Navios Sagittarius: behind the scenes at a major salvage operation with Tsavliris

Ecospeed allows cost-effective, non-toxic fouling control on underwater ship hulls

Propeller repair and modification

Hydrex White Paper No.8
Ecospeed gives a very thorough and lasting defense against cavitation and corrosion damage for a ship hull’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 Ecospeed on the rudder we can break the never ending cycle of painting, suffering damage, having to perform extensive repairs in drydock followed by a full repainting, again and again.

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

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In this magazine you can read an article that describes in detail a major salvage operation that Hydrex carried out earlier this year in Denmark for the Tsavliris Salvage Group.

It is hard to communicate the complexity and difficulties involved in carrying out a successful salvage operation of this magnitude, because the vessel had run aground so heavily and was so badly damaged and at risk of foundering. On top of this there were the highly variable weather conditions and constant pressure to complete the repairs in the shortest possible time.

For this reason Hydrex mobilized 24 divers full time, in two shifts, for the duration of the operation. The Hydrex team was organized and assembled by Hydrex in Antwerp and headed up by some of Hydrex’s most experienced diver/welders, who were able to provide much technical input and assistance to the naval architects and salvage master during the planning stages.

A second article focuses on the most important benefits that the Ecospeed underwater hull coating system has to offer shipowners in regard to the hull performance and underwater maintenance of their vessels. Ecospeed is a system which uses a hard glassflake vinylester resin coating that can be cleaned underwater without any risk of chemical pollution to the environment or of damage to the coating. The coating will only improve in smoothness with each cleaning.

The magazine also contains an article on the different types of propeller repair and modification services that Hydrex offers its customers. When propellers get damaged due to impact with ice or debris, Hydrex can help shipowners repair them without going to drydock, even when the damage is extensive. Hydrex diver/technicians are professionally trained to perform a wide variety of operations, both above and below water, anywhere in the world. Icy conditions and extreme winter circumstances will not prevent our teams from providing the service you need.

The magazine ends with an abstract of Hydrex White Paper No. 8 which has aquatic invasive species as its topic and offers a novel, complete solution to this problem which is a hot topic in the shipping industry at this time. Like all our White Papers and our quarterly Journal of Ship Hull Performance, it will be available free of charge in its entirety at www.shiphullperformance.org as soon as it is published.

If you have any questions, feel free to contact us 24/7 for further information. Our technical department is ready to create a tailor-made solution for your specific needs.

Best regards,

Boud van Rompay
Navios Sagittarius: behind the scenes at a major salvage operation with Tsavliris

A world’s first in underwater repair: the insertion of a complete, prefabricated replacement hull section in a badly damaged ship at anchor.

Disaster and salvage

On Friday 22nd July, 2011 the Tsavliris Salvage Group urgently dispatched salvage tug Stevns Battler in response to a call for assistance from bulk carrier Navios Sagittarius (GRT: 38,849, DWT: 75,756), laden with 73,419 metric tons of iron ore pellets. The Sagittarius had run aground on the Tonneberg Banke, about 23.5 miles east of Frederikshavn, Denmark, while on passage from Finland to China.

Tsavliris Salvage Group is a Piraeus based, world class, professional marine salvor, dedicated to saving life and property at sea and to protecting the marine environment from accident-related pollution. With tugs on permanent station at strategic locations around the world, Tsavliris is well situated to deliver immediate expert assistance to any casualty worldwide.

In more than half a century of operations, the Group has successfully handled over 2,000 casualties, offering every service relating to marine salvage and towage, extending to complex wreck removals, and partnering with today’s shipowners in fulfilling their obligation to protect the marine environment from pollution.

The Sagittarius was in the safe hands of one of the world’s leading salvors.

On the 23rd of July, a Hydrex diving team had carried out a preliminary video inspection which found large penetrations, indentations and cracks in the hull, and heavily deformed plates.

The salvage team arrived the same day and prepared a refloating/salvage plan, incorporating environmental and safety measures.

Stevns Battler’s sister salvage tug Stevns Breaker arrived on the scene on Sunday 24th July and connected forward.

Lightering vessel MPP Shield and crane barge Sanne A were also mobilized.

On July 26th, a salvage plan was approved by the Danish authorities and on July 28th, after about 3,000 tons of cargo had been transferred to the lightering vessel, by pressurizing certain tanks and with the assistance...
of tugs, the *Sagittarius* was refloated.

On the 23rd of July, a Hydrex diving team contracted by the salvors had carried out a preliminary video inspection which found large penetrations, indentations and cracks in the hull, and heavily deformed plates. However, it was impossible to get a full picture of the damage with the ship still aground.

The vessel was then towed to Frederikshaven for a detailed underwater inspection, extensive bottom repairs, and reloading of cargo.

The Danish environmental protection agency vessel *Mette Miljoe* was also in the vicinity monitoring the situation.

**Detailed inspection**

With the *Sagittarius* refloated it was possible to carry out a detailed inspection of the hull and note all damage. Tsavliris had signed a Lloyd’s Open Form salvage contract with Navios and subcontracted several companies to carry out inspection and repairs.

