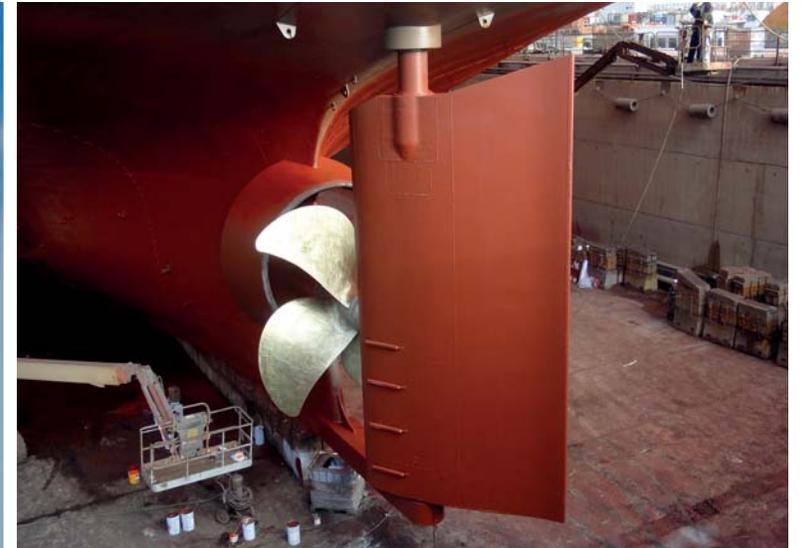


SUBSEA INDUSTRIES



Hull protection and performance

ECOSPEED®

SHIP HULL PERFORMANCE TECHNOLOGY

The purpose of Ecospeed is to offer a long-lasting, non-toxic protection to all ship hulls and underwater gear and to provide a system of keeping a hull very smooth and free of fouling for the service life of the vessel with minimal repair and no replacement. Instead of using chemicals to try to kill and repel marine fouling organisms, Ecospeed uses a hard, impermeable, impenetrable coating along with manual removal of fouling at an early stage.

What does Ecospeed technology consist of?

The technology can be broken down into its constituent parts:

1. Coating. A glassflake reinforced resin coating that is impermeable, impenetrable, long-lasting, inert and non-toxic. The coating is applied usually in two coats each of 500 µm dry

film thickness (DFT) to a properly prepared hull, either at new build (ideal) or in drydock for an in-service vessel. It works equally well on steel, aluminum or GRP. A minimum of about 3 hours is required in between coats and there is no maximum overcoat time. This coating has extraordinary adhesion and bonding qualities. It is very tough and resistant to abrasion. It is also flexible and remains firmly bonded to the plates even when these flex considerably.

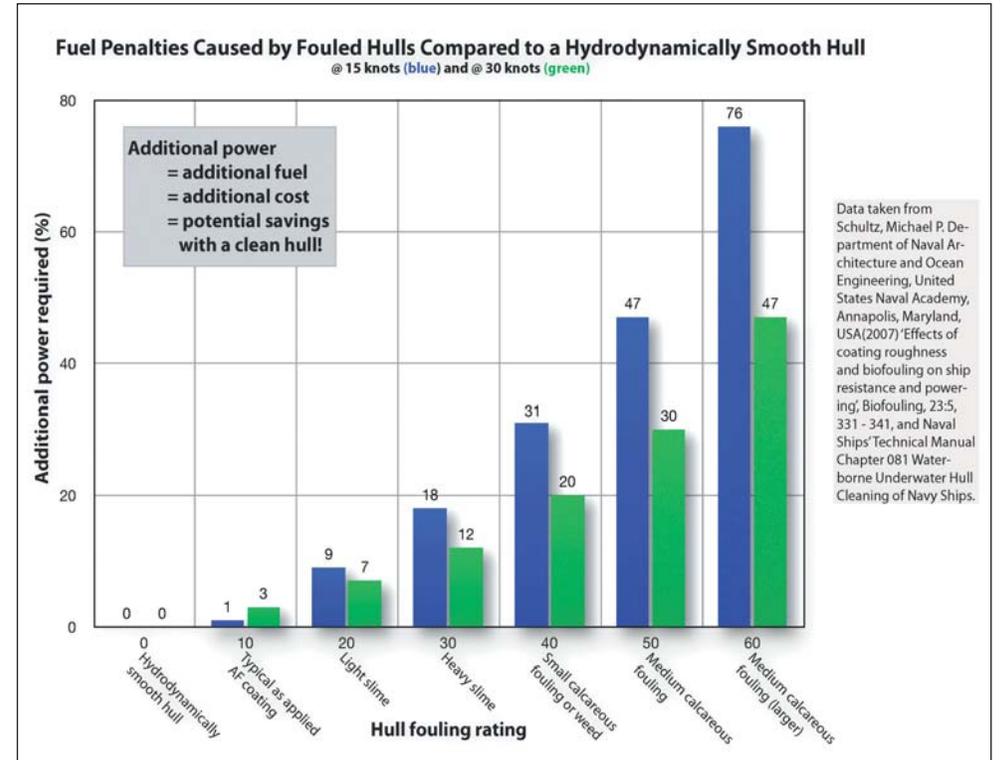
2. Routine underwater cleaning. Once the coating has been applied, it will need to be cleaned routinely to keep fouling to never more than slime and light weed. This is done in the water using specially developed equipment and tools. This lends this technology its extraordinary fuel efficiency. Frequency of cleaning will depend very much on the operating pattern and environment of the ship. In tropical waters,



