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SPRING 2021

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We strive towards further innovation every single day. At present, we are particularly focused on CO2 Carbon Capture and reutilization and Power to X in the same process.

We are always happy to elaborate on our Generation II scrubber, CO2 project and extensive knowledge of Maritime Scrubbers in general for all interested parties.

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Ian Cochran
Editor,
*Clean Shipping
International*

WE NEED TO ACT NOW!

To get to net zero emissions, what ship and equipment designs will be needed in the future? What do we need to do now – and how?

These are the main questions on shipowners lips, as they strive to comprehend the sheer number of solutions being thrown at them to reach the International Maritime Organization's (IMO) goal.

The net result of all of these initiatives is to polarise the industry into separate camps, especially in the near term, until a universally accepted solution is found.

Of course, impending regulations also need to be fit for purpose, as down the years, several have proved to be impracticable.

Flexibility will be key going forward with a combination of technologies coming together to solve the problem.

With a new fuel will come new engine designs and supply chain logistics to make it work. But as one leading shipowner said in a recent webinar: "Let's concentrate on what is possible today."

The so called e-fuels look as though they are going to be very expensive, but with further research and development, the cost will come down – but will it be to the level of today's options?

As it has been pointed out time and time again, an importer of soya beans into China will not care about how his or her cargo is shipped, only the cost involved.

In the container trades, major shippers, such as Amazon, Walmart and so on, are getting more involved in how goods are shipped, as are the major trading houses. All are claiming to be turning "green".

PROBLEM WITH CLAUSES

One problem, recently highlighted by a leading drybulk broker, is that a standard charterparty does not include any clauses on the amount of emissions the ship involved emits, thus not declaring a carbon footprint.

A charterparty also rarely depicts alternative fuel use, such as wind-assisted ships, although with Cargill and other major charterers becoming involved, this is gradually changing.

Proper measurements still need to be developed – no measurement, no improvement, as the old saying goes.

Despite the clock ticking, shipowners are still ordering standard ships with standard equipment installed, except for LNG-ready and other designs, which have proved to be expensive to retrofit. Further down the road, ammonia will need large storage space on board the vessel.

A standard design is purely down to costs, as large shipyards normally offer a standard package at a set price with the owner paying for any extra add-ons, such as scrubbers.

Methane, hydrogen and other alternative fuels currently doing the rounds have huge challenges ahead before they become commercially viable alternatives to what is on offer today, both technically and commercially.

The bunkering and storage infrastructure of, say, hydrogen will take several years to develop – maybe not at all without a sound business case.

BIGGEST BURNERS

For example, out of the world fleet, it has been estimated that 20,000 vessels burn around 80% of the mainstream fuels.

Drybulk still makes up the largest vessel sector and tends to involve tramp ships that will often not know the next destination once their current voyage is completed.

World trade is forecast to double by 2050, just at the time when the shipping industry should be reaching net zero emissions. To cope with this huge demand, more ships will obviously be needed.

This is only 30 years away, just over a ship's lifecycle, so we need to be investing in new ideas, technology and designs now and ensuring they are workable both in technological and economic terms.



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Editor: Ian Cochran

iancochran74@gmail.com

Project Director: Jonathon Ferris

Jonathon.ferris@csi-newsonline.com

Sub-editor: Samantha Robinson

sam.robinson.journalist@gmail.com

Publisher: Bill Robinson

publisher@csi-newsonline.com

Designer: Justin Ives

justindesign@live.co.uk

Published by Maritime AMC, *Clean Shipping International* supports Clean Shipping Initiatives.

The views expressed in *Clean Shipping International* are not necessarily those of Maritime AMC unless expressly stated as such and disclaim any responsibility for errors or omissions or their consequences or for advertisements contained in this magazine and has no legal responsibility to deal with them.

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LAST WORD

How the IMO is taking the industry forward to a more environmentally friendly future



As Founding Chair of the newly formed GloFouling Alliance, Darren Jones is tasked with bringing together industry leaders to tackle two pressing IMO environmental objectives, a remit that has far-reaching effects, he tells *Clean Shipping International*



Darren Jones
Director, Sonihull

TIME TO TACKLE THE INVADERS

Darren Jones, director of Ultrasonic anti-fouling system provider Sonihull is taking up the Founding Chair of the International Maritime Organization's (IMO) GloFouling Alliance (GIA).

To give it its full title, he is Chair of the Global Industry Alliance (GIA) for Marine Biosafety, part of the IMO's GloFouling Partnerships project, often shortened to the "GloFouling Alliance".

The GIA was launched in June 2020 to bring together shipping industry stakeholders, the private sector and global regulators to address the impact of biofouling on greenhouse gas (GHG) emissions and the transfer of harmful aquatic species.

In essence, the partnership is a collaboration between the Global Environment Facility (GEF), the United Nations Development Programme (UNDP) and the IMO.

Also involved are more than 50 strategic partners, which include government agencies, industry associations, international non-governmental organisations (INGOs),

academia and other international and regional inter-governmental organisations that share the same goal.

Jones explains that GloFouling is a global initiative, designed to bring together committed leaders from maritime, shipping, ocean energy, aquaculture and other ocean-based industries, to support two pressing IMO environmental objectives via improved biofouling management — namely, to protect marine biodiversity and decarbonise shipping.

"Environmental" no longer means "expensive", he says. Done correctly, preventing biofouling will be the exact opposite. Carbon and costs can both be reduced with existing technologies and that means that all countries can benefit from a united approach, especially those whose marine environments and livelihoods are most likely to be damaged by invasive species.

Explaining the task ahead, he says that, in a nutshell, the aim of the GIA is to tackle two of the most pressing environmental issues of our time — invasive species and GHG





A Sonihull control unit

emissions — while ensuring operational efficiencies for operators, ports and other areas of the industry.

Although “environmental” in title, these goals mirror the operational pressures on the world’s fleet. Operators are trying to reduce CO₂ emissions and fuel consumption, which are directly linked to the control of biofouling.

Jones’s short-term goals include the standardisation of data gathering to improve measuring, and the aggregation of the most practical solutions from the world’s leading technologies.

As antifoulings are probably one of the costliest aspects of vessel efficiency, *Clean Shipping International* asked whether it was the intention to eventually replace antifoulings with a new type of coating.

Jones reveals that biofouling, and its prevention, costs the commercial maritime sector an estimated \$100bn annually. While there is no “silver bullet”, there are significant margins

to be gained from implementing existing technologies.

Currently there are around 94,000 ships in the world’s merchant fleet, with a total capacity of 2bn deadweight tonnes. Thus, it is going to be impossible to implement 100% zero-emissions vessels in the immediate future. But, by combining new technologies and existing technologies, marine industries will be able to meet the economic and environmental challenges created by biofouling, without restrictive capital costs, without unnecessary downtime and without leaving a toxic legacy.

“Steel vessels will always need to be coated, for corrosion protection and for biofouling prevention. I see these coatings being developed to work in harmony with other measures so that they enhance advances being made in hull cleaning systems, ultrasonic antifouling systems and extended drydock/repainting intervals,” he says.

At the time of writing, none of the major paint manufacturers had joined

the GIA partnership. However, by 2026, any marine anti-fouling system that uses a biocide will have to be re-submitted for very lengthy and expensive approvals.

“Coating industry insiders already expect that many of the current biocide systems will be discontinued before 2026, as demand grows for future-proof biocide-free solutions,” Jones explains.

“The IMO’s ultimate goal is for ‘zero-harm’ solutions, where poisons can be factored out, at the same time as addressing invasive species control and maintaining or improving vessel performance.

“It is hoped that the coating majors will engage with the GIA in the coming months so that the industry can tackle these issues together, combining the best of all the available technologies to develop viable and effective anti-fouling systems that are fit for the future,” he added.

Addressing the question of hull cleaning bans in certain areas of the

world and how the GIA is going to address this, Jones says that all of the bans were as a direct result of invasive species concerns.

"The processes, legislation and technology that has developed in recent years to control invasive species in ballast water gives us the pathway needed to apply the same measures to protect against invasive species that arrive on hulls, or in seachests, or on box cooler elements," he says.

"With effective legislation and practices, such as remotely operated vehicles and self-contained cleaning systems, it should be relatively simple and viable to ensure that vessels are clean when they depart, clean in transit and clean when they arrive."

FUEL SAVINGS

Turning to propeller and rudder polishing, which have become popular, as more owners and operators see the financial benefits, Jones says:

"I think owners and charterers will always adopt designs and maintenance regimes that save them money. A dedicated propeller and hull cleaning programme executed on an Aframax tanker can deliver nearly \$2m in fuel savings in the five-year period between drydockings.

"But prop-cleaning does have its downsides. It still involves expensive diving teams between drydocks and the newly clean surfaces begin to foul immediately after polishing. This means that the operator gets a 'sawtooth' effect in their fuel efficiency figures and transit times between major drydocks — along with the associated spike in CO₂ emissions," he says.

He adds that, by contrast, ultrasonic antifouling systems, such as those offered by Sonihull, cost a fraction of diving and polishing regimes and maintain clean propellers, control surfaces and operating speeds between drydocks. These systems are already being used on hundreds of commercial propellers and hard-to-reach niches, saving millions of dollars in fuel consumption and millions of tonnes of CO₂ each year, he says.

Describing the relevance of cathodic protection, he says that Impressed Current Anti Fouling (ICAF) systems are still relevant, although "we've seen

that in warmer waters like those plied by ships in the Middle East Gulf, they are much less effective.

