Hydrex restores balance to over 25 propellers with blade modifications across the globe

Hydrex White Paper No. 5

Ecospeed news & results

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SHIP HULL PERFORMANCE TECHNOLOGY
Ecospeed ship hull performance technology lasts the lifetime of the vessel. The need for full repaints during future drydockings is eliminated.

An impermeable and extremely tough coating is combined with an underwater cleaning system keeping the hull roughness at an optimum level and resulting in a major saving in fuel.

Ecospeed is a 100% non-toxic technology and is guaranteed for 10 years. Its surface texture will improve over time with regular inwater hull maintenance.

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Over the last months Hydrex diver/technicians have carried out more than 25 propeller modifications around the world. Our divers were active in the Netherlands, Greece, Denmark, Spain, Italy, Panama, Singapore, the U.S.A. and many other countries. All operations were performed to restore the propellers’ balance. They were brought back to as close to their optimum performance as possible after the blades had suffered damage due to collisions with ice or debris.

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 at the end of this article.

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 perfectly accurate to achieve an ideal result with the repair. 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. As diver/technician experts, 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.

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 Hydrex diver/technicians. They are certified to make a full assessment of the condition of the propeller. The exact dimensions and position of the damage can then be communicated to the Hydrex technical department supervising the operation. This is essential because the calculations need to be

Severely damaged blades can be cropped in-situ to restore the propeller’s performance as much as possible.
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 some years of service an engine sometimes loses some of its performance. By calculating the possibilities of a propeller optimization we can restore the performance. Hydrex has been cropping propellers since 1985 and straightening them since 2000.

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

of the propellers 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.

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 by the Hydrex research department.

First a detailed underwater inspection is performed by a Hydrex diver/technician team 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 to 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 some years of service an engine sometimes loses some of its performance. By calculating the possibilities of a propeller optimization we can restore the performance. Hydrex has been cropping propellers since 1985 and straightening them since 2000.

“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.”

Diver/technicians positioning the latest version of the Hydrex cold straightening machine over a bent propeller blade.
out by our divers who 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 propellers 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**

Over 25 propeller blade straightenings and croppings were carried out by Hydrex diver/technician teams over the last few months in Europe, Asia and North and South America. Below is a small selection of some of these operations.

**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. The team mobilized from the Hydrex office in Tampa together with all the equipment they needed for the operation. Both operations were carried out at the same time while the ship was trimmed and at some 60 meters from the quayside.

While part of the team replaced the damaged seals, the rest of the team repaired the propeller. They used a pontoon with the cropping equipment on it to reach the blades. One of the blades had been severely bent and had suffered several cracks, which ruled out any possibility of straightening it. The team made an exact assessment of the damage and used these measurements to find the best cutting line.

“If straightening is not an option, the affected area on the blade will be cropped to restore the hydrodynamic balance and to achieve the greatest possible efficiency for the vessel.”

They then cut the damaged blade after which they cut the opposite blade at exactly the same place. This was done to make sure that the propeller would be balanced again and to bring its performance back as close to...
Hydrex uses in-house developed state-of-the art equipment.

optimized as could be achieved. 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 his vessel again with both its propeller and stern tube seals back intact with only a minimal delay.

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 in-house developed 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 that would make sure that the propeller’s balance would be restored.

Propeller blade repair and rope guard replacement in Algeciras
A Hydrex diver/technician team mobilized with one of the company’s workboats from the Algeciras office to perform a rope guard replacement, a propeller blade repair and a shaft wear-down reading on a 183-meter tanker while the vessel was at anchor in the bay.

The operation was carried out in the dry while the vessel was trimmed. The team first installed a platform around the stern to give the Hydrex technicians access to the stern tube seal assembly and the propeller. They then removed the old rope guard and positioned the replacement and bolted it in place. Next the team performed an inspection of the propeller and discovered a crack on the leading edge of one of the blades. The crack was ground out and its edge was smoothed. The operation was concluded with the performance of pintle measurements. All three parts of the operation were performed in one day, avoiding any delay for the customer.

