

SUBSEA

PROTECTION AND PERFORMANCE

Magazine



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Corrosion damage repair made easy



Test plate showing the benefit of an Ecofix and Ecoshield combination.

Subsea Industries has launched a new product for filling and building up a corroded and pitted steel surface to its original form prior to recoating with Ecoshield. Ecofix is as tough as the steel itself, machinable, and can be used to repair most pitting or corrosion damage on rudders, stabilizer fins, thrusters and other underwater gear.

Ecofix is used in combination with Ecoshield, the ultimate rudder protection coating. When a rudder or other piece of underwater ship gear has not been properly protected, the surface will become corroded. Cavitation damage can cause severe pitting. The steel needs to be restored to its original shape with a smooth surface prior to recoating.

This is where Ecofix comes in. It is a superior, tested and proven filler. Because it uses the same basic resin as Ecoshield, the coating can be applied just one hour after the filler. The bonding and hardness are extraordinary. This is the effective alternative to metal facing or very expensive alternative fillers. And because it is part of the Eco-speed/Ecoshield family, it is fully compatible with the coating. ■

ECOFIX® **CORROSION REPAIR**

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Editorial



In this magazine we write about a wide variety of projects that were carried out with our range of coating systems. They showcase the specific benefits we can offer to different sectors.

The first article deals with the finalization of a big offshore project carried out in China. Our Ecolock coating was applied on a newbuild Floating Storage and Regastification Unit (FSRU). The application was finished at the start of this year.

Next you can read about the docking of polar research vessel RRS *Ernest Shackleton*. After sailing with our Ecospeed coating for eight seasons in the ice the coating was still in excellent condition and is likely to outlive the vessel.

We finish the magazine with a detailed look into erosion and corrosion damage on rudders. We also talk about how our specialized Ecoshield coating can put a stop to this damage for good.

A handwritten signature in black ink, appearing to read 'BVR', with a long horizontal line extending to the right.

Subsea Industries NV
Boud Van Rompay
Founder

Second major Ecolock project in China completed



Floating Storage and Regastification Unit (FSRU) during its undocking.

Earlier this year application of Ecolock was finalized on a newbuild Floating Storage and Regastification Unit (FSRU) in China. This was the second project carried out for EXMAR, after the application on the *Caribbean FLNG* in 2013.

Like the first project, the FSRU was built in blocks. These blocks are coated individually before assembly, leaving only the weld seams and the areas inaccessible due to the support blocks to be painted after the barge is assembled. Coating over weld seams after the blocks have been assembled is very easy. The Ecolock system then consists of a single, homogenous covering of the steel. It leaves a smooth finished surface and the erection joint paint blends in perfectly with the coating of the rest of the hull.

As with all Ecolock applications, a

trained and qualified paint inspector was on site monitoring the entire preparation and application to ensure adherence to the specifications at each step of the process and to assist with any problems that may arise. This is essential for a coating that is intended to last the life of the unit. Ecolock comes with a warranty as long as it is applied according to the specifications.

Ecolock is an extremely tough and durable coating designed to remain in excellent condition for up to 20 years without drydocking, repair or replacement. Ecolock can be cleaned underwater as often as needed to meet the UWILD and weight requirements of FPSOs, drill ships and other offshore vessels. Ecolock is the result of continual R&D on offshore hull coatings since the 1990s. ■

