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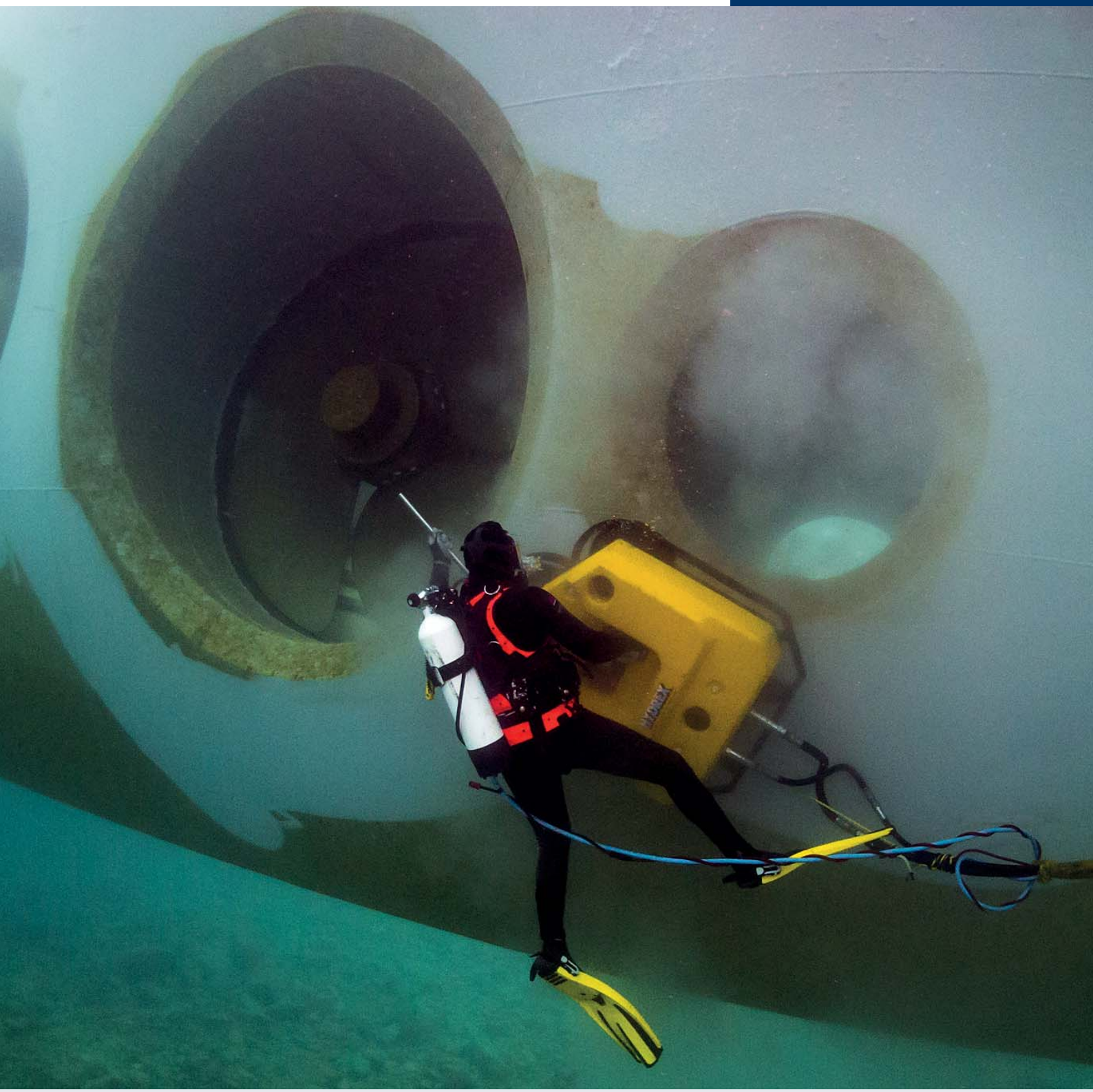
SHIP HULL PERFORMANCE TECHNOLOGY

NEWS LETTER



Total Protection

The rudder of MV Elisabeth Russ before Ecospeed was applied in 2004, showing heavy cavitation damage.

The rudder of MV Elisabeth Russ in drydock in 2011. No further cavitation damage has occurred in the intervening 7 years.

