Alternative ship hull coating system

ANTIFOULING The cost of in-water cleaning of ship hulls is dwarfed by the resulting fuel savings. David Phillips from Hydrex Group explains why a combination of hull protection and fouling control requires the fewest economic and environmental compromises.

The problem with underwater cleaning of hulls to remove slime (microfouling) and hard fouling lies not in the cleaning itself but in the type of hull coating being cleaned.

The majority of coatings on ship hulls as part of fouling control systems deteriorate as a result of underwater cleaning. Underwater cleaning of biocidal antifouling coatings constitutes a hazard to the environment due to the pulse discharge of biocides produced by the cleaning. In many ports and states, in-water cleaning of hulls bearing biocidal coatings is therefore justifiably prohibited. Some ports and states have gone as far as to prohibit in-water hull cleaning altogether.

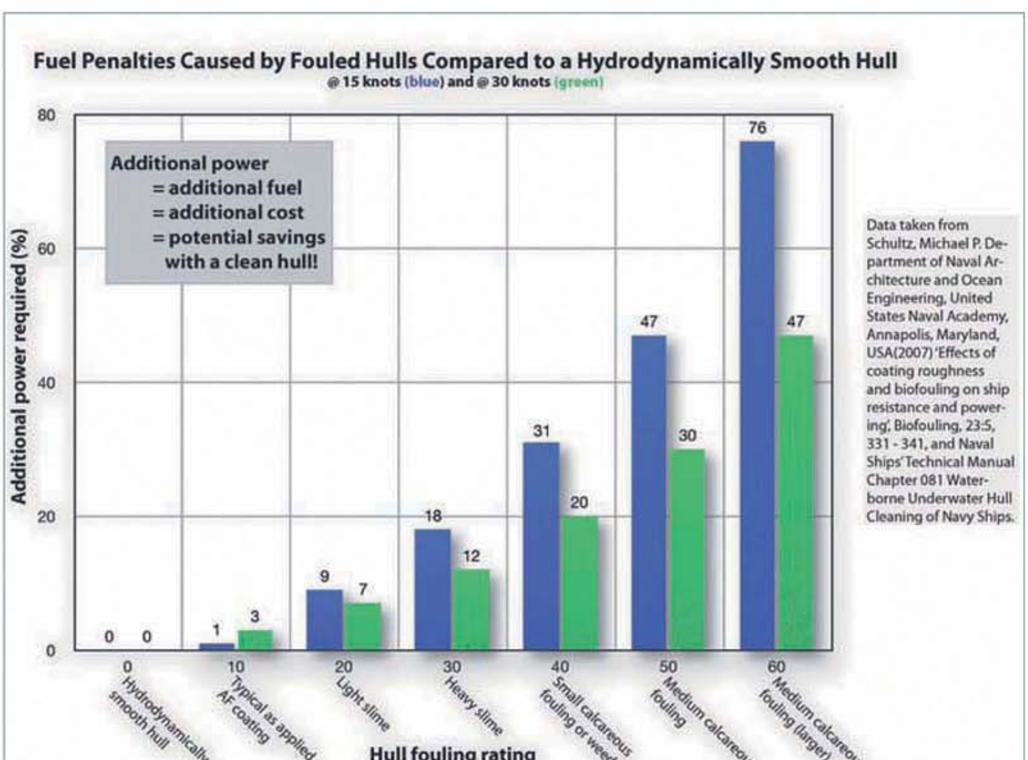
Problems with hull coating systems

There are three main problems with ship hulls and hull coating systems:

Corrosion The hull of a ship must be adequately protected from the effects of the oceans. This is a matter of protecting investment, of remaining operational and of safety. A particular form of corrosion is cavitation damage, which especially affects propellers and rudders as well as adjacent areas. There are also operational conditions that can be extremely challenging to the protection of the ship's hull, such as ice and other harsh environments.