Ecospeed decision validated by Ernest Shackleton

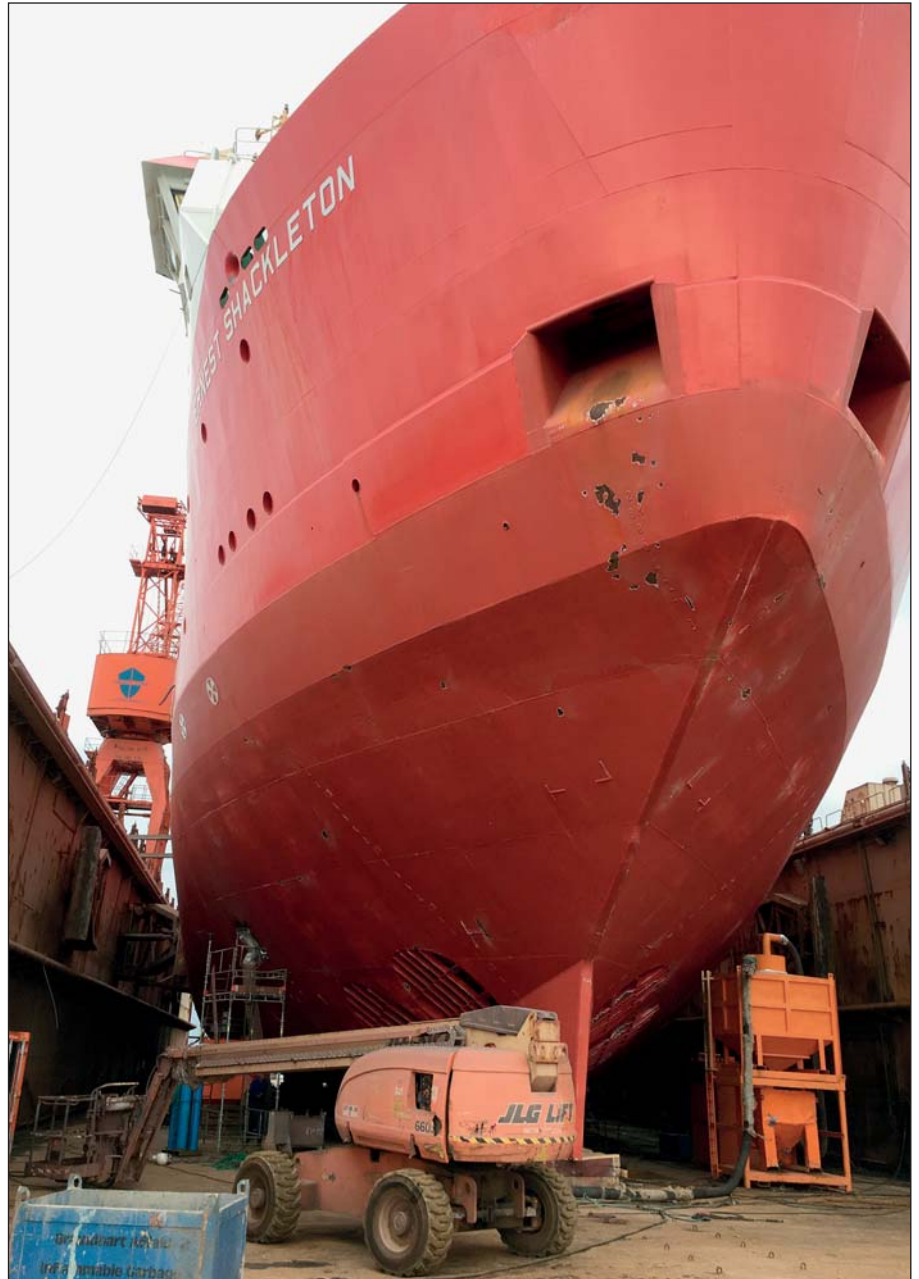
British Antarctic Survey's decision to apply the Ecospeed hard coating to the hull of its new polar research ship RRS *Sir David Attenborough* has been validated after the recent drydocking of sister vessel RRS *Ernest Shackleton*.

The 80m long vessel, initially coated with Ecospeed in 2009, drydocked last month at the Orskov shipyard, in Frederikshavn, Denmark. The hull was found to be in almost perfect condition.

RRS *Ernest Shackleton*, launched in 1995, is a logistics vessel used to transport cargo, fuel and passengers. The ship has basic scientific capability and undertakes research work in the Antarctic.

Built by Kverner Kleivin Leirvik, Norway as the MV *Polar Queen* for the Rieber Shipping of Bergen she was deployed in the Antarctic by other national programmes before being acquired by The British Antarctic Survey in August 1999.

In eight seasons operating RRS *Ernest Shackleton* with Ecospeed coating, BAS had to touch up Ecospeed only in areas of mechanical damage and carry out minor repairs around the bow, the most susceptible area to ice impact. Following the performance on *Ernest Shackleton*, the hard coating was applied in 2015 to the hull of sister ship, RRS *James Clark Ross*. Results were again exemplary. *James Clark Ross* is scheduled to drydock next month.



Only a small patch had to be touched-up during the recent docking, despite the Ernest Shackleton encountering heavy Antarctic ice.