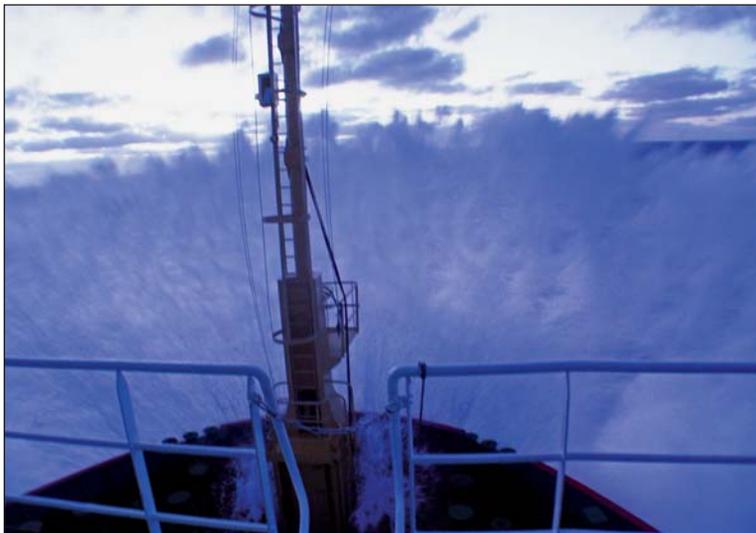
Ecospeed coated hull being cleaned of slime.



Ecospeed's non-toxicity makes it the ideal coating for a company that takes its environmental responsibilities seriously.



Fuel penalties graph.



The RRS Ernest Shackleton in Antarctic ice up to 2.5 m thick during the 2009/2010 seasons.

and especially if the ship is idle for periods or spends much time at anchor or quayside, the hull may need to be cleaned regularly. In colder waters or ice conditions, cleaning need be much less frequent, even as little as a few times a year. There is a distinct foul-release property to the coating which becomes more noticeable as the coating becomes smoother and smoother. It has been found that it is possible to break down the hull cleaning to better adapt it to the ship's schedule. So one side of the hull can be cleaned during one port visit and the other side and/or flat bottom and niche areas can be cleaned on a subsequent visit to the same or another port.

3. Touch-ups in drydock. The coating is expected to last the full service life of the ship without need for replacement or any major repair. However, mechanical damage such as that caused by collision or anchor chain abrasion, or by welding on the hull or other causes can easily be touched up during routine drydocking. Because the coating consists of a single, homogenous layer, any repair or touch-up easily blends in without any difficulty. The integrity of the hull coating is maintained despite such repairs. Because no repaint is needed, several days and up to a week can be saved in drydock times during each visit.

The coating alone provides superior hull protection, but it is the full Ecospeed technology in all its parts that results in the major fuel savings. ■

Cardinal problems solved



The effect of cavitation erosion and corrosion can be devastating if the wrong protection is used.

Our technology has solved several cardinal problems relating to ship hull performance and protection.

With our line of environmentally safe coating products, combined with a profound knowledge of underwater maintenance work and tools, we have succeeded in providing a massive breakthrough in the field of underwater ship hull performance and protection with a substantial reduction in fuel consump-

tion, virtually zero emission and huge time and cost savings during newbuilding and drydocking.

1. Hull surface friction

By optimizing surface roughness to its upper limits without future deterioration or degradation, we solved the problem of hull surface friction. As the coating has a lifetime equivalent to

that of the ship, its surface characteristics are maintained over the same period.

2. Fuel savings

By optimizing hull friction and using the best possible surface hydrodynamic characteristics, proven fuel savings over the lifetime of the ship are most often found to be in the 20-40 % range. In contrast with AF compounds that rapidly degrade over time, our coatings last. Therefore the performance of the ship does not degrade either.

3. Corrosion

We have reduced the corrosion problem to a zero effect. Ship hulls handled by us keep their sacrificial anodes 100% intact, even after prolonged periods of 5-10 years in the water. Corrosion is virtually absent on our hulls.

4. Cavitation erosion

Cavitation erosion and corrosion thus caused is entirely solved. Cavitation erosion damage resulting in often very expensive repairs and time loss in drydock can now be avoided entirely. 450 rudders have been protected so far.

