PAINTSQUARE

The Importance of Hull Coating Specifications

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The international shipping community faces several challenges related to environmental performance, with the reduction of greenhouse gas emissions (GHG) being high on the international sustainability agenda. Hull coatings are usually claimed to offer between 1% to 10% GHG mitigation potential depending on type and operational assumptions.[1] However, the 2021 IMO Guidance on treatment of innovative energy efficiency technologies for calculation and verification of the attained Energy Efficiency Design Index (EEDI) and EEXI[2] states that 'category A' energy efficiency technologies, which includes hull coatings, affect the propulsion power and/or the reference speed of a vessel, and therefore their effect cannot be measured in isolation.

Although the energy-saving potential of a hull coating system and the effect on GHG emissions may be difficult to measure, poor in-service coating performance, or the inability of the coating to control biofouling over time, can result in increased biofouling accumulation rates, which will have a direct impact on operational efficiency. Biofouling is the collective term used for the accumulation of aquatic organisms on surfaces and structures that are immersed in, or exposed to, the aquatic environment. The attachment of such organisms on ships' hulls translates into additional fuel costs and subsequently to increased emissions.

A recent study commissioned by the Global Environment Facility, United Nations Development Programme, and International Maritime Organization (GEF-UNDP-IMO) GloFouling Partnerships Project collated findings on the impact of biofouling on GHG. According to the findings, a thin layer of slime (0.5mm) covering up to 50% of the surface can amount to 20% to 25% increase in GHG emissions, whereas a light layer of small calcareous growth could lead up to a 55% increase.[3]

Apart from its impact on the ship's operating costs and efficiency, biofouling has been identified as a significant vector for the translocation of non-indigenous marine aquatic species, which could potentially become invasive. To address the risk of introducing potentially harmful species via biofouling, the IMO's Marine Environment Protection Committee (MEPC) adopted in 2011 the

Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species ('the Guidelines').[4] In 2018, MEPC 72 agreed to review the Guidelines, which led to the establishment of a Correspondence Group. The review process is currently ongoing with a target date for completion of 2023.

BIOFOULING CONTROL MARKET

To combat biofouling effectively, a suitable fouling control system in conjunction with an adequate risk-based biofouling management strategy is essential. In terms of biocidal coatings, which dominate the market for fouling control, selecting the optimal system for a specific ship is a complex task as there are multiple options available to choose from. These include manufacturer, coating technology, regional variations in formulations, biocidal packages, together with individual ship specific factors.

All of these choices affect the expected, and actual, in-service performance. Although environmental pressures encourage innovation, the increased market fragmentation, and the frequent introduction of new products, without a proven successful track record, make the selection process even more complex ***(Table 1)***.

Table 1: Biofouling control market fragmentation.

SEGMENT	PRODUCTS	TOTAL PRODUCTS
Marine	378	917
Yacht	539	

***Multiple formulations under the same commercial name are included as different products. The list is not exhaustive. Some yacht product formulations may be available only in limited locations.**

The number of biocides used in marine products is limited; however, there are more than 35 different combinations of biocides and booster biocides available on the market. The marine market is dominated by products with two biocides, and about 80% of the products included in the list are copper-based ***(Fig. 1).***