BAS Superintendent Andrew Webb, said: “*Shackleton*’s hull condition is the best I have seen after typical ice year operations.” After sailing for six years BAS had to account for touch-up coats to areas impacted by the ice during the many seasons in the Polar region. This year they

needed to repair even less surface area than expected, despite the vessel encountering heavy Antarctic ice.

The durability of the coating and the ease with which repairs can be carried out were the reasons why



Ecospeed will now be applied to Sir David Attenborough (artist impression courtesy of BAS/Cammell Laird).



In 2015 the RRS James Clark Ross was coated with Ecospeed to protect the hull against impact with ice.



In eight seasons operating RRS Ernest Shackleton with Ecospeed coating, only those areas most susceptible to ice impact needed touch-ups.



RRS Ernest Shackleton in Antarctic ice up to 2.5 m thick.

BAS/NERC selected Ecospeed for the newbuild RRS *Sir David Attenborough*. The 15,000gt polar research ship is under construction at the Cammell Laird shipyard in Birkenhead, Liverpool, UK.

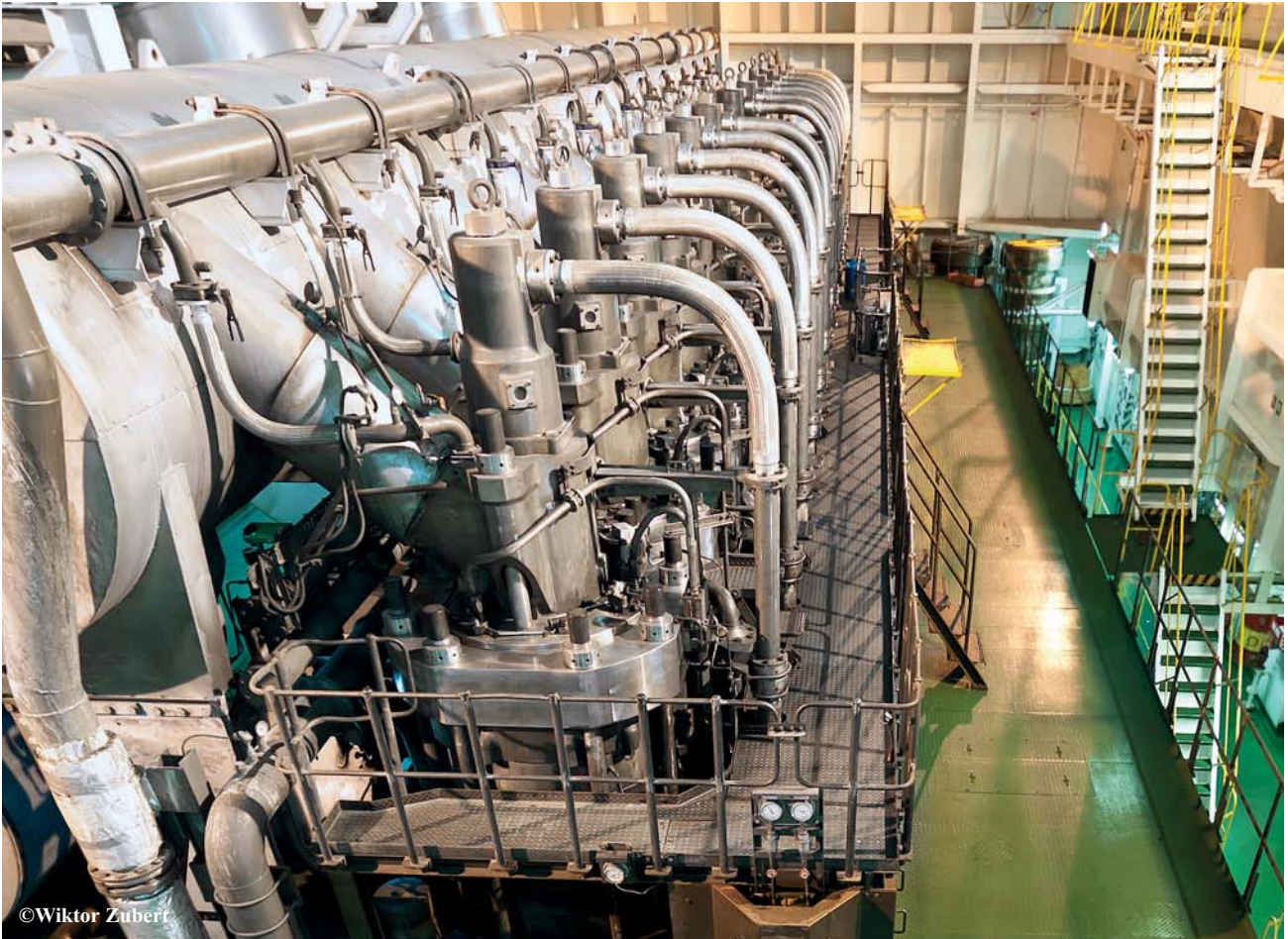
The shipyard initially wanted to apply its preferred supplier's coating system, but based on their experience with the *Ernest Shackleton* and the *James Clark Ross*, BAS chose Ecospeed instead. The coating does not need to be applied under strict environmental conditions or require any sophisticated application equipment.