Propeller blade cropping close to the Hydrex headquarters
Two blades of the propeller of a 210-meter vessel were cropped in Rotterdam, the Netherlands, because the blades were too severely bent to be straightened. 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.

Crack repair on propeller blades in France
When a 200-meter container vessel suffered cavitation and other damage to its propeller, a Hydrex diver/technician team traveled to Le Havre, France, to perform the required modifications to the damaged blades. The team ground out the cracks on two of the propeller’s

“On some occasions an entire blade has to be replaced. This work can also be carried out by our divers who are trained to perform a wide variety of operations, both above and below the waterline.”

The area that needs to be cropped is marked on the blade prior to cropping.
blades and cropped the cracked area on a third propeller blade. Next all rough edges were polished to make sure that no further cavitation damage would occur. The diver/technicians worked in shifts to perform the repair as fast as possible to make sure that the vessel did not lose any unnecessary time.

**Propeller cropping on tanker in Rotterdam**

A Hydrex diver/technician team mobilized to a 180-meter tanker berthed in Rotterdam after the vessel had suffered damage to the blades of its propeller. The crew first carried out a detailed underwater inspection of the blades, which revealed that two of them had been bent and needed to be cropped. The information acquired during the inspection was used to calculate and determine the correct measurements needed to modify the trailing edges of the blades. The two blades were then cropped and all edges on the cropped areas were ground and polished.

**Balance restored to propeller in Las Palmas**

An inspection of the propeller blades of a 200-meter bulker revealed that two of its blades needed to be cropped during the vessel’s stop in Las Palmas at the end of February. After the Hydrex diver/technicians arrived at the vessel, they first took all the required measurements during an underwater inspection. These measurements were then used to calculate the most economical cutting line that would make sure that the propeller’s balance would be restored. After the team finished the cropping of the two blades, the edges of the cropped areas and the leading edges of the blades were ground smooth. The operation was performed to restore the propeller’s balance and bring it back to as close to its optimum performance as possible after the blades had suffered damage due to cavitation or collisions with ice or debris.

**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.

**Propeller blade cropping on ro/ro vessel in Panama**

When a blade is damaged too severely by ice or other floating debris, straightening is not feasible. If it is decided that cropping is the only option, measurements are taken and used to calculate the exact radius of the area to be cropped. This was the case with the propeller blades of a 197-meter ro/ro vessel. A Hydrex diver/technician team mobilized from the office in Clearwater, U.S.A. to assist the vessel in Panama. To make a full assessment of the damage, the team first performed an underwater inspection. They then used the information acquired to find the best cutting line that would bring the performance of the propeller back as close to its optimal condition as possible. The actual repair job consisted of the four blades being modified underwater one after the other by the Hydrex diver/technicians. The area to be cropped was marked out on each blade and verified. The blade was then cropped and its edge ground to give it the correct radius. When the cropping was complete, the blades were polished to make sure that any remaining loss of efficiency would be minimal.

”If required Hydrex diver/technicians work in shifts to perform a repair as fast as possible to make sure that a vessel does not lose any unnecessary time.”
Despite a proven track record of reducing fuel consumption and cost saving, underwater ship hull cleaning is much less used than it could or should be.

Introduction

Historical note
Cleaning ship hulls of marine fouling has been a fact of maritime life since humankind first took to the sea in boats. The Greek priest and author Plutarch (45–125 AD) discusses the cleaning of ship hulls in Symposiacs. The British Royal Navy was well aware of the importance of removing fouling from the hulls of their men of war in the 18th and 19th centuries when “Britannia ruled the waves.” Captain James Cook landed his ship Endeavour at Ship Cove in Marlborough Province, New Zealand in 1769 on his way around the world so that it could be careened (turned on its side) and the hull cleaned.

It has long been known that fouling on a ship’s hull greatly increases hull friction and slows the vessel down, makes it more sluggish and less maneuverable.

Technology advanced to the point where ship hulls could be underwater cleaned with the ship still afloat by divers using a variety of hand and mechanical brushes and scrapers. Cleaning the hull with the ship in the water avoided “careening” or the more modern equivalent, drydocking, thus saving time and expense while still getting the job done.

