COATINGS, COMPLIANCE AND CARBON CUTTING

Yigit Kemal Demirel, Hempel, discusses how carefully selected hull coatings can play a role in securing compliance and cutting exposure to carbon costs.

Change can often lead to friction and resistance, and the two are certainly evident when it comes to the drive for decarbonisation in the maritime sector. Impelled by new energy efficiency targets and carbon costs, ship operators face the difficult task of sourcing cost-effective means to reduce their reliance on fossil fuels. And while much of the focus has been on low-carbon fuels and hybrid power, a well-maintained hull – one where friction and resistance are minimised – should not be overlooked.

The impact of hull resistance on fuel consumption has long been known and a standardised method of measuring changes in hull and propeller performance was introduced by the International Organization for Standardization (ISO) in 2016. ISO Standard 19030 provides a means of calculating changes in ship speed and fuel consumption that are

Figure 1. Ship operators face the difficult task of sourcing cost-effective means to reduce their reliance on fossil fuels.

Figure 2. The role of a well-maintained hull in the decarbonisation process should not be overlooked.

attributable to hull and propeller fouling. But with the emergence of new regulations on greenhouse gas emissions and energy efficiency, it is worth examining how hull measures influence compliance and cost exposure.

Regulatory regime

The key regulatory measures to consider are the International Maritime Organization's (IMO) Energy Efficiency Existing Ships Index (EEXI) and Carbon Intensity Indicator (CII) – as well as its 2050 ambition and indicative checkpoints in 2030 and 2040 – plus the European Union's Emissions Trading Scheme (EU ETS) and FuelEU Maritime. The IMO targets of reaching net-zero emissions by or around 2050 will demand the adoption of zero or near-zero emission fuels and technologies, but a hull with lower resistance will reduce fuel consumption and thus the spend needed on costly clean fuels. EEXI and CII are affected by the choice of hull coating.

For the EU measures, the impact on fuel consumption translates to fewer EU Allowances needing to be purchased under EU ETS. For FuelEU Maritime, which demands stepped improvements in well-to-wake energy intensity with penalties for any excess, even once vessels are using alternative fuels, effective hull coatings mean lower use of fuels and thus reduced cost.

The benefits of a clean hull are apparent, particularly when it is clear that many other options for deep reductions in fuel use or switching to new clean fuels may not currently be viable for ship operators. Hull coatings, on the other hand, offer proven and verifiable savings on all vessel types.

But to quantify them for a specific vessel, it is important to understand that not all hull measures nor all hull coatings are equal. To explain why, ship operators need to know why hull coatings work and the technology involved in coatings that separates the good from the ineffective. As an example, consider two products with very particular properties: Hempaguard X7, a silicone-based low friction coating; and SeamFlow, a weld seam fairing solution.

Coating solutions

Hempaguard is an advanced marine coating solution designed as an eco-friendly fouling control coating for underwater hulls. Incorporating cutting-edge technology, it enhances fuel efficiency, reduces maintenance costs, and minimises the environmental impact associated with traditional antifouling coatings.

Table 1. Comparison over a five year dry-docking cycle.

	SPC + hull propeller cleaning at 3 and 4 yr	Hempaguard X7 + Seamflow + propeller polishing twice/yr
Hull coating	SPC applied at dry dock	Hempaguard X7 + Seamflow applied at dry dock
Hull related measures	Hull cleaning after 3 and 4 yr	None
Propeller related measures	Propeller cleaning after 3 and 4 yr	Propeller polishing, twice/yr
Total fuel consumption	~42 000 t	~34 200 t
Total fuel cost (HFO at US$572/t)	~US$23.85 million	~US$19.57 million

Hempaguard is an example of environmentally conscious innovation in the marine industry by merging antifouling and fouling release technologies through the biocidal activation of a hydrogel layer. This results in enhanced fouling control performance while minimising biocide release into the environment. The limited amount of biocide used in Hempaguard efficiently prevents biofouling and significantly improves fuel efficiency even after prolonged operation times.

Hempaguard X7 offers scientifically proven 'Out-of-Dock Power Savings' of an average of 6% compared to conventional antifouling coatings. The achieved power savings are comparable to those resulting from other Energy Efficiency Technologies (EETs) such as a Mewis Duct. The term 'out-of-dock power saving' is suitable for defining this reduction in the required power at a constant speed. In addition, it offers 1.4% speed loss over five years. Combined, these features provide up to 20% fuel savings compared to the market average of conventional antifouling coatings.

SeamFlow has a different function, mitigating one of the negative impacts of ship construction on hull performance. When hull plates are welded together, seams are created that alter the hull topography and increase drag on the vessel. Although the welds protrude by only 3 – 9 mm, their dragging effect on a vessel's operation adds up to a significant amount. To reduce this, Hempadur SeamFlow can be applied around welding seams during dry-docking. The specialised epoxy material has a very high sag resistance and good flowability, with excellent resistance to prolonged immersion and cracking.

