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Drie reuzen in Urk

Wind als winstmodel

(Af)gebouwde schepen in 2013

Harde coatings voor scheepsrompen

Door D. Phillips

Hard Coatings for Ship Hulls

Viable, Non-Toxic Alternative for a Long-Lasting Smooth Hull

Cleaning STC coated hull of major cruise ship. After nearly two years in service with multiple cleanings the hull coating is in pristine condition.

Ship hull coatings introduced into general use following the ban of TBT in 2008, have not satisfied expectations. However, a very different, alternative approach to ship hull protection and performance is capable of exceeding the performance of TBT SPCs (tributyltin self polishing copolymer) without any of the environmental liabilities that resulted in their well-overdue outlawing.

In a climate of "this is how we have always done it" it is worthwhile to review the requirements of a ship hull coating system. These points are applicable to any ship. A ship hull coating system ideally should:

- offer long-lasting protection against corrosion;
- not require frequent replacement or major repair;
- maintain a smooth hull for the life of the ship (thus ensuring fuel efficiency);
- have the ability to be cleaned in the water without damage to coating or harm to environment;
- be easy to apply, not requiring special equipment or skill or requiring excessive time;
- be environmentally safe, non-toxic, free from harmful heavy metals, chemicals, oils and other substances;
- provide for protection against spread of invasive species;
- be cost effective (particularly low total ownership cost).

A ship hull coating system such as that described above would be very valuable in that it would save shipowners/operators a great deal of money while also protecting the marine environment.

Current Coating Practices

The vast majority of ship hull coatings in use today are biocidal antifouling coatings that rely for effectiveness on heavy metals such as copper and zinc along with a variety of other toxic substances to deter or kill marine organisms and thus keep fouling off the ship's hull.

The next most used are foul-release coatings, which do not contain listed biocides but that rely on surface properties to make attachment by fouling organisms difficult – or to make it easy for those that do attach, to be washed off by the flow of water past the fast moving hull.

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Why these Coatings Fall Short

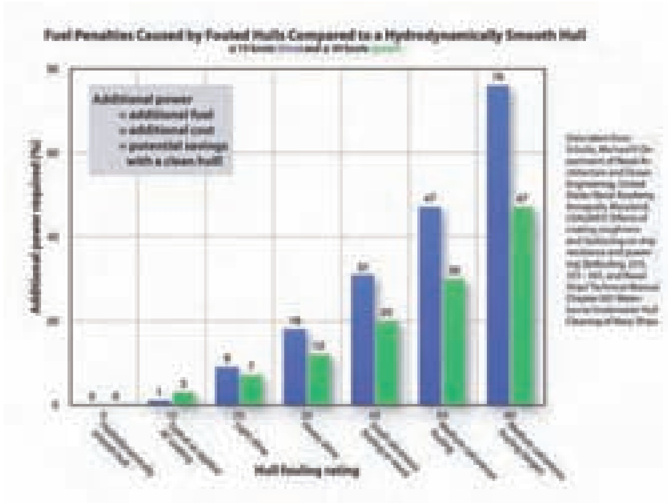
When one compares the requirements of a ship hull coating system listed earlier in this article to the reality of using a typical AF (antifouling) or FR (foul release) coating, the general dissatisfaction of shipowners/operators with these coating systems is readily seen. Biocidal antifouling coatings are toxic to the environment. They are soft and therefore do not last very long. Their effectiveness is limited in that they do not prevent a slime layer from building up, which in itself can carry a fuel penalty of as much as eighteen per cent, and they do not keep general fouling off for the ship's dry-docking interval. If the ship is idle for extended periods, the antifouling coating does not work. Such coatings really need to be cleaned before the end of the dry-docking interval. However, they are not suited to such cleaning. The cleaning itself creates a pulse discharge of biocides which greatly depletes the remaining biocide layer and is harmful to the marine environment. The AF coating scheme needs to be repaired at every dry-docking and the topcoat replaced. The entire coating system needs to be replaced every ten to fifteen years. Foul-release coatings are also toxic even if less so than biocidal antifouling systems. They tend to suffer from all the other problems mentioned above in connection with biocidal antifouling coatings. They tend to be fragile, deteriorate badly over the ten to fifteen year period in between full reapplication, and are hard to repair. They are ineffective against slime, can be penetrated by fouling organisms, and are not suitable to ships that are idle for extended periods. Surely there must be a better way.

Hard, Surface Treated Composite Coating as an Alternative

There is an alternative approach to ship hull protection and performance. It is known as a Surface Treated Composite or STC system.

An STC coating is a hard, inert, glass flake reinforced resin designed to be applied once to properly prepared hull, either at new build or in dry dock and to last the life of the hull without the need for major repair or replacement. The STC coating must be conditioned after application in order to achieve its full hydrodynamic potential as a very low friction coating. The conditioning is done with special equipment in the water by divers a month or so after application. It smooths the micro-roughness inherent in such a coating, leaving the macro-roughness or slightly dimpled surface intact. This macro-roughness is a key to the coating system's success. The secret of the STC coating's corrosion protection lies in the glass flakes which are of a large aspect ratio and made of the best quality glass for the job, and the resin which is chosen for its adhesion, bonding strength, toughness and flexibility. The resulting coating is impermeable (absolutely water tight) and impenetrable and even has ice abrasion resistant certification while not intended only for ice-going vessels. A stronger version of the same type of coating can be used on rudders, bulbous bows and other underwater gear and is capable of completely proofing such gear against cavitation and corrosion damage.