For a brief time towards the end of the 20th century the introduction of the highly toxic TBT into hull paints gave the illusion that ship hull cleaning was an unnecessary thing of the past. This was an unfortunate delusion, as it was soon found that TBT was a two-edged sword and the damage the poisonous substance caused to the marine environment was extensive and intolerable. Nevertheless, during the “TBT era” the subject and practice of underwater ship hull cleaning went into decline in terms of repute, technology, skill and general availability.

The TBT deception also resulted in the current attitude towards underwater cleaning held by many shipowners/operators who consider it a hassle and a logistical nightmare. The tendency is to avoid underwater hull cleaning.

Hydrex offices in India ready to mobilize

Hydrex has two fully staffed offices in India. One in Mumbai and one on Visakhapatnam, covering the East and the West Coast of India.

Equipped with a complete array of Hydrex diving and repair equipment, both offices are ready to carry out any necessary repair and maintenance work and provide preventive as well as problem solving services.

All operations will be carried out by professional Hydrex teams, trained and qualified to perform complex technical tasks underwater. All procedures are fully approved by all major classification societies.
Vicious circle
However, the antifouling technology which replaced TBT-laden hull paint was relatively ineffective. All ship hulls developed a biofilm or slime layer at the very least, regardless of the bottom paint used, and this, combined with rough hull coatings, carried with it a fuel penalty of 20% or more. And there was an additional liability to the antifouling technology which replaced the TBT paints: the coatings could not be cleaned without damage to the paint and to the marine environment.

Rising costs of bunker fuel mean that a 20% fuel penalty is intolerable.

The underwater hull paint industry has created a “damned if you do, damned if you don’t” situation for shipowners/operators which included frequent dry-docking and paint replacement, a built-in fuel penalty, and coatings which were ineffective in preventing fouling yet were not suitable for underwater cleaning, the only practical means of avoiding the fuel penalty incurred.

Today underwater ship hull cleaning, thoroughly and efficiently done on an industrial basis and on a suitable hull coating, is the answer to reducing fuel costs, cutting GHG emissions, preventing the spread of non-indigenous species and avoiding marine chemical pollution.

Practical approach
Much of the literature reviewed on the subject of underwater ship hull cleaning takes a theoretical approach to the subject or is produced by people who are remote from the slime, weed, barnacles and other fouling on the typical ship hull, have not looked at fouled hulls underwater or cleaned ship hulls or talked to those who know. Often they try to compare underwater cleaning to apparently similar activities carried out on land, demonstrating an unfamiliarity with hydrodynamics and the differences between operations carried out on land and in the water. The real issues are not necessarily identified. Potentialities are missed. Restrictions are also missed. The result is that the view of underwater cleaning currently in circulation in the maritime industry and in academic writings tends to be rather impractical and divorced from reality, leaving shipowners and operators ill-informed on the subject.

This paper is a realistic survey of the subject of underwater ship hull cleaning, examining benefits as well as difficulties and limitations with a view to providing an accurate and useful summary which can be put into use by shipowners and operators on an immediate basis using today’s technology to save 20% or more on fuel costs and GHG emissions, reduce the need for drydocking, prevent the spread of non-indigenous invasive species and all without polluting the marine environment. Knowledgeable experts on and practitioners of underwater ship hull cleaning have been consulted with a view to describing real situations, issues and solutions.

This White Paper will be accessible in its entirety at: www.shiphullperformance.org and is available in printed form at no charge.
Ecospeed ECOTEC-STC named one of best projects of 2010

During a conference held at the European Parliament in Brussels, Hydrex was presented an award for the ECOTEC-STC project which was named as one of the best LIFE projects completed in 2010.

To select the best LIFE-Environment projects a lengthy identification and evaluation process was followed, based on a set of best practice criteria. These were developed by EU Member States in collaboration with the European Commission. The objective was to help improve the dissemination of LIFE project results by clearly identifying those projects which could have the most positive impact on the environment if widely applied.

