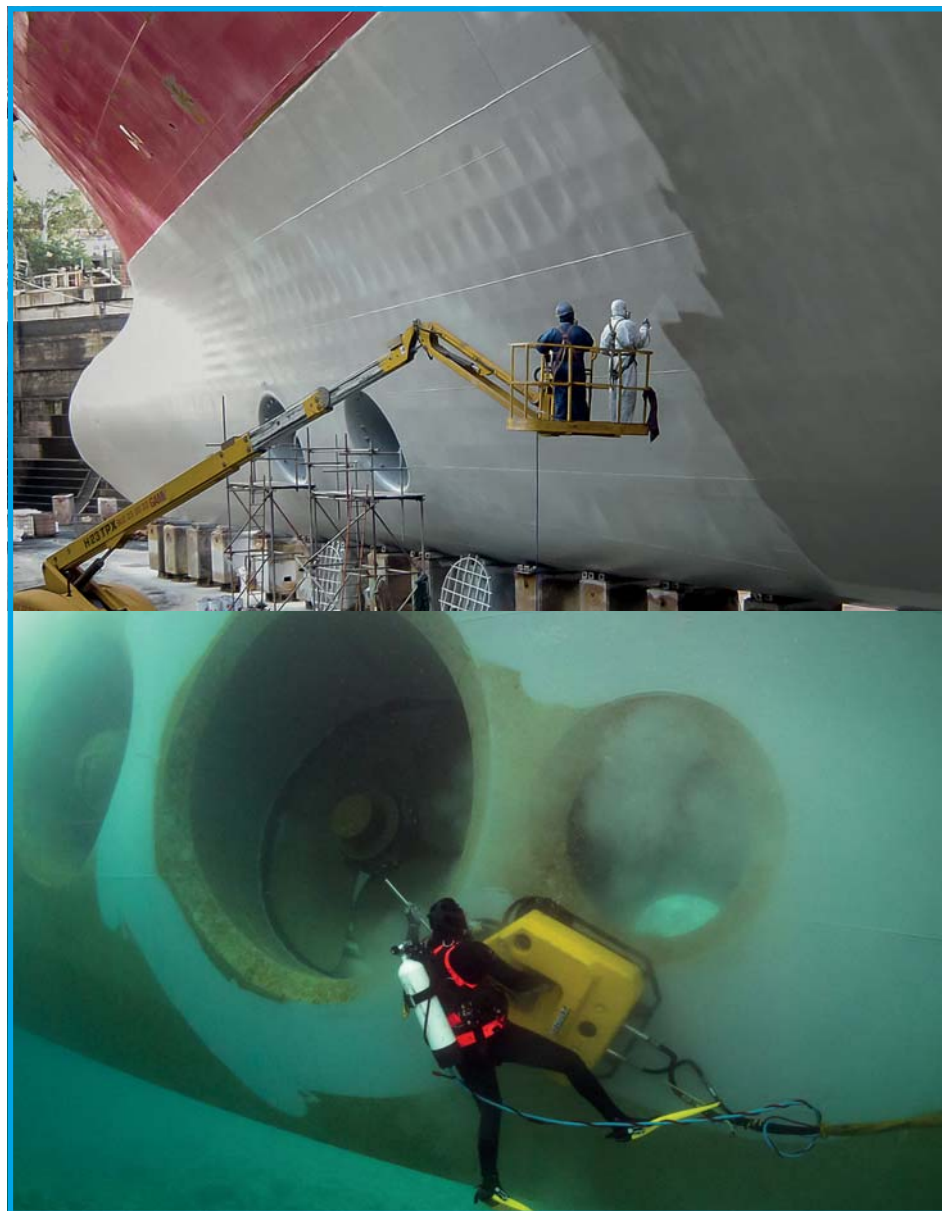


WHITE PAPER

Extending the Interval Between Drydocking to Ten Years



From a hull protection and fouling control point of view, a ten year drydocking interval is perfectly feasible and very economical



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Part I. Introduction

Drydocking a ship is a complex, expensive, time-consuming and stressful activity, regarded by most shipowners, operators, officers and crew as a necessary evil.

Time spent in drydock is time spent out of service.

It is becoming increasingly difficult to find drydock time available when and where one would like it, particularly for larger vessels. Thus drydocking often takes a vessel well away from its normal operating route.

Many different activities need to be scheduled for accomplishment during a drydocking and these activities may interfere with each other. The weather can be an important factor, particularly since drydocking usually involves painting.

That drydocking is necessary is not in question. In order to keep ships operating safely and efficiently for 25 years or more they have to be taken out of the water periodically for inspection and any needed repair. What is in question is how often this needs to occur. Technology is advancing and conditions which were prevalent twenty or thirty years ago are not necessarily the same today.

Currently the usual interval between mandatory drydocking for most ships is two and a half to five years, depending on type and age of ship. This has been extended to seven and a half for certain ships and under certain conditions.¹

A ten-year drydocking interval is a dream for most shipowners, operators, officers and crew – one which, if it could be attained, would reduce operating expenses and help

make the shipping industry more viable.²

The challenge to extending the drydock interval

The main challenges to a seven and a half, ten or even twelve year interval between dockings are hull corrosion protection and fouling control.³ By “hull” here is meant the entire external underwater part of a ship including the wetted hull, the rudders, propulsors, stabilizers, thrusters, sea chests, bilge keels, cathodic protection system and all the other external, submerged features and appurtenances of a vessel.

The continual attack by salt or fresh water, cavitation, oxidation, abrasive particles (gravel, lava, sand), ice and occasional solid contact renders these parts of a ship particularly prone to damage, erosion, corrosion and general reduction or weakening of the steel, aluminum or other material from which they are made. Salt water is potentially more damaging than fresh.