*The Hydrex team of 24 full-time divers was organized and assembled by the Technical Services Officer for Hydrex in Antwerp and headed up by some of Hydrex’s most experienced diver/welders.*

The chief subcontracting company for the inspection, planning and repair work was Hydrex. Tsavliris had previously contracted Hydrex to carry out a stern tube replacement on the bulk carrier *Minoan Euro* in Manila. Captain George Polychroniou, Tsavliris’ Operations Manager overall in charge of both salvage projects confirmed that, “The cooperation with Hydrex was excellent in both operations.”

This was particularly important in a complex salvage operation which lasted three months and for which Hydrex mobilized 24 divers full time, in two shifts, for the duration of the operation, under the technical directions of Tsavliris naval architects and salvage master. The Hydrex team of 24 full-time divers was organized and assembled by Onno De Nooijer, Technical Services Officer for Hydrex in Antwerp, Captain Barend Visser, Tsavliris Salvage Master and Michalis Chourdakis, Tsavliris Technical Consultant, and headed up initially by Toon Joos, one of Hydrex’s most experienced diver/welders, who was able to provide much technical input and assistance to the naval architects during the planning stages. Toon was later replaced by Jan Botte who successfully led the Hydrex divers for the majority of the repair operation.

Thus it was Hydrex divers who examined the hull, took measurements and photographed and videoed the damage. They reported two very large holes in the hull, one about 5 x 5 meters aft on the port side and the other about 8 x 1.8 meters near the forepeak on the port side, as well as many smaller holes, cracks and indentations.

The Hydrex divers furnished the information along with their suggestions for repair to the Tsavliris naval architects team. The four-man team was headed by Michalis Chourdakis.
Formation in 3D of a large steel plate to exactly match the shape of the deformed and fractured bottom plate required accurate measurements from the divers and analytical calculations from naval architects,” he continues.

“Finally, cutting the heavily deformed hull area and fitting of a large, new pre-fabricated section following the vessel’s original drawings and making it resistant and watertight was the top challenge.”

The repair was a combination of accurate engineering and precise cutting,
fitting, assembly and final welding, and the coordination between the naval architects and the divers/technicians implementing their plans was close and continuous. Professionalism on the part of the individuals and groups involved, coupled with excellent teamwork contributed largely to the success of the entire operation.

Planning and fabrication

Without accurate measurements and data, the naval architects could not produce drawings and plans which would work. So the first step was to get accurate measurements for the two major areas of damage (one near the forepeak, the other further aft, both on the port side), on a hull that was badly deformed, pierced, torn and indented.

In order to do this, the Hydrex team constructed large frames on the deck and then lowered these into the water and secured them in place over the two large damaged areas. These were then used as a reference so that measurements could be taken and relayed to the naval architects. The frame for measuring the 8 x 1.8 m damaged area was subsequently also used in the fabrication of the doubler plate itself.

Using these measurements and the original drawings of the ship, the naval architects were then able to produce final drawings from which a section and a doubler plate could be fabricated and installed.
From these finished drawings, a section was prefabricated at the local dockyard to repair the large hole, and a doubler plate was constructed to cover the long damaged area with three holes in the area of double bottom ballast tank (DBBT) No. 1.

The steel used in fabrication had to be 12mm thick which is too thick for easy, rapid bending. So the plates had to be measured and cut to fit the hull as closely as possible.

**Installation, cutting, welding**

With 24 diver/technicians on the job, work continued in two shifts, day and night, whenever weather permitted. As fabrication of the section and the doubler plate was completed, preparation for installation began. In the case of the section it was necessary to cut through the hull plates where the hull was distorted and broken. Divers armed with gas cutting torches (which use gas without the need for a cutting electrode) and the more usual arc cutting torches, proceeded to cut a hole in the hull about 5 x 5 meters in size. The prefabricated insert was lowered into the water by the crane barge which was used throughout the operation, and pulled into place with chain blocks.

*Example of steel plate cut to fit the deformation of the hull.*

*Fabrication of the section used to repair the 5 x 5 meter hole in the aft section of the hull, port side.*
The hatch built into the bottom of the hull section to provide access to divers so that they could work inside to secure the section.

The section was built with a hatch at the bottom so that divers could enter the section from the outside and weld inside. When the section was all secured in place, the hatch itself was welded shut.

Originally it was thought that the section would then be welded in place all the way around but due to the difficulty of taking precise measurements, the distortion of the hull and the gaps resulting when the section was in place, it was decided to have the section bolted in place with a seal to ensure a watertight fit and then welded from the inside. This solution worked very well.

The finished section being lowered into the water and inserted into the cut-out in the hull using chain blocks.

The hatch built into the bottom of the hull section to provide access to divers so that they could work inside to secure the section.
way around, with a minimum of three passes as with all the welds on the hull.

While work was going ahead with the section, another Hydrex team worked on the fabrication and installation of the 8 x 1.8 m doubler plate in the area of DBBT No. 1. The frame was fabricated and used for measurement and then the plate itself was cut and attached.

Unlike with the section, the hull did not need to be cut in order to install the doubler plate. It was welded on to the hull as reinforcement. Where the distance between hull and plate was too large to weld directly, the divers used metal bars to fill the gaps. The bars were welded to the plate and to the hull. The plate was welded all the way around, with a minimum of three passes as with all the welds on the hull.

When the wet welding was finished and the water could be pumped out, the surveyor was able to confirm to the naval architects that the wet welds were satisfactory and acceptable.