"Seachests and box coolers are an integral part of a vessel's efficiency and they remain a mainstay of Sonihull's commercial marine installations. If fouling develops in a seachest and on box cooler elements, cooling systems will not perform as designed and you could end up with some very costly downtime. They also present the ideal environment for invasive species transport," he says.

Traditional seachest and box cooler systems rely on either chemical dosing or ICAF systems with sacrificial anodes to flood the seachests with poisonous chemicals and keep weeds algae and molluscs at bay. Both of these have their downsides — ICAF systems require very regular replacement of expensive copper anodes, while dosing systems require a large on board supply of hazardous chemicals.

Ultrasonic systems use physics instead of chemistry to keep these niche areas clear of marine biofouling and they remain effective regardless of water temperature and vessel activation.

Vessels operating with ICAF systems to protect their box coolers, can save more than 90% of these systems capital and lifetime maintenance, repair and operation costs if they are replaced with Sonihull systems, he claims.

If a vessel is off-hire, due to reduced demand or lock-down restrictions, it is under attack while just sitting at anchor. Anti-fouling coatings don't work when the vessel is stationary and ICAF systems will only work properly when main systems are running.

Sonihull systems require a fraction of the power of ICAF systems and will protect idle ships' cooling systems from biofouling and avoid the need to drydock, to clear the seachests, before safely re-commissioning.

In addition, there is no draining, cutting, drilling or welding needed. So, there's not a requirement for class re-surveying, Jones says. They can be fitted by small, isolated teams in a matter of hours. This means that work can be carried out in accordance with COVID-mandated guidelines and can even be fitted while a vessel is at sea.

Continuing to talk about Sonihull, Jones says that the company is already delivering results for worldwide fleets, helping commercial shipping realise efficiencies that traditional antifouling approaches are not capable of delivering.

He claims that Sonihull is a "zero-harm" system that can banish biofouling in refrigerated seawater pipework, seachests, propellers, box coolers and rudders without extra cleaning regimes, poisonous biocides or microplastic pollution from ablative coatings.

Sonihull can keep propellers clean between drydockings — removing up to 20% of five-year fuel costs and millions of tonnes of associated CO₂ emissions.

In large vessels, before counting the reduced maintenance costs, Sonihull systems pay for themselves in about four to six weeks, in fuel savings alone, Jones claims.

ULTRASONIC SOUND

Explaining how the company's ultrasonic system works with hull coatings today and how it is controlled, he says Sonihull works with any hard surface that can support an ultrasonic sound wave.

Silicone-based coatings can dampen the resulting signal, but all other coatings are compatible. It is a fit-and-forget system with central control and fault-monitoring, he says.

Through the process of ultrasound-induced non-inertial cavitation, microscopic bubbles are created as the pressure drops and are popped as the pressure increases.

Jones says that this process should not be confused with inertial cavitation, which is the process caused by massive pressure differences on propeller blades or inside large pumps — the forces involved in ultrasonic induced non-inertial cavitation are several orders of magnitude smaller and will not damage metal or painted surfaces.

The resulting water movement inhibits the creation of a biofilm and the colonisation by larger, more complex organisms. The micro-jets created during bubble-collapse have been proven to prevent barnacle and mussel larvae from embedding on the surface.





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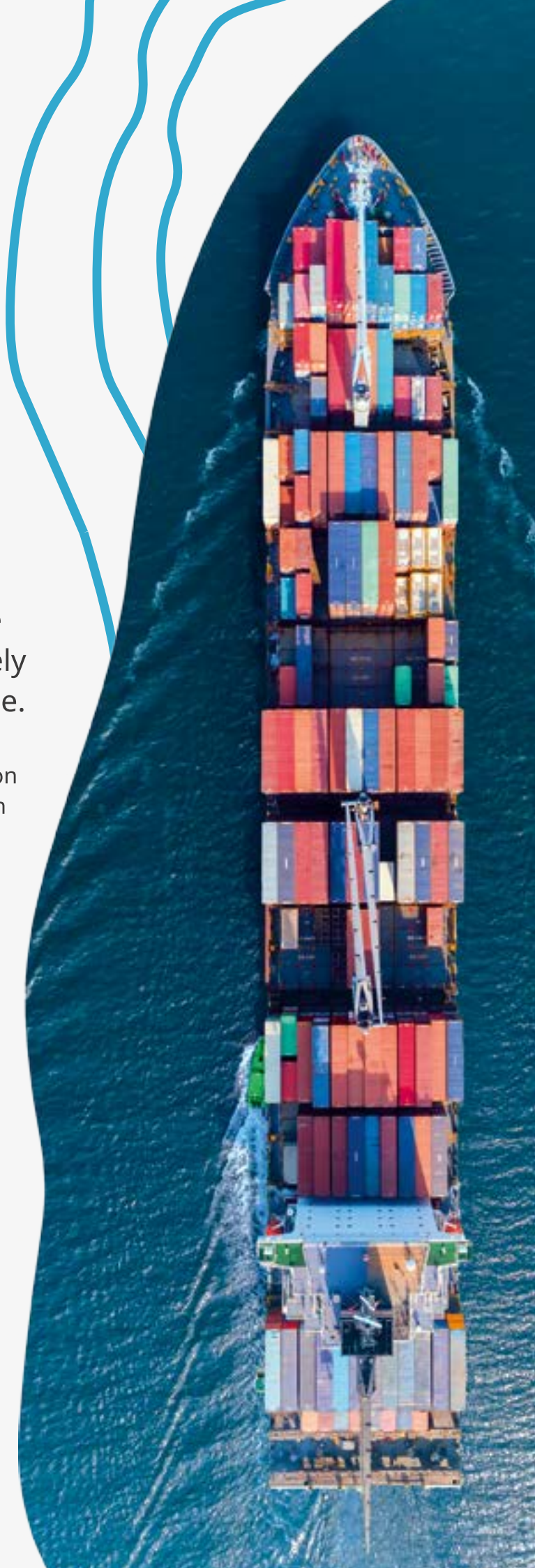
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How has the introduction of the International Maritime Organization's low sulphur cap fared amid what has been one of the most turbulent years in living memory?



IMO2020: ONE YEAR ON

One year on from the introduction of the International Maritime Organization's (IMO) low sulphur cap (IMO2020), indications are that the transition has been extremely smooth. This is testament to the preparations of all stakeholders prior to the new rules entering into force, the organisation claims.

"Through 2020, just 55 cases of 0.5% compliant fuel being unavailable had been reported in IMO's Global Integrated Shipping Information System (GISIS)," says Roel Hoenders, the IMO's head of air pollution and energy efficiency. "Given that more than 60,000 ships plied the world's oceans in trade last year, this was a remarkably low percentage of ships encountering difficulty in obtaining compliant fuel."

"We had a great deal of preparation during 2019 and before, from all stakeholders, and all indications are that there have been no significant issues with supply of low sulphur fuel oil."

Even during the covid-19 pandemic, cargo-carrying ships continued to

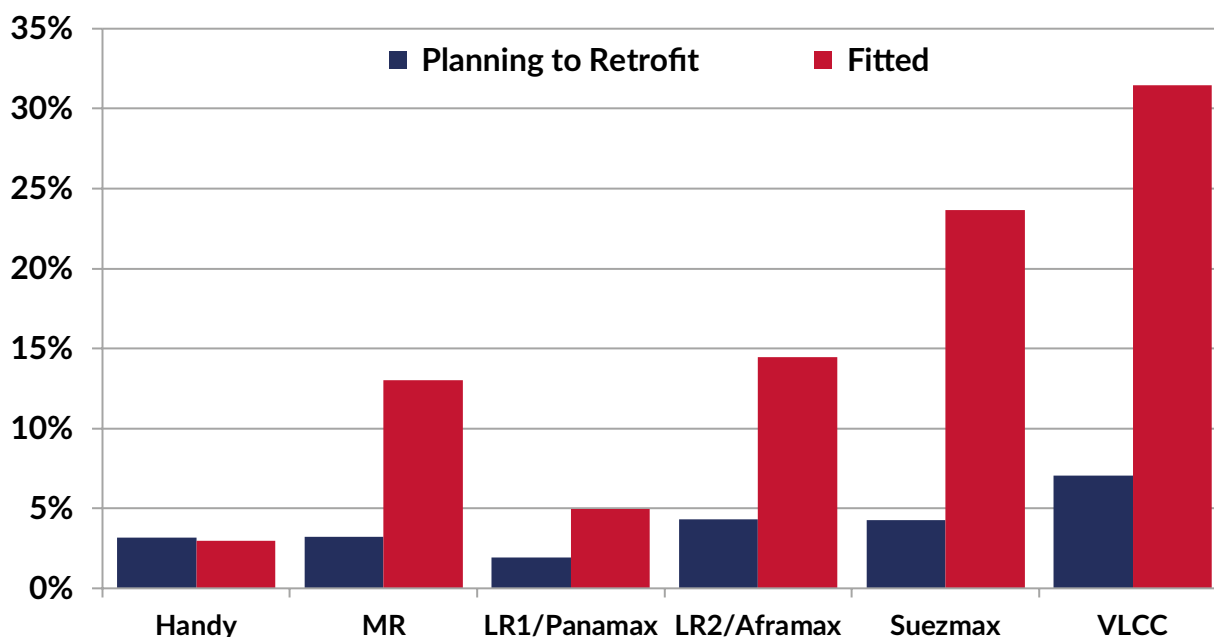
deliver goods and commodities, including essential foods and medicines, around the world and the introduction and implementation of IMO2020 did not cause any disruptions in trade.

