feature

Lithium-ion Batteries

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PHOTOGRAPHY **SUPPLIED**

A LI-ON INVESTMENT

The benefits of Li-On batteries are well documented – lighter, smaller, longer life and faster recharging. But do they offer better value-for-money and improved performance versus traditional lead-acid batteries?

The owners of the 1970s MK1 Salthouse Corsair *Marinus* have, over the past five years of ownership, tackled significant upgrades of this popular design.

Like many of the Corsairs of the time, *Marinus* was originally fitted with a single 210hp Caterpillar engine. Cruise speed at 2,200rpm was 11 knots with a maximum of around 15 knots depending on the load.

While the Corsair has an enviable reputation for punching into seas for'ard of the beam, handling can also be tricky going downwind. Various modifications to the design have been tried over the years – including reducing the keel area – with varying degrees of success.

Increasing speed certainly improves the handling, but boats tend to get heavier over time – for a variety of reasons – so higher horsepower engines have become the norm. Yet few owners have concentrated on weight reduction as a means of improving performance.

On the recommendation of Moon Engines Ltd, *Marinus*' original engine was swapped for a new factory-reconditioned Cummins 6BTA 330, a PRM 2:1 reduction, down-angle gearbox and a Bri Ski 25 x 23 four-bladed propeller.

This resulted in a weight reduction of approximately 100kg over the original machinery and, combined with the 50 percent increase in horsepower, performance increased to a cruise speed of 15 knots and a maximum of 22.5 knots. A great improvement!

Additional weight savings and improvements in reliability and ongoing running costs came with the replacement of the original engine-driven compressor refrigeration. A new Isotherm 12VDC fridge and a new freezer were fitted, delivering better temperature control. A further weight saving of 60kg was a bonus.

Fortunately, both these items fitted almost perfectly into the spaces occupied by the original cabinets and thanks to some clever woodworking from craftsman boatbuilder Kevin Hilt, the new installation has blended seamlessly with the original cabinetry.

Access to the tank fillers and breathers under the floor is also now possible, a nice feature to have since the piping to both these needed to be replaced.

With the new refrigeration placing an extra burden on the batteries and *Marinus* now cruising at higher speeds, sufficient engine running time to recharge the batteries became significant issue, especially as sitting at anchor with a large diesel running unloaded just to charge batteries is inadvisable.

Enertec Marine Ltd was consulted to come up with an electrical revision for the boat that would avoid fitting a small genset (more weight and maintenance). After considerable discussion and exploring various options it was decided to fit as many solar panels as practicable.

Unfortunately the Corsair's cabin top layout doesn't lend itself to large areas for panels with unrestricted access to sun all day. A compromise was achieved by adding a single 90-watt Juice flexible panel on top of the canvas bimini and two further 90-watt panels on the cabin top in front of the flybridge, giving a total solar capacity of 270 watts.

The fridge and freezer typically use around 70-80 amp-hours per day of battery capacity in the summer, with other loads such as the inverter, pumps, lighting and electronics adding a further 20 amp-hours.

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The solar array can usually supply the energy required during daylight hours but the night time load results in a deficit of energy over a total 24-hour period. So each subsequent day starts with a deficit of battery capacity.

This becomes a problem without running the main engine and recharging from the alternator. Given the characteristic slow recovery of lead-acid batteries, the result is unacceptable engine running time.

These issues were anticipated by Enertec and the plan was to ultimately install its new Juice lithium-ion batteries, which were in development in partnership with Auckland University at the time.

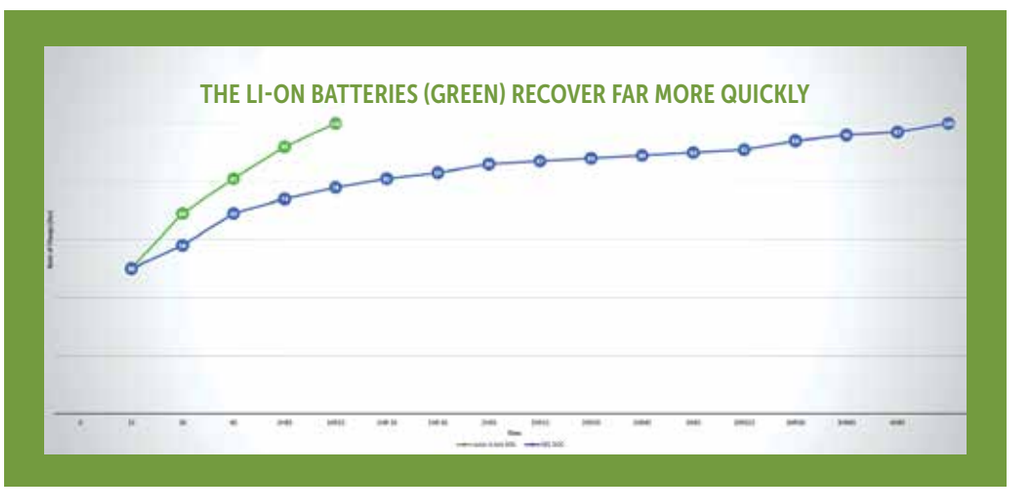
ABOVE *Marinus* has benefitted from substantial weight loss and better batteries.