Over a 3.5 year period the objective of this project was to evaluate the environmental and economical benefits of Ecospeed as a biocide-free durable hull protection and antifouling system. The project was divided into several Project Tasks which were all carried out under the supervision and organization of Hydrex NV.

The project has shown that Ecospeed as a Surface Treated Coating is a valuable alternative technology to the biocidal copper based antifoulings that are currently on the market. From the project tasks that were carried out, it has been demonstrated that Ecospeed exhibits the following environmental and economical benefits:

- There is no need for full re-application in drydock. After supervised application, Ecospeed comes with a guaranteed lifetime of 10 years and an expected lifetime of 25 years.
- Ecospeed has low VOC contents and in comparison with foul release coatings or copper-based antifoulings, far fewer VOCs are emitted with each application.
- Effluent analysis has shown that Ecospeed is 100% free of biocides and therefore environmentally safe.
- Regular underwater treatment of Ecospeed is put forward as a Best Available Technology to minimize the risk of transferring non-indigenous marine species (NIS).
- Advanced maintenance tools have been developed to clean and condition simultaneously.
- The analysis of the roughness characteristics has demonstrated an optimization of surface characteristics by underwater treatment.

The dissemination activities and events organized around the project results engendered significant interest. Proof of increased interest in Ecospeed as an alternative to antifoulings is given by the number of applications since the beginning of the project. Over 100 applications were carried out since December 1, 2006, of which more than 60 were full hull applications.
Conditioning improves ship hull performance even further on world’s largest Ro-Pax Ferry

Six months after its launch, the 240-meter Ro-Pax ferry *Stena Britannica* was conditioned underwater in Harwich, United Kingdom.

The conditioning was carried out together with a quick and simple cleaning which removed the small amount of marine fouling that had attached to the hull, consisting mainly of a thin layer of slime.

This conditioning is what makes Ecospeed unique. It is carried out with specially designed tools and brings the smoothness of the coating’s surface to an optimum condition by removing any slight roughness caused by application. This allows for an improvement of Ecospeed’s surface characteristics with each further hull cleaning throughout the service life of the vessel. It sets Ecospeed entirely apart from anti-fouling and foul-release paints that deteriorate over time.

Stena Line actively works to avoid damage to the marine and land environment. Whenever new operations are being planned or when new technology is being implemented, the environmental consequences are evaluated to minimize the company’s ecological footprint. Ecospeed fits in perfectly with these objectives. The coating is 100% environmentally safe, contributes greatly to reduced fuel consumption and therefore GHG emissions, and thus fits perfectly with Stena Line’s own ecological beliefs.

Hydrex West Africa in Port Gentil, Gabon

Hydrex West Africa is situated in Port Gentil, Gabon right next to Cape Lopez Bay. Working closely together with the headquarters in Antwerp the office can benefit from Hydrex’s long tradition in the ship repair and offshore industry.

Port Gentil is a general and bulk cargo port. It is the only port on the Gabon coast with a bunkering service. Thanks to the sheltered environment, the bay is ideally suited for in water work. This combined with its central location on the African West sea coast makes it the ideal place to have repair or maintenance work carried out on a ship, barge or rig in optimal circumstances.

Hydrex West Africa can mobilize teams immediately to service vessels and offshore units in Port Gentil or any other suitable location in West Africa. A good example of this is the recent removal, repair and reinstallation of a 40 ton swing-up azimuth thruster of an offshore crane barge that was servicing rigs in an oil field off the coast of Gabon. The entire operation was performed while the unit stayed at anchorage just outside the oil field.

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Fast and high quality in-situ repair services in the Western Mediterranean area and North Africa

The Hydrex office in Algeciras is ready to mobilize immediately with their two dedicated dive support vessels. Both vessels are fully equipped as service stations for a wide range of repair operations and allow for a fast response in the bay of Algeciras, Gibraltar and North African ports.

As part of the Hydrex group, Hydrex Spain takes advantage of the companies’ 37 years of experience. All operations are carried out by highly certified diver/technicians all of which have been trained in the headquarters in Antwerp and have extensive experience, enabling the office to offer their customers the high quality Hydrex is known for.