Fuel efficiency Any deviation from a hydrodynamically smooth hull carries a "fuel penalty." This includes roughness due to poor construction or finish, poor choice of paint or substandard paint application, a deteriorated coating and a hull with microfouling (biofilm or slime) or both micro- and macrofouling. The penalty can be anywhere from 1-3% for unfouled paint as applied, to 80% or more for a heavily fouled, badly deteriorated hull coating. This greatly increases a ship's fuel consumption and consequent atmospheric emissions. The hull coating system that is used can therefore play a huge role – positive or negative – in the cost of running the ship. At current fuel prices, this can be the make-break point of profit or loss for a ship.

Environmental concerns Pollution or contamination of oceans and waterways from heavy metals and various chemicals used as biocides in antifouling paints, and from silicone oils and other substances used in foul-release paints, can have disastrous effects on the marine environment, contaminating both the water column and the sediment. The harmful effects can persist for years or decades, rendering ports, harbours, marinas and estuaries so contaminated that they cannot be dredged by the usual procedures without the risk of very serious pollution through re-suspension of the chemicals. Furthermore, invasive aquatic fauna (and to a lesser degree flora) are carried as ship hull fouling from one environmental zone to another, where they can be destructive. The threat of the spread of aquatic invasive species has escalated to a point where California, for example, is considering legislation to prevent ships from entering state waters if any macrofouling is present. The IMO is also considering this issue in depth and recently instituted voluntary measures to combat the threat posed by ship hull fouling to ecosystems. This has great



Fuel penalties graph

economic significance since imported species can destroy local species and upset entire local economies.

The fuel penalty incurred from a rough, fouled hull has negative ramifications for the environment as well. The more fuel a ship burns to travel from A to B, the more CO_2, NOx, SOx and particulate matter it emits. Volatile organic compounds (VOCs) from hull coating application can be added to this list. Hazardous waste from the disposal of old paint when a ship is prepared for a new hull coating is also an issue.

Almost all traditional ship hull coating systems have been a compromise in which one or more of the above factors have been sacrificed for the sake of others.

The problems surrounding ship hull protection and fouling control centre on two factors: economics and the environment. A solution must be economically viable so that ships can operate at a profit. And for obvious reasons it must be environmentally sustainable.

Existing solutions

The main coating systems in use today are of two general types:

The first and by far most prevalent consists of biocidal antifouling coatings. Copper is the most common biocide in use. Others include zinc and a variety of pesticides and herbicides sold under names such as Diuron and Irgarol. These coatings come in various forms but follow the same basic principle: They attempt to kill the fouling organisms before or after the organisms attach themselves to the hull. The main environmental problem is that these poisons are indiscriminate in what they kill or affect. They tend to remain in the water and sediment, harm non-target organisms, work their way up the food chain and can endanger human health. They are also ineffective in preventing the spread of aquatic invasive species that attach to "niche areas" below the waterline.

The chief economic problems with these antifouling paints are that they generally are ineffective against microfouling, cannot be cleaned and need repair and recoating every few years, resulting in a badly deteriorated coating with the accompanying rise in fuel consumption.

The second coating, which is gaining market share, is the foul-release, non-biocidal type. It provides a slick surface that is hard for fouling organisms to adhere to and easy to remove from. These coatings are most suited to ships that travel fast and frequently and are not laid up for extended periods. They, too, do not prevent a slime layer from building up. They must be cleaned very gently at the microfouling stage and, if allowed to acquire macrofouling, cannot be cleaned without damaging the coating. There is evidence that while they do not contain biocides as such, they are not free from toxicants. More research on their toxic effects is definitely needed.