The section was attached to the hull using bolts and a seal.
The quality of the wet welding was of the standard required. This was important because when the wet welding was finished and the water could be pumped out, a surveyor, the naval architects and the owner came inside to inspect, and the surveyor was able to confirm to the naval architects that the wet welds were satisfactory and acceptable. Had the welding not been up to standards, it would have been necessary to go over all the welds on the inside of the hull and dry weld over all the seams, which would have added a great deal of time to the job. This meant that the team working on the inside of the hull could concentrate on the other repairs needed to fix the section in place and make the vessel seaworthy.
Preparing and lowering the doubler plate into the water so that it could be welded in place to repair the 8 x 1.8 m rip in the hull near the forepeak.

In its quest to provide cost effective services to customers, Hydrex developed procedures to address different kinds of damage to propellers. This research led to the design of the Hydrex cold straightening machines first used in 2002.

By taking advantage of this technique damaged blades can be straightened underwater, allowing the ship to return to commercial operations without the need to drydock. Blades can be brought back close to their original form, restoring the propeller’s optimum efficiency.

The cold straightening machines have been in use for quite some time now but the Hydrex research department has been looking into ways to expand the technique even further to improve our services. A new version of the straightening machine was recently put into practice. It is compatible with the existing models and is used to restore more severely bent propeller blades to their original condition.
As a note, speed was of the essence in this job as the ship was on a long term charter and each day it was out of service was costing tens of thousands of dollars.

Speed was of the essence in this job as the ship was on a long term charter and each day it was out of service was costing tens of thousands of dollars.

It was a testimony to the skill and conscientiousness of the divers and salvage team that after ten weeks and hundreds of meters of wet welding, the work was inspected and found to be excellent.

In addition to the repair of the two main areas of damage, there were many smaller holes and cracks which had to be repaired so that the vessel could sail. These holes and cracks were being repaired while the work of designing and fabricating the section and large doubler plate was going forward.

The Sagittarius sails!

The final step for the salvor and the diving team was a full inspection of the underwater hull on CCTV in order to gain the approval of the classification society for the vessel to sail.

The Sagittarius passed the inspection on October 13 and resumed passage under her own steam to her destination, China.

At time of writing she was just outside Singapore, having rounded the Cape and traversed the Indian Ocean.

Summary

It is hard to convey in a short article and a few photos the complexity and difficulties involved in carrying out a successful salvage operation of this magnitude to a vessel which had run aground so heavily and was so badly damaged and at risk, all under highly variable weather conditions and constant pressure to complete the repairs in the shortest possible time.
The successful manning of a 24-man team, mobilization, equipment, and execution of the work on a project of this size can only be undertaken by a large, well trained and experienced company. Hydrex was also running a large similar operation in Fujairah in association with Mr. Chourdakis (Tsavliris), along with several smaller projects overlapping the Navios Sagittarius salvage operation and amounting in total to an additional 24 diver/technicians performing operations around the world. Onno De Nooijer explains that there were challenges for Hydrex to overcome in the initial manning and organizing of the teams and ensuring that the various skills needed were adequately represented, but this was ironed out and for the majority of the project there was a very stable and highly skilled team of divers/technicians with the right skill set and all working together. Mr. Michalis Chourdakis said of the team, “Hydrex’s technical abilities and competence are well above average of other big companies for underwater work.” The Hydrex personnel were, in their turn, very impressed with the work and support of Tsavliris, the salvage master, and the professionalism of the naval architect team.

The naval architects under Mr. Chourdakis surmounted the engineering difficulties created largely by the severely weakened hull and the problems of measurement and execution under poor weather conditions, and their planning and its execution solved the ship’s problems so that she was able to sail to China via the Cape of Good Hope without having to offload all of her cargo or go into drydock at a nearer port for repairs, a testimony to their skill.

The professional fabrication and construction services of the Frederiks-haven dockyard were employed in building the section and the doubler plate, both of which worked admirably when installed. Crane operators, workboat crew, the Danish naval command, the Danish environmental authorities, the classification society surveyors all played their different and vital roles in executing the salvage.

The extensive know-how and experience in salvage operations of the Tsavliris Group, represented on site by salvage master, Mr. Barend Visser with his experience, credentials and managerial efficiency, were brought to bear in coordinating and overseeing the entire project and bringing it to a successful conclusion under demanding circumstances with more than satisfactory regard for the ship’s schedule, the protection of the environment and the safe management of the divers.

Few salvage companies in the world have the personnel, know-how, equipment and experience to successfully manage a salvage operation of this nature and few underwater repair companies have the specialized personnel, equipment, expertise and skill to execute the needed repairs.

It is, as far as we know, the first time that an entire hull section has been prefabricated and inserted into a ship’s hull, cutting away the existing damaged plates, with the ship still afloat, thus permitting the vessel to continue on a major voyage without the need to drydock.

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Using our flexible mobdock method to create a dry underwater environment, we have carried out stern tube seal repairs and replacements underwater for some years now in cooperation with top specialist suppliers.

This technology brings drydock conditions to the ship rather than having to take the ship to drydock, saving a considerable amount of time and money in doing so.

This class accepted method is performed by our diving teams under our warranty. It can be used while the ship is carrying out its usual cargo or other commercial operations in port.