Some ships limited their air pollutants by installing exhaust gas cleaning systems/scrubbers. More than 2,350 systems were formally reported to the IMO as an approved "equivalent method" by flag States administrations.

The majority of ships trading worldwide switched from using heavy fuel oil (HFO) to using very low sulphur fuel oil (VLSFO), which were new blends of fuel oil, produced by refineries to meet the new limit, in accordance with IMO guidance and ISO standards.

Guidance issued by IMO on dealing with the new fuel blends in advance of the new requirement addressed implications of switching to VLSFO, including assessing and managing risks and highlighting potential safety risks, so that the risks can be mitigated.

% of Current Tanker Fleet Fitted/to be Fitted with Scrubbers



Source: Gibson Shipbrokers

Through 2020 and into 2021 to date (end January), IMO has not received any reports of safety issues linked to VLSFO.

Nonetheless, during 2020, an IMO correspondence group considered fuel oil safety issues in general and the need for further mandatory requirements to ensure fuel oil supplied meets the required standards and quality.

The group's report is now available and will be discussed at the next session of IMO's Maritime Safety Committee (MSC), MSC 103 in May of this year.

Prior to that, the eighth session of the Sub-Committee on Prevention of Pollution from Ships (PPR 8), scheduled to meet remotely from 22-26 March, 2021, will further consider VLSFO fuel quality issues, including possible effects on black carbon emissions.

Provisions in regulation 18 of MARPOL Annex VI regulate fuel oil quality. The International Convention for the Safety of Life at Sea (SOLAS) covers issues such as flashpoint (SOLAS regulation II - 2/4.2.1).

"Following a turbulent 2020 that saw a brief oil price war, a global pandemic and oil demand destruction, it is perhaps not surprising that it feels like concerns surrounding IMO2020 have long gone"

Apart from the requirements in MARPOL Annex VI and SOLAS, VLSFO is required to meet ISO standard 8217, as well as ISO Publicly Available Specification (PAS) 23263, providing guidance as to the application of the existing ISO 8217 marine fuel standard to 0.5% sulphur limit compliant fuel oils.

Following a turbulent 2020 that saw a brief oil price war, a global pandemic and oil demand destruction, it is perhaps not surprising that to many it feels like concerns surrounding IMO2020 have long gone.

Examining the economics of using scrubbers, Gibson Shipbrokers said that prior to the onset of the pandemic, owners of tonnage fitted with scrubbers enjoyed a very healthy discount for high sulphur fuel oil (HSFO) versus VLSFO, which averaged between \$250 per tonne and \$300 per tonne in key bunkering hubs between December, 2019 and January, 2020.

However, the pandemic-driven oil price collapse meant that the spread sank to just \$40-\$60 per tonne between April and November last year.

For scrubber fitted tonnage, this meant that the savings for burning HSFO fell from \$16,000 per day in January last year to just \$3,000-\$4,000 per day on the basis of VLCCs trading on TD3C (VLCC – Middle East Gulf/China) route and slow steaming for most of last year, Gibson calculated.

Despite such a dramatic decline, the scope for scrubber cancellations was limited, due to contractual obligations with shipyards and scrubber manufacturers.

However, more recently, scrubber economics have started to become more favourable once again. Offering some welcome news to those who invested in this technology was the upward trend in oil prices seen in January of this year.

The spread between HSFO and VLSFO widened to around \$80-\$100 per tonne and scrubber savings climbed to above \$5,000 per day for VLCCs.

In terms of tanker statistics, the scrubber uptake is the highest in the VLCC sector, followed by Suezmaxes, Gibson said. However, scrubber use is considerably lower for the smaller size groups.

According to Gibson's records as at January, 2021, scrubbers have been installed on 31% of the existing VLCC fleet, while another 7% is yet to be retrofitted. In addition, 32% of current VLCC orderbook is expected to be fitted with the technology.

As a result, close to 40% of the VLCC fleet could be scrubber-fitted by the end of this year, the shipbroker said.

The actual scrubber penetration in the spot market is expected to be even higher when excluded tonnage (Iranian, sanctioned/storage vessels) are accounted for, while the anticipated recycling during 2021 will also reduce the absolute number of non-scrubber fitted tankers.

Although the scrubber uptake is significant for larger crude carriers, we are unlikely to see further exponential growth, Gibson countered.

Major scrubber manufacturers reported a sizeable slowdown in new scrubber orders last year. Regulatory scrutiny is also expected to intensify. Today, the list of ports where the use of certain scrubber types is banned is

extensive, while some governments are calling for a gradual phase out of the technology, for example the EU, or in extreme cases an outright ban – Canada's stance.

For now, however, while tanker supply/demand conditions remain severely unbalanced, even a modest scrubber premium could mean staying afloat and earnings above daily operating expenses, Gibson said.

"Offering some welcome news to those who invested in scrubber technology was the upward trend in oil prices seen in January of this year"

Another positive stance was taken by Star Bulk Carriers Corporation's president, Hamish Norton, during Capital Link's Dry Bulk Sector webinar in January.

During his talk, he described the company's scrubber strategy as a good decision. He claimed that the company had already covered half the cost of installing the technology, adding that the company expects to cover the rest of the costs this year.

In 2018, Star Bulk decided to equip its entire fleet with scrubbers, and at the time said that it expected the average cost per unit, including installation, to be below \$2m per vessel.

Despite last year's unfavourable market conditions in terms of bunker prices for shipowners and operators with scrubber-equipped tonnage, Norton said that Star Bulk had hedged

fuel spreads at the end of 2019 and at the beginning of 2020.

January's favourable differential of \$100 per tonne will become more advantageous for scrubber-equipped vessels this year.

"We think that the market will get better than that over 2021, as basically jet fuel and other low sulphur transportation fuels increase in demand," he said during the webinar.

The current bullish sentiment was also shared by Wärtsilä's Sigurd Jenssen, who said that scrubber inquiries were picking up again this year.

He also agreed that the fuel price differential would increase going forward making the case for scrubbers more attractive (see Exhaust Gas Cleaning System feature).

Last year, Wärtsilä referred its customers to a report from CE Delft on the climate impact of EGCS.

The study compared the results to the use of low sulphur fuels and was calculated from a well-to-wake perspective in order to achieve an accurate comparison.

It concluded that the environmental impact of EGCS would be less than that of low sulphur marine fuel. The report also noted that CO₂ emissions associated with producing and installing an EGCS were small compared to those generated when operating the system.

These emissions were mainly related to the energy demand of the system's pumps, which typically result in a total increase in CO₂ emissions of between 1.5 and 3%.

By contrast, with de-sulphurised fuels, the overall CO₂ footprint increase was as a result of the refining processes. Theoretical calculations range from an increase in CO₂ emissions of 1% to as much as 25%, when removing the sulphur content of the fuel.

CE Delft said that while the lower figure was not physically possible, the higher percentage increase was applicable only to a quality of fuel that is too high for marine applications.

Therefore, the conclusion was that the CO₂ emissions associated with the production of low sulphur fuels would be between these extreme values.

PURETEQ: STATE-OF-THE-ART SCRUBBER SYSTEMS

PureteQ designs, delivers and commissions built-to-fit maritime scrubber systems for open-loop, hybrid-ready and fully hybrid (closed loop, with and without bleed-off) operation to shipowners who want to save money on fuel by continuing to use heavy fuel oil (HFO).

Recently, we have seen the price span between compliant fuel and HFO increase and interest for scrubber systems are increasing with the price span.

All scrubber systems come with state-of-the-art intuitive control systems with full remote accessibility. In times like these, it is very convenient to get 24/7 remote on-line support/guidance to ship crews from our professional marine engineers. This

feature has contributed greatly to all our customers gaining a competitive advantage.

The scrubber system is a design of superior quality, with easily installed water treatment systems. The open tower in-line scrubber system has no moving parts nor obstructions such as a packaging layer. The simple construction also requires less maintenance and is simple to operate for the crew.

For shipowners and operators with remote access, we offer a remote Scrubber System Modular Training Program. In times where crew changes often, "touch and go" remote training has high value for all stakeholders. Some shipowners even choose to have

the onshore employees participate in the Remote Specialist Training. In general, training cannot be overestimated as it leads to higher up-time and compliance rates as well as better performance and less operational costs.

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PureServ is PureteQ's dedicated service organisation. We offer fair-priced service agreements designed to meet shipowners' specific needs based on a ship's operational pattern and qualification of its crew.

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PureteQ





Test setup (micro scrubber)

Our service team has received extensive training to assist shipowners in safeguarding continuous operation, reliability and MARPOL compliance of their scrubber systems. This entails expert support and guidance for all scrubber systems on-site or via the safe PureteQ remote system, depending on the ship's conditions and the client's requirements. Our validated concepts allow us to assist crews remotely with trouble shooting and advice on operation and maintenance, as well as optimisation and training of new crew.

PureteQ PureServ is happy to quote a service agreement for scrubber systems of any brand to safeguard MARPOL compliance as well as optimise operational performance.

GENERATION II SCRUBBER

PureteQ Scrubber Systems are among the most reliable, safe and user-friendly scrubber systems in the industry. On top of that, PureteQ scrubbers feature the

lowest OPEX in the business, as well as being easy to install. We have now simplified the installation even further in our "Generation II" scrubber system.

