The case for better antifouling technology

Biofouling tackled head-on

by Markus Hoffmann, *Technical Director, I-Tech*

Biofouling and the ways of tackling it encompass the full range of environmental challenges that shipping faces. Not only does it impact carbon emissions, but it also affects the spread of invasive species. Even the means to combat fouling itself are strictly regulated, given their effects on ecosystems. At the same time, finding the right coating for a vessel's operational profile is complex yet essential for efficient, cost-effective operations. It creates a complex puzzle for owners to solve – made all the harder by an altering regulatory environment and a literally changing climate.

In recent years, the need to take fouling more seriously has escalated. Increased risk from climate change, alongside a greater understanding of the damage fouling can impart, combined with the regulatory, societal and political pressure for shipping to reduce its environmental impact, have pushed the maritime industry to get more serious on the subject and find viable, long-term solutions. What are the main issues then, and where should owners start looking for answers?

'Hotspots' and the negative feedback loop

Biofouling and climate change are inextricably linked. Biofouling, especially what is commonly referred to as 'hard' fouling caused by shell-forming marine life, such as barnacles, causes some of the highest levels of hydrodynamic drag created by their volcano-shaped shells on vessel hulls. According to the research paper **Economic impact of biofouling on a naval surface ship**, a vessel with just 10% barnacle coverage requires an increase in shaft power of 36% to maintain the same speed through the water compared to a ship free of hard fouling. It leads to higher fuel costs, increased emissions, and reduced efficiency for many owners and operators.

A recent study from I-Tech and independent marine coating consultants from Safinah found that, out of 249 vessels surveyed, nearly every ship had a degree of underwater hull hard fouling. On 44% of the surveyed vessels, over 10% of the underwater hull surface was significantly covered with hard fouling to a level deemed by experts to cause an 'unacceptable' impact on performance. Approximately 25% of vessels displayed hard fouling coverage of between 10-30%, and the remaining vessels suffered much higher levels. It might mean there is at least an increase of 110mt of carbon emissions and $6.0b spent on marine fuel per year (basing on the assumptions made by Michael P. Schultz in a 2012 paper that quantified the impact of biofouling on a naval frigate's shaft power requirements).

This high level of fouling is compounded by the fact that fouling hotspots are growing globally due to our environmental footprint causing rising temperatures. Warmer waters around the Mediterranean and Asian regions have long presented an added challenge for shipping's antifouling efforts, as warmer waters provide a better environment for fouling organisms to grow. With the 'hotspots' growing, so are the risks of biofouling.

It is clear that biofouling produces a negative feedback loop if not tackled head-on. Higher levels of hull fouling could equate to higher emissions; higher emissions could equate to increased carbon footprint; increased carbon footprint could equate to rising water temperatures. It is an issue that affects both the longer-term ability of shipping to meet climate goals and its day-to-day performance.

Niche areas and the risks of invasive species

Further data gathered and analysed by Safinah and I-Tech during a 2020 study shows that nearly every vessel poses a biosecurity threat, despite the uptake of advanced coatings that tackle hull biofouling.

A significant proportion of this biosecurity threat comes not from hard fouling on flat underwater surfaces but niche areas spread through a vessel's submerged structure, such as sea chests and gratings. Although the data is difficult to obtain, these areas could account for as much as 10% of the total underwater hull surface of the global shipping fleet.

The consequences of niche area fouling are multi-fold – and significant. For one, this type of biofouling can detrimentally impact the vessel's health and efficacy if it's allowed to accumulate without maintenance. For example, fouling build-up in a sea chest can impact the functioning of box coolers, a vessel's water-cooling system. When heavy fouling occurs here, the box cooler's ability to control temperature can be compromised or even completely fail.

But perhaps most notably, biofouling in niche areas poses a significant biosecurity threat to marine ecosystems through its role in transporting invasive aquatic species. In some parts of the world, evidence suggests that 70-80% of invasive species introductions have occurred through biofouling. According to the International Maritime Organization (IMO), several studies have determined that vessel biofouling has been a comparable, if not more significant, factor to untreated ballast water for introducing invasive aquatic species.

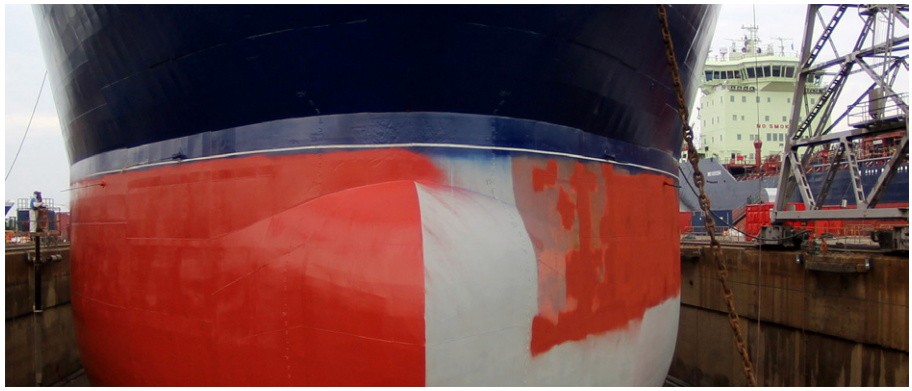
A whole new standard for antifouling

Recent findings from the tanker *Calypso* clearly demonstrate a way around this and that the power of effective antifouling coatings cannot be underestimated, particularly where these 'hotspots' are becoming increasingly rife.