The STC coating is not designed to kill or repel marine fouling.



Graph showing fuel penalty associated with different levels of fouling.

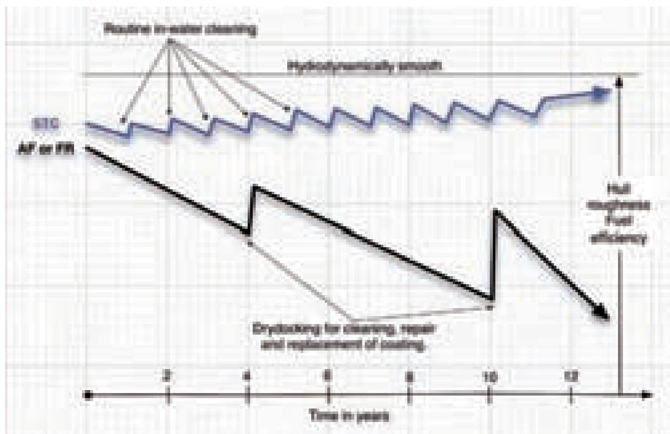
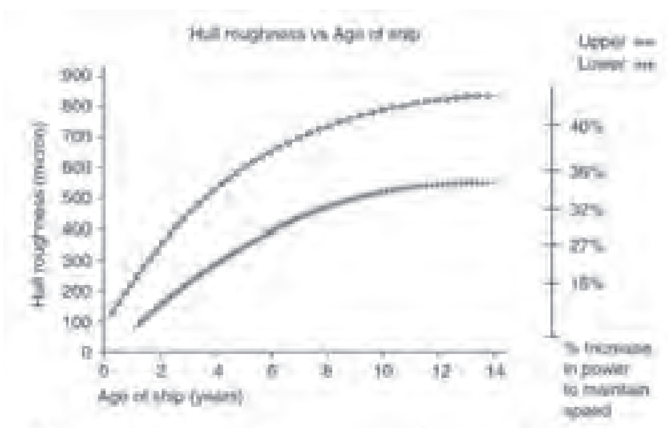


Chart comparing the gradual degradation of AF or FR coatings over time compared to the gradual improvement in smoothness of an STC.



Increased average hull roughness with ship age and effect on powering with conventional coatings. Source: International Marine Coatings Akzo Nobel, Propeller Issue 15, January 2003, p 7, as used in Chapter 7 of Advances in marine antifouling coatings and technologies, edited by Claire Hellio and Diego Yebra, page 161.

Coating comparison between conventional coating after a season in the ice (above) and a STC after two seasons in the same ice conditions (beneath).

It will accumulate fouling and will need to be cleaned. This cleaning is done in the water whenever necessary to maintain a very light level of fouling if any. The coating can be cleaned as aggressively and frequently as needed without harm to the marine environment and without damage to the coating. In fact, the coating improves in smoothness with repeated cleaning/conditioning as long as this is done correctly with the correct equipment by trained divers. The STC coating is not subject to long-term paint degradation, in contrast to the antifouling and foul-release coatings mentioned earlier. The combination of the coating, the conditioning and the cleaning is what makes the STC system so effective when it comes to saving fuel. Of course there is a cost to the underwater maintenance, but the potential fuel savings far outweigh this cost and make it a worthwhile investment with a fast payback.

The STC coating is easy to apply, although its success depends on correct application without deviation. Preparation of the hull is similar to that required for any good quality coating: a profile of at least 75 µm and a cleanliness of SA2.5 or better. But the coating goes on in two coats of 500 µm each with no primer or any other type of coating. The result is a homogeneous layer of glass flake reinforced resin, very hard and tough but flexible enough to remain bonded to the steel, aluminum or GRP substrate – despite the heavy flexing that ships' plates are subjected to. No special equipment or environmental requirements are needed for application. This type of coating has very low VOC (volatile organic compound, the resolvent in coatings) content, much lower than that of typical AF or FR coatings.

Benefits of STC Type Coating

The main benefits of the STC approach to ship hull protection and performance:

- Fuel savings between ten and 25 per cent over the life of the hull compared to AF or FR coatings.
- Fewer and shorter drydockings, saved materials and labor of repetitive reapplication required by other coatings, and absence of environmental clean-up costs.
- Reduced fuel consumption equals reduced atmospheric emissions, an environmental benefit.
- Environmental safety, no marine pollution by heavy metals, biocides, oils or other toxic substances.
- Elimination of the spread of hull-borne invasive aquatic species.
- No need for repeated reapplications, a financial and environmental benefit.
- Resistance to ice abrasion for ice-going ships.
- A cleaner, better looking water line, important to some ships such as cruise vessels.

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