This scrubber system aims to reduce the total cost of installation, considering the experience of installing more than 100 scrubbers on different types of ships at various shipyards around the world.

From 2018-2020, the total cost of installation almost tripled on most shipyards across the world. We as manufacturers took on the responsibility to make green investments more attractive to shipowners and therefore set an ambitious goal to decrease the total cost of installation by 40% on retrofit projects and 25% on newbuildings.

We have not reached this ambitious goal just yet, but we have, nevertheless, produced ideas that will significantly cut the cost of installing PureteQ scrubbers, by double digit percentages.

CO₂ CAPTURE AND REUTILISATION

In 2020, we began a research programme into carbon capture and reutilization technology and have now applied for patent on a process that combines carbon capture from exhaust gas with Power to X. Combining the processes allows for lower cost of removing/reducing CO₂ as some of these costs are offset by earnings/benefit of producing hydrogen.

Currently, we are performing tests on lab scale and we have fully automatised the system (PureteQ control system), so that the cell and micro scrubber is working 24/7. The results are promising. Our test on the scrubber tower is progressing and we have now begun testing the tower in an industry located just 30 miles from our HQ. We are testing on relatively clean gas from LNG-fuelled generator sets, so there is no fluid treatment/cleaning involved yet. We are now building a bigger scale plant with a small PureteQ scrubber on a portable skid, so that we can transport it to different locations, testing various types of exhaust gasses.

Furthermore, PureteQ is involved in a project based on an American patent of chemical sequestering of CO₂. The process transforms the CO₂ to sodium carbonate and sodium bicarbonate (baking soda), which in turn can be used to augment oceans' natural carbon cycle or other purposes.

Finally, we are involved in a Dutch CO₂ capture project together with DTU. The aim is to reduce the current cost of carbon capture in amine processes.

We are always happy to elaborate on our CO₂ project, Generation II scrubber, service concepts and extensive knowledge of maritime scrubbers in general for all interested parties.

For more information, contact:

Anders Skibdal, CEO

Tel: + 45 4017 1400

Email: anders@pureteq.com

Michael Mouritzen, Sales Director

Tel: +41 4014 4481

Email: mim@pureteq.com

pureteq.com



ECOSPRAY: A CLEAR VISION FOR A CLEANER FUTURE

The past year has redefined the rules, causing us to face a turnaround in our perspectives. The maritime industry is not only dealing with a crisis due to the pandemic, but is growing and adapting to new challenges and preparing for the future: 2050.

Since industry urgencies have changed, we need to consider the long-term perspective. Not just when it comes to regulations, but also environmental awareness and sustainability. Together with the latest technologies, these are the drivers towards the CO₂-neutral path. Decarbonization is undoubtedly the most important priority in our industry and a crucial opportunity – even if, in terms of applicability, the regulatory framework still requires clarity.

The Ecospray path towards decarbonization functions with a new business model, new products and remarkable technology in order to achieve the 2050 zero emission target. With a clear vision in mind – to make clean energy a reality – Ecospray has, in the past year, invested time and effort into developing new solutions and finding innovative ways to approach the market.

"We saw 2020 as entering a big tunnel, but we wanted to invest as much as we could to prepare for the end of the tunnel in order to serve the market in the best possible way," says Ecospray CEO Stefano Di Santo. "Ecospray's technological solutions leverage three distinctive factors: technology delivered as a service; the analysis and use of relevant data; and finance, to facilitate access to innovation and significantly advance the transition towards decarbonization and the creation of clean energy."

Ecospray's mission to tackle the environmental impact of all industries is solidified by a new business model: not limiting itself solely to being a scrubber-maker, but becoming a multi-product company and empowering digitalisation ranging from technology to process, and products to services. This visionary

approach, in collaboration with Relayr – a company specialising in internet of things (IoT) solutions – ultimately envisions the adoption of a model based on a pay-per-use offering, through which equipment is no longer purchased, but provided in exchange for a usage fee.

Offering innovative financing options, we will be able to create even more value for our customers and ensure that they can focus on their core business.

OUR ROADMAP TO 2050

Concurrently, we have never ceased doing what we were created to do: uncovering new innovative solutions, skipping one generation of technological evolution and meeting with new challenges across brand new sectors.

For more than a year, we have been working on a solution for decarbonization, in collaboration with universities and research centres. Our fuel cell technology is unique, as it reduces costs and environmental impact, coupling carbon capture with energy production simultaneously. With a cross-industry application, the Carbon Friendly Fuel Cells feature a different technology than that typically used, which we believe will be in use by 2023.

If our horizon is 2050, our newest solutions – ranging from emission-removal AI systems to fuel-saving and air-and-water filtration solutions – represent the present. Smart scrubbers and new technologies to sanitize onboard spaces are just two examples.

An advanced remote AI-enabled control and monitoring system is the technical core of our new smart scrubber: the integration of Relayr's IoT and AI allows us to guarantee constant compliance with International Maritime Organization regulations for the containment of air pollution in the maritime environment. Moreover, it allows significant savings in terms of performance and maintenance through remote monitoring and advanced life-cycle analysis. The ability to constantly monitor and analyse the scrubbers'

performance ensures longer equipment life and fuel savings by optimising pumping operation, while also allowing for a significant reduction in operating costs.

Regarding health and safety, the need to sanitize onboard environments and surfaces from viruses and bacteria has galvanised us to deliver our latest solutions for air treatment. BreathES drastically reduces pathogens and contaminants inside closed spaces, in the air and on surfaces, ensuring a smoother "return to service" for passenger and other ships and providing a safe environment for guests and crews.

BreathES is a package that combines different technologies (including UVGI lights, bi-polar cold plasma ionizers and filtration) with an air-quality monitoring system and a centralised control unit with shoreside/cloud data collection and analysis. Everything is connected in our signature platform One: from real-time awareness to performance, analytics, and maintenance services, the EGCS are under control.

Substantial research and development investments have also brought about the development of several water treatments. With our innovative solutions for vessels, available from the second half of 2021, performances beyond compliance will be achieved on a variety of applications, including DeSOx wash water, galley and laundry water, and bilge water.

We have a clear vision for the future, as outlined by our roadmap to 2050: decarbonization is now inevitable and imperative, so we have made a choice for our future. We truly believe that all our technologies for the planet actively support decarbonization and the creation of green power.

For more information, contact:
Ecospray Technologies
Via Circonvallazione 14/14A 15050
Alzano Scrivia (AL) Italy
Email: info@ecospray.eu
Tel: +39 0131854611
ecospray.eu





With arguments raging over the merits of various exhaust gas cleaning systems, *Clean Shipping International* spoke with leading suppliers to gain their views on the best way forward

OPEN, CLOSED OR HYBRIDS?

Setting the scene during recent conversations on the merits of various exhaust gas cleaning systems (EGCS) was Finland-based ship designer, naval architecture and marine engineering firm Foreship, which suggested that better-than-expected return on investments from open-loop systems will translate into further orders once coronavirus-related uncertainties pass.

Foreship's scrubber selection recommendations to ensure ship emissions meet IMO2020 0.1% fuel sulphur content criteria are made totally independent and based on cost, complexity and vessel operating profile. With services ranging from feasibility studies to concept design, basic design, detail design and supplier evaluation, Foreship said that with around 60 exhaust gas scrubber references to date, the company has built up extensive experience of open-loop, closed-loop and hybrid systems, covering a variety of class rules and yard installations in Europe, North America and Asia.

Olli Somerkallio, Foreship's chief operating officer, explained that the majority of the hybrid systems the company has worked on have been destined for cruise ships or ROPAX vessels, where vessels spend more time operating on coastal voyages and in port.

However, lower cost open-loop scrubbers have represented a larger part of the company's workload, with owners switching to lower sulphur fuels where port restrictions on washwater demand it.

"It's understandable that some local authorities take a negative view on acidity in washwater and the presence of heavy metals, no matter how low the concentrations, especially where water exchange rates are not high," he said. "Hybrid scrubbers that switch to closed loop operations in port certainly provide one option but the other remains to install an open loop system and manage a switchover to low sulphur fuels in port."

Somerkallio said that the combination of covid-19 and cut-throat oil pricing has eaten



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Olli Somerkallio, Foreship chief operating officer



Andritz port barge design for vessels not fitted with a scrubber

into the differential between high-sulphur and low-sulphur content fuel oils, leading demand for scrubbers to stagnate. These circumstances also had consequences for future scrubber technology demand.

Cruise ships that need hybrid scrubber systems to accommodate closed-loop operations in waters identified as especially sensitive had already been equipped, while covid-19 has driven some older vessels that might have been hybrid candidates to the recycling yard.

The total cost of open-loop scrubbers, including equipment and installation, is significantly lower than fitting hybrid systems and owners that have committed to this technology are reporting returns on investments far more rapidly than anticipated.

Somerkallio explained: "When oil prices recover, we expect this type of scrubber to attract significant new investment. For cargo shipowners, the fact that the closed loop needs alkali in significant volumes will always make it an expensive option.

"Although lower fuel cost in port can shift the economics in favour of the hybrid option for some ships, for

cargo ships the cost of the closed loop operation kills the economics of the scrubber," he said.