The accumulation of biofouling in the form of plant and animal life which naturally adheres to any submerged object, man-made or natural, reduces the hydrodynamic smoothness of the hull and can also damage the protective coating and even the hull itself. This in turn adds friction or drag to the hull and propellers. The result is that more fuel must be burned to achieve the ship’s cruising speed. The rougher the hull and propellers become, the higher the fuel penalty incurred. This not only shows up in higher costs to the operator but also in increased environmental impact through additional noxious gas and particulate matter emissions resulting from the higher fuel consumption. With conven-

The main challenges to a seven and a half, ten or even twelve year interval between dockings are hull corrosion protection and fouling control.

¹ DNV “Assessment of Ships and Managers for the Acceptance of Extended Interval Between Bottom Surveys in Drydock,” (January 2011).

² BIMCO, “Doing without drydocks,” (8 Oct 2010).

³ Bjarne Jansen & Helge Vold, “7.5 years – the coating challenge,” DNV MANAGING RISK (15 Oct 2010).

tional coatings, the longer the interval between drydocking, the rougher the hull is likely to become until at around the ten year mark it becomes necessary to thoroughly clean the hull of all fouling, blast it back to bare metal and reapply the entire coating system consisting of multiple layers of different types of paint.⁴

In addition to this fuel penalty, biofouling on the ship's hull has recently come to be regarded increasingly as a vector for the translocation of invasive, non-indigenous marine species from one environmental zone to another. Precautionary guidelines and regulations have been or are being proposed and enacted to combat this threat. In general terms, the more fouled the hull, the greater the risk of spreading NIS.⁵

Answering the challenge

The protection of the hull over a ten or even twelve year period can be accomplished with currently available coatings if the appropriate system is used. Certain types of coating become smoother over time as a result of in-water cleaning, rather than rougher as is the case with conventional hull coatings.⁶

This leaves biofouling control as the perceived largest challenge to an extended drydock interval. The concern is that conventional approaches to hull protection and fouling control will not perform over that period and that the fuel penalty incurred from increased hull roughness would therefore

make a drydock interval of ten or twelve years too expensive in terms of added fuel costs, especially with the price of fuel as high as it currently is, and that this will result in increased GHG emissions. Also that the spread of NIS would increase. The challenges are mainly commercial and environmental.

This White Paper presents the case for a system of hull protection and fouling control which can easily last for ten or twelve years without any need for drydocking and can keep the ship's hull well protected and virtually free of biofouling for that length of time, becoming smoother not rougher over time, thus avoiding the fuel penalty and preventing the translocation of NIS.

The type of system described herein is non-toxic and environmentally benign. It is also cost-effective and will, when standardly applied and maintained, result in considerable savings for both owner and operator over the service life of a ship when compared to conventional coating systems.⁷

Since hull protection and fouling control are considered the biggest challenges to a longer interval between mandatory drydocking, this White Paper focuses on these without going into detail on other aspects of mandatory drydocking such as tail shaft removal and other inspections and repairs required by IMO or State regulations and classification societies.

⁴ Hydrex White Paper No. 9, "Hull Coating Degradation – the Hidden Cost," (February 2012).

⁵ MEPC Annex 26, Resolution MEPC.207(62), "2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species," (15 July 2011).

⁶ Hydrex White Paper No. 9, "Hull Coating Degradation – the Hidden Cost," (February 2012).

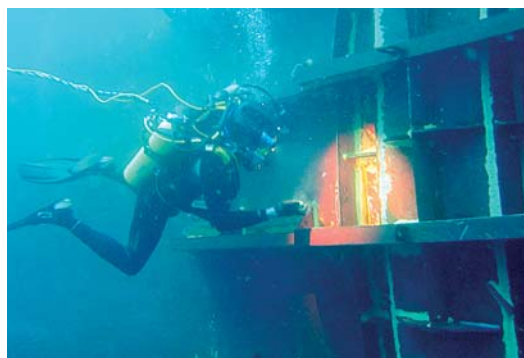
⁷ Hydrex White Paper No. 4, "Ship Hull Coating Systems Simplified," (May 2011).

Part II. Why drydock at all?

A car has to go to the garage for service or repairs. An airplane goes to the hangar for routine inspection, service, maintenance and repairs. A ship is a highly complex vehicle with a large number of structural, mechanical and other parts which need to be kept in good working order so as to ensure its efficient and safe operation. The number of different systems, motors, watertight structures and all the other units and equipment involved in just keeping the ship afloat and getting safely from point A to point B is considerable. Add to that the internal workings of different types of ships such as the hotel facilities of a cruise ship, the weapons and communications systems of a warship, the tank and pumping equipment of a VLCC

and you can see that any ship would need to have a pit stop from time to time in order to keep it running at optimum.

Of course, many conversion, maintenance and repair jobs can be done with the ship afloat and even operating normally. And they are. Development of advanced underwater repair and maintenance procedures has made it possible for many of these activities that used to require drydocking to be done with the ship still afloat.⁸ Straightening bent propeller blades, repairing leaking or damaged stern tube seals, removing and replacing bow thrusters, welding a damaged hull, repairing rudder cavitation damage, as well as hull cleaning and propeller polishing or cleaning can all be done without requiring



(left) Stern tube repair in flexible mobdock, (above right) Propeller cold straightening machine being deployed, (below right) Major repair of hull crack on damaged cargo vessel.

8 BIMCO, "Doing without drydocks," (8 Oct 2010).

the ship to drydock. This of course avoids many of the headaches connected with drydocking and can save a great deal of expense.

There are still a few maintenance and repair operations which cannot be done with the ship still afloat and therefore require drydocking. One such operation is pulling the tail shaft for inspection and maintenance/repair/replacement. Modern ship design has made it possible to extend the period for this, however.

