now without going into all that, which you can at the library, just use the chart as a guide. It gives you a starting point, a place to measure your battery and rate it. Some "deep cycle" batteries intentionally use a slightly lower concentration of acid (lower specific gravity) to achieve a longer lasting battery. As a consequence, they will always measure lower on the "State of Charge" table. Just think of it as a relative value. OK?

State of Charge Table

Rested 24 hrs (liquid) 48 hrs (gel) 95 deg F

	25%	**50%**	**75%**	**100%**	**Float**	**Gassing**	**Equalise**
Liquid	11.96V	12.16V	12.48V	12.78V	13.46V	14.36V	16.00V
Gel Cell	12.18V	12.38V	12.58V	12.78V	13.48V	*Note	**Note
***Note: Never exceed 14.10V charging Gel Cell batteries**							
****Note: Never attempt to equalise a Gel Cell battery**							

In practice, boaters either burn up their batteries from too many charge cycles, or overcharges, or they destroy the plates and acid by taking them all the way down and not completely recharging them. In the first instance, the water needs to be topped off frequently. In the second, the voltage deteriorates with each charge/use cycle. Which are you? I want to point out something very important when considering Gel cell batteries. When a lead/acid battery (including Gel cell) approaches fully charged state, a higher concentration of charged ions congregate at the plates and some provide the energy to split water to gases. You will notice bubbles in the wet cell. You will not notice them in the Gel Cell, but they are there nonetheless. As Oxygen and Hydrogen gasses form on the plates, the jelly loses contact with the plate, decreasing the surface area. This increases the internal resistance under load (impedance) which causes a rapid rise in voltage until the jelly comes back into physical contact. At the moment the jelly is displaced, heat builds and accelerates the destruction of the plates. This effect is much less noticeable in wet cells, as the liquid removes the heat more quickly, than the jelly can. It's physical! Liquid is more viscous than jelly. There are a few alternator regulators that do not react quick enough to the changing battery impedance, and as a consequence rapidly destroy Gel cell batteries. The only way to replace the lead burned off, is to purchase new ones! Ouch, that can be very expensive. I will elaborate more about regulators in Part 5.

In review of the electrical, mechanical, and chemical properties of batteries: Electrons flow in and out of the battery and between cells, performing electrical work. Charged ions must have physical movement to react with the plates. Ions must physically move into contact with the plates. The chemical reaction transforms ions into salts, releasing available electrons in the process, and visa versa when electrons are absorbed. Add the effects of heat buildup and loss of water via gases and you have a pretty good understanding of batteries. The useful life can be shortened by overcharging, undercharging, or charging too frequently. Ni-Cad batteries are a solid-state version of lead acid batteries. If undercharged, they will deteriorate. They prefer to be discharged all the way without worry of lost capacity. In fact if not used completely before recharging, they suffer a condition called "memory" and have less capacity with each recharge. Drain them all the way before recharge. A new version, known as nickel-metal hydride, does not suffer from "memory" and make a more versatile replacement. These each have a charged cell voltage of about 1.25 volts, which is less than an alkaline's 1.5 volts. Direct substitution of ni-cads for alkaline in a flashlight (without changing

(Continued on page 12)

Attention

Ferrocement Boat Owners

CONTACTS

Ian McFarlane /Trudy Snowdon: *"S/V Lilly-Ann"* 69 Manly Road, Manly Q 4179 Ph: (07) 3348 6567
e-mail: mcfarli@citec.qld.gov.au

Len Brind: *"S/V Tava"* Ph: 018 159 925

Roy Schoon: Ph: (07) 3395 0248

(Co the bulb) produces a dim light. Alkaline batteries pack about 5 times the energy per unit of weight as a ni-cad, making them very useful for flashlight or small radio use on boats. Some new makes can accept 5 to 10 recharges with a special charger, reducing the replacement interval.


Ferro News

November 1996 Bi-Monthly Newsletter for Ferrocement Boa Issue 1

Welcome Aboard

Attitude

inside...
We Take a Closer Look at TAFA; a Hartley South Seas
Seminar Part I - Electrical Systems Seminar 3
Easier Ways to Strip Paint and Varnish 4
Your Questions Answered 5


Ferro News

September 1997 Quarterly Newsletter for Ferrocement Boat Issue 4

RAY'S HELL

inside...
How to use Zincs 2
Seminar Part III - Electrical Systems Seminar
Water Blasting - a twist 5

Join the growing list of ferrocement boat owners who read an particpate in Ferro News, a quartley news letter just for them, owners of ferrocement boats. Already 4 issues old, we are growing stronger. We profile readers yachts, relate cruising experiences, insurance and get technical with: repairs, paint, electrical and much more.

FERRO NEWS SUBSCRIPTION

4 Issues: 12 Months : $10 (Australia) $13 (Overseas) Back Copies $2

Name: ____________________

Postal Address: ____________________

____

Vessel Name: ____________________

Design Name: ____________________ **Length:** ____________________

Mail To: Ian McFarlane, 69 Manly Road, Manly Q 4179, Australia