He acknowledged that criticisms are levelled at open-loop scrubbers based on sulphurous washwater, but emphasised that only specific ports and coastal waters block their use. While the efficiency indices driving International Maritime Organization (IMO) regulations favour liquefied natural gas (LNG) over heavy fuel oil (HFO), December's Marine Environment Protection Committee (MEPC 75) nonetheless pointedly replaced the phrase "liquid effluents" with "discharge water" in its latest scrubber guidelines evaluation.

Somerkallio added that new research from Tampere University, the Finnish Meteorological Institute and the VTT Technical Research Centre showed that using EGCS in combination with HFO result in lower particulate emissions than marine gas oil. "If there was an outright ban on the open loop, I believe there would only be a very small number of scrubber installations altogether each year. I don't believe that would be an environmentally desirable outcome," he concluded.

ALL-IN-ONE SYSTEM

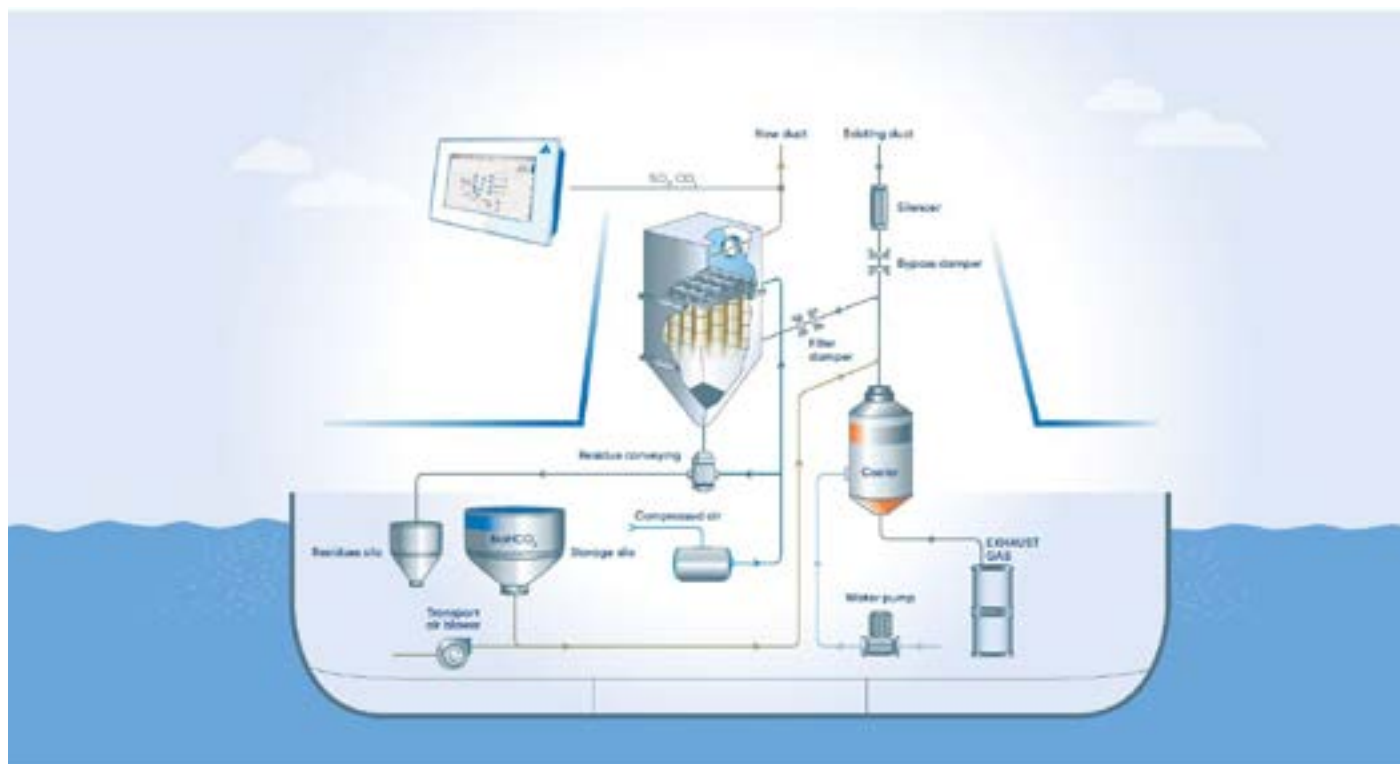
Austrian plant engineering company, Andritz has developed what it claims is an "all in one" dry scrubber system, which the company calls its "dual/multi-filtration system", as part of its SeaSOx EGCS range.

Marine solutions sales manager, René Schöberl told *Clean Shipping International* that the dry system uses sodium bicarbonate as an absorbent.

He explained that being a system that does not use washwater, it is ideal for coastal and inland vessels, ferries, including ro-ros and ropaxes, feeder ships and small cruise vessels where there are likely to be restrictions on washwater discharge.

There are two versions of this scrubber — a dual-filtration modular system for removing SOx and fine particulates. In addition, Andritz offers a multi-filtration version for removing SOx, NOx and particulates.

The company also has a mainstream SeaSOx scrubber for washwater and applicable to worldwide trading vessels. It is available in-line (I-type) or as a bypass system (U-type)



.A schematic of the Andritz dry dual multi-filtration scrubber system

and is offered in either a round or rectangular shape.

It can be installed as an open loop, closed loop, hybrid ready or hybrid fitted solution.

Schöberl claimed that Andritz was the only company that had successfully installed SeaSOx scrubbers and dual/multi-filtration systems to class satisfaction.

"As we are offering the complete portfolio – common wet scrubbing, as well as the filtration system – we are looking for the right solution for each vessel/fleet respectively," he said.

Thus far, the company has installed a filtration system on La Méridionale's roro ferry *Piana*. The test results were even better than expected, Schöberl said.

An agreement to install the world's first dry EGCS on *Piana* was signed in Marseille back in the summer of 2018.

This solution uses patented Bicarbonate sodium bicarbonate as the absorbent and a pulse jet fabric filter for SOx and particulate removal. One 9.6MW main engine and one 1.26MW HFO auxiliary was fitted to the filter system.

Andritz was responsible for the design, engineering and supply of the main equipment. Partner SOLVAY was in charge of the sodium bicarbonate delivery and the discharge of the residues.

In addition, German shipowner TT-Line installed two SeaSOxwet open-loop scrubbers for the two main engines in December 2019 and January 2020 on board the ropax Marco Polo, which operates in the Baltic (Sweden – Lithuania).

Two others were ordered for the reefer container vessels 'Dole Chile' and 'Dole Colombia', operating between the United States, South America and Europe in October, 2019 for their reefer container vessels.

By fitting this technology, Dole is able to burn high sulphur fuel oil, while complying with IMO2020

"As this filtration system is interesting for lots of ship owners/managers and also ports, we have developed a barge solution to serve vessels arriving at a port and are not fitted with a scrubber," he said.

"The restrictions will get tighter and there will be more in the near future," he concluded.

ENVIRONMENTAL IMPACT

Late last year, Wärtsilä referred its customers to the oft-quoted CE Delft report, regarding the climate impact of EGCS.

The study compared scrubber results to the use of low sulphur marine fuel and was compiled from a well-to-wake perspective in order to achieve an accurate comparison.

CE Delft concluded that the EGCS' environmental impact would be less than that of low sulphur marine fuel.

Its argument was that CO₂ emissions associated with producing and installing an EGCS were small compared to those generated when operating the system.

CO₂ emissions were mainly related to the energy demand of the system's pumps, which typically result in a total emissions increase of between 1.5% and 3%.

By contrast, with de-sulphurised fuels, the overall CO₂ footprint increase was a result of the refining processes. Theoretical calculations range from an increase in CO₂ emissions of 1% to as much as 25% when removing the sulphur content of the fuel.

The report said that while the lower figure was not physically possible, the higher percentage increase was applicable only to a fuel quality that was too high for marine applications.

Its conclusion, therefore, is that the CO₂ emissions associated with the production of low sulphur marine fuels would be between these extreme values.

Turning to the perceived open loop scrubber problems, Wärtsilä's exhaust treatment's director, Sigurd Jenssen, told *Clean Shipping International* that despite the ban on open-loop scrubbers in some areas of the world, he had seen no shortage of orders for this type of equipment.

In newbuildings, the mainstay of the company's EGCS orderbook, some owners had opted for a mix of open loop and hybrid types. "It depends on the owner," he explained.

He said that there had been several retrofits last year, but nothing like the number seen in 2018 and 2019 – the boom years leading up to the IMO's low sulphur ruling.



Sigurd Jenssen, director Wärtsilä exhaust treatment systems

However, since the business case for installing a scrubber system has improved, there have been more inquiries for retrofits recently.

Back in 2019, scrubber suppliers found it challenging to reserve space at a shipyard for retrofits, due to the volume of work.

SOx and particulate matter (PM) scrubbing is not going to stop, he said, while for NOx, Wärtsilä offers an exhaust gas recirculation (EGR) solution whereby the gas is recirculated into the turbocharger's side inlet.

Scrubbers are just one of the methods available and are the first step along the journey of emissions control, as there is a potential to add on other abatement technology today. In essence, fuel forms one part of the abatement equation, while abatement technology forms another, he said.

He also claimed that it was relatively easy to upgrade a scrubber system for other emissions abatement solutions, as long as the work is planned in advance. For example, converting an open loop system into a hybrid type scrubber involves adding additional water handling equipment, etc.

For newbuildings and retrofits, Wärtsilä offers a modular solution for ease of installation.