Ships have been sailing for up to nine years (and counting) with Ecospeed without having to replace the coating on their rudders or having to opt for important and costly steel repairs.

Ecospeed can be applied on a rudder at a very low cost, especially compared with the large drydock costs. It will give a rudder supreme protection against cavitation and corrosion damage for the rest of the vessel's service life.

Ecospeed is a really fast and easy way of keeping a rudder's performance at maximum efficiency at all times.

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Ecospeed comes out on top after two year test on dredger

In April 2010 parts of the flat bottom and Kort nozzle of a 96-meter trailing suction hopper dredger were coated with Ecospeed in Klaipeda, Lithuania, while the rest of the vessel was treated with the same coating system that had been used during previous dockings. When the vessel came into drydock in August 2012 at the Damen Shipyard in Flushing, the Netherlands, the Ecospeed coating was still in very good condition while no protection was left on the rest of the underwater vessel.

Dredger in drydock with traditional coating completely gone.

The 96-meter trailing suction hopper dredger has a hopper capacity of 4,500 cubic meters and a loading capacity of 6,780 tons. Because the ship is not very long for a vessel with such loading capacity, it is ideally suited for maintenance and deepening work in smaller sea ports. In order to be able to unload in shallow water, a gate valve is mounted in both overflows. This makes it possible to unload without opening the bottom doors. As the ship can carry approximately 3,200 tons in water depths of up to five meters, the dredger is also suitable for so-called outer shore replenishments which are part of coastal protection works.

The coating used until now (left), and Ecospeed (right) after two years of dredging.

Because of the nature of the operations the ship is used for, it almost constantly grinds against the mud and sand of rivers and ports. It is essential that the underwater ship is given a strong and lasting protection. If the underwater coating is gone in less than a year then the hull will be completely exposed to the grinding impact of the sand, making the vessel much more vulnerable to mechanical damage.

Not satisfied with their previous coating, the owners decided in 2010 to apply Ecospeed on those areas most prone to damage. Ecospeed is

Traditional coating (left) completely gone and Ecospeed (right) still in good condition on the Kort nozzles of the dredger.

The Ecospeed coating is still protecting the vessel after two years in operation.

a hard coating that can withstand the constant impact of debris, ice or the grinding of sand. This has been proven on numerous occasions by ships sailing with Ecospeed in harsh winter conditions for over seven years. During the recent docking it was clear that the coating had given the vessel a much better protection. This once again confirms Ecospeed's long lasting qualities. ■

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Ecospeed rudder applications prevent cavitation damage

Last month several rudders were coated with Ecospeed in China. The rudder of a 294-meter container vessel was treated in Shangai. Around the same time a 125-meter LPG tanker had its rudder coated in Dalian.

The owners decided to use Ecospeed after cavitation damage had appeared on the rudders of their vessels. Ecospeed will prevent similar damage from occurring again.

The coating provides the rudder (and/or the entire underwater hull) with an impenetrable protective layer. At the same time its toughness and 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.

Application of second layer of Ecospeed on LPG tanker.

Ecospeed is applied in only two identical layers.

After steel surface treatment, an Ecospeed application is very simple and fast.

No repaint will be needed during future drydockings.

Ecospeed protects rudders against cavitation damage.

Tests in a flow channel were carried out in Grenoble. These have confirmed that Ecospeed performs extremely well under severe cavitation. The tests were divided into six stages. Ecospeed was exposed to an increasing pressure drop, leading to a growing cavitation force. Even after the last stage no erosion was present on the test patch coated with Ecospeed.

With an Ecospeed application no repaint will be needed during drydocking. Ecospeed is guaranteed for ten years. At most, minor touch-ups will 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. This allows rudders to operate at maximum efficiency. The ship's performance therefore remains stable and the owner's investment is secured.

Thanks to the Ecospeed application, the rudders of both vessels will be safeguarded for the remainder of their service life. ■

The only coating that can keep up with your ship's engine

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

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

Ecospeed gives a very thorough and lasting defense against cavitation and corrosion damage for a ship hull's entire service life. The coating comes with a ten year guarantee. No repaint will be needed during future drydockings.