5. Anti-fouling toxic particles emissions

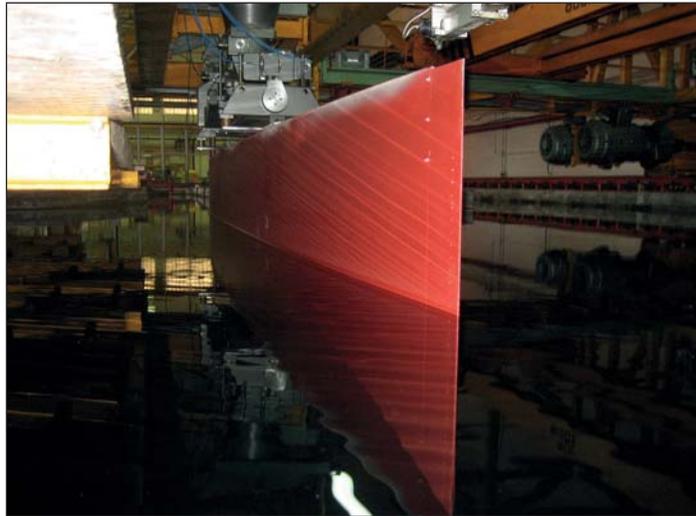
Yearly 1 million tons of AF toxic chemicals and heavy metals are being used and lost at sea. This extremely damaging pollution resulting in billions of silt and sediment remedial cost can now become a thing of the past entirely

6. Repeated application of degraded AF coatings.

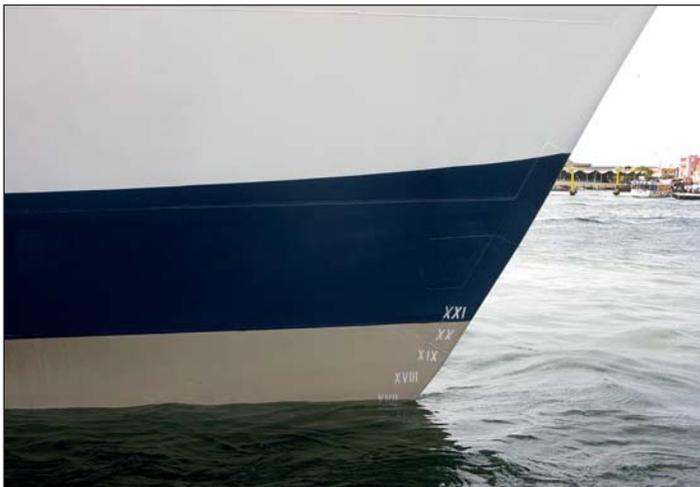
This is now an obsolete routine as our coatings last the lifetime of the ship. Peak distribution of toxic materials caused by repeated applications in drydock and thus emissions in ports and rivers has been overcome.



Ship hulls coated with Ecospeed keep their sacrificial anodes intact.



Stringent testing has been carried out on our coatings to achieve the best possible result.



The Ecospeed coating on a cruise vessel is still intact after 8,5 years. The vessel can be seen here in drydock and in water.



Navy vessel after sailing with Ecospeed on its hull for several years.

7. Time and effort in drydock

As reapplication is never necessary, work and time in drydock can be more than halved. Planning for work in drydock can be made to be very precise as paint renewal is avoided. Only small touch-ups may be needed. Waiting for acceptable weather is no longer necessary. This allows drydock companies to deliver on time. As a result, more ships can be docked in the same period.

8. Transfer of invasive species

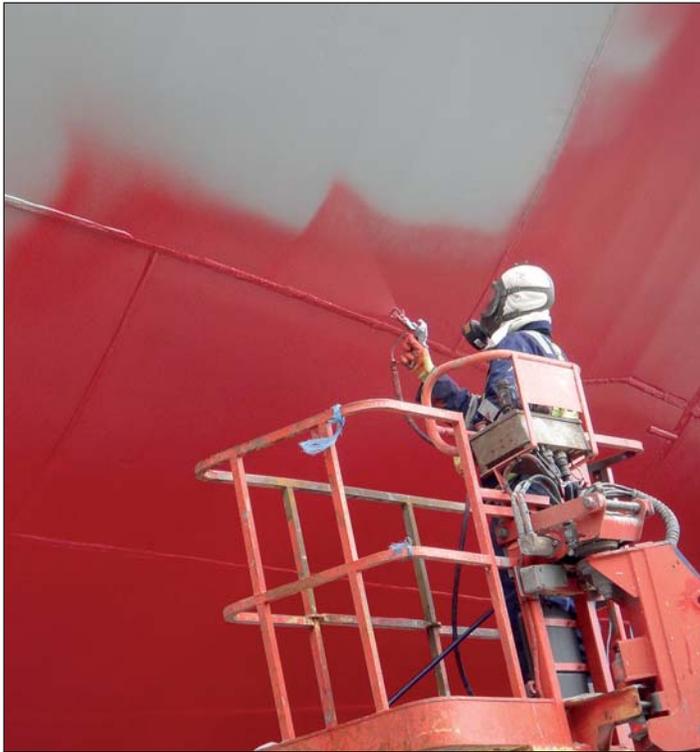
This has become a totally manageable and cost-effective method and poses no major problems other than the repeated, environmentally safe, cleaning in-situ of the ship hull. Even when done frequently, its cost is dwarfed by the fuel savings thus realized. Mitigation of the transfer of invasive species and very large fuel savings, never obtained before, are obtained by the same method i.e. regular in-situ underwater cleaning or other sanitation technologies.