RRS *Sir David Attenborough* is scheduled for operational duties in 2019 and will be one of the most advanced polar research vessels in the world. ■

About BAS

British Antarctic Survey (BAS), an institute of the Natural Environment Research Council (NERC), delivers and enables world-leading interdisciplinary research in the Polar Regions. Its skilled science and support staff based in Cambridge, Antarctica and the Arctic, work together to deliver research that uses the Polar Regions to advance our understanding of Earth as a sustainable planet. Through its extensive logistic capability and know-how BAS facilitates access for the British and international science community to the UK polar research operation. Numerous national and international collaborations, combined with an excellent infrastructure help sustain a world leading position for the UK in Antarctic affairs. For more information visit www.bas.ac.uk.

The only hull performance system that gives your engine a break



©Wiktor Zubert

Ecospeed provides your vessel with long-term protection and dramatically improves the ship's performance.

An impermeable and extremely tough coating is combined with

an underwater cleaning system. This keeps the hull roughness at an optimum level and results in a major saving in fuel.

Ecospeed gives a very thorough and lasting defense against cavi-

tation and corrosion damage for a ship hull's entire service life. The coating comes with a ten year guarantee. No repaint will be needed during future drydockings.

ECOSPEED®
SHIP HULL PERFORMANCE TECHNOLOGY

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Eliminating rudder cavitation damage

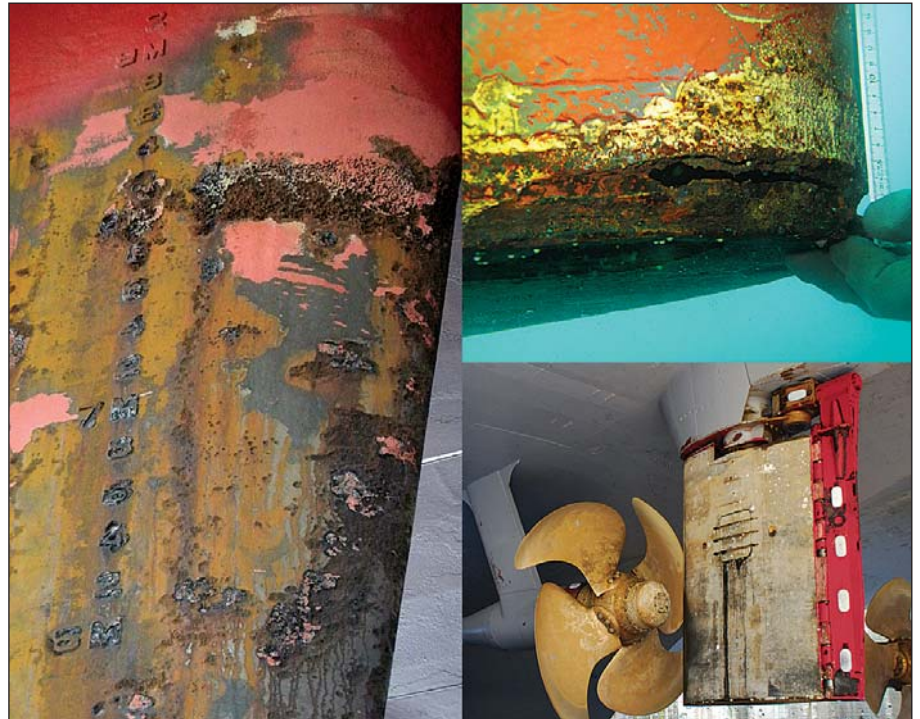
A ship's rudder is particularly prone to damage caused by erosion and corrosion. The problem figures more prominently in high-speed container carriers and other fast ships than in slower vessels. However, it is a potential hazard for all vessels.