Visit the special stern tube seal repair section on our website for more information and examples of the many seal repairs we have performed in recent years.
Ecospeed allows cost-effective, non-toxic fouling control on underwater ship hulls

There is currently no hull coating available which will not foul. The only way to remove this fouling is by cleaning it off. Like it or not, ship hull cleaning is an essential part of operating a vessel or a fleet efficiently and economically. Any level of fouling, including biofilm or slime, carries with it a considerable fuel penalty. With current fuel prices, this is too much to ignore.

If a ship is to sail clean then the cleaning must be 100%. It takes longer and therefore costs more. However, this extra time and money is more than recovered since the ship operates with a clean hull, thus benefiting from the maximum fuel savings. It is also the way to prevent the spread of any level of fouling, including biofilm or slime, carries with it a considerable fuel penalty. With current fuel prices, this is too much to ignore.

Ecospeed underwater maintenance is carried out with specially designed tools.

New versions of the underwater hull cleaning equipment are regularly put into practice to achieve an even faster cleaning rate without losing any of the quality.
non-indigenous species (NIS) and thus avoid falling “foul” of the increasingly tight regulations on this subject. Finally, along with regular cleaning goes regular inspection of sea chests and other nooks and cran-

gies so that the ship can be kept in top running condition and any problems can be predicted and avoided.

In most circumstances, the best and most viable approach is to clean the ship 100% and to do so regularly and always before sailing if the ship has been stationary for a long enough period to have become fouled.

And ship hulls must be protected with a system which lends itself to fast, effective underwater cleaning without risk of damage to the coating and without posing any kind of hazard to the environment.

**Ship hulls must be protected with a system which lends itself to fast, effective underwater cleaning without risk of damage to the coating and without posing any kind of hazard to the environment.**

There are a number of important reasons for the shipping industry to lean towards a more efficient and environmentally safe approach to hull coating and fouling control. The current financial climate and the growing concern for the environment have made these factors harder and harder to ignore.

- Rising cost of fuel. The price of bunker fuel has been rising and all indications are that it will continue to do so. This is a major concern for all shipowners/operators who are looking for ways to reduce this cost so that they can maintain a profit margin without having to raise their prices excessively. Therefore keeping a ship’s hull in smooth condition and free even of slime can add up to savings as high as 20% or more.

- Pressure to safeguard the marine environment from the harmful effects of chemical biocides con-

**The need for efficient and environmentally safe fouling control**
emissions go hand in hand with fuel consumption. These emissions tend to be in direct proportion to the amount of fuel burned by ships. Propulsive fuel consumption can be reduced in a number of ways. A major factor is avoiding the extra fuel required to overcome the hull friction increase caused by hull coating deterioration and fouling. Reduce fuel consumption by maintaining a smooth hull and removing slime and other biofouling in a timely manner and this will automatically reduce the emissions of atmospheric pollutants.

- Efforts to limit the spread of invasive non-indigenous species (NIS) via ship hull fouling. Greater and greater pressure is being exerted to prevent or limit the spread of invasive non-indigenous species (NIS) via shipping, both from ship hull fouling and from ballast tanks. The only effective way to eliminate the spread of NIS is to clean a ship’s hull thoroughly before it leaves one environmental zone to go to another. The only hull coating which can be cleaned successfully is a hard coating, including surface treated coatings such as Ecospeed.

- The problem of accumulating pollution and contamination of ports and harbors and their immediate surroundings, along with the great difficulty of dredging or trying to clean up those areas.

- Rising concern about harmful atmospheric emissions of the so-called green house gases (GHG). Harmful emissions go hand in hand with fuel consumption. These emissions tend to be in direct proportion to the amount of fuel burned by ships. Propulsive fuel consumption can be reduced in a number of ways. A major factor is avoiding the extra fuel required to overcome the hull friction increase caused by hull coating deterioration and fouling. Reduce fuel consumption by maintaining a smooth hull and removing slime and other biofouling in a timely manner and this will automatically reduce the emissions of atmospheric pollutants.

- The economic need to extend the interval between drydockings. Many operations to the underwater hull and other parts of the ship below the water line can be accomplished more quickly and economically with the ship still afloat, without pulling the vessel out of the water in drydock. The pressure to drydock vessels less frequently and for shorter periods of time so as to keep costs down is increasing. This can be clearly seen in the push towards...
This procedure is made easy by the coating’s technical properties. Cleaning can be carried out whenever needed, at any point in its lifespan, without causing damage.

Regular underwater cleaning of the coating results in improved hull smoothness each and every time the hull is cleaned. The coating will maintain its integrity at all times. Tests have shown that a very large number (+500) of repeated underwater hull cleanings improves its surface texture without any adverse effects.

Fouling can be removed in drydock with high pressure tools or underwater while improving the coating.

a 7.5 or even 10 year drydocking interval. The main obstacles to this extended interval are hull corrosion and fouling. The main incentive, if these factors are handled, is a great reduction in costs.

These six factors are all driving the industry in the same direction: use of a hard, inert, non-toxic coating and routine in-water cleaning. This is where Ecospeed comes in. Ecospeed is a hard, inert, specially-formulated glassflake vinylester resin surface treated coating system that includes routine underwater cleaning without the risk of chemical pollution to the environment or of damage to the coating. Ecospeed can be cleaned aggressively and rapidly and will only improve in smoothness with each cleaning.