9. Building costs

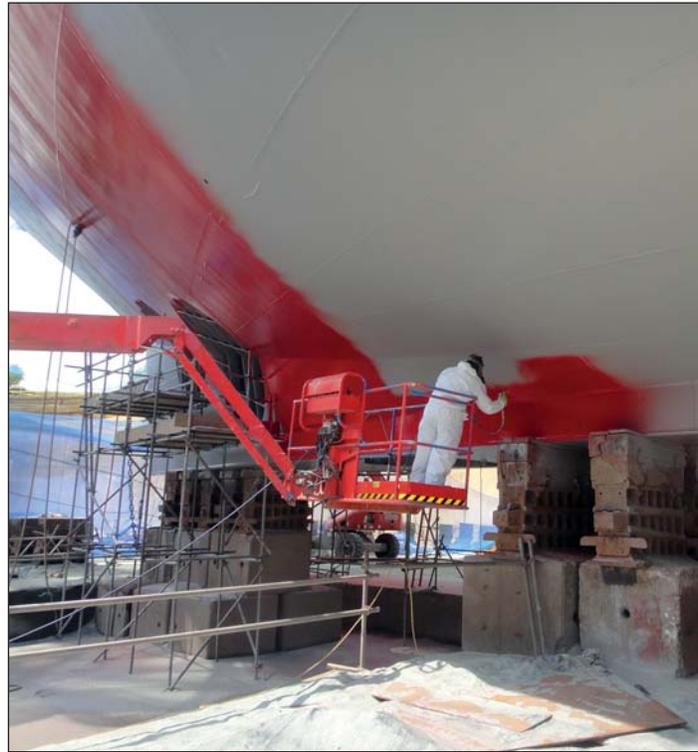
Cost for new building ships is substantially reduced as the repairs of these homogenous coatings, easy to apply and repair, are many times more efficient resulting in thousands of man hours saved during the building process. The reapplication of AF paint for speed trials in drydock at the end of the building period is not necessary any longer as a simple underwater hull cleaning is sufficient. The latter saves more than the total cost of the coating material supplied.

10. Financial

As the coatings will last the lifetime of the ship, they are now part of the investment and other accounting and financial rules can be applied than if it were a simple repetitive application and therefore returning cost. The cost of repeated application of chemicals has changed into a fixed asset, entirely part of the ship.



Application is a one-time investment, with no repaints needed for the rest of a ship's service life.



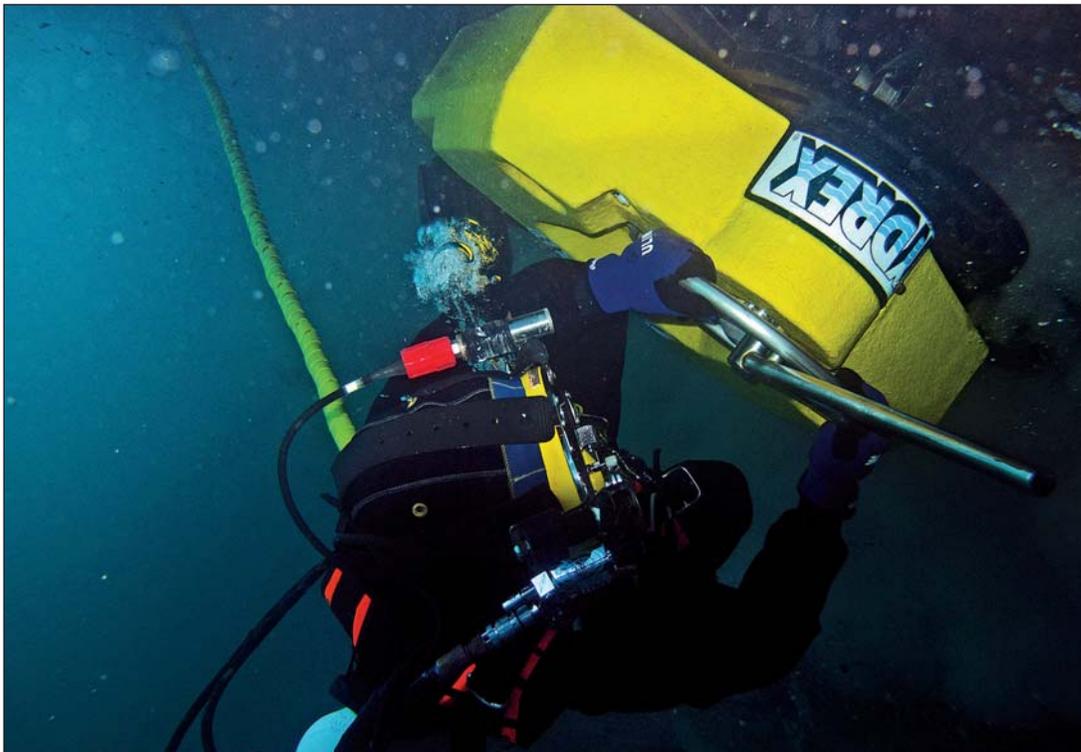
Application of our coating systems is fast, flexible and easy.