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Eliminating hull-borne aquatic invasive species

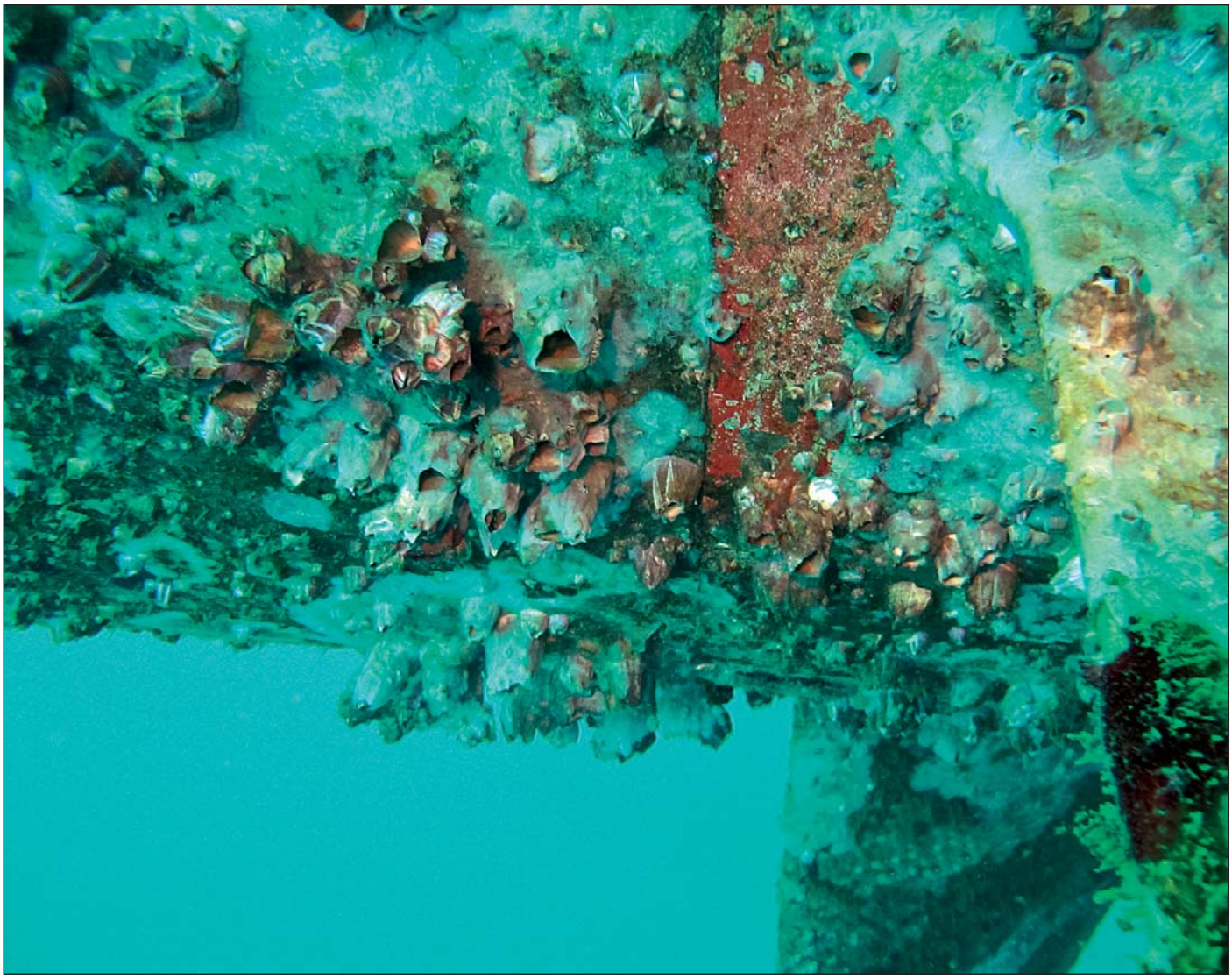
an alternative, practical and fully workable approach

by David Phillips, *Editor, Journal of Ship Hull Performance*

One hears and reads a great deal these days about aquatic invasive species (AIS), also known as non-indigenous marine species (NIMS), non-indigenous species (NIS), aquatic nuisance species, alien species and by a number of other names. NIS is perhaps the most prevalent term in non-scientific circles. While earlier efforts to prevent the spread of NIS translocated by shipping concentrated on ballast water and how to treat it, in the last few years ship hull fouling has increasingly come to be recognized as an equal or greater culprit in the problem.