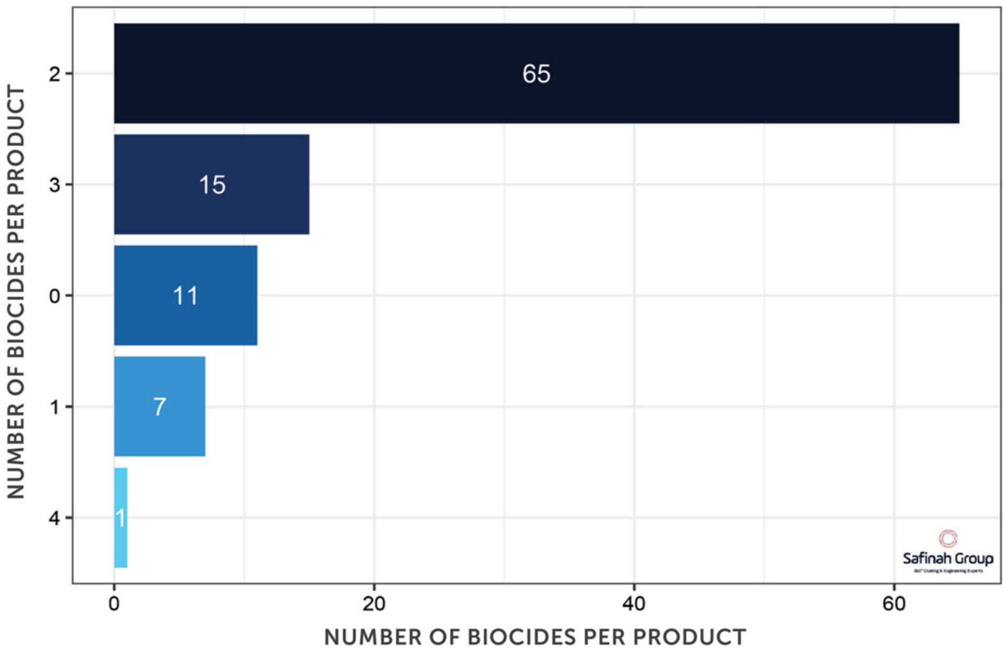

Fig. 1: Marine products' biocidal packages. COURTESY OF SAFINAH GROUP

Despite the number of technologies and systems on the market, in-service coating performance data allowing independent comparisons between technologies / products and the effects of different operational conditions, has been limited. Data on coating condition assessments gathered during dry dock projects dating back to 2009 can be used to address this knowledge gap.

HULL COATING DATA INSIGHTS

The authors' company has started to release findings based on its unique in-house database of coating condition assessments, assembled from supervision activities carried out during dry dockings dating back to 2009.

A study based on a sample of 270 ships, including all main vessel types, revealed that all ships had some level of fouling present on arrival at dry dock.[5] According to the sample, 60% of the ships were reported to have less than 10% of the total submerged area of the hull covered in hard macrofouling. However, this can still result in significant fuel penalties depending on the biofouling composition, and its dispersal across the hull ***(Fig. 2)***. The data also showed that more than 40% of the ships were found to have in excess of 20% hard macrofouling across their flat of bottom area.

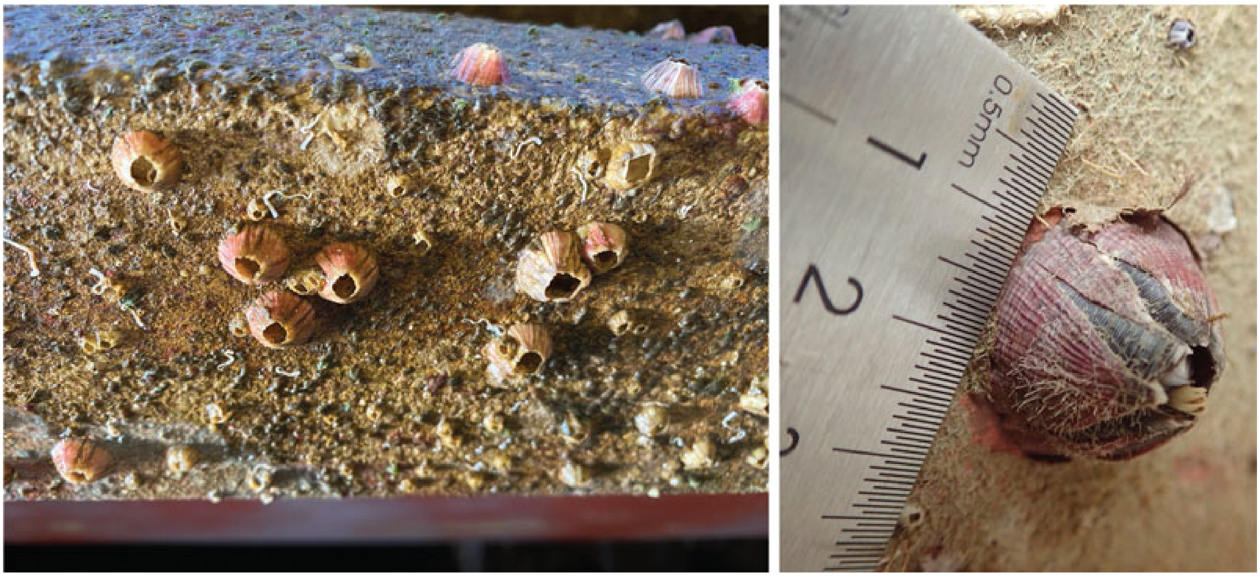

Fig. 2: Examples of barnacle fouling *(left)*, with a ruler to show the barnacles' relative size *(right)*. COURTESY OF SAFINAH GROUP