A ship's rudder, placed directly behind the propeller to give the ship maximum manoeuvrability, is particularly prone to erosion followed by corrosion. The erosion in this case is caused by hydrodynamic cavitation.

Hydrodynamic cavitation is a phenomenon that accompanies turbulent fluids. The turbulence in the fluid, caused by the ship's motion through the water and particularly by the action of the ship's propeller, results in areas of greatly reduced fluid pressure. Due to the low pressure, the water vapourises. This creates small, vapour-filled cavities or bubbles in the fluid up to about 3mm in diameter. The cavities travel through the water and the pressure around them increases, causing them to suddenly collapse. The implosion of the cavities is accompanied by a complex set of physical processes. It is the collapse of the cavities and the



Cavitation bubbles and resulting damage.



Rudders with cavitation erosion damage.

attendant high pressure pulses, speeds and temperatures in the water that cause the damage.

The forces involved are very large. It is as if the surface affected has been subjected to repeated, heavy blows from a hammer accompanied by high temperatures. This causes what is known as cavitation erosion as the surface material, first paint and then steel, begins to flake away. The process can be greatly magnified by the presence of gravel or other hard particles in the water.

One need only examine a ship's rudder that has been subjected to cavitation damage to see that very real damage is caused by this phenomenon. Rudders become deeply pitted, paint coatings and hard steel simply disappear, whole plates can fall off and the rudder practically

disintegrates altogether – all as a result of this cavitation damage.

The process can take place in a remarkably short period of time. Sometimes six months is all it takes for serious rudder damage to occur. The first step is that the cavitation causes the paint coating on the steel to erode, eventually exposing bare steel. The erosion of the steel is then accompanied by the electrochemical process of corrosion because the steel is no longer protected. The effect is multiplied as the cavitation continues, and the erosion it causes is augmented by the natural corrosion of bare steel exposed to water – the electrochemical process and the oxidation that this brings about.

Cavitation damage is not limited to the ship's rudder. The propeller is also subject to the phenomenon, as



The damage caused by cavitation (left) and a typical welding repair (right).

are stabilisers, the vessel's hull and other parts of the underwater vessel where the water flows are particularly swift or turbulent. But the rudder is especially prone to this problem due to its position and form.

Attempts to solve the problem

Rudder cavitation damage is not new, nor are attempts to solve the problem. Naval architects, shipbuilders and scientists have been working on a solution since the current propeller/rudder combination came into use. There are references to cavitation observation experiments being carried out as early as 1895.

The attempts to solve cavitation damage to rudders have been numerous since then. They come under the broad classifications of

- design changes to the ship and/or rudder
- efforts to contain erosion after the cavitation erosion has set in, as in the use of sacrificial anodes, and
- attempts to “cavitation-proof” the rudder through coatings, metal facings, different materials and similar methods.

The lack of success (until recently) of these approaches is well summed up in the following quote from a paper presented by J. Friesch at the Sixth International Symposium on Cavitation in Wageningen, the Netherlands, in 2006: “Rudder cavitation is a long-recognised problem in the shipping industry. Nevertheless, we are still far away from practical, final solutions to improve the situation.”

Preventing cavitation damage

The ideal approach to cavitation erosion would be protecting the hull to prevent any such damage from occurring. Add to this a rudder design that is efficient and yet reduces cavitation as much as practicably possible, and one would have the solution.

This solution does exist. It consists of a coating that is tough and flexible enough to withstand the forces of cavitation so that they do not cause a breakdown of the coating, which would then begin the cycle of eating away the underlying steel.

