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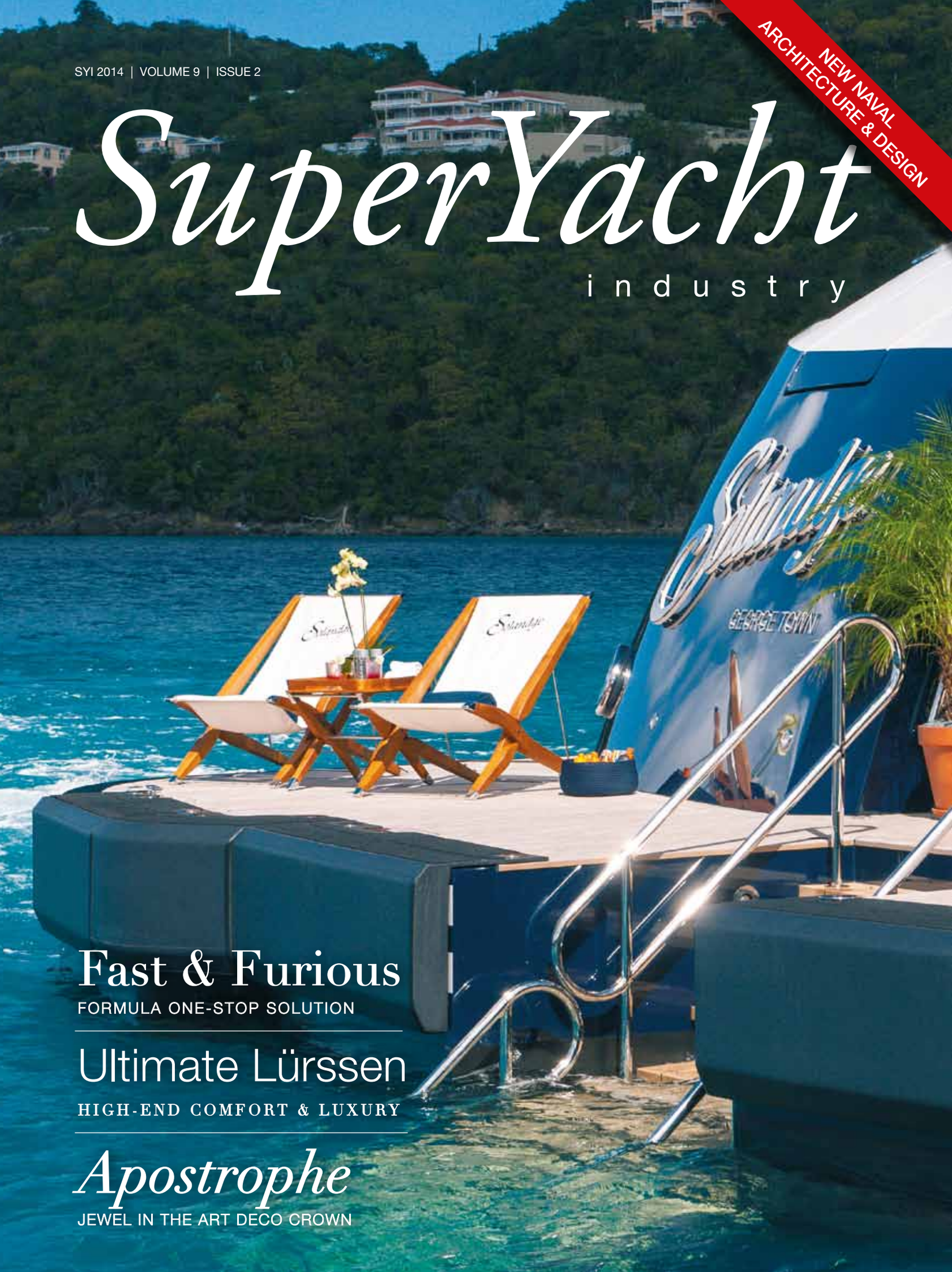
NEW NAVAL ARCHITECTURE & DESIGN

SuperYacht industry



Fast & Furious
FORMULA ONE-STOP SOLUTION

Ultimate Lürssen
HIGH-END COMFORT & LUXURY

Apostrophe
JEWEL IN THE ART DECO CROWN

Photo courtesy of Rondal

HAS THE DREAM METAL FINALLY CAUGHT ON?

Titanium MOMENTUM

TITANIUM IS STRONG, VERY LIGHT, RESISTS CORROSION AND HAS A BEAUTIFUL, LUXURIOUS FINISH. PLUS, ITS EXPENSE HAS MADE TITANIUM AN OBJECT OF EXCLUSIVITY. ON THE FACE OF IT, IT'S THE perfect metal for superyacht fabrication. And yet, as metallurgist Ko Buijs explains for SuperYacht Industry, this unique metal has only recently begun to attract the attention of luxury yacht builders.