The analysis also revealed the following trends:

Hull Coating Selection

More than half of the ships with less than 10% hard macrofouling on arrival change manufacturer. However, surprisingly, half of the ships with more than 20% remain with the same manufacturer, and often the same technology or product is applied. This indicates a lack of systematic reviews of coating performance across the fleet.

Hull Coating Performance

Currently, there is a trend for choosing products marketed as offering superior performance, largely due to market and regulatory drivers. However, applying advanced technologies does not necessarily result in superior performance.

The findings to date suggest that there is significant variability in the performance of products across different coating technology levels. For example, often technologies perceived or marketed as "lower grade" are more effective on certain ship types employed on specific trades than more expensive alternatives.

This is especially true if specifications are not tailored to individual ships. Another recent study by the authors' company, based on a smaller sample of ships, revealed that 15% of vessels arrived in dry dock with significant areas of "polish through" of the antifouling coatings, often covered in mature biofouling. Polish through areas expose the underlying tie coat, and these areas are prime candidates for biofouling accumulation. If the antifouling specification is not appropriate for the ship's specific trade, then significant polish through can occur before the end of the inter-docking period ***(Fig. 3)***.

Fig. 3: Example of 'polish through' on ship hull coatings. COURTESY OF SAFINAH GROUP

Fouling release coatings, which are based on a silicone matrix that either prevents fouling attachment or facilitates easy removal through the action of the water flowing over the submerged hull surface while the ship is sailing, are the main alternatives to polishing systems. Fouling release coatings are generally more suited for higher activity, faster ships. Although recently developed products claim improved performance at lower speeds, they may not be an option for all vessel types/trades. While this may make them an attractive option for some vessels such as LNGCs, which are typically one of the more active ship types in the global fleet, there are other issues that must be considered, including the following:

- **The application process** can be challenging due to the need for masking to protect surrounding areas from contamination, and also the need for dedicated application equipment, which adds both time and cost to the operation ***(Fig. 4)***. Fouling release coatings are also sensitive to temperature and humidity during application.
- **Traditional fouling release coatings** have poor anti-abrasion properties and are easily damaged during poorly executed underwatering-water cleaning, during canal transits, entering/exiting ports, etc., and hence are definitely not suitable for ships trading in ice conditions.