While there are recommended approaches to dealing with hull-borne NIS, they tend to take the conventional approach to biofouling control. If these approaches were effective, the problem would not keep coming up.

Is a better approach available?



Macrofouling in a niche area of a ship coated with antifouling paint.

The NIS problem

Marine ecosystems are local. When non-native species are introduced, deliberately or accidentally, they can cause serious environmental and economic problems in their new environment. They do this in a number of ways which can include the destruction of local species which are important to the environment they are invading, damage to infrastructure in their new locale and obliteration of local industry.

There's no question among scientists that NIS are a serious, expensive, global problem, nor that ship hull fouling is one of the major vectors for the transfer of aquatic NIS.

NIS are an economical as well as an environmental problem. It is more efficient and far less expensive to prevent the translocation of NIS in the first place than to try to repair the damage they cause and eliminate the now-established species and prevent their further spread. Thus it is the responsibility of all those who sail ships between environmental zones to make sure that they are not translocating NIS via fouling on their ship's hull.

Need of change

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.

The pressure, mostly regulatory, on shipowners and operators to prevent the spread of NIS via ship hull fouling is also increasing, with some rigorous measures on the horizon.

The major international initiative regarding hull-borne NIS has come from the IMO in the form of "2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species" adopted 15 July 2011. These voluntary guidelines, still under review, recommend various hull husbandry measures and record keeping designed to, as the title suggests, minimize the transfer of NIS. These guidelines are still under review.

Australia and New Zealand have been at the forefront of recognizing and addressing the issue of NIS. They have been working on revising the ANZECC (Australian and New Zealand Environment and Conservation Council) code with a view to preventing bioinvasions into Australia and New Zealand via international shipping. They have commissioned extensive and in-depth studies of current technology for biofouling control including types of coating and in-water cleaning methods and have published their findings. They have issued draft guidelines and are evaluating public response before finalizing.

Recognizing the increasingly serious problem of invasive alien species in Europe, the European Commission is currently working on a dedicated legislative instrument on Invasive Alien Species which is due to be adopted this year.

The California State Lands Commission has drafted proposed legislation designed to prevent the introduction of NIS into California, which is making its way through the legislative machine. California is working with other Pacific Coast US and Canadian states and provinces, Oregon, Washington, Alaska, British Columbia and Hawaii.

The Polar Code is expected to include measures to prevent the import of NIS into sensitive polar waters.

It would seem that we are heading inexorably towards mandatory regulations concerning ship hull biofouling control.

Implementing an effective system can be much less expensive and stressful if one looks well ahead, plans new builds accordingly now, chooses hull coating systems with impending regulation in mind and applies them at the next scheduled drydocking. The industry learned the hard way with TBT what happens if you just procrastinate and hope that it will all go away.

The problems with the current approach

All hull coatings foul in varying degree. How much they foul depends on the coating itself, the operational pattern of the vessel, the climate and therefore the temperature of the water in which the ship operates. Perhaps 90% of the world fleet is using biocidal antifouling coatings. In most cases the coating is applied at newbuild stage and patched, renewed or replaced during each class-required drydocking. The vessel operator may schedule in-water cleaning in between drydocking but in-water cleaning of hulls and particularly of niche areas is fairly infrequent.

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, but in-water cleaning is an essential 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 just as much or more than on the state of the hull at the port of destination. Current efforts by ports and States to limit the spread of NIS concentrate on incoming ships and neglect those that are outward bound.

Biocidal coatings have four main issues:

1. They are toxic and by their nature pollute the marine environment and pose a hazard to non-target organisms, to marine life in general and potentially to human health, as numerous studies have found.[i]
2. They are not suitable for in-water cleaning. The cleaning depletes and damages the coating and produces a pulse discharge of biocides.
3. A number of copper-tolerant and other biocide-tolerant aquatic species have been found (for example the fouling alga *Ectocarpus siliculosus* and the invasive bryozoans *Shizoporella subtorquata*) which thrive on these toxicants and are not deterred by the copper-based AF coatings. The biocide tolerant species become tougher and more resistant than the non-biocide tolerant species in the environment which they invade, posing a worse problem than normal invasive species. Thus biocidal antifouling creates "gladiator species" of invaders which dominate the invaded area.[ii]
4. Biocidal AF coatings require a water flow for the biocides to be replenished and continue to leach. The lack of flow in niche areas makes this type of coating ineffective or less effective. While they can be effective in preventing much of the macrofouling on the main hull, at least for a year or two, there are many so-called "niche areas" of the ship which they do not protect, these areas being protected from the main flow of water past the hull. Sea chests, gratings, the stern area, bilge keels, thruster tunnels and