WORDS BY JOHN GAULDIE

There are few superyacht yards in Germany and the Netherlands who have not had a visit from Ko Buijs, owner of Dutch metallurgical advisory office Innomet. As well as lecturing on titanium at technical universities, he is largely behind the yachtbuilding sector's increasing awareness of titanium's unique properties and growing expectations for the metal. Superyacht yards are ready to listen, he says, but until owners are convinced, the yards remain hesitant.

"I'm still surprised that this unique metal hasn't been used more in yachtbuilding. According to the yards, there seem to be no clients asking for titanium and that's largely to do with lack of awareness, I believe. That's been my experience in Germany as well as in the Netherlands. Nevertheless we're talking with one yard about a complete titanium hull and a number of suppliers are starting to produce titanium deck equipment."

No More Tea Stains

It's quite well-known that stainless steel type AISI316 has a limited resistance against maritime environments. Most of this corrosion is caused by aerosols and chlorines. Corrosion is visible most of the time as so-called tea stains, however severe corrosion is possible as well. The resistance of the passive oxide skin of AISI316 is very limited and this material is extra susceptible to corrosion, especially if the surface is rough or grinded.

"Such trouble is completely solved by applying titanium," Mr Buijs says. "That's the very reason nowadays we're seeing more and

> *Until owners are convinced, the yards remain hesitant.*

more suppliers apply titanium in equipment and parts for mega yachts instead of stainless steel. This is a remarkable, but understandable development."

Seawater & Atmospheric

Examples of titanium products in the superyacht industry include winches, hatches, cooling systems, heat exchangers and deck equipment such as eye plates and sheet systems. The extraordinary and unique corrosion performance of titanium offers new perspectives for these applications.

Titanium is a reactive metal with a standard negative potential roughly four times more negative than the negative potential of iron. Yet this very ignoble metal behaves in a very noble way in that the titanium dioxide skin provides such excellent protection. Titanium is so reactive that a titanium oxide skin forms spontaneously in contact with air, without the presence of water. By contrast, iron needs moisture as well as air in order to oxidise.

There are titanium products that guarantee continual use of titanium in seawater for 40 years without steps having to be taken to prevent corrosion. In other words cathodic protection is not necessary. In the last 60 years titanium has proved an especially good choice of material for use with saline, brackish and dirty water. So it's not surprising that titanium is nowadays chosen very frequently for the fabrication of seawater-cooled heat exchangers and piping systems.

Ko Buijs, owner of Dutch metallurgical advisory office Innomet.

Workfloor Training

Apart from the cost, there are very few hurdles for yards and superyacht suppliers considering a switch from stainless steel to titanium.

"Machining titanium is not particularly difficult, and for welding the degree of difficulty is actually lower than stainless steel. There are certain preparations necessary to ensure a successful finish, particularly with welding because titanium is a reactive metal after all. Craftsmen on the workfloor are going to need some training, but it's not a big step. Polishing titanium is a bit more difficult than stainless steel but perfectly possible."

Mr Buijs revealed that he is currently involved in providing polished titanium cutlery for the aviation industry. A Boeing 747 has around 500 cutlery sets on board for Business Class. Titanium means half the weight and has an attractive finish.

Winning from Ore

Titanium is the fourth most abundant element in the earth's crust, so why is this metal so expensive? To a great extent, the answer lies in the costs involved in obtaining it, Mr Buijs explains. As a rule, all ignoble metals are extracted as a metal oxide. The lower the position of the standard potential of the metal in the nobility table, the more difficult it becomes to separate the metal from the bound oxygen.

Iron can be quite easily separated from the bound oxygen. This can be represented by the reduction formula $2FeO + C + e \rightarrow 2Fe + CO_2$. This reaction takes place in a blast furnace and the 'e' in the formula stands for the energy that needs to be added to make this reduction possible.

If one adapts this mechanism to titanium oxide, also called rutile, nothing happens, since titanium oxide must be treated very differently in order to separate these two strongly bound elements. That means several reduction steps. It's clear that it takes a lot of energy to win titanium from its ore. Therefore a large part of the price of titanium is determined by the need for so much energy.

Cost, Cost, Cost

Titanium's price per kilo is around four to five times more expensive than stainless steel AISI316. However, Mr Buijs highlights a number of factors necessary for a true comparison.

"Titanium weighs half as much, so that brings the cost back in the right direction. Also titanium doesn't need any corrosion allowance. Corrosion is eliminated so basically so the cost of maintenance is eliminated, too. Titanium has stronger mechanical properties than stainless steel, so that can mean less metal in constructions. Titanium coolers and condensers have no issues with microbial induced corrosion (MIC), which stainless steel does. So although the higher price of titanium is going to end up coming from the owner's pocket, I don't see any problem given the exclusive nature of the metal. And in the long-term the metal pays for itself."

i. www.innomet.nl