The benefits of underwater cleaning on Ecospeed

1. Ecospeed improves with each underwater treatment

One of the many unique factors of this underwater hull coating system is that with repeated underwater hull cleaning, the coating’s surface aspect does not degrade but gradually improves.

Permanent rudder repairs now possible without drydocking

Hydrex has developed an entirely new method enabling permanent repairs of rudders without drydocking the ship. Permanent repairs were hitherto not possible and ships had to drydock in case a major defect was found. The newly designed equipment is lightweight and can be mobilized very rapidly in our special flight containers. Therefore this new service is now available worldwide.

Major defects on rudders very often cause unscheduled drydocking of ships. The new method designed by our technical department allows engineers, welders and inspectors to perform their tasks in dry conditions. Class approved permanent repairs in-situ, without moving the ship, are now possible and commercial operations can continue. Steel repairs and replacements can be performed and pintle and bushing defects can be solved without the loss of time and money associated with drydocking.

The equipment can be mobilized within hours to any port in the world and is available for rapid mobilization from the Hydrex headquarters in Antwerp.
This will prevent any increase in fuel consumption over the years as would happen with traditional, active anti-fouling paints which are known to degrade steadily over time. The ship hull can be kept close to its optimum hydrodynamic condition thereby producing major fuel savings.

Despite the aggressive nature of certain types of fouling, no rust or damage to the steel will be present on the underwater hull of the vessel after cleaning.

fouling paints which are known to degrade steadily over time. The ship hull can be kept close to its optimum hydrodynamic condition thereby producing major fuel savings.

2. Long lay-up periods have no effect on the condition of the Ecospeed coating

As a consequence of the current economic climate, more and more ship owners are forced to lay one or more of their ships up for longer periods. For some types of ships (military ships are a good example) the normal pattern of operation sometimes includes lengthy lay-ups followed by rapid mobilization. This has, however, no adverse effect on an Ecospeed coating which can always be restored to its optimum condition, regardless of how much fouling has attached itself to the hull while the vessel has been laying idle. Cleaning a severely fouled hull is more time consuming and expensive than cleaning a lightly fouled ship, and it is probably better policy, especially if fast mobilization is required, to clean the hull often enough to keep the fouling to a more manageable level, even if the vessel is out of service.

Ecospeed is ideally suited for ships which have a stationary period because an impermeable barrier is created during application. This gives the coating its excellent and durable anti-corrosive properties and protects the underwater hull against mechanical damage. Despite the aggressive nature of certain types of fouling, no rust or damage to the steel will be present on the underwater hull of the vessel after cleaning. The hard fouling is unable to penetrate or damage the glassflake vinylester coating.

This is illustrated by a cruise ship that remained stationary in the Caribbean for seven months after it was coated with Ecospeed. After this period the coating’s qualities allowed a complete removal of all fouling from the underwater hull of the vessel during an underwater cleaning without causing any damage to the underlying paint layer which was restored to its original pristine condition.

3. TBT-free, copper-free, biocide-free and silicone oil free solution

In 2008, stringent tests were carried out within the framework of an EU LIFE demonstration project to provide scientific data and to authenticate the non-toxicity of the Ecospeed hull performance technology. This research proved that the coating is 100% toxin-
free and that there is no negative effect on the water quality or the marine environment at any point of its application or use. Moreover, the massive amounts of VOC and zinc anode emission associated with conventional hull coating systems are reduced to almost zero.

As part of the tests, comprehensive sampling was performed at the start, during and after the underwater cleaning of several ships. These samples were then examined, and the results verified that there is no impact on the water as a result of the underwater maintenance, even in close proximity to the cleaning unit used. Because the water in the ports could have affected the tests and to verify the results, additional tests were performed in a lab in worst case scenario circumstances which led to the same conclusions.

Examination of the samples showed that only marine fouling is removed during the cleaning process and that the Ecospeed coating stays intact and has no effect on its surroundings.

4. The solution to the NIS problem

The underwater cleaning of Ecospeed can be regarded as a safe measure that prevents, rather than remedies, the spread of NIS. Firstly, Ecospeed can be cleaned on a regular basis without damaging the coating’s surface. The cleaning interval is optimized to minimize fouling and the associated increase in fuel consumption. In other words, regular cleaning prevents heavy fouling from occurring and at the same time presents an opportunity to inspect so-called niche areas. Secondly, Ecospeed is a very durable coating that withstands abrasive cleaning for which very effective specialized tools have been developed. As a result, many of the fouling organisms will be destroyed during cleaning.

5. Underwater cleanings on Ecospeed allowed

After the submission of the experimental results of aforementioned EU-LIFE demonstration project to port authorities and environmental agencies worldwide, several major ports have already overturned the existing general ban on underwater hull cleaning, specifically making an exception for vessels coated with Ecospeed.

The Netherlands was one of the first countries worldwide to practically ban the in-water cleaning of ship hulls in order to avoid the pulse release of TBT or other biocides associated with the cleaning of AF paints. Ships moored in ports continue to leach biocides, which leads to accumulation in
6. Specially designed equipment used by trained divers

Underwater maintenance of Ecospeed is carried out with specially designed underwater hull cleaning tools that simultaneously remove all fouling and optimize the smoothness of the paint surface.