In-water cleaning of a cruise ship hull with a surface treated composite coating on the hull.

similar nooks and crannies tend not to be kept clear of macrofouling by biocidal antifouling coatings.

Some ships have switched to fouling release coatings with or without cleaning. This system is only effective on the main hull of fast ships which do not stay long in port or at anchor.

Fouling release coatings have the following issues:

1. They tend to be fragile and easily damaged. Thus they cannot be cleaned with abrasive brushes and only microfouling can be gently removed without ruining the coating.
2. They require a water flow past them to work. Thus in niche areas they are ineffective.
3. If a vessel is laid up for any length of time it tends to foul.
4. There is a question about the toxicity of these coatings. For example, studies have shown that silicone fouling release coatings interfere with the enzymes in barnacle glue. This is a biochemical reaction, not simply a surface energy manifestation. Research has also shown that silicone oils can smother benthic organisms. At the very least, more research is required. The precautionary principle applies.[iii iv]

Frequent drydocking for cleaning of the hull would be ideal. This is, however, impractical and not feasible for economic reasons and because, particularly in the case of large ships, drydock facilities are inadequate to cope with frequent drydocking.

The IMO guidelines, the draft ANZECC code revision, EU guidelines, the California State Land Commission proposed regulations all acknowledge the need for in-water cleaning between drydocking in order to remove macrofouling that has accumulated on the hull and in the niche areas, regardless of coating type, and which therefore poses a threat of spreading NIS.

However, in most ports and States, in-water cleaning of biocidal antifouling coatings is forbidden.

And even where it is permitted, underwater cleaning of a biocidal antifouling, and fouling release coatings is often damaging to the coating and hazardous to the environment. In-water cleaning of a fouling release coating with any degree of macrofouling is at least damaging to the coating and possibly to the environment as well. The environmental effects of fouling release coatings are largely unresearched although there is evidence of toxicity.

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 fully workable solution which is acceptable to governments, port authorities, environmental groups and the shipping industry. The ideal solution would also bring with it fuel savings, reduction of GHG and other emissions and elimination of the contamination of ports and oceans caused by heavy metals and other toxicants contained in traditional biocidal antifouling paints.

Comprehensive approach

It can be a big mistake to adopt a one-track approach to solving the NIS issue without taking other related factors into consideration.

NIS are an environmental and economic problem. Any solution to the problem has to take into account all related environmental and economic factors. Otherwise the solution simply becomes a new problem.

The main factors, environmental and economic, that need to be taken into account in any address to the hull-borne NIS problem:

1. Preventing the spread of NIS
2. Avoiding toxic pollution of water column and sediment contamination
3. Improving fuel efficiency, thus reducing noxious air emissions
4. Doing all of the above in a way that is economical and cost-effective to the shipping industry so as to reduce the overall cost of shipping

That is quite a challenge, but any solution, in order to be workable, popular and enforceable, has to balance up all these factors. The test of any approach is how little one has to compromise with any of these points.

Alternative, non-toxic approach

This brings us to the crux of this article: an alternative approach to the NIS problem which is novel, different and aligns with the recommendations of the above quoted study.

By its very nature this technology is disruptive of the status quo in the shipping industry. However, we have already established the fact that the status quo is not working. So it's time to look at an alternative

approach. This is one possible alternative.

There are a number of non-toxic coatings and systems. The one described here is a commercially available glassflake STC. This system combines a hard, inert glassflake reinforced coating with routine in-water cleaning.