Increasingly there is pressure on ship operators to take steps to eliminate or reduce the spread of invasive aquatic species via ship hull fouling.^{9 10} Before too long, vessels arriving at their destination with a heavily fouled hull may find themselves required to drydock their ship to have the fouling removed before they enter State waters or a port, or simply be turned away.

Above all there is underwater hull painting which can only be done in drydock. This includes repair of the coating system, renewing a biocidal antifouling system, reapplying a fouling release coating and all the various painting operations which conventional hull coating systems seem to demand.

IMO, State and classification society required drydocking

Also, as with cars, trucks, airplanes, trains and other vehicles, over time a number of laws and rules have been enacted which require, usually for the safety of crew and passengers but also for the protection of the environment, that certain routine inspections or surveys of ships be carried out in order for the vessel to continue to operate legally.

In addition to this, insurance companies have developed over time methods of classi-

fying ships in terms of their risk. In order for the insurance companies to provide insurance, they needed to know how much of a risk a ship was. This led to a classification system using letters and numbers. From this have developed a number of classification societies who have the expertise required to carry out this inspection and classification and to verify a ship's compliance to international (IMO) and individual States' laws and regulations.¹¹

These classification societies have also developed systems of rules of their own and their services are employed by shipowners to verify and certify that their ships meet the various requirements that they are supposed to. The classification societies become involved at the planning stages of a new ship, survey the ship during construction, certify it upon completion and then carry out routine surveys and inspections periodically while the ship is in service to make sure that it remains "in class." In the case of an accident occurring, the applicable classification society inspects the damage and determines the seaworthiness of the vessel and what repairs must be carried out either *in situ* or in drydock or both to get the vessel back up to the class requirements.¹²

The IMO, individual States and the classification societies require that ships undergo surveys or inspections at regular intervals, some of which must be carried out in drydock so that the underwater parts of the ship can be inspected, the integrity of the hull checked and a number of other examinations and inspections performed which are difficult to carry out with the vessel still afloat. Such surveys require periodic drydocking, although in certain cases some of these inspections can be replaced by Underwater Inspection In Lieu of

9 MEPC Annex 26, Resolution MEPC.207(62) "2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species," p. 15 (15 July 2011).

10 Hydrex White Paper No. 8, "Invasive Aquatic Species," (January 2012).

11 Philippe Boisson, "Role and Responsibility of Classification Societies in Maritime Safety," Chapter 8 of *II Jornadas Internacionales de Seguridad Marítima y Medio Ambiente*, Instituto Universitario de Estudios Marítimos, A Coruña, (November 2005).

12 IACS (International Association of Classification Societies) "Classification Societies – What, When and How?" (2011) <http://www.iacs.org.uk> accessed July 2012.



Underwater inspection in lieu of drydock (UWILD) being conducted via diver and close circuit TV equipment on board the workboat/diving platform.

Drydocking (UWILD).^{13 14} The frequency of such drydocking depends on the type of ship (e.g. passenger or cargo), the age of the ship and a number of other factors.

For example, following is a quote from Merchant Marine Circular No. 204 from the Panama Maritime Authority, under whose flag a healthy proportion of the world fleet sails, based on the IMO's Safety of Life at Sea (SOLAS) convention 74 amended. This circular concerns "Outside Ship's Bottom inspection and Dry docking Interface Periods for Panamanian Flagged Vessels."

3. The Panama Maritime Authority notifies to all Ship Owners/Operators, Legal Representatives and Recognized Organizations that the outside ship's bottom inspection periods for the Panamanian Flag registered ships, are as follows:

3.1. Cargo ships of 500 Gross Tonnage and above:

3.1.1 In accordance with the International Convention for the Safety of Life at Sea 74, as amended (SOLAS 74) Regulation I/10(a)(v), all cargo ships in possession of a Cargo Ship Safety Construction Certificate require a minimum of two inspections of the outside ship's bottom during any five year period of validity of the relevant certificate.

3.1.2 Cargo ships of 500 Gross Tonnage and above shall be subject to a minimum of two inspections of the outside ship's bottom, during the five year period of validity of the Cargo

3.1.3 Ship Safety Construction Certificate. One such inspection shall be carried out on or after the fourth annual survey in conjunction with the renewal of

¹³ MCA (Marine & Coastguard Agency [UK]) "In-Water Surveys," Marine Guidance Note MGN 217 (M) (January 2002).

¹⁴ IMO, "Guidelines for the Assessment of Technical Provisions for the Performance of an In-Water Survey in Lieu of Bottom Inspection in Dry-Dock to Permit One Dry-Dock Examination in any Five-Year Period for Passenger Ships Other than Ro-Ro Passenger Ships," MSC. 1/Circ.1348 (2 June 2010).

the Cargo Ship Safety Construction Certificate. Where the Cargo Ship Safety Construction Certificate has been extended under SOLAS as amended, regulation I/14(e) or (f), this (5) five-year period may be extended to coincide with the validity of the certificate. In all cases the interval between any two such inspections should not exceed 36 months.

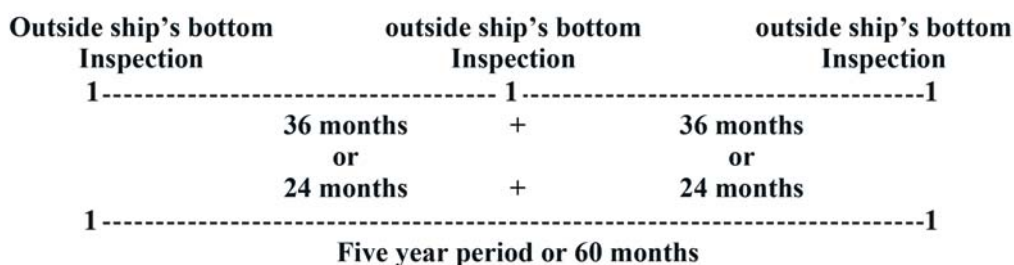
No extension will be permitted on the period of 36 months between any two such inspections.

proper equipment and suitably trained staff is available.