BELOW The new fridge/freezer cabinet.

Marinus' owner was concerned about the perceived safety of lithium batteries but was satisfied that the use of lithium-ion iron phosphate technology – combined with the sophisticated cell balancing and inbuilt safety electronics – would provide a satisfactory system. These batteries had been designed to comply with the relevant AS/NZS 3004.2:2014 standards relating to lithium-ion batteries in marine applications.

Because Li-On batteries can be discharged by 80 percent and then recovered to fully charged in a short time, they provide around twice the useable capacity of lead-acid (flooded, AGM and GEL) batteries.

Traditional lead-acid batteries have a maximum recommended discharge rate of 50 percent and recovering the last 15-20 percent capacity takes a long time. For most boaties this means their lead-acid batteries only provide



WHAT ELECTRICAL MODIFICATIONS WERE REQUIRED?

Because cost was a factor the new system had to deliver the required performance benefits at an affordable price.

The advantage of the Enertec Juice battery was that it met the required AS/NZS standards and was also designed for easy retrofitting into an existing, conventional lead-acid battery system.

The standard Cummins engine alternator did not require modification as the charge voltage was suitable for the Juice battery and the batteries' built-in electronics protects them from any alternator or solar regulator malfunction. In addition, each battery has a unique built-in test feature to ensure that all the protection mechanisms are functioning correctly.

Installation time on *Marinus* was around four hours but this would vary depending on access and sophistication of the system, ie; how many charge sources are involved and the number of battery banks.

Total cost was around a quarter the cost of a small diesel genset installation and the resulting performance gain – in the case of this vessel – has been similar. The lifetime of the Juice Li-On is expected to be at least three times that of the lead-acid GEL batteries and, given the reduced engine running required and the weight/space savings, the upgrade makes financial sense.

The owners now have a boat with systems that work extremely well for their needs and *Marinus* has also shed a considerable amount of weight!

The advantages of upgrading to lithium-ion varies between vessels but they offer a compelling argument even for older yachts and launches.

A correctly designed Li-On battery offers around 80 percent useable capacity.

around 35-40 percent useable capacity.

A correctly designed Li-On battery offers around 80 percent useable capacity. The practicality of this is that a replacement Li-On battery bank can be nominally half the size of the original lead-acid battery bank.

The previous lead-acid battery bank comprised 400 amp-hours of GEL batteries weighing 140kg. The replacement Li-On setup of 200 amp/hours weighed just 26kg and occupied less than half the physical space. A big weight reduction simultaneously offered a big performance boost.

With the very short recharge time on the Juice Li-ON battery, it

Total cost was around a quarter the cost of a small diesel genset installation, with a significant performance gain.

LEFT The Li-On installation was considerable lighter and smaller than the lead-acid bank.

is now possible to recover any energy shortfall with very limited engine running. The standard alternator on the Cummins engine has a nominal rating of 130A but in practice derates to around 90A hot rating.

It does however have the benefit of being able to deliver the maximum current output at a fast-idle speed of 950 engine rpm. This is important when battery charging at anchor as the engine can be run at a quiet and comfortable speed.

The graphic shows the comparative recovery times of the previous GEL battery bank vs the new Juice lithium bank. It shows the time to replace 100 amp/hours in the respective banks (100 amp/hours is the typical daily load on the electrical system). From these graphs it can be seen that it is almost impossible to fully recharge the GEL bank without very long engine run times, whereas with the Li-On bank this is quite feasible.

The battery bank can now be recovered on a daily basis.

Another noticeable benefit of the Juice Li-On is that terminal voltage is still around 13V at 50 percent state of charge, compared with 12.2V for the GEL. This has made the on-board 2kW TBS inverter/charger run more efficiently, as well as other electrical components in the system. BNZ

WANT TO KNOW MORE ABOUT LI-ON BATTERIES?
Contact Enertec Marine at 09 414 4730 or info@enertec.net.nz.

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