A complete set of complementary equipment was designed in-house to allow divers to clean the flat areas as well as the harder to reach parts of the hull without damaging the coating. Sea chests and other nooks and crannies are best cleaned out using underwater high pressure water jet equipment. This combination makes it possible to have a 100% clean hull after each maintenance session, resulting in the best possible hydrodynamic condition of the underwater hull throughout the service life of the vessel and the removal of any potentially harmful invasive aquatic species which the ship may have picked up.

The Hydrex R&D department is constantly working on improving the available underwater cleaning equipment even further. New versions of the tools are regularly put into practice to achieve an even faster cleaning rate without losing any of the quality.

Hydrex diver/technicians are specially trained to work with the latest versions of the underwater hull cleaning tools. This allows them to carry out underwater maintenance of the Ecospeed underwater hull coating in the shortest possible time frame. They are also trained to be flexible. The combination of these factors makes it very easy for them to adapt an underwater cleaning operation to the schedule of a ship.

7. Less drydockings required, less time in drydock needed

Over the last couple of years there has been a trend of extending the maximum drydock interval from five to seven and a half years. Several large classification societies already allow this extension, but only if a stringent set of rules is followed.

One of the requirements is the execution of a very strict preventative or semi-preventative underwater maintenance plan. Ecospeed’s qualities make the coating ideally suited for such a regime. Regular underwater cleaning, removing any marine fouling at a very early stage, will maintain and improve the ideal surface characteristics. This benefits the hydrodynamics of the vessel throughout its service life and helps avoid any risk of spreading NIS.

Besides helping owners to make their ships eligible for a lengthening of the
be cleaned aggressively and rapidly and will only improve in smoothness with each cleaning. Underwater maintenance of Ecospeed can be regarded as a safety measure that prevents, rather than remedies, the spread of NIS. For these reasons several economically important ports have already overturned the existing general ban on underwater hull cleaning, specifically making an exception for vessels coated with Ecospeed.

Ecospeed’s qualities also make the coating ideally suited for the very strict preventative underwater maintenance plan that is part of the requirements to extend a vessel’s drydock interval to 7.5 years.

Ecospeed can, however, also be cleaned with high pressure tools in drydock, which is the standard practice when a ship enters drydock. It is done to clear away any fouling and residues, especially salt residues that may adhere to the paint system. With Ecospeed the coating is always in a brand new, excellent condition after high pressure washing, requiring only minor touch-ups where mechanical damage has occurred. The surface texture is very smooth. The high pressure washing reveals without exception that Ecospeed does not need any additional paint layers and at most would require less than 1% touch-ups as long as the paint was standardly applied in the first place. When washing an antifouling paint in drydock, the floor of the drydock is a complete mess, discolored with dirty red water filled with toxins and antifouling paint chips spreading everywhere. With Ecospeed, none of the paint material is lost. Only the fouling is removed. The coating stays on the ship instead of dispersing in the water and contaminating the shipyard and the surrounding waters.

Summary

Ecospeed is a hard glassflake vinyl-ester resin coating that can be cleaned underwater without any risk of chemical pollution to the environment or of damage to the coating. Ecospeed can be cleaned aggressively and rapidly and will only improve in smoothness with each cleaning. Underwater maintenance of Ecospeed can be regarded as a safety measure that prevents, rather than remedies, the spread of NIS. For these reasons several economically important ports have already overturned the existing general ban on underwater hull cleaning, specifically making an exception for vessels coated with Ecospeed.

Underwater maintenance of Ecospeed is carried out with in-house designed underwater hull cleaning equipment by specially trained Hydrex diver/technicians. This allows them to clean the flat areas as well as the harder to reach parts of the hull without damaging the coating.
Fully equipped for a worldwide fast response
A ship with bent or cracked propeller blades might experience severe vibrations while sailing. The classification society might demand a repair before the vessel is allowed to sail on. By straightening the blades or cropping them, Hydrex can restore the propeller’s balance, resulting in a green light from the class for the vessel.

A propeller modification can easily be combined with any other maintenance or repair operation that needs to be carried out on the vessel, as was the case with several of the examples that can be found below. Thanks to the flexibility of the Hydrex teams this allows a vessel to keep to its schedule.

Prior to a propeller repair, a detailed underwater inspection is carried out by our divers. They are certified to make a full assessment. Exact dimensions and position of the damage can then be communicated to the Hydrex technical department supervising the operation. This is essential to obtain exact calculations. Hydrex team members are not only divers, but have experience in dealing with all kinds of different situations and circumstances. They are trained to think with the people in the technical department, divers or former divers themselves. They can assist in working out the best solution and have the skill and experience needed to implement the theoretical solutions that have been worked out.

**Blade straightening**

By taking advantage of the in-house developed cold straightening technique, damaged blades can be straightened underwater, allowing the ship to return to commercial operations without the need to drydock. Optimum efficiency of the propeller can be restored by bringing the blades back close to their original form. The cold straightening machine has been in use for quite some time now but the Hydrex research department has been looking into ways to enhance the technique even further to improve our services. A new model of the straightening machine was recently put into service. It is compatible with the existing model and is used to restore more severely bent propeller blades.