Prior authorization from this Administration to be granted by the Panama Seguma Office is necessary to complete an alternate inspection with the ship afloat.

3.1.7 Where an inspection of the outside of the ship's bottom is not completed within the periods specified above. To restore the validity of the Certificate should be carrying out the appropriate survey which, in such

Explained as follows:



3.1.4 The inspection of the outside of the ship's bottom and the survey of related items, should include an inspection to ensure that they are in a satisfactory condition and fit for the service for which the ship is intended.

3.1.5 Inspections of the outside of the ship's bottom should normally be carried out with the ship in a dry dock. However, consideration may be given to inspections of the ship's bottom not conducted in conjunction with the renewal survey to be carried out with the ship afloat in case of ships others than bulk carriers and oil tankers less than 15 years of age.

3.1.6 Inspections with the ship afloat should only be carried out when the conditions are satisfactory and the

circumstances, should consist of the requirements of the survey that was not carried out, but its thoroughness and stringency should have regard to the period of time beyond the survey due date. The Administration will investigate why the survey was not carried out within its lapse of time and consider further action, if necessary.

3.2. Cargo ships of less than 500 Gross Tonnage:

3.2.1 Irrespective of the navigation area this group of ships shall be subject to a minimum of two outside ship's bottom inspections during any five year period following the same instructions applicable to Cargo ships of 500 Gross Tonnage and above.

The required inspections of the ship's bottom for the renewal surveys of the Cargo Ship Safety Certificate under the provisions of the Decree 45 of the Republic of Panama could be carried out with the ship afloat.

Prior authorization from this Administration to be granted by the Panama Segumar Office is necessary to complete an alternate inspection with the ship afloat.

3.3. Passenger ships:

3.3.1 Irrespective of the navigation area passenger ships shall be subject to two outside ship's bottom inspection with the ship in a dry dock in a five (5) year period (60 months). In all cases the period of time between these two bottom inspections in dry dock shall not exceed 36 months. The remaining bottom surveys of these ships can be carried out as underwater surveys. Consecutive underwater surveys will be allowed for these ships.

3.3.2 The required inspections of the ship's bottom for the renewal surveys of the Passenger Ship Safety Certificate can be carried out with the ship afloat.

3.3.3 Inspections with the ship afloat should only be carried out when the conditions are satisfactory and the proper equipment and suitably trained staff is available, and previous authorization has been issued by this Administration through the Panama Segumar Office.

3.3.4 Operators of Panamanian Passenger ships of less than 15 years of age will make the request for underwater survey in lieu of dry dock directly to the ship's Recognized Organization. The Recognized Organization will evalu-

ate the request and, after considering all relevant information, make a recommendation to this office. If the request is approved, the underwater examinations will be performed according to the Recognized Organization procedures, by personnel of companies certified by the Recognized Organization to do these surveys and to the satisfaction of the attending surveyor.¹⁵

This excerpt from the Panama Maritime Authority Circular is used only as an example of prevailing regulations regarding ship bottom surveys and drydocking.

Full details of the regulations regarding drydocking can be found online and in various documents issued by the IMO, by States and by the classification societies. Some of them are universal in scope, being governed by international law, while others vary from State to State and classification society to classification society.¹⁶

Some ships are required to drydock twice in any five year period, the longest interval being 36 months. Others may waive one of those drydockings and have an underwater inspection instead. More recently the classification societies have made it possible for many ships less than 15 years old to extend the interval to seven and a half years before mandatory drydocking.¹⁷

Drydocking and paint

This then brings us to the biggest single item which causes a ship to go to drydock voluntarily: PAINT (or perhaps one should say, PAINT and BIOFOULING, since it is really a combination of the two).

The major reason for voluntary drydocking of a ship is that the hull needs to be cleaned of biofouling and the paint coating

The major reason for voluntary drydocking of a ship is that the hull needs to be cleaned of bio-fouling and the paint coating repaired or replaced.

¹⁵ Panama Maritime Authority General Directorate of Merchant Marine, Merchant Marine Circular No. 204, "Outside Ship's Bottom inspection and Dry docking Interface Periods for Panamanian Flagged Vessels," (August 2009).

¹⁶ International Association of Classification Societies (IACS) "Requirements concerning SURVEY AND CERTIFICATION," IACS Rec. 2011.

¹⁷ Germanischer Lloyd, "Guidelines for Extended Dry-Dock Interval," (2010).

repaired or replaced.