11. Ice-going and icebreak-ing ships

RRS Ernest Shackleton, RRS James Clark Ross, HMS Protector, all of British Antarctic Survey, have been coated with our products with great and conclusive results. Another 150 applications on ice going hulls have shown that our coating can withstand the impact of ice for many years on end, proving its superior strength and durability.

Summary

We have optimized hull surface roughness and hence hull friction resulting in fuel savings in the 20-40% range. We have cracked all major problems in corrosion and cavitation erosion. We have halted all anti-fouling toxic emissions. We have substantially reduced the cost and time of drydocking and its peak distribution of toxic particles due to repainting work. We have provided the most adequate solution to mitigate the transfer of invasive species. We have significantly reduced new building costs. We have formulated the best way to prevent loss of coating in ice and general arctic conditions. ■



Cleaning of our coating systems is 100% environmentally safe and can be carried out without damaging the coating. Our underwater cleaning machines are available for sale to owners and contractors.



Many case studies have shown that our coatings can withstand the impact of ice for ten years and longer.

Ecospeed in pristine condition after sailing in ice for five years



Ecospeed condition after application in 2011 (top) and after sailing in icy waters for five years (bottom).

When the 194-meter ro-ro vessel *Oceanex Sanderling* drydocked in Gibraltar in April, the coating on her underwater hull was still in excellent condition. The ship has been sailing between Halifax and St. John's in Canada with Ecospeed on her hull since 2011, often in icy conditions.

Despite this, only a few touch-ups were needed on the areas that were coated with Ecospeed in 2011.

Ecospeed is guaranteed for 10 years and has a life expectancy of 25 years and will therefore protect vessels against cavitation and corrosion damage for the remainder of their service life

without the need for a full repainting during future drydockings. This is a very important benefit for the owner of this vessel who needed to have his vessels repainted every year with his previous coating. Bad weather and expensive drydock costs in Canada made drydocking in the Mediterranean area the most feasible option for this yearly task. This cumbersome undertaking will no longer be necessary with the one time Ecospeed application that was carried out.

Another advantage of Ecospeed to both shipowner and shipyard is ease and flexibility of application. The entire system is applied in only two homogeneous coats and the overcoating

time can be as short as three or four hours, all the way up to weeks or even months if needed. Therefore Ecospeed can easily be adapted to a shipyard's schedule or to unpredictable weather conditions.

Further maintenance of the underwater hull is very easy, whether in-water or dry. This is due to the extremely tough surface which can be cleaned of even the heaviest fouling. In-water maintenance procedures can be repeated wherever and whenever needed during the vessel's lifespan without causing damage or deterioration in the quality of the coating's surface. In fact, each cleaning significantly improves the coating's



Ecospeed can be cleaned easily in-water or in the dry without damaging the coating.