He stressed that the financial case for scrubbers will not change going forward, as the alternative would be to switch to other more expensive fuels. As mentioned, the business was

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becoming more favourable again as the fuel price spread widens and should continue to rise going forward.

At a spread of around \$100 per tonne between high sulphur fuel and low sulphur fuel, the scrubber case becomes a good investment, he thought.

Jenssen also claimed that being able to offer a lifecycle solution set Wärtsilä apart from other system providers, as within the group the skill sets exist to support an installation on board and the infrastructure is also in place to offer spare parts and technicians anywhere in the world.

This has encouraged many service and maintenance agreements being signed with the installation contracts. The pumps and valves are mainly standard equipment, which the crew can maintain, as they should be familiar with this equipment.

Wärtsilä also offers classroom and simulator training at its Land and Sea Academy, as well as on-site, hands-on training in operations and maintenance on-board.

Looking ahead to the IMO meetings this year, he said that the industry needed predictability with no rule changes. He thought that there were still some ambiguities in the scrubber regulations. However, he said these could easily be ironed out.

He stressed that Wärtsilä has and will still argue for goal-based and not solution-based standards in emissions reduction systems regulations and guidelines.

In general, Jenssen thought that the newbuilding sentiment was picking up again, but by how much will depend on how the pandemic pans out in the next few months. However, he said that the market had been more active recently, compared to much of 2020.

Despite the rise of LNG as a fuel engine fitted or LNG-ready newbuildings, he thought that the majority of containership, bulk carrier and tanker owners opt for scrubbers when ordering anew.

He also explained that as Wärtsilä had been in this particular segment for 10-12 years, the company was at the forefront in research and development (R&D) and in the art of keeping vessels operating almost emission-free.

Jenssen is based at Moss in Norway, where the R&D is carried out, but the company also has operations in Finland and Poland, and its equipment is manufactured primarily in China and Vietnam. The monitoring equipment mainly comes from Europe.

Today, Wärtsilä markets its scrubber technology to both shipowners and shipyards. In general, the shipyards were maturing in terms of installations, he concluded.

INCREASED INTEREST

Steven Pieters, Alfa Laval's sales director, exhaust gas cleaning, told *Clean Shipping International* that while it was true that most systems being ordered were the open loop variety, over the past months, the company had seen an increased interest in hybrid systems.

He also confirmed that Alfa Laval offers and has delivered all types of scrubber systems.



Steven Pieters, Alfa Laval sales director, exhaust gas cleaning

Although he said that Alfa Laval can't predict what will happen with regulations, the company does follow their developments closely.

"As a scrubber supplier, we ensure our systems are fully compliant with today's regulations and we anticipate upcoming regulations with our technology and development, making sure our customers will also comply tomorrow," he said. "An example of this can be seen with our open-loop scrubbers. They are all designed as hybrid-ready, having the necessary connections present for a later conversion to a hybrid system if the customer so chooses."

FAVOURABLE SPREAD

Chelsea Technologies' Adam Jolliffe, senior sales manager – maritime, said the rapid payback times scrubber owners saw during 2019 and the first few months of 2020 quickly stalled, as the spread between HSFO and VLSFO narrowed to historic lows last March.

However, that spread is now creeping back up and the future of scrubbers once more looks bright, illustrated by a recent report from Gibson Shipbrokers (see Leading Edge) saying that 40% of VLCCs are now set to install scrubbers, given that savings had increased to some \$5,000 per day.

"Scrubbers represent a legitimate compliance method for the IMO2020 global sulphur cap, slashing air pollution and reducing the health-related dangers for crews and coastal communities. Yet they have been mired in a certain level of controversy and uncertainty since their introduction – and regulation change has never been out of the headlines.

"An EGCS represents a multi-million-dollar financial outlay for a shipowner. At the time of writing (beginning of February), scrubber systems are still a long-term investment and payback times are expected to remain in the years rather than months. Shipowners need to future proof their systems if they're to see the full return on investment," he said.

Under the IMO scrubber rules, the equipment's washwater effluent is required to be monitored to ensure that it is not damaging the marine environment.

An issue with a ship's engine or scrubber could inadvertently push oil or other pollutants through the system, he stressed.

Global regulations are clear on which kinds of pollutants must be monitored, as well as how to measure for these irregularities. There is one exception – polycyclic aromatic hydrocarbons (PAH).

PAH particles are a series of carcinogenic hydrocarbons created as a by-product of poorly or improperly burnt marine fuels.

As things stand, there is a global divergence in measurement regimes across different jurisdictions, with the IMO requiring measurement for



only the most common type of PAH particle and others like the US Coast Guard (USCG) requiring a full range PAH measurement.

The IMO is currently seeking to harmonise global regulations on this. New regulations are anticipated at MEPC 76 to achieve this, and it is expected that this approach will see the higher standard introduced globally, Jolliffe explained.

The long-term nature of scrubber investments means that shipowners are tasked with anticipating future regulatory change. Shipowners are facing major regulatory risks, as their entire multi-million-dollar system could be in danger months or years before an owner has seen a penny of profit.

For this reason, owners need to ensure that their scrubber washwater monitoring systems measure PAH particles to the higher standard today. A system must use a proven, accurate methodology to provide a full-range PAH measurement, he said.



Adam Jolliffe, Chelsea Technologies senior sales manager — maritime

"Chelsea's Sea Sentry system uses bespoke sensors and a user-friendly interface to provide this full-range lab accurate analysis. Installed in hundreds of vessels and certified by DNV GL and ClassNK, Chelsea's Sea Sentry is trusted by shipowners seeking to futureproof their vessels from impending regulation," Jolliffe says.

"Scrubbers are an opportunity for shipowners and will lead to significant OPEX savings if the systems remain compliant. However, their cost and payback time highlight the need for shipowners to ensure that they have done all they can to future proof their installation against regulatory change."

EXTENSIVE SUPPORT



John Kristian Pedersen, segment director marine & offshore, DESMI Pumping Technology

John Kristian Pedersen, segment director marine & offshore, DESMI Pumping Technology joined the argument by saying that the ban on open-loop discharge is only limited to a few ports where the ships only burn a minority of their fuel, so it will not have a great impact on the scrubber business case for most owners.

He agreed that hybrid systems were more expensive than an open loop scrubber types and due to the current spread between HFO and compliant fuel, the more expensive systems can be difficult to justify at this point of time. However, if the system is prepared so it can also operate in closed-loop mode in the future, DESMI will support the scrubber manufacturers with the best technical and economical solution.

"At present, only the ships with a large fuel consumption and where it

is not too difficult to install systems seem to be attractive at the moment. However, with the vaccine against covid-19, we expect that the world and the fuel prices are already on the recovery route and increasing the interest for the technology as a valid alternative," he said.

DESMI also offers after-sales services and support throughout the lifetime of the installation/vessel. This offering does not stop with the scrubber installation but covers the complete range of products, such as engine room pumps, pump control systems and engine room fans, as well as ballast water systems.

Addressing MEPC 76, Pedersen said: "We hope that it will be possible to take a more holistic approach looking at both air and water emissions.

"Scrubbers have some great advantages by saving all the energy that the refineries elsewhere would need to refine the HFO. This corresponds — as far as we are informed — to about 10-20% CO₂ reduction. It also captures a lot of the particulate matter and generally, the scrubbers are reducing the sulphur to lower levels than the 0.5% global cap.

"Furthermore, with our Optisave systems for controlling the pump operation in accordance to actual needs and engine loads, safe guarding the total power consumption for the system is being kept to a minimum at all conditions. A great asset to keep the total costs down at all times."



A typical DESMI pump installation

FUTURE DEVELOPMENTS

Looking ahead, Marcello Vercellino, Ecospray's sales manager, said: "Bearing in mind the 2050 zero-emission target, Ecospray is working on the development of new solutions to reduce CO₂ and greenhouse gas (GHG).

"As with many other players, we are looking forward to the finalisation from IMO of the EEXI/EEDI calculation guidelines and carbon intensity indicator (CII) limits, which have an impact on any new technologies under development (for example fuel cells).

"In order to plan investments, shipowners and all the marine industry players need to have a clear scenario for the future and precise indications on how to manage the energy transition and the decarbonisation process.

"While Circular 883 issued in 2019 definitely helped significantly in clarifying operational aspects and real-life scenarios of EGCS usage on board ships, we still think there would be room for further clarifications and harmonisation on some key compliance aspects of the rules, for example pH limit calculation and PAH measurement methods," he said.

He explained that Ecospray's portfolio boasts a wide range of EGCS to meet all the needs: both open-loop and hybrid design, Inline or U-Type configuration, in different sizes, to serve engines with a rated power from 5-80MW.

The Ecospray EGCS are designed for SOx removal from different types of vessels — such as cruise ships, ferries, and commercial vessels — and can be integrated with a broad set of new technologies for green ships.

With regards to the EGCS design, open-loop and hybrid systems have different features and the adoption of one of the two depends on the client's needs and specific assessments, plus the evaluation of operational profile of each specific ship.

"Ecospray has installed mostly open-loop types, proving that this design is still the most cost-effective solution for ships sailing worldwide (for technical, operational and economic reasons).

"For this reason, we recommend the open loop type, especially if integrated with our second generation of

washwater filtration system, not only to comply with actual IMO requirements but to go beyond the expected parameters, mitigating also possible visible effects overboard," he said.

SMALLER IMPACT



Laura Langh-Lagerlöf, commercial director
Langh Tech

Laura Langh-Lagerlöf, commercial director of Langh Tech, said that in her opinion it is understandable that more and more areas ban the use of open loop scrubbers.