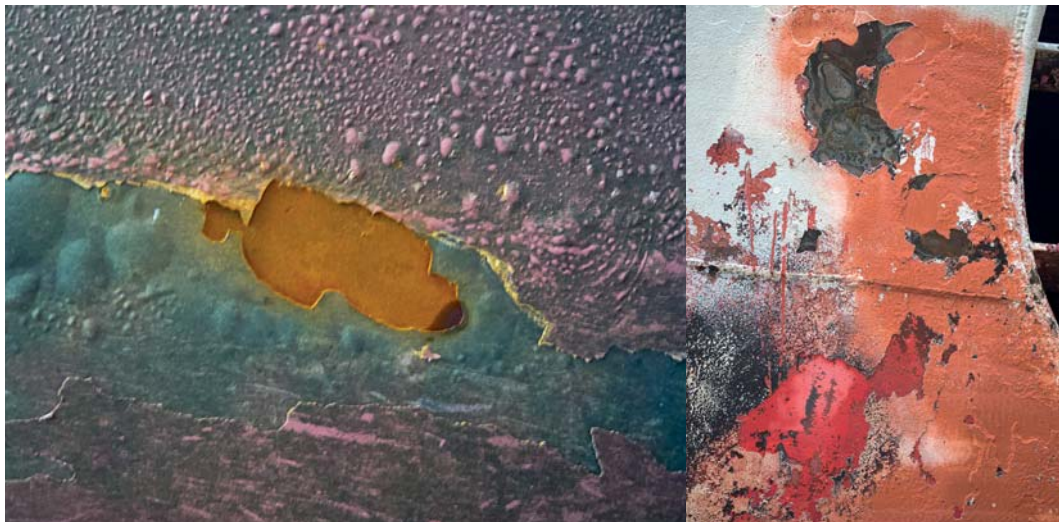
Although there are claims that antifouling paint or fouling release coatings will keep a ship fouling free for five years or longer, ship operators' experience on the whole with the post-TBT coating systems varies considerably from these claims. Instead, a few months or a year after a ship has launched with a new or replenished or patched paint coating she is already experiencing noticeable drag due to fouling, the fuel efficiency is dwindling and the operator finds himself having to spend a great deal more money on fuel compared to initial sea trials. The longer a conventional coating system goes without full reblasting and recoating, the rougher the hull becomes and the higher the fuel penalty climbs, reaching as much as 25-40% after ten years or so just as a result of hull coating degradation, not even factoring in biofouling.¹⁸

drag, emit a higher volume of GHG and risk the spread of non-indigenous invasive species

2. Have the hull cleaned in the water
3. Drydock the ship and have the hull cleaned and the coating repaired/patched/renewed or replaced entirely.

The problem with option 1 is obvious. Much higher fuel costs raise the overall cost of shipping. The spread of invasive species may not be a concern to the ship operator but will become so as States and the IMO impose regulations to prevent such a spread. The same applies to GHG emissions which are obviously higher as more fuel is consumed in getting the ship from A to B and will soon become the subject of regulation.

With conventional hull coatings, either biocidal or fouling release systems, option 2 (much cheaper than option 3), presents new



Ship hull coatings after years of spot blasting, patching and reapplying antifouling coatings.

When the fuel efficiency drop becomes noticeable, the operator has a few options:

1. Ignore the fouling, spend a great deal more money on fuel to overcome the increased

problems. With biocidal antifouling coatings, even light in-water cleaning creates a pulse discharge of biocides which is hazardous to the environment both in terms of water pollution and sediment contamination.

¹⁸ Hydrex White Paper No. 9, "Hull Coating Degradation – the Hidden Cost," (February 2012).

Trying to clean a biocidal coating will also deplete the coating, reducing its effective life. Because these coatings are relatively soft, the cleaning roughens the hull surface itself and thus defeats the economic purpose of the cleaning – to improve fuel efficiency.¹⁹

In the case of fouling release coatings, again, unless the cleaning is very light and there is only a biofilm present, the coating will be damaged by the cleaning and will then be ineffective or less effective in preventing fouling from attaching or in releasing it easily.

Unless a ship operator commits to hull grooming or very regular cleaning which does not permit more than a slime layer to accumulate before the hull is cleaned, then a fuel penalty varying between about 7% to 40% or considerably more in the case of heavy calcareous fouling will accrue.²⁰

The alternative will be to drydock every year or two to have the hull properly cleaned and the coating system repaired, replenished or replaced. This may be good for paint sales but is not economical for ship operators.

This section on paint applies specifically to biocidal antifouling paint systems and “non-stick” fouling release paint systems. It does not apply to certain hard Surface Treated Composites (STCs) which can be effectively cleaned in the water without damage to coating or environment.

Section summary

Ships do need to drydock periodically for certain repair and maintenance operations which can only be done with the ship out of the water. In fact, these activities are rather few and most needed repair and maintenance can be carried out with the ship afloat.

There are international, State and classification society regulations which require

ships to drydock periodically for inspection and certificate renewal. The period varies from twice every five years to once every seven and a half years. Bottom surveys can also be carried out underwater under certain circumstances.

The main reason a ship has to voluntarily go to drydock is to remove accumulated biofouling and repair or replace coating systems. This applies to biocidal antifouling and fouling release coating systems. The longer a vessel operates without reblasting the hull and reapplying the coating system, the rougher the hull becomes and the higher the fuel penalty incurred.

If hull fouling is allowed to accumulate beyond a slime layer, then the threat of spreading invasive aquatic species increases and steps need to be taken to prevent this spread. This may require drydocking the ship.

The need to drydock to clean off biofouling and repair or replace the coating system is not applicable to Surface Treated Composites (STCs) since these are expected to last the life of the ship and can be cleaned in the water without negative effects to coating or environment. In the case of NIS, the ship can be fully cleaned before sailing and will thus arrive at the destination port without macrofouling.

¹⁹ Hydrex White Paper No. 4, “Ship Hull Coating Systems Simplified,” (May 2011).

²⁰ Hydrex White Paper No. 9, “Hull Coating Degradation – the Hidden Cost,” (February 2012).