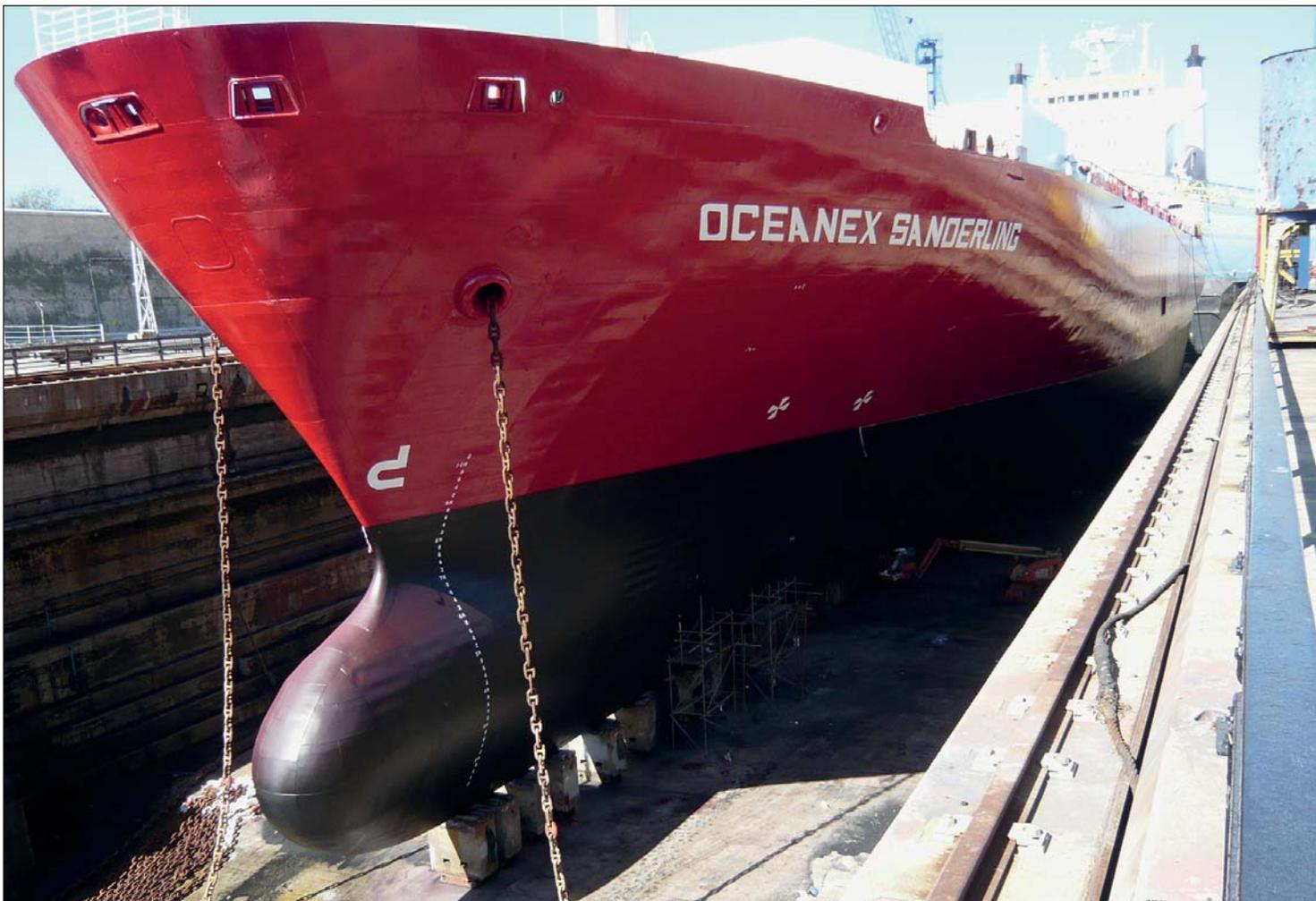


Condition of the underwater hull prior to Ecospeed.

surface characteristics. The Ecospeed system keeps a ship's underwater hull at optimum performance throughout its service life and helps shipowners save enormous amounts of money by reducing fuel consumption.

Ecospeed is 100% non-toxic through-out the entire service life of the vessel and lends itself to environmentally safe maintenance. The above mentioned reduced fuel consumption also leads to a corresponding reduction of the carbon footprint. The combination of these two factors offers significant value to the owner's choice of Ecospeed in terms of a company's corporate responsibility towards cleaner seas and environmentally safe ship hull husbandry.

It is therefore no surprise that in 2011 the owner of m/v *Oceanex Sanderling* quickly saw the advantages of Ecospeed and decided to take the plunge and switch from the traditional coating he had been using. Five years later his choice has proven to be the right one and he will continue to enjoy the benefits of Ecospeed for many years to come. ■



Oceanex Sanderling ready to leave drydock in 2011.

ECOSHIELD®

THE DIAMOND STANDARD IN STEEL PROTECTION

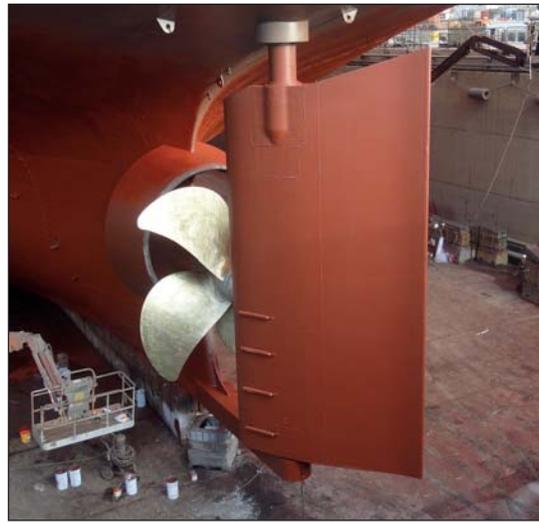
Ecoshield gives a very thorough and lasting defense against cavitation and corrosion damage on rudders and other running gear and this for a ship's entire service life.

The coating equally provides the rudder with an impenetrable protective layer while its flexibility enables absorption of the forces that are produced by cavitation. This prevents the damage normally caused by this phenomenon.

Without proper protection against cavitation and the resulting erosion and corrosion damage, the financial consequences can be severe.

By removing the existing paint layers and applying Ecoshield on the rudder we can break the never ending cycle of painting, suffering damage, having to perform extensive repairs in dry-dock followed by a full repainting, again and again.

With an Ecoshield application no full repaint will be needed during drydocking. Ecoshield is guaranteed for ten years. At the most, minor touch-ups will be required.



Ecoshield still in excellent condition on rudders after five years

Five years after Ecoshield was applied on their rudders, three container vessels belonging to the same owner, docked in Naples, Italy. The coating was still in excellent condition and only small touch-ups were needed. Ecoshield will keep on protecting these rudders against cavitation and corrosion damage.