Impact assessment

Building on work conducted as part of the GEF-UNDP-IMO Glofouling Partnerships Project, a detailed case study from Hempel evidences the energy efficiency outcomes of the two products on a 40 000 dwt bulk carrier over a five year dry-docking cycle. The study compares this option with a baseline scenario of applying a Self-Polishing Coating (SPC), with hull and propeller cleaning in the third and fourth years.

A key point of comparison between the two coating scenarios is the total fuel consumption over the five-year dry-docking period. The study shows that the baseline scenario (the SPC) results in a total fuel consumption of around 42 000 t over five years, whereas the combination of Hempaguard X7 and Seamflow has much lower total fuel consumption of below 34 200 t.

The difference in fuel cost savings delivered with the silicone-based coating and seam-fairing solution are, therefore, considerable: around US$19.57 million compared to around US$23.85 million for an SPC coating and responsive cleaning – a saving of nearly US$4.3 million. This equates to around 18% fuel saving over five years compared to the baseline.

This case study found that the combination of Hempaguard X7 and Seamflow can lead to an immediate power saving, i.e. out-of-dock power saving, of 7.82%, after the dry-dock, placing it on a par with other hull and propeller efficiency measures that demand significant installation work such as Mewis ducts and pre-swirl fins, as shown in Table 1.

Under the case study, the bulk carrier with Hempaguard X7 and Seamflow consistently demonstrates favourable attainable CII values for each year, starting at 5.48 g of CO_2 emitted per cargo-carrying capacity and nautical mile in 2024 (B rating). The values gradually increase to 5.58 (C) in 2025, 5.69 (C) in 2026, 5.79 (C) in 2027, and finally reaches 5.89 (D) in 2028.

By comparison, the vessel with an SPC coating and responsive cleaning exhibits poorer CII values with consecutive E ratings after the first year, indicating non-compliance with the regulatory threshold, relatively lower energy efficiency and higher environmental impact over multiple years.

As the case study makes clear, applying the correct combination of coatings offers a simple and affordable solution to mid-term compliance, and a fuel cost saving that can deliver strong return on investment, supporting the application of future carbon-cutting measures. Immediately applicable, well-proven and verifiable, high-quality hull coatings are a critical first step in efficiency that can ease the friction and resistance that is often evident in the discussion about the technologies that will support shipping's energy transition. DB

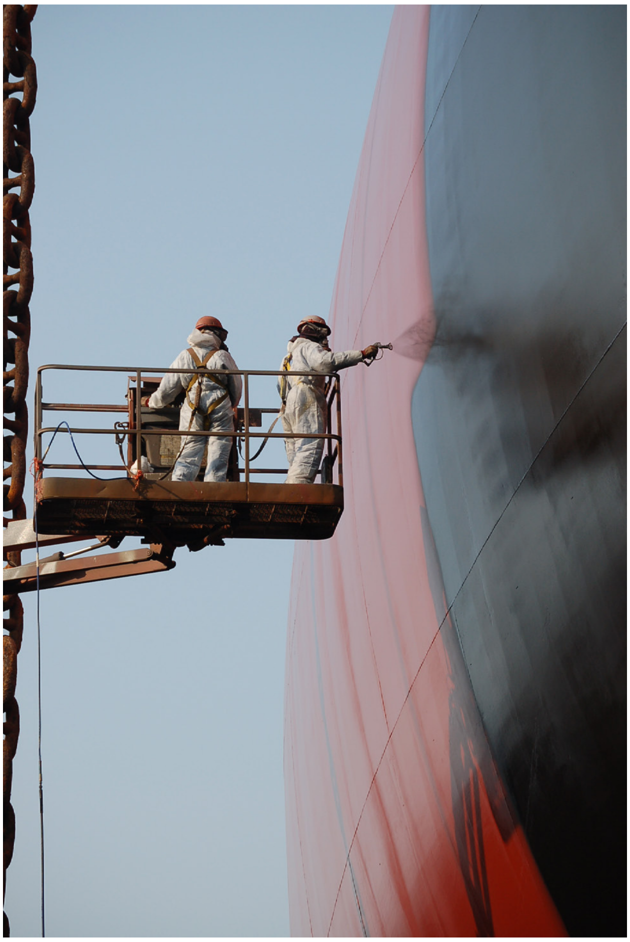

Figure 3. Application of advanced hull coating on the vessel.

Table 2. Attainable CII values under different scenarios.

	2024	2025	2026	2027	2028
Baseline scenario: SPC + responsive cleaning	6.12 (C)	7 (E)	8.09 (E)	6.74 (E)	6.69 (E)
Present scenario Hempaguard X7 + SeamFlow	5.48 (B)	5.58 (C)	5.69 (C)	5.79 (C)	5.89 (D)