Part III. Drydocking issues

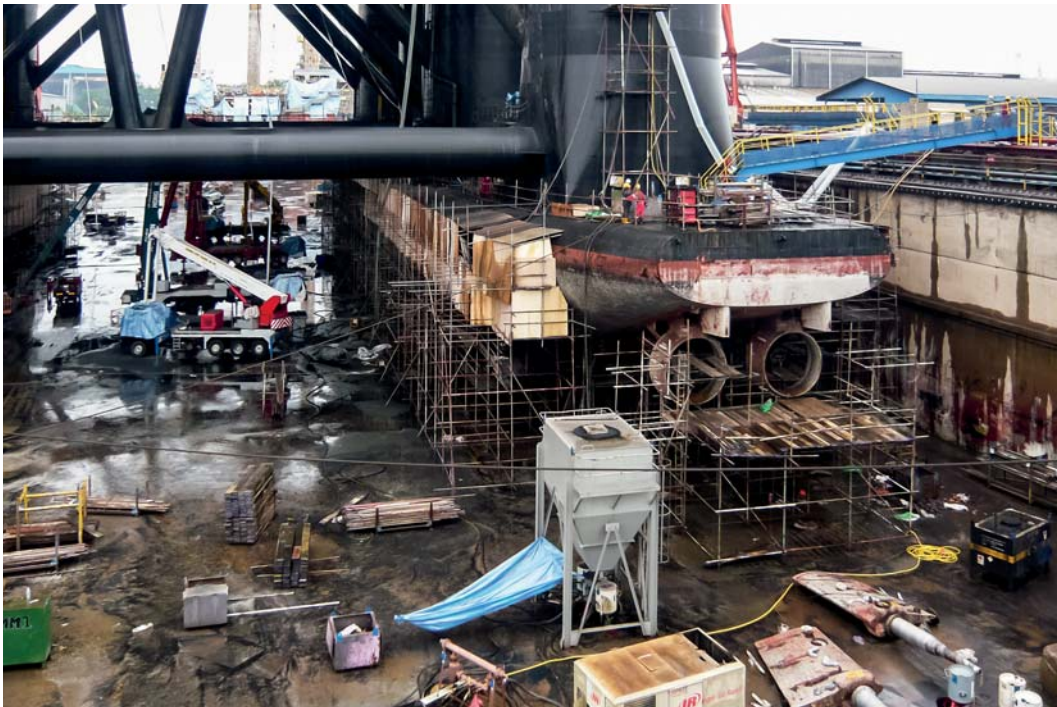
There are a number of issues associated with drydocking which contribute to its reputation as a necessary evil. Some of the main ones are listed here, not particularly in order of magnitude.

1. Having to go to drydock at all
2. Finding a convenient drydock which is capable of doing any work required to a high standard and which is available for any given vessel when it is time for that vessel to go to drydock
3. Interrupting normal ship operations for what can be a considerable length of time in order to get the ship into drydock, the work done and the ship undocked again
4. The extensive and costly preparations which may be needed prior to drydocking, depending on the type of ship (a naval

vessel, for example, may have to unload all of its ammunition before entering drydock, cargo vessels and tankers discharge their loads and the tanks must be clean and gas free, etc.)

5. The cost of the drydocking itself including the drydocking fees, outside contractors and all the various specialists required to carry out the work
6. The possibility of damage occurring to the ship in drydock or as a result of docking or undocking, hazards to crew and drydock employees and other dangers involved.

It is worth having a look at these points so that one can see clearly the advantages of drydocking less frequently and for shorter periods of time.



Ship in drydock.



Ship in drydock.

1. Having to go to drydock at all

The reasons for drydocking have been covered in the previous part of the White Paper. There is no complete avoidance of drydocking. However, any factors which can make those visits as infrequent as possible are welcomed by all shipowners and operators.

2. Finding a convenient drydock which is capable of doing any work required to a high standard and which is available for any given vessel when it is time for that

vessel to go to drydock

Ships often follow set routes. For example, a cruise ship may routinely cruise the West Coast of the United States and Canada, visiting Alaska and back to Long Beach. Lack of a suitable drydock or shipyard on that route may force the ship to go through the Panama Canal to a US East Coast or Gulf Coast facility. This adds unwelcome extra time and expense to the procedure of drydocking. However, it may be necessary due to conflicting schedules, lack of the right

size drydock or necessary services or low quality of workmanship or a number of other factors.

The larger the ship, the fewer drydocks there are that can service it and the further out of the way it may have to go for drydocking.

Whether the ship's route is set or not, it is more the exception than the rule that there will be the necessary drydock facility available just when and where it is most convenient.

3. Interrupting normal ship operations for what can be a considerable amount of time in order to get the ship into drydock, the work done and the ship undocked again

What is a ship's daily revenue? For the owner, what is the daily time charter fee? For the operator, how much lost revenue and profit does an inactive day for a ship represent? Even military ships have a value associated with being in operation or potential operation, whether or not their country is at war.

Not having a ship available for a number of days or weeks or even longer can be extremely costly to the owner and/or operator of that ship or to the taxpayer.

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This is a fixed, calculable sum for any given ship. If it spends two weeks in drydock, it loses twice as much revenue as it would if it undocked after one week. If a ship drydocks once in ten years it saves half of what it would spend if it has to drydock twice in the same period of time.

If drydocking is at all avoidable, then the owner or operator or both benefit financially by being able to keep the ship working and earning its daily income.

4. The extensive and costly preparations which may be needed prior to drydocking,

depending on type of ship (a naval vessel, for example, may have to unload all of its ammunition before entering drydock, cargo vessels and tankers discharge their loads, etc.)

One may think of drydocking as simply sailing to the drydock, having the ship towed in and then emptying out the dock so that the ship is ready for service, repair, maintenance. However, extensive and costly preparation is required to get a ship ready for drydock, varying in extent by type of ship, but much more in all cases than one might imagine.

Cargo vessels of any kind need to have the cargo discharged ahead of time. Tankers need to have their tanks empty, clean and gas free. That means finding a suitable place to unload. In the case of cargo that needs to be delivered in Singapore before the vessel can drydock in Shanghai, and where the next port of call is Colombo, one can see that the drydocking will be very inconvenient and expensive. Passenger vessels need to discharge their passengers. Warships must unload all their ammunition and any potential security threats from having the ship in drydock would need to be taken care of.

Living arrangements need to be made for the crew while the ship is in drydock. Electric power, water, sewage and a hundred and one other things need to be prepared for so that the ship can be drydocked.

These preparations involve time, money and stress for the officers, crew, operator and owner of the ship.