Calypso was painted on its vertical sides and bottom of the hull with a five-year copper-free antifouling product in November 2015 and embarked on a 63-month-long operation through heavily impacted fouling areas across global routes. In addition, the tanker remained static for over a month while waiting to dry dock, exposing the hull to a very high fouling risk.

The result of this operation is massively significant – for the vessel operator Team Tankers, I-Tech, whose active agent Selektope® was used to power the coating, and for the wider industry. Following over five years at sea, *Calypso* was carefully examined. Whereas the vessel showed a normal amount of wear after the period, it demonstrated zero barnacle growth across its hull, despite the duration of the period and the landscape in which the ship took its route.

Because of this, the vessel exhibited far lower than expected speed loss. Thanks to the use of the Selektope®-powered coating, *Calypso* displayed an average weighted speed loss of only -0.5%, providing a whole



Photos: I-Tech

new standard for antifouling technology in maritime and combatting this hydrodynamic drag.

Regulations and the battle on biofouling

The increasing effectiveness of these coatings will play an essential role in helping owners to comply with a dizzying number of new regulations. On climate and CO_2 emissions, as decided on IMO's Marine Environment Protection Committee June gathering this year, the Energy Efficiency Existing Ship Index (EEXI) and the Carbon Intensity Indicator (CII) are the latest additions to these regulations. These could push antifouling coatings further into the conversation, as they mandate continuous improvements in terms of greenhouse gas emissions.

Owners and operators looking to meet energy efficiency and carbon emissions regulations may be required to turn to tactics such as slower speeds to help them do so. And indeed, it's likely to be one of the preferred responses to these new regulations for many owners. That, however, comes with complications: the slower a vessel travels, the easier it is for organisms to foul the hull and niche areas.

Aggravating matters, some coating technologies have reduced efficacy at these slower speeds, increasing the risk of fouling. Furthermore, fluid dynamics increase the importance of hull coatings at relatively low speeds. Viscous friction impacts performance at lower speeds more than wave friction, increasing the relative impact of coatings on performance. It's clear then that even though owners will need to think about how they operate, investing in coatings will be crucial in responding to EEXI and CII.

When it comes to the CII, aside from derating engines, the only other major way to approach the requirement is to invest in alternative fuels. We know these will be more expensive than conventional fuels, so investing in clean technology such as coatings remains a valid approach with real return on investment.

Similarly, regulations surrounding coatings themselves, and more specifically their compositions, complicate the matter of antifouling technology. Regionally and nationally, the industry is seeing increasing – and stringent – regulations surrounding biocides to protect the ecosystem and public health. These include, e.g., copper oxide, frequently found in antifouling coatings. Korea is clamping down on copper on the grounds of worker health, while the likes of California, Australia and New Zealand are limiting the amount of it in coatings out of environmental concerns.

At the same time, efforts to reduce invasive species and protect ecosystems are emerging at an increasing frequency. For one, port authorities in California have stated that all vessels of GT 300 or more have been required to complete and submit a "Marine Invasive Species Program Annual Vessel Reporting Form" at least 24 hours before their first arrival of the calendar year at a Californian port. Ships must also present a Biofouling Management Plan and record all management actions in a Biofouling Record Book. In New Zealand, all international vessels arriving into the country must have a fully clean hull.

It is important to note that these regulations are likely to increase alongside the pressure put on shipping to reduce its environmental footprint, making it challenging for many coating manufacturers to ensure their product is viable, effective, and in line with these evolving requirements.

Selektope®, I-Tech's proprietary antifouling technology, is technically classified as a biocide but isn't a typical one due to its ability to repel species and fouling – where other biocides terminate. Because it's highly effective in small concentrations, it reduces the overall biocidal load of any coating to which it is added. One of the product's core advantages from a regulatory standpoint is the small quantities of Selektope® that are effective in the paint. The active agent only needs to be applied to coatings at 0.1% weight-for-weight – or a few grams per litre compared to 500-700g of cuprous oxide.

Tackling the issue effectively

Just like the maritime industry, all aspects of the biofouling landscape are changing continually. That is, besides one: our need to effectively tackle the issue. From the threat of invasive aquatic species on our ecosystems to the impact climate change has on the prevalence of fouling, antifouling technology will be instrumental in our collective efforts to reduce our environmental impact. ■