Jobs recently carried out by Hydrex Spain include a propeller modification, pipe repairs, rudder repairs and stern tube seal repairs in Algeciras, propeller modifications in Cadiz and an azimuth bow thruster removal and reinstallation on a pipe laying vessel in Cartagena.

Hydrex US: Fully operational in North America

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 drydock.

All used methods are fully approved by all major classification societies.
Ecospeed in excellent condition on icebreaker after crushing 2 meter thick ice on numerous occasions

Last month the 80-meter, 1800 ton deadweight, ice strengthened ship RSS Ernest Shackleton came into drydock in Frederikshavn in Denmark after sailing with Ecospeed on its underwater hull since October 2009. The vessel is primarily used as a logistics vessel to resupply the stations of its owners, the British Antarctic Survey.

During its voyages to Antarctica, RSS Ernest Shackleton has been crushing ice of 2 meter thickness on several occasions. Despite this the Ecospeed coating on the underwater hull of the vessel remained in excellent condition requiring only some very small touch-ups.

Both the ice-belt, the area on the bow just above the underwater hull of the vessel, and the rudder of the vessel had not been coated with Ecospeed during the previous docking. These areas had suffered severe corrosion and mechanical damage. During last month’s docking both areas were given the same protective Ecospeed treatment as the underwater hull of the vessel to prevent this damage from occurring again.

A full report on the success of Ecospeed on the RSS Ernest Shackleton will follow in an upcoming issue of the Hydrex magazine.
Ecospeed chosen to protect rudders of several container vessels

R
ecently the rudders of four container vessels, owned by three different owners, were coated with Ecospeed at shipyards in China, Singapore and Qatar. The rudders of these vessels are given lasting protection by Ecospeed against cavitation for the remainder of their service life.

The decision to use Ecospeed was made by the shipowners after cavitation damage had appeared on the rudders of their container vessels. Two of the owners are returning customers for Ecospeed and so they had experienced firsthand the benefits of an Ecospeed coating.

A great deal of effort goes into the design and manufacturing of rudders because they are an important part of a vessel. Therefore they ought to be protected properly. Ecospeed’s durability provides this protection because the coating will remain intact for the lifetime of the vessel. The coating is both flexible and tough. It provides the vessel with an impenetrable protective layer. At the same time its flexibility enables absorption of the forces that are produced by cavitation. This prevents the damage normally caused by this phenomenon.

Tests in a flow channel have confirmed that Ecospeed performs extremely well under severe cavitation. These tests were divided into six stages during which the coating was exposed to an increasing pressure drop, leading to a growing cavitation force. After the last stage no erosion was present on the test patch coated with Ecospeed. The tests were sponsored by the French Ministry of Defense and were carried out in Grenoble.

Ecospeed will remain intact for the lifetime of the vessels, is guaranteed for ten years, and will prevent similar damage from occurring again. The rudder will not have to be repainted during future drydockings and extensive repairs will not be needed. Planning the maintenance of the vessel’s stern area therefore becomes much easier. The smoothness attained by the coating also provides optimum hydrodynamic conditions for rudders to operate at maximum efficiency. The ship’s performance remains stable and the owner’s investment is secured.
Turnkey underwater solutions for the offshore industry

- Offshore repair and maintenance services
- Worldwide network of offices and service stations
- Fully trained and certified diver/technicians
- Removal of heavy marine fouling on FPSO and drill vessels
- Fast response centers with instant mobilizable equipment

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Keeping ships in business

Hydrex underwater technology and services provide high quality solutions to the repair and replacement problems encountered by ships and offshore vessels.

We deliver a complete line of services that may reduce or avoid off-hire time entirely. From major projects to simple inspections, Hydrex has the worldwide facilities and capability to meet your demands.

Drydocking is not necessary so time, trouble and expense are saved by doing work in-situ. Hydrex services cover highly technical major repairs or replacements of a ship’s external underwater equipment such as thrusters, propellers, rudders, stern tube seals and damaged or corroded hulls.

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