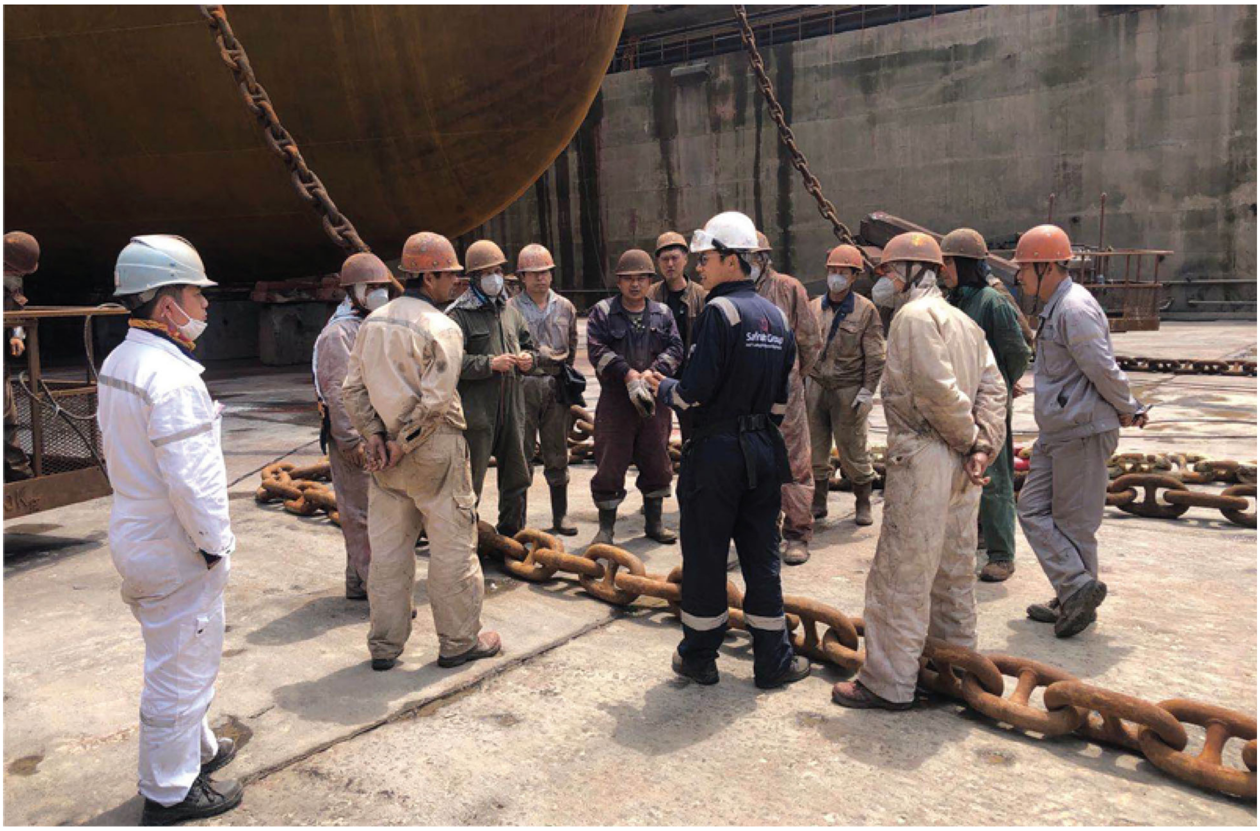

Fig. 4: Preparing for ship maintenance during drydock. COURTESY OF SAFINAH GROUP

Unlike biocidal antifoulings, the number of times fouling release coatings can be re-coated during dry dock is limited before full blasting of the hull is required.

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CONCLUSION: FUNCTIONAL SPECIFICATIONS

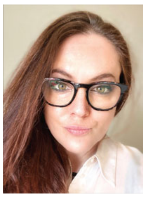
Based on more than 512 comprehensive technical specification reviews, as part of systematic coating selection and pre-planning activities, and nearly as many specifications scanned for obvious errors prior to dry docking supervision activities since 2021, the authors' company has identified some of the main factors leading to poor in-service performance.

Often, this is a result of poor communication between different departments within the client organization, and the lack of strategic alignment as well as incomplete or inaccurate information provided by clients to paint manufacturers, or assumed by the manufacturers. Although a large number of decision makers select advanced options, there are additional factors, such as ensuring that the specification is appropriate and tailored to a specific ship trade, that can limit sub-optimal performance.

Optimal biofouling protection is achieved through informed product selection and specification, controlled application and installation, monitoring and appropriate maintenance. Identifying the optimal solution for individual vessels starts with a careful consideration of a variety of ship-specific factors affecting the suitability of potential fouling control technologies.

Examples of such factors include typical operational profiles and associated environmental parameters, expected activity and speed patterns. For example, based on the company's knowledge of antifouling schemes, a significant difference in scheme thickness (the dry film thickness applied) can be seen for what appears as relatively minor changes to the scheme parameters. A relatively small increase in predominant sea surface temperature of 3 C (moving from 25 C to 28 C) could require a significant increase in the antifouling scheme thickness—typically, up to 30%. A vessel with a scheme suitable for 25 C but predominantly trading at 28 C could experience early polish through of the antifouling. Areas of early polish through could quickly accumulate biofouling with subsequent increase in fuel consumption and greenhouse gas emission, as well as significantly higher future dry dock costs. Furthermore, other factors such as application location, season, product availability, biofouling management options, cleaning equipment availability at typical destinations, and many others also need to be considered. The output of such a methodical analysis of these various factors leads to a robust and objective "functional" specification, as opposed to the "generic" specifications that dominate coating selection at present.

ABOUT THE AUTHORS



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