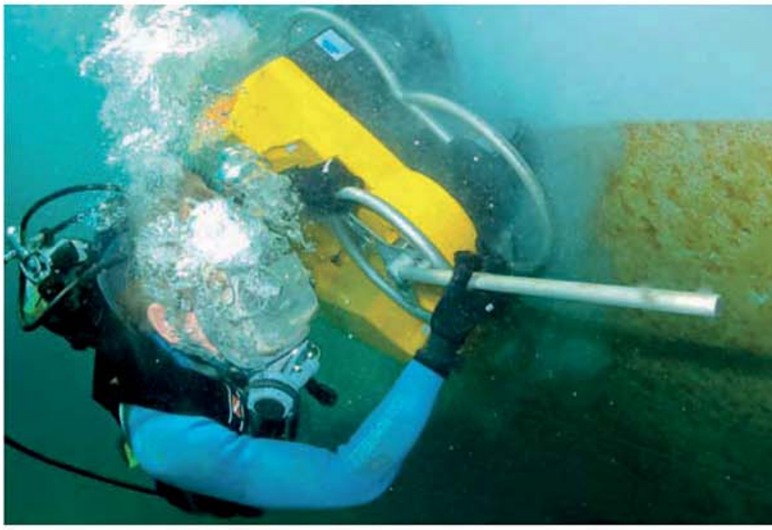
A third, far less prevalent type of coating is hard and inert. It is non-biocidal, non-toxic and has been mainly used in zones where fouling is much slower to accumulate, such as in arctic regions or very cold waters. While these coatings can be cleaned in the water, many of them, such as epoxies, tend to deteriorate with in-water cleaning and thus cause mounting fuel consumption.

Surface-treated coating

An alternative type of hard hull coating system seems to require the fewest compromises of all. Known as surface-treated coating (STC), it is essentially a whole system for hull protection and fouling control.

STC consists of a glass flake vinyl ester resin coating, which provides the best possible hull protection when combined with routine in-water cleaning to remove fouling in its early stages and optimise fuel consumption. Ecospeed®, produced by Antwerp-based Hydrex Group, is an example of an STC. ▶

A "niche area" of a hull coated with biocidal antifouling paint



Ecospeed coated hull being cleaned of slime using a Hydrex medium-sized, self-propelling in-water cleaning tool

STC after several years of service cleans back to pristine condition


Same ship (Interscan *MV Patriot*) after 18 months with a conventional coating (left) and again after 18 months trading in ice with Ecospeed STC (right)

The coating is applied once on a properly prepared hull and lasts the lifetime of the ship. Only very minor repairs are needed during routine dry-docking. This coating improves hydrodynamically with every in-water cleaning, becoming smoother and thus less likely to foul. It can be cleaned as often as needed without any harmful effects on the environment or coating. It even solves the problem of cavitation damage to rudders.

How does an STC such as Ecospeed fare when judged against the points covered above?

Corrosion Because it is mainly glass, is designed to last the life of the hull without replacement and is not subject to cavitation damage, an STC, if correctly applied, is a hull's best protection against corrosion. The use of the coating reduces or even entirely eliminates the need for impressed current systems.

Fuel efficiency In the long run (the life of the ship), an STC can save a shipowner/operator upwards of 25% in fuel costs when compared with a conventional hull coating. The coating does not deteriorate over time as others do. In fact, it becomes smoother and creates less friction with routine cleaning. A proper cleaning routine can keep fouling down to at most a light slime, thus reducing the fuel penalty to near zero.

Environmental concerns An STC is completely non-toxic. After in-water cleaning of the hull using a high pressure jet, a ship can leave any environmental zone entirely free of fouling and thus not translocate invasive aquatic species to other environmental zones. This is the ultimate solution to the problem of the spread of invasive species via hull fouling. Atmospheric pollution will decrease in proportion to lower fuel consumption. An added bonus is that Ecospeed is very low on VOCs and is only applied once, thereby eliminating pollution from repeated applications.

Ecospeed is in use by an entire national navy, a leading cruise line, a number of ice-going vessels and icebreakers, and cargo vessels of all types. It is also being applied to the hull of the *Sea Launch Odyssey* rocket-launching vessel.

Conclusion

At a time when answers to the hull coating system problem are being sought, STCs such as Ecospeed present a solution immediately available to shipowners/operators. Applied and maintained correctly, an STC is the hull protection and antifouling system that requires the fewest economic and environmental compromises.