The rudder of another container vessel from the same owner was given the same treatment recently. He now has over 40 of his vessels sailing with Ecoshield on their rudders. The recent



Rudder of container vessel after five years in service.



No full repaint was needed on rudders of the vessels that docked in Naples last month.

dockings in Naples confirmed once more that Ecoshield is the best possible way to protect your rudders against cavitation and corrosion damage.

Different owners, different ship types, same lasting result

Over the last two months a number of other rudders were also coated with Ecoshield to safeguard them for the rest of their



Surface preparation prior to Ecoshield application.

lifetime. Belonging to seven different owners, vehicle carriers, container vessels, bulk carriers and tankers were among the vessel types that were treated. No repaint will be needed on the rudders of all those vessels during future drydockings.

Suited for newbuilds and existing vessels

Protection of the running gear of your ships is best begun at the newbuild phase. When a ship comes into drydock, main-



Ecoshield is applied in two identical layers offering a homogenous coating.

tenance of its stern area, especially cavitation and corrosion damage repair, can take a long time. There are strict procedures concerning blasting, painting, welding and propeller and stern tube seal work. Painting is then assigned to the end of the schedule. As a consequence it may be rushed or not done at all or else prolong the stay in drydock.

With an Ecoshield application one can avoid these problems from day one because the underwater gear will not need to be repainted during future drydockings. Ecoshield will remain intact for the lifetime of the vessel. It is guaranteed for ten years. At the most, quick and easy touch-ups amounting to less than 1% of the surface area will be required. Planning the maintenance of the vessel's stern area therefore becomes much easier.

The newbuild phase is the perfect time to apply Ecoshield. However, the coating can also be used to protect vessels that have been in service for some time and are already facing

cavitation and corrosion damage. Such was the case with the rudders coated over the last months.

Ecoshield's flexibility makes it easy to adapt the application schedule to the rest of the activities at the shipyard or drydock in a way which does not interfere with them. Overcoating time can be as short as three hours, which means that for smaller surfaces such as rudders or bow thrusters the two coats required can usually be applied in one single day.

Groundbreaking protection for all running gear

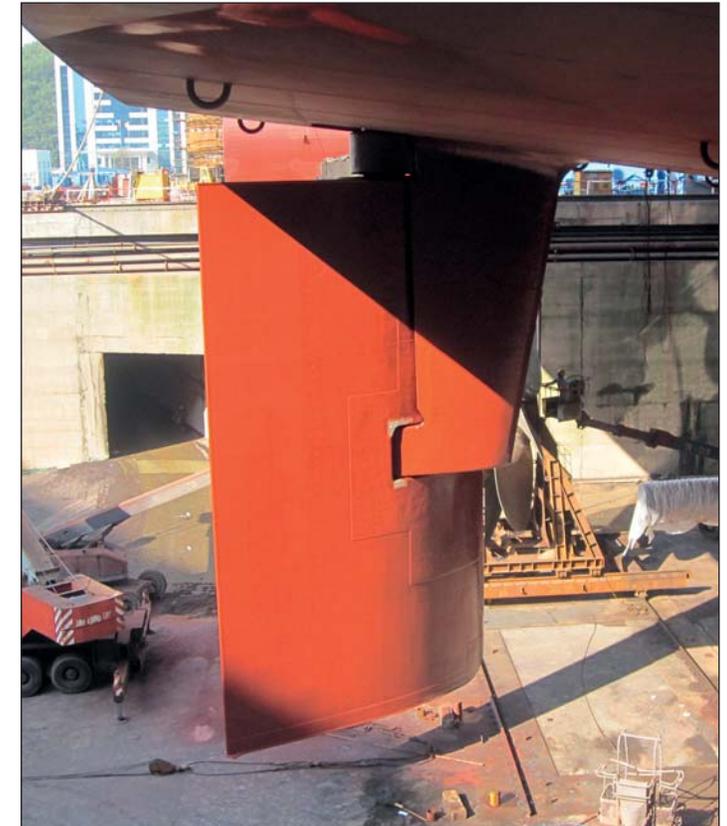
Besides offering rudder protection, Ecoshield is also suitable for thrusters, azimuth thrusters, azipods, thruster nozzles, Kort nozzles, thruster tunnels and other underwater ship gear which needs special protection from corrosion. The extra strength coating protects these areas for the service life of the ship. There is no need for recoating or major repair. For this reason the nozzle of an oil tanker was also coated with Ecoshield, as was the thruster tunnel of a vehicle carrier.

Conclusion

If one takes into account the costs of the temporary underwater repairs and the regular inspections required by a condition of class until the next drydocking or the costs for rudder repairs in drydock, it becomes clear that the investment in a coating system that offers extra protection from day one is very easily won back. For this reason more and more owners have Ecoshield applied on the rudders and other running gear of a large part of their fleet or have it included in the rudder specs of their newbuild vessels. These owners invest in the right coating system for protection because they know the savings that will result.

A White Paper with full details about protecting rudders and running gear from cavitation damage is available in the Publications/Papers section of www.shiphullperformance.org for free download.