"It is logical that closed-loop operation has a smaller impact on the environment as the residues from

the washwater are removed and delivered ashore for proper treatment," she added.

She explained that the company, which also manages ships, focused on closed-loop and hybrid scrubbers. Langh also supplies closed-loop water treatment systems for other scrubber manufacturers, for instance Valmet, CR Ocean and Hyundai, which are using the company's closed loop water treatment for some of their projects.

"We also have open-loop scrubbers in our product range as most of the owners still want to invest only in open loops. Anyway, all open-loop systems that we supply can later be upgraded to hybrids," she explained.

BUILDING ON SCIENCE

Aleksander Askeland, chief sales officer, Yara Marine Technologies, said: "We are excited to see how IMO/MEPC will eventually address the issue of scrubber washwater and the discharge of same into the oceans.

"All available science documents that washwater discharge is harmless even within confined waters. We are confident that IMO/MEPC will build further regulatory development for scrubbers on science, like they have done to date," he said.

He explained that Yara Marine Technologies offers the full range of



Yara scrubber systems getting ready for installation

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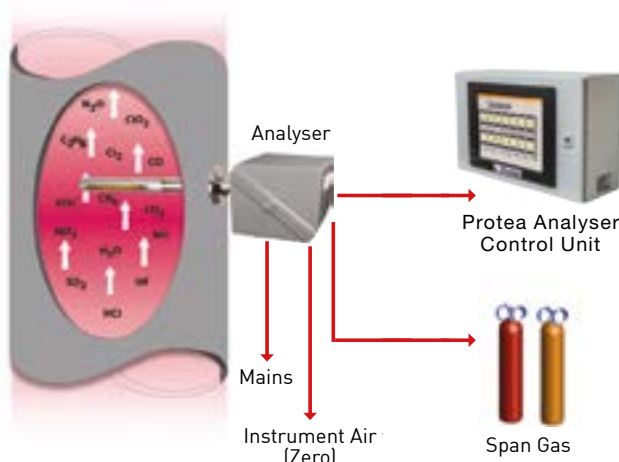
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UK Maritime and Coastguard Agency

European Commission Directive 2008/67/EC of 30th June 2008, amending Council Directive 96/98/EC on marine equipment (4th Amendment) Annex 2, A2/2.1- On board NOx monitoring and recording devices, MARPOL 73/78 Annex VI regulation 13 and the NOx Technical Code.

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Concerning Electrical Installations - IACS E10 Test Specification for Type Approval and relevant IEC 60945

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RINA Rules for the Classification of Ships - Part C "Machinery, Systems and Fire Protection", Chapter 3, Section 6, Tab.1 and IMO Res. MEPC.259(68) Chapter 6 "Emission Testing" as well as the relevant requirements of Revised MARPOL Annex VI and NOx Technical Code 2008.

Lloyd's Register - Type Approval Certificate Protea P2000

LR Rules & Regulations for the classification of ships (July 2014) LR Test Spec No.1 (2015)
IMO Resolution MEPC 184(59) - 2009 Guidelines for exhaust gas cleaning systems
IMO NOx Technical Code (2008)

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scrubbers — open, hybrid and closed loop. Only open and hybrid types are used by shipowners, while closed loop scrubbers are virtually non-existent.

Askeland also said that the coronavirus pandemic has had a major impact on the shipping industry.

As a result, he said that the company now has their hands full with online training to help superintendents and chief engineers overcome downtime. The number of training courses has nearly doubled.

"Scrubbers are still considered as new equipment and our experience is that key crew members could still use better understanding, more experience and training," he said.

Scrubber downtime is often due to lack of knowledge on maintenance, troubleshooting and general operations. A trained crew always makes better decisions, thus

preventing downtime. That is why those who invest in scrubbers, also ensure that they invest in the people who keep them running, he explained.

Crew training is more popular now than ever, he said. Online training is usually either a one- or a two-day course. They must adapt to both beginners and more experienced crew, and they need to fit the crew's schedule.

The online training programme focuses on expanding equipment operation knowledge and safe maintenance standards for crew, electrical and engine officers, technical staff and superintendents.

"Yara's scrubbers are quite easy to operate, but you need to know what you are doing and there has never been a better time to do training and to maintain SOx scrubber system skills than now," he said.



Aleksander Askeland, chief sales officer,
Yara Marine Technologies

"Operational disruptions are expensive, and proper training minimises the risk of downtime. Also, we see cases where maintenance is performed incorrectly, with very bad results. Correct operation and maintenance makes you compliant, extends the life cycle of the scrubber, saves time, saves spare parts and reduces overall operational costs."

SHORT SEA TRADE OFFERING

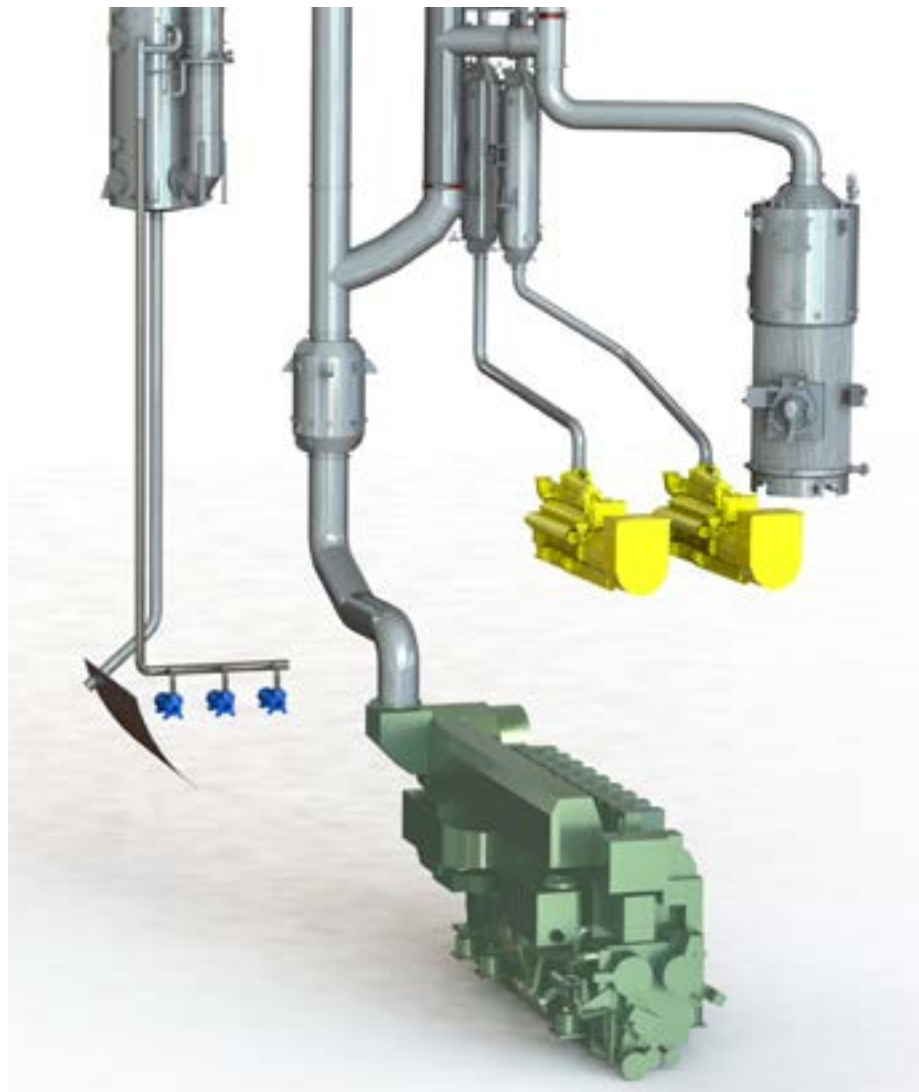
In 2013, Bremen-based engineering company SAACKE installed a scrubber on board Carl Buettner's products tanker *Levana*. Today, the company offers open loop and hybrids, which are capable of operating in both open and closed mode.

These are of particular interest to smaller and mid-size ships on short sea trades, the company explained. Larger vessels tend to burn a small percentage of fuel in zero discharge areas and so may prefer to switch to diesel oil when manoeuvring and when in port.

Looking to this year's IMO meetings, the company said that it was likely that the regulations in respect to measurement methodology and threshold (PAHs) and the quality of bleed-off water might be re-specified.

On the other hand, SAACKE said that the company will be happy if the high emission of soot and particulate matters from non-scrubber fitted ships would be regulated as well. In this respect a scrubber, that reduces particles by more than 80% by weight, gives a remarkable contribution to environmental protection.

SAACKE is a leader of the SAARUS project, which aims to reduce the harmful fine/ultrafine particles even further, the company explained.



A SAACKE scrubber system

CHELSEA: STAYING AHEAD OF SCRUBBER WASHWATER REGULATIONS

The rapid payback times scrubber owners saw during 2019 and the first few months of 2020 quickly stalled, as the spread between high sulphur fuel oil and very low sulphur fuel oil narrowed to historic lows last March. However, that spread is now creeping back up and the future of scrubbers once more looks bright: Gibson Shipbrokers recently said that 40% of VLCCs are now set to install the systems, as savings increase to \$5,000 per day.