There is a type of coating that has been in use on rudders and ships' running gear for more than ten years and has proven to be “cavitation-damage-proof” on the rudders to

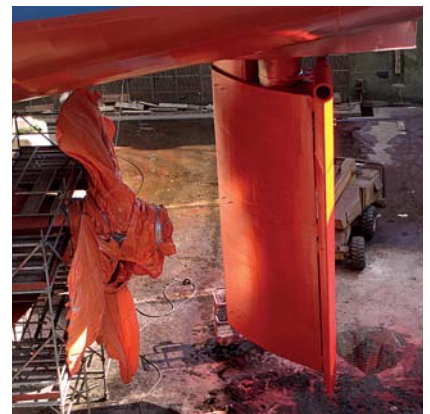
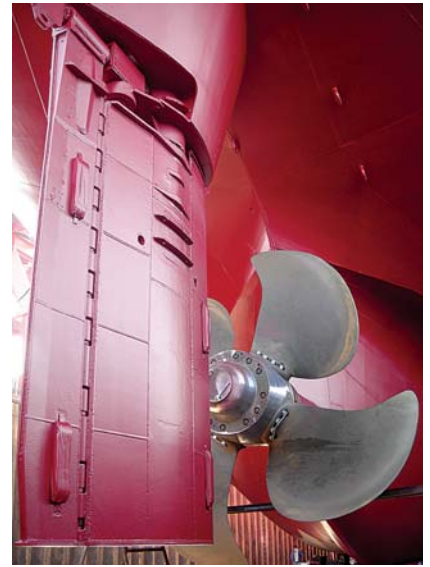
which it has been applied. Aside from some minor touch-ups, none of the rudders that were properly prepared and coated have had to be recoated, even after more than ten years. None have suffered from cavitation damage since the coating was applied. For those shipowners and operators who have tried this coating for their rudders, the cavitation damage problem ceased to exist. It is a specially formulated, glassflake-reinforced coating. One such coating is Ecoshield.

In terms of preparation and application requirements, the coating is not particularly demanding. The surface must be grit-blasted to remove any previous coating and create an adequate anchor profile and clean surface. Either on newbuildings or when an existing coating is being replaced, two coats about 500 microns thick each are applied, adding up to a dry film thickness (DFT) of at least 1,000 microns.

The second coat can be applied approximately three hours after the first, allowing very rapid completion