You can give the rudders and running gear of your vessels the same lifelong protection. Contact one of our offices for more information. ■



An Ecoshield application is easily adapted to a yard's schedule.



Application of first layer on nozzle of crude oil tanker.

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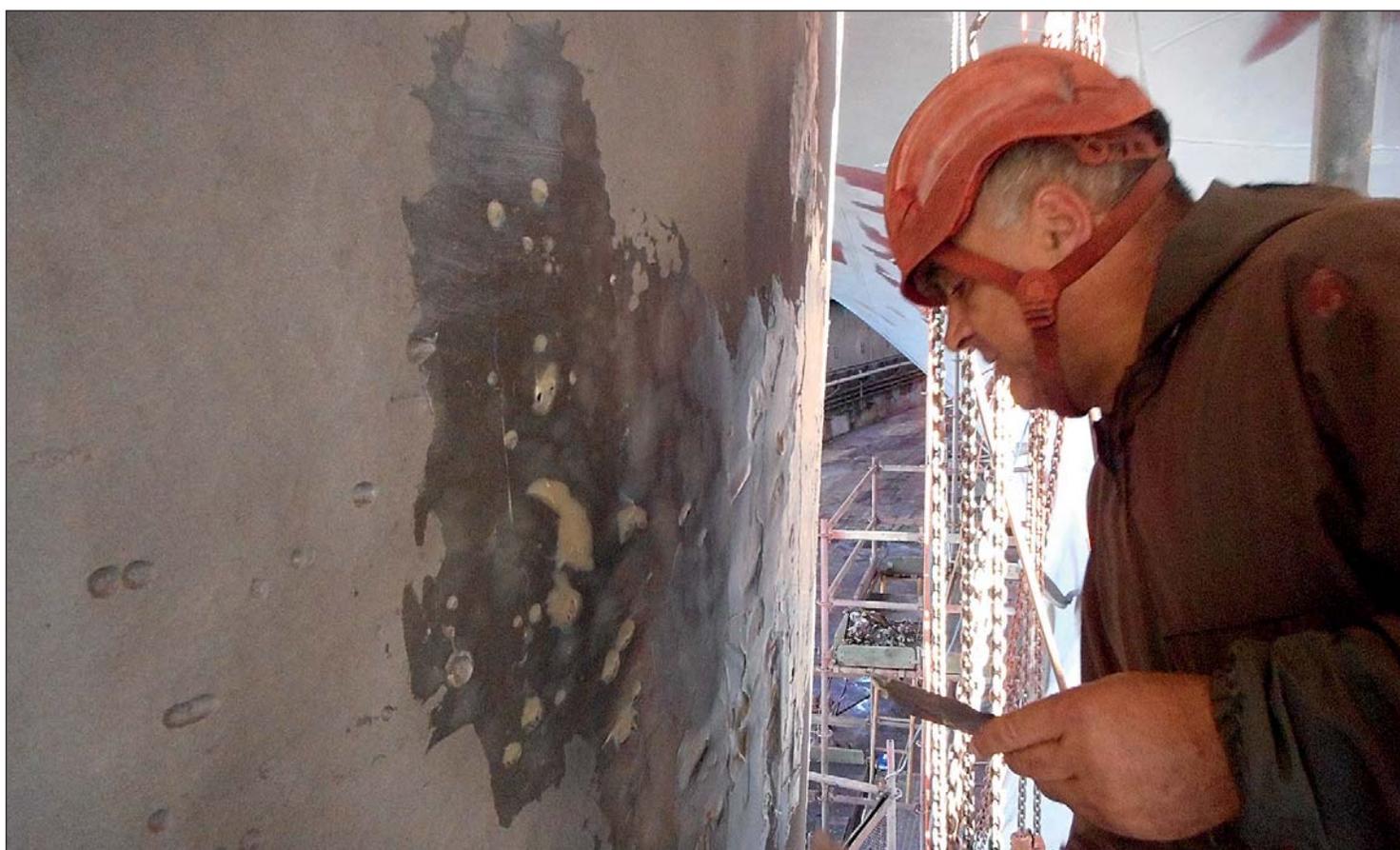
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Test plate to show the benefit of an Ecofix and Ecoshield combination.



Corroded areas like this can be filled with Ecofix.



Ecofix application on rudder of LPG tanker.

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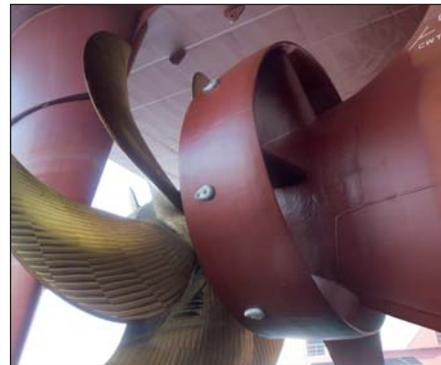
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The combination of Ecofix and Ecoshield will keep the rudder in pristine condition from now on.

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.

www.subind.net

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