Even severely bent blades can be straightened underwater, allowing the ship to return to commercial operations without the need to drydock.

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*Hydrex diver/technician cropping a propeller blade.*

*Diver/technicians positioning the latest version of the Hydrex cold straightening machine over a bent propeller blade.*
Cropping

If straightening is not an option, the affected area on the blade will be cropped to restore the hydrodynamic balance. This is done to achieve the greatest possible efficiency for the vessel. This kind of repair is carried out with the propeller blade cutting equipment that was also developed in-house. A detailed underwater inspection is performed to obtain the exact parameters of the damage which are then used for a detailed calculation of the ideal cutting line. This allows the customer to know in advance what the result of the operation will be. He can then make an informed decision.

Restoring optimum propeller performance

Both cropping and straightening are done to restore the propeller’s performance as close to its optimum condition as possible and to balance it. This can help a vessel that is suffering loss of speed due to an out-of-balance propeller. Propeller optimization is sometimes also done to restore the performance even if no real damage has occurred, as after years of service an engine loses some of its performance. By calculating the possibilities of a propeller optimization the performance can be restored. Hydrex has been cropping propeller blades since 1985 and straightening them since 1990.

Both cropping and straightening are done to restore the propeller’s performance to as close to its optimum condition as possible and to balance it.

On some occasions an entire blade has to be replaced on a variable pitch propeller. This work can also be carried out by our divers.

They are trained to perform a wide variety of operations, both above and below the waterline, anywhere in the world and sometimes even in the most extreme conditions.

Hydrex not only offers repair services, but can also help customers when they have the need for preventive or other special custom projects. At the end of 2010, for example, preventive modifications were made in Bremerhaven to the blades of three ice-going sister vessels. When several of this customer’s vessels suffered damage and the propeller blades needed cropping after the 2009-2010 winter, the owner wanted to find a way to prevent this from occurring to his other container vessels. When the 2010-2011 winter promised to be equally harsh, he wanted to give the blades extra strength and make them less susceptible to damage from ice or other debris. This was done by modifying the blades to a very specific design that made them less prone to damage while keeping the performance of the propeller as close to optimum.
as possible. The operation was performed in close communication with the manufacturer of the propellers.

Some cases in point.

**Underwater propeller blade cropping in Mexico**

In Manzanillo, Mexico, a Hydrex diver/technician team cropped two of the six blades of the propeller of a 208-meter container vessel. Both blades had suffered heavy cavitation damage and needed to be cropped to restore the propeller’s balance. To make a full assessment of the damage, the team first performed an underwater inspection. The information acquired was then used to calculate and determine the correct measurements needed to modify the trailing edges of the propeller blades. The two blades were then cropped and all edges on the cropped areas were ground and polished. In this way optimum efficiency of the propeller was restored by bringing the blades back close to their original form while the vessel remained afloat.

**Hydrex not only offers repair services, but can also help customers when they have the need for preventive or other special custom projects.**

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**IN-SITU BOW THRUSTER OPERATIONS**

The Hydrex lightweight flexible mobdocks are designed to be easily transported around the world and are used to close off the thruster tunnel on both sides, allowing divers to perform repairs and other operations in a dry environment around the bow thruster unit.

This technique enables them to reinstall the propeller blades of an overhauled thruster inside the thruster tunnel after the unit has been secured or replace the blades or seals and perform repair work on a specific part without removing the unit.

Since the development of this flexible mobdock technique, numerous thruster repairs have been carried out by Hydrex diver/technicians around the world.

There is no need to send the vessel to drydock as all operations can be carried out in port or while the vessel is stationary at sea. Normal commercial activities can therefore continue without disruption.
Combined cold straightening and cropping in Italy

In Gioia Tauro, Italy, a Hydrex team straightened four damaged blades of the propeller of a 265-meter vessel and cropped the remaining two. The team used the cold straightening machine to bring the bent blades back to their original shape. For the cropping they used the measurements taken during a detailed inspection to calculate the most economical cutting line to make sure that the propeller’s balance would be restored.

Simultaneous stern tube seal and propeller repair on vessel in New York

Earlier this year a Hydrex diver/technician team replaced three seals on a 180-meter tanker berthed in New York while concurrently cropping two of its propeller blades to restore balance to the propeller. Both operations were carried out at the same time while the ship was trimmed forward at some 60 meters from the quayside. While part of the team replaced the damaged seals, the rest of the team repaired the propeller. One of the blades had been severely bent and had suffered several cracks, which ruled out any possibility of straightening it. The team cropped the damaged blade after which they cut the opposite blade at exactly the same place to make sure that the propeller would be balanced again. Besides carrying out both parts of the operation simultaneously, the team also worked in shifts around the clock to limit the off-hire time of the vessel. This allowed the superintendent to sail the vessel again with both its propeller and stern tube seals back intact with only a minimal delay.

Cold straightening in Rotterdam

The crew of a 183-meter tanker suspected that there was damage to their vessel’s propeller blades caused by sailing through ice. An underwater inspection carried out by a Hydrex team confirmed this to be the case. The vessel was therefore trimmed during its stay in Rotterdam, and the team straightened the bent propeller blade tip. This restored the blade to its original condition.
One hears and reads a great deal these days about aquatic invasive species (AIS), also referred to as non-indigenous marine species (NIMS), non-indigenous species (NIS), aquatic nuisance species, alien species and a number of other names. We shall refer to them here as NIS, perhaps the most prevalent term in non-scientific circles.