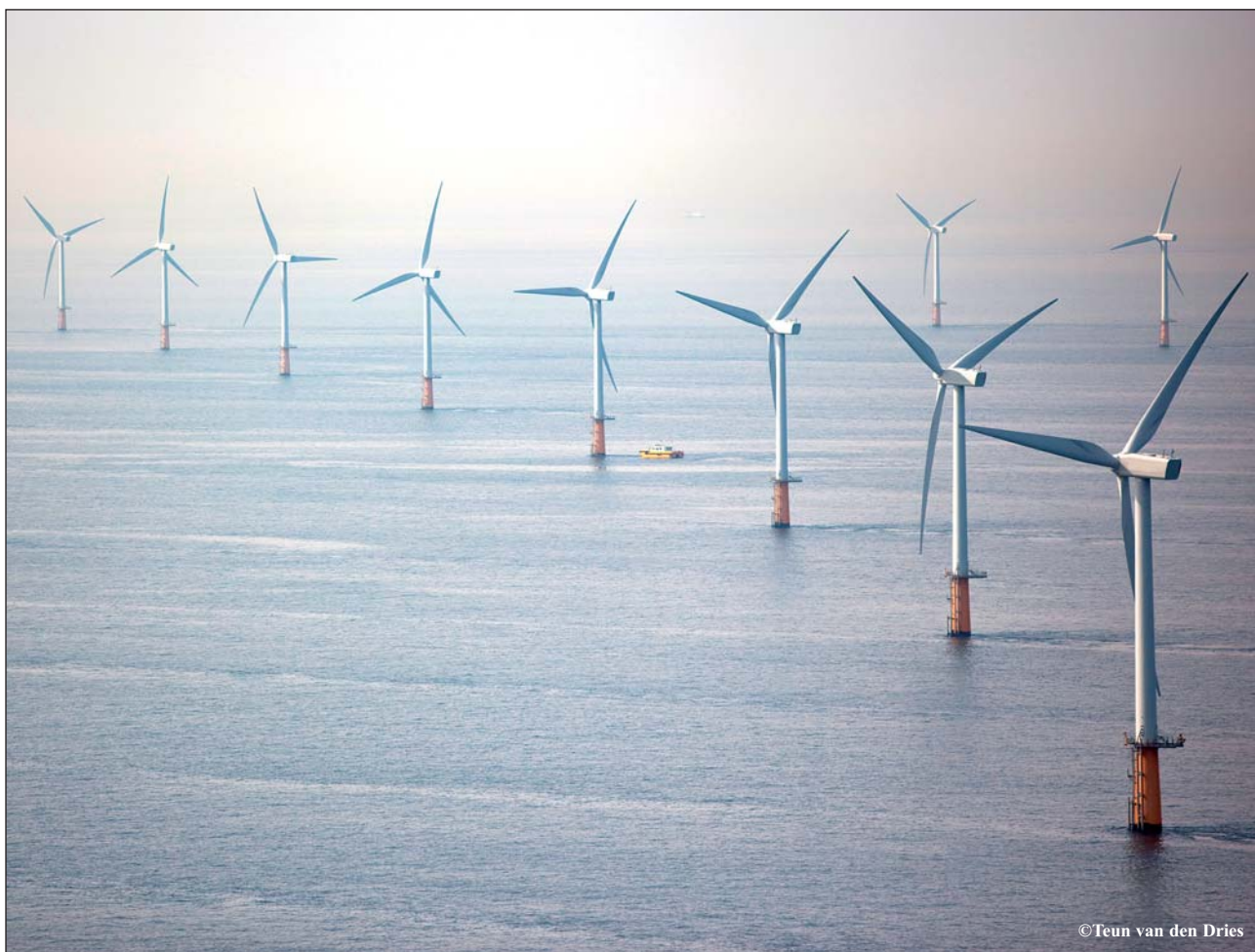
of the coating job. The curing time is minimal (the vessel can leave dry dock 24 hours after the final coat). The coating has very low VOC (volatile organic compound) content and consists simply of two homogenous coats: no primer, no epoxy, no tie-coat, no antifouling or foul-release topcoat. Once applied and cured, the coating, technically a variation of a surface-treated composite (STC), forms an extremely tough and durable surface that will continue to protect the rudder for the full service life of the ship without the need for replacement. The coating can be cleaned as often as needed to keep the rudder or other running gear free of fouling. Since this approach to rudder protection was first discovered and applied in 2004, a large number of rudders, well over 400, have been successfully coated or recoated in this fashion on a wide variety of vessels. ■

ECOSHIELD®
THE DIAMOND STANDARD IN STEEL PROTECTION



The rudder of the Maersk Deva after five years in service with conventional rudder coating (left), and five years after Ecoshield glassflake rudder coating was applied.

UV resistant corrosion protection



The latest member in our range of coating systems is ultraviolet (UV) resistant and preserves its color while at the same time offering the corrosion and abrasion protection our coatings are known for.

Regular coatings will quickly lose their original color when exposed to the ultraviolet radiation present in sunlight. This is problematic when colorfastness

is required, as is the case in for example offshore wind farms.

Ecolast is highly resistant against salt, ultraviolet radiation, waves or even ice. Mechanical damage to the coated surface is minimized. This is especially important for (semi-)submerged structures like wind turbines that are located in splash or tidal zones.

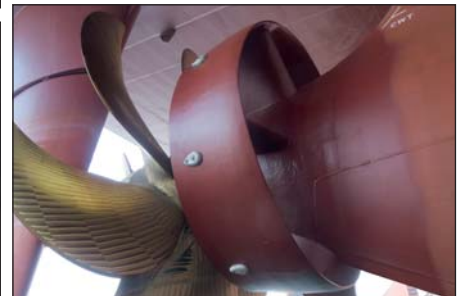
Like all other coatings systems in

the Subsea Industries family, Ecolast is also unaffected by corrosion. As a result no repaint is required once the coating has been applied.

Application of Ecolast is done in two homogenous layers, with no need for primer or any other extra layer. This makes the application very fast and easy to adapt to the schedule of a yard.

ECOLAST®
LONG TERM UV RESISTANT

SUBSEA INDUSTRIES



Subsea Industries NV, was founded in 1983 specifically to take care of the design, development and marketing of what has become an evolving line of underwater hull and propeller

cleaning equipment as well as the line of hard hull coating systems.

All products produced by Subsea Industries have the same goal in

mind: To keep the underwater part of your vessel in the best possible condition for its entire lifetime at the best possible performance.

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