5. The cost of the drydocking itself

Drydocking fees vary greatly from one shipyard to another. Some examples will give an idea of orders of magnitude. Quotes for drydocking a Panamax bulk carrier in three different shipyards in China ranged from

\$570,000 to \$647,000 for 20 days with all repairs. A 12-day stay in drydock for the ship ended up costing \$238,000 after considerable expert negotiation.²¹

The actual cost of drydocking can also greatly exceed initial estimates as new repairs are found to be needed, the weather holds up work (particularly exterior painting) and for a number of other reasons. It is not at all unusual for the owner to pay a bill which is much higher than the original quote. In any event, even the best and smoothest of drydockings are still very costly.

... even the best and smoothest of drydockings are still very costly.

6. The possibility of damage occurring to the ship in drydock or as a result of docking or undocking, hazards to crew and drydock employees and other dangers involved

This point does not require much amplification. Ships are designed to live in the water, not on dry land. All of their dynamics are based on being afloat. Taking a ship out of the water and supporting it on wooden blocks is a tricky and hazardous operation and one which preferably occurs as infrequently as possible.

These are some of the general issues connected with any drydocking. They are enough to encourage shipowners and operators to welcome anything which can make drydocking as infrequent an event as possible in their lives.

Paint specific issues

There are, however, other issues connected with current practices regarding underwater hull coating and their relationship with drydocking.

1. Conventional biocidal and fouling release coatings do not last very long and are very

much subject to degradation. They need to be repaired and replaced.²² The tendency is to spot blast and patch these coatings for the first two or three drydockings and then eventually, when the coating is unbearably rough, to blast the hull back to bare steel and replace the whole system, perhaps after ten or twelve years. The patching and repair done in drydock contributes to the coating degradation and the fuel penalty steadily increases over the ten or twelve year period in between complete replacement of the entire coating system.

2. The frequent repair and replacement of toxic coatings is harmful to the environment. The toxic waste that comes off a hull coated with a biocidal coating tends to make its way back into the local marine environment, pollutes the water and contaminates the sediment. The ultra high concentrations of heavy metals and various toxic substances around any shipyard testify to this. Frequent reapplication of hull coatings also results in high VOC emission. The regular repair and replacement of hull coatings in drydock constitutes an environmental hazard.

The regular repair and replacement of hull coatings in drydock constitutes an environmental hazard.

For these reasons, a long-lasting Surface Treated Coating is a better choice. It is applied once and lasts the life of the hull with only very minor touch-ups required in drydock (typically less than 1% of the wetted surface area, which adds up to a few cans of paint) and is environmentally benign. It can be cleaned repeatedly in the water without harm to coating or environment. And it becomes smoother with each in-water cleaning, avoiding the paint degradation associated with other types of coatings.

²¹ Idwal Marine Services "DRY-DOCK MANAGEMENT" (2012).

²² Hydrex White Paper No. 9, "Hull Coating Degradation – the Hidden Cost," (February 2012).

Part IV. How to avoid hull paint driven drydocking

How to avoid having to go to drydock frequently in order to repair or replace damaged, worn or depleted underwater hull coating systems is so simple it seems to have escaped the shipping industry's broad notice....

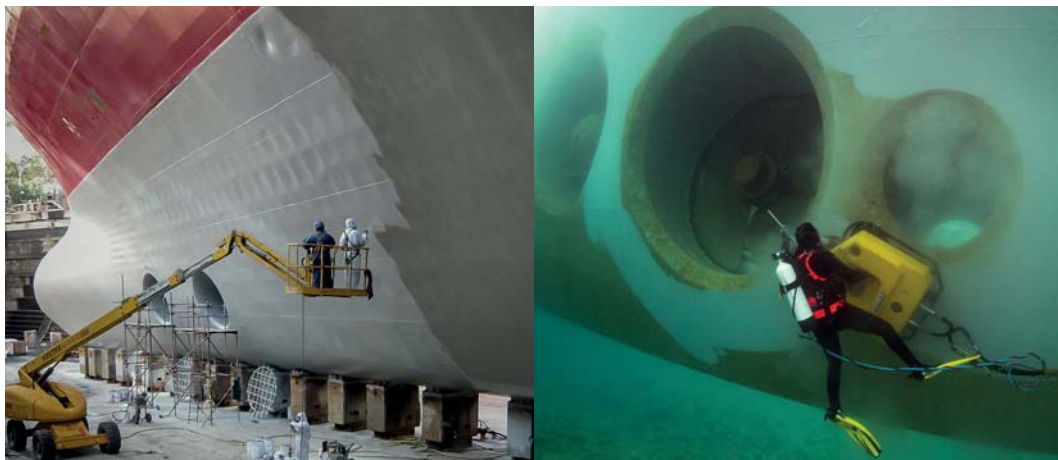
How to avoid having to go to drydock frequently in order to repair or replace damaged, worn or depleted underwater hull coating systems is so simple it seems to have escaped the shipping industry's broad notice:

1. At newbuild or at next drydocking a long-lasting, extremely durable and tough non-biocidal, non-leaching underwater hull coating is applied after the hull has been blasted to Sa 2.5.
2. Routine in-water hull cleaning is thereafter used to keep the hull free of any macrofouling and most microfouling.

repeated applications, it is economically sound for shipowner and operator.

The answer is really that simple. But since it may appear to be too simple, further explanation is provided.

The most durable, most resilient, toughest, best protecting underwater hull coatings are glassflake based surface treated composites (STC). They have been proven to stay on the hull in the harshest of conditions (2.5 meter ice mixed with volcanic lava in Antarctica, for example). Applied to rudders they even prevent cavitation damage to the steel. They work well on steel, aluminum and glass-reinforced plastic hulls. In order for them to adhere properly they require grit blasting of



(left) Applying an STC and (right) in-water cleaning of an STC coated hull.