The hard coating is properly applied over the entire underwater hull including niche areas (but not the propeller). Inside sea chests, on the rudder, in the thruster tunnels, everywhere. If applied properly on correctly prepared steel, aluminum or GRP it can last the life of the hull with minimal touch-ups during routine drydocking. The coating is homogenous and relatively thick (1000 microns usually). No primer or other type of coating is required. It is applied directly to the prepared hull, usually in two coats, with an overcoat time of about three hours minimum and no maximum. It is very easy to apply.

This hull is then cleaned regularly in the water using mechanical brushes, high pressure water jet and a variety of other tools. Ideally from a fuel consumption and NIS point of view, the fouling is kept at no more than a light slime layer. The frequency of cleaning will depend on the operating pattern of the vessel and the climate where it is sailing.

Cleaning of the main hull is done by large, diver operated multiple brush machines. Niche areas are cleaned with smaller brushes and with high pressure water jet equipment. If the ship is cleaned regularly then there need be no concern about bioinvasions on the part of the fouling removed since it will be local species. Using this system a 400 meter VLCC can be cleaned at anchor by two teams of divers in under twelve hours.

In order for the niche also to be cleaned thoroughly then a third team concentrates only on them and the overall time of cleaning remains the same. The cost of the cleaning is far outweighed by the resulting fuel savings. Even a slime layer can produce a fuel penalty of as much as 18%. With today's fuel prices, the cost of cleaning can more than be recouped on the very next voyage. One major cruise line using this system has announced fuel savings of 10% compared to their previous biocidal antifouling system.

The fouled ship is cleaned before leaving port. Thus any fouling picked up locally will be removed and not translocated. Very little fouling accumulates en route. Therefore, the ship arrives at its next port of call with a clean hull. If it remains in port for any length of time and accumulates any macrofouling, it is again cleaned before leaving port so that the potential NIS are cleaned off before the ship sails.

This system has the added benefit of making a 7.5 or 10 year drydock interval possible, at least from the underwater hull protection and maintenance and fouling control point of view. The coating is expected to last the entire service life of the ship with only minor touch-ups of any mechanical damage which can easily be carried out during routine, class-required drydocking without interfering with other activities.

Some changes would be required to operations and infrastructure so this system could not be expected to be applied universally over night. But it could begin implementation for any vessel at its next scheduled drydocking. It's a matter of blasting the hull, replacing the coating and beginning a cleaning routine. And it can be implemented immediately on all new builds. Many shipping companies have already implemented the system successfully.

It is a novel, simple, workable approach which has been tested and validated commercially. It eliminates active, toxic ingredients in bottom paint and substitutes elbow grease – cleaning. The fouling organisms are easily removed without harm to the coating or hazard to the environment.

This article appeared originally in Ship & Offshore magazine (www.shipandoffshore.net) and is reprinted here with the permission of Ship & Offshore. ■

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i Oliver Floerl et al., "Review of biosecurity and contaminant risks associated with in-water cleaning," for The Australian Department of Agriculture, Fisheries and Forestry, September 2010, p. 4

ii J. Gonzalez, L. Johnson, "Copper-Tolerant Hull-Borne Invasive Species: Further Analysis," University of California Cooperative Extension–Sea Grant Extension Program, (April 2008).

iii Daniel Rittschof et al., "Compounds from Silicones Alter Enzyme Activity in Curing Barnacle Glue and Model Enzymes," PLoS ONE, 2011.

iv Monika Nendza, "Hazard assessment of silicone oils (polydimethylsiloxanes, PDMS) used in antifouling-/foul- release-products in the marine environment," Marine Pollution Bulletin 54, no. 8 (August 2007): 1190-1196.

Condition after years of use

Ecospeed after sailing in the ice for two years. The ice belt, with clearly visible damage, had not been coated with Ecospeed along with the underwater hull. This has now been remedied to prevent similar damage from reoccurring.

Ecospeed is an environmentally safe underwater ship hull coating system which provides the vessel with long-term protection and dramatically improves the ship's performance. The coating gives a very thorough and lasting defense against cavitation and corrosion damage for a ship hull's entire service life.

It provides the underwater vessel 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.

Ecospeed comes with a 10 year guarantee and is expected to last the lifetime of the vessel. This is in strong contrast to traditional antifouling paints where a new application is necessary during each drydocking. With an Ecospeed application no repaint will be needed. At most, minor touch-ups will be needed. Planning the maintenance of the vessel therefore becomes much easier.

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