NIS are an economical as well as an environmental problem.

For some time the concentration on the shipping industry’s role in the spread of NIS centered on ballast water. More recently the focus has extended to include ship hull fouling as a vector of NIS translocation just as important as ballast water if not more so.

The NIS threat is increasing due to more shipping traffic and also perhaps because the antifouling systems in use since the ban of TBT have been generally much less effective in eliminating hull fouling.

It is more efficient and far less expensive to prevent the translocation of NIS in the first place than to try to clean up the damage they cause and eliminate the now-established species and prevent their further spread.

Legislation and regulation to prevent the spread of NIS via ship hull fouling is increasing in severity with some quite rigorous measures looming.

Efforts to deal with the problem to date have not been effective. It is generally agreed that in-water cleaning must be part of any handling, yet the antifouling and foul release coatings in general use impose severe restrictions on in-water cleaning. Frequent drydocking is not economically or logistically feasible.

The time is right for a thoroughly workable solution which is acceptable to governments, port authorities, environmental groups and the shipping industry. The ideal solution would tie in with fuel savings, GHG and other emission reduction and curtailing the contamination of ports and oceans with heavy metals and other toxicants.

So far the efforts of states and ports have been in the direction of preventing ships arriving in their waters with fouled hulls and NIS. For example, the ANZECC code forbids in-water cleaning of vessels in Australian waters for fear that incoming vessels will bring NIS into Australia which will then establish themselves there. But forbidding in-water cleaning means that vessels leaving Australian ports, especially those that have been laid up for some time, will sail with a fouled hull and carry Australian invasive species all over the world. This may appear to help with the local problem but in fact magnifies the international situation. And NIS is by its very nature an international problem.

A novel approach would be for ports and states to at least place equal emphasis on ships sailing or leaving their port with a clean hull. This

A typical “niche area” of a hull, painted with a conventional biocidal antifouling paint.
A great deal of work has been done on the subject of NIS by the IMO Marine Environmental Protection Committee’s Correspondence Group on the development of measures to minimize the transfer of invasive aquatic species through bio-fouling, under the coordination of New Zealand. This White Paper will outline an existing, workable, environmentally and economically beneficial method of eliminating the threat of further spread of NIS via the ship and boat hull fouling vector using only currently extant, proven technology and methods.

would require international cooperation but the IMO is there to make sure that such international cooperation on important shipping related matters is obtained. And if such a solution also carried with it great financial benefits to shipowners/operators the world over, then it is quite likely to be accepted and adopted.

The two major barriers to effective handling of the global NIS problem are 1) the hull coatings in general use are not suitable for in-water cleaning, whereas in-water cleaning is a vital part of the solution to NIS; 2) in order for the NIS spread to be curtailed, ships must leave their port of origin with a clean hull and concentration needs to be on the beginning of the voyage rather than on the state of the hull at the port of destination. Ships do not foul while steaming. They foul when they are stationary.

This White Paper has been inspired by IMO MEPC Annex 26, 2011 Guidelines for the Control and Management of Ships’ Biofouling to Minimize the Transfer of Invasive Aquatic Species, section 12, Future Work.

Hydrex has an office located in Clearwater in the Tampa Bay area that is ready to mobilize immediately. The office has a fast response center that is equipped with an extensive range of state of the art logistics, trucks, tools and diving support equipment. This enables Hydrex US to efficiently service vessels and offshore units calling on ports in Canada, North, Central and South America as well as the Caribbean.

All staff members of the Hydrex office in Clearwater undergo stringent training at the Hydrex headquarters in Antwerp. They can carry out both simple and complex high quality jobs even in the harshest of circumstances.

Repairs to thrusters, propellers, rudders, stern tube seals, damaged or corroded hulls and all other underwater repair and maintenance services are done while the vessel is in situ. This eliminates the need to dry-dock.

All used methods are fully approved by all major classification societies.

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Fully trained and certified diver/technicians

Removal of heavy marine fouling on FPSO and drill vessels

Turnkey underwater solutions for the offshore industry

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Fast underwater repairs keep ships out of drydock

Hydrex offers turnkey underwater repair solutions to shipowners wherever and whenever they are needed. Hydrex’s multi-disciplinary team will help you find the best solution for any problem encountered with your ship below the water line. We will immediately mobilize our diver/technicians to carry out necessary repair work without the need to drydock.

Hydrex has a long track record of performing complex permanent underwater repairs to thrusters, propellers, rudders, stern tube seals and damaged or corroded hulls. By creating drydock-like conditions around the affected area, our diver/technicians can carry out these operations in port or at anchor.

All the projects we undertake are engineered and carried out in close cooperation with the customer and any third party suppliers, relieving the customer of all the hassle of coordination, planning and supervision.

Headquartered in the Belgian port of Antwerp, we have offices in Tampa (U.S.A), Algeciras (Spain), Mumbai and Visakhapatnam (India), and Port Gentil (Gabon).

All Hydrex offices have fully operational fast response centers where an extensive range of state-of-the-art equipment is available at all times.