This system works on the basis of replacing chemicals with good old-fashioned elbow grease and employs more people – good for local economies. Since the cost of this system is overshadowed by the savings from a reduced fuel penalty and from avoiding

the hull to Sa 2.5. A good profile is key to their success. Once properly applied they are guaranteed to last for ten years intact and are expected to last the full service life of the hull – 25 years – requiring no more than very minor touch-ups during routine dry-

docking. The STC is applied to the entire wetted surface area, including all niche areas. The only exception is the propellers which at this time are best left uncoated and cleaned regularly.²³

The routine cleaning of the underwater hull needs to be tailored to each vessel. Warmer waters and longer times in port or at anchor mean faster and heavier fouling and therefore more frequent cleaning. Colder waters, shorter times in port, operating in ice and similar factors usually mean that the ship will foul less and will require more infrequent cleaning.

From an economic point of view, with cleaning organized efficiently so that even the largest ships can be fully cleaned including all niche areas in 6-12 hours, one can afford to clean once every month or two and still save a great deal of money with this system of hull protection, compared to conventional systems. (Underwater cleaning is described in great detail in Hydrex White Paper No. 5 "Underwater ship hull cleaning: cost-effective, non-toxic fouling control," published in July 2011.)

When one takes into account the total cost of ownership of the ship, the savings really mount up: fuel savings from reduced drag; savings on costs of drydocking and repairing or replacing the hull coating system; saving on off-hire expenses while ships are in drydock for repainting. Those are some of the financial savings. There are also major environmental savings. The absence of toxic chemicals emitted into the water column and contaminating the sediment is only one part of it. The improved fuel efficiency from a smooth hull means lower CO₂ and other air emissions. Not having to blast off and replace toxic paint coatings helps eliminate pollution around shipyards. Not having to repaint

regularly means reduced VOCs. Keeping a hull and niche areas clean eliminates the spread of invasive aquatic species via ship hull fouling.

The infrastructure for in-water cleaning on an industrial scale is in its infancy. But there was no network of fuel stations or even of highways when the internal combustion engine driven automobile was introduced but this did not prevent it coming into widespread use. The increase in demand for internet services is leading to greater and greater availability of wi-fi networks. Thus as the demand for fast, efficient and economical in-water cleaning grows, so will the supply. The infrastructure is easy to establish. It is not a major obstacle to overcome.

The restrictions placed by certain ports and States on in-water cleaning were designed to prevent water and sediment contamination by heavy metals and biocides from antifouling paint and to prevent the distribution of invasive aquatic species by macrofouling from badly fouled ship hulls. They are not needed in the case of non-toxic coatings and the regular cleaning of ships' hulls where only a slime layer or weed or grass are present or any macrofouling has been picked up in the local area. Many ports and States permit in-water cleaning of non-toxic hull coatings where the fouling is limited to a biofilm and/or where the fouling has been picked up locally.²⁴

²³ Hydrex White Paper No. 10, "Ship Propeller Maintenance: Polish or Clean?" (March 2012).

²⁴ Hydrex White Paper No. 8, "Invasive Aquatic Species," (January 2012).

Part V. Conclusions

There are many reasons for ships to extend the drydock interval to seven and a half, ten or even more years. An extended drydock interval would help reduce the cost of shipping and be of great benefit to the environment.

The main barrier to this drydocking interval extension is fouling control. An associated but lesser barrier is hull corrosion protection. It should probably be stated as underwater hull protection and fouling control as these are two sides of the same coin.

Current practices consist mainly of the use of biocidal antifouling coatings with a much smaller reliance on fouling release coatings. For a number of reasons, neither of these types of coatings is suitable for in-water cleaning. These types of coatings will not control fouling sufficiently over an extended period and need to be drydocked fairly frequently for coating replenishment, repair or replacement or an excessive fuel penalty will accrue.

One possible answer is very frequent “hull grooming” of fouling release coatings if it can be demonstrated that this does not pose a water pollution problem. However, these types of coatings tend to be fragile, suffer from mechanical damage and then cease to work, thus requiring a trip to drydock to repair the coating. They also have the liability of fouling more seriously if the ship

is laid up, and then in-water cleaning by the usual mechanical brush approach will definitely damage the coating.

The obvious answer is the application of a very tough, long-lasting but chemically inert, nontoxic surface treated composite. This type of coating will last more than ten years without need of replacement or major repair and is expected to continue to provide full hull protection for the life of the ship. It is not biocidal nor “non-stick” but requires routine in-water cleaning to keep it free of fouling. This cleaning is easy and cost-effective in terms of fuel savings and is environmentally safe.

Proper preparation of the hull and correct application of an STC coupled with a regimen of in-water cleaning of the hull, the niche areas and the propeller are an economically viable means of extending the drydocking period to seven and a half, ten or even more years while preserving the integrity of the hull and keeping the ship fouling free.

In addition to the economic benefits, this system has many environmental benefits which include the elimination of pollution of the water column and contamination of sediment, the reduction of CO₂ and other air emissions, the reduction of VOCs and the elimination of the spread of invasive aquatic species via hull fouling.

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Making Waves

**Sensible, comprehensive,
simple but vital information on:**

- saving fuel costs by optimizing ship
- state-of-the-art, environmentally-safe fouling control
- reducing GHG emission from shipping
- containing invasive species
- reducing drydocking



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www.shiphullperformance.org



European Headquarters

Hydrex nv

Haven 29

2030 Antwerp - Belgium

Phone: +32 3 213 53 00 (24/7)

Fax: +32 3 213 53 21

E-mail: hydrex@hydrex.be

www.hydrex.be

US Office

Hydrex LLC

604 Druid Rd E

Clearwater, FL 33756 - USA

Phone: +1 727 443 3900 (24/7)

Fax: +1 727 443 3990

E-mail: info@hydrex.us

www.hydrex.us