Scrubbers represent a legitimate compliance method for the IMO2020 global sulphur cap, slashing air pollution and reducing the health-related dangers for crews and coastal communities. Yet they have been mired in a certain level of controversy and uncertainty since their introduction — and regulation change has never been out of the headlines.

An exhaust gas cleaning system represents a multi-million-dollar financial outlay for a shipowner. At the time of writing, scrubber systems are still a long-term investment and payback times are expected to remain in the years rather than months. Shipowners need to futureproof their systems if they're to see the full return on investment.

HARMONISING RULES

The IMO rules that permit scrubbers require that their washwater effluent is monitored to ensure that they are not damaging the marine environment. After all, an issue with a ship's engine or scrubber could inadvertently push oil or other pollutants through the system.

Global regulations are clear on which kinds of pollutants must be monitored as well as how to measure for these irregularities. There is one exception though: polycyclic aromatic hydrocarbons (PAH).

PAH particles are a series of carcinogenic hydrocarbons created as a by-product of poorly or improperly burnt marine fuels. As things stand, there is a global divergence in measurement regimes across different jurisdictions, with the IMO requiring measurement for only the most common type of PAH particle and others like the United States Coast Guard requiring a full range PAH measurement.

The IMO is currently seeking to harmonise global regulations on this. New regulations are anticipated at MEPC 76 to achieve this and it is expected that this approach will see the higher standard mainstreamed globally.

The long-term nature of scrubber investments means that shipowners are tasked with anticipating future regulatory change. Shipowners are facing major regulatory risks, as their entire multi-million-dollar system could be in danger months or years before an owner has seen a penny of profit.

For this reason, owners need to ensure that their scrubber washwater monitoring systems measure PAH particles to the higher standard today. A system must use a proven, accurate methodology to provide a full-range PAH measurement.

FUTURE PROOFING

Chelsea's Sea Sentry system uses bespoke sensors and a user-friendly interface to provide this full-range lab accurate analysis. Installed in hundreds of vessels worldwide and certified by DNV-GL and ClassNK, Chelsea's Sea Sentry is trusted by shipowners seeking to futureproof their vessels from impending regulation.

Scrubbers are an opportunity for shipowners, and will lead to significant OPEX savings if the systems remain compliant. However, their cost and payback time highlight the need for shipowners need to ensure that they have done all they can to future proof their installation against expected regulatory change.

Author: Adam Jolliffe, senior sales manager – maritime, Chelsea Technologies



For more information, visit:
chelsea.co.uk

MAGTREAT®-S: SETTING NEW STANDARDS

MagTreat®-S is a stable, non-foaming suspension of magnesium hydroxide that is used as an alkali in marine scrubbers. It is based on the natural mineral brucite and is made in various slurry make-down plants, which are strategically located near main ports.

Since the introduction of IMO 2020 enforcing measurements to drastically reduce the emission of sulphur oxide (SOx) the sales of MagTreat®-S have skyrocketed. What makes shipping lines choose MagTreat®-S and not another alkali?

Henk Don, Managing Director of the Rotterdam-based company Europiren BV says: "I believe it is a combination of various unique properties of our product and our service." Europiren is the exclusive distribution partner of the Brucite+ group of companies, which includes Russian Mining Chemical

Company LLC and its subsidiaries for the mining and processing of brucite (natural magnesium hydroxide). RMCC started its activities in 2002 and reached total sales of 450.000 tons in 2020.

"MagTreat®-S offers significant advantages in handling and efficiency compared to caustic soda" says Don. MagTreat®-S is a non-hazardous product, thanks to its buffering capacities at a pH of 10. This is a big advantage in handling and storage as no special requirements are needed. Thanks to the bivalent magnesium ions, magnesium hydroxide is 30% more efficient based on 100% alkali. But caustic soda is delivered as a 50% solution and MagTreat®-S in its highest concentration has 65% solids. In that case, the efficiency of MagTreat®-S is even 70% higher, which means shipping

lines can save significantly storage space on board.

The natural magnesium hydroxide from Brucite+ comes from the world's largest brucite deposits in Russia. It is unique in its high level of purity and the absence of any crystalline quartz. There is often some confusion about the chemical analysis of the different magnesium hydroxides. In the mineral world, it is common practice to list all components as "oxides", but in reality the components are present in a different chemical form.

Don confirms: "We often get questions about the abrasiveness of MagTreat®-S because people confuse silica (sand) with silicates (for example talc). MagTreat®-S only contains a small percentage of silicates and does not contain noticeable amounts of silica. Silicates have the same hardness as



Mining of brucite with latest mining technologies and with maximum care for the environment



In Antwerp and Rotterdam MagTreat®-S is supplied by barge which offers flexibility in volumes and delivery times

magnesium hydroxide and therefore MagTreat®-S has the same low abrasion rate as synthetic magnesium hydroxide and much lower abrasion rates as brucite from other sources. This is confirmed by endurance tests in extreme conditions in the lab, but even more importantly by the absence of any signs of excessive abrasion after supplying tens of thousands of tons to marine scrubbers."

Some magnesium hydroxide suspensions are known for creating problems with foaming in the scrubber, but not so for MagTreat®-S. It contains a unique additive that combines stabilisation with anti-foaming properties. Don states: "Initially, we also had some issues with foaming, depending on the salinity of the scrubber water. But since we changed to a new formulation foaming has not occurred anymore."

MagTreat®-S is distributed through a network of different slurry make-down plants, strategically located close to main ports. MagTreat®-S is shipped in dry form to different plants where it is processed to a suspension. The suspension can be supplied with different solids contents, ranging from 32 to 65% solids. Don underlines: "We always promote the use of 65% solids because this offers the biggest benefits in terms of economy (lowest costs per ton based upon 100% alkali), storage space required and carbon footprint (less transport of water). But of course,

if the customer prefers to buy product with a lower solids content, we can fulfill those needs as well."

In Rotterdam and Antwerp MagTreat®-S is supplied by a dedicated barge that also serves as a floating storage. The biggest advantages of supplying by barge are the maximum flexibility (delivery times of less than 24 hours) and the absence of any interruption of the onshore operations. Europiren expects to be able to offer this service also in other ports within the foreseeable future.

*"MagTreat®-S
has the same
low abrasion
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sources"*

Europiren has also started to supply MagTreat®-S to several ports in Asia. According to Don, it supplies from Europe at the moment, but Brucite+ has decided to build a new milling plant in Eastern Russia, close to the border with China. "From there, we can better serve the markets in China and other countries in eastern Asia. We are also in the process of setting up slurry make-down plants close to the main ports in Asia," Don states.

The carbon footprint of raw materials is gaining importance in many industries and, indeed, also in shipping. MagTreat®-S has a very low carbon footprint: compared to synthetic magnesium hydroxide it is more than 50 times lower and, compared to caustic soda, more than 100 times lower. This is thanks to the absence of any chemical processing and efficient logistics that mean travelling just a short distance by truck with minimal transport of water.



For more information, contact:
Rotterdam Science Tower,
18th Floor, Marconistraat 16,
3029 AK Rotterdam, The Netherlands
Tel: +31-(0)6-150 81 860
Office: +31-(0)10-350 62 06
E-mail: h.don@europiren.com
info@europiren.com
europiren.com

PROTEA: MONITORING MARINE EMISSIONS

This is a demonstration of collaboration between users and manufacturer, enabling state-of-the-art developments to meet the requirements of a critical industrial sector to meet environmental goals.

Protea, among its extensive advanced analyser range, manufacture a marine In-Situ Continuous Emission Analyser. The analyser — the P2000 — is a variant of an analyser previously manufactured by Procal Kittiwake and is an in-situ analyser.

This unique approach to monitoring exhaust emissions monitoring is an ideal solution for the marine industry to enable compliance with IMO regulations. The P2000 In-Situ analyser is fitted directly to the exhaust with the gas monitored within the exhaust duct. The in-situ technique, unlike extractive systems, does not require any sample preparation components.

Extractive monitoring systems require the sample to be transported to an analyser cabinet employing pumps, filters, heated line and other sample conditioning components, all

of which necessitate inclusion in a maintenance regime.

The P2000 analyser is certified by several classification societies as an analyser system suitable to monitor sulphur dioxide (SO₂) and carbon dioxide (CO₂) and report the SO₂:CO₂ ratio.

The P2000 was first installed on early exhaust gas cleaning systems (EGCS) in 2010 and was developed from a successful land-based analyser. Since 2010, several hundred P2000 have been installed on several classes of vessels, both on scrubbed and un-scrubbed applications.

The installed base of in-situ analysers are photometers using the absorption of selected infra-red wavelengths to determine the concentrations of both CO₂ and SO₂.

The analyser is zero based, therefore every 12 hours the system automatically switches in instrument air, which forces out the exhaust gas from the probe enabling the analyser to verify zero. In the same way, manually or automatically certified test gas can be introduced allowing a span check (Fig 2.)

Protea took over the manufacture of the Kittiwake Procal analyser range, including the successful P2000 used in both land-based and marine applications. In the process of evaluating the performance of the installed base, it was determined that the P2000 was an ideal solution for the majority of land-based applications.

However, for marine installations, the instrument would benefit from a series of product improvements.

Working with existing users and marine industry specialists, the outcome of the evaluation identified three main areas that would benefit from improvements:

- » Capable of monitoring lower levels of SO₂ in a background of relatively high water vapour
- » Capable of monitoring post scrubber (EGCS) with liquid phase water vapour carryover
- » Enhanced support to enable vessels engineers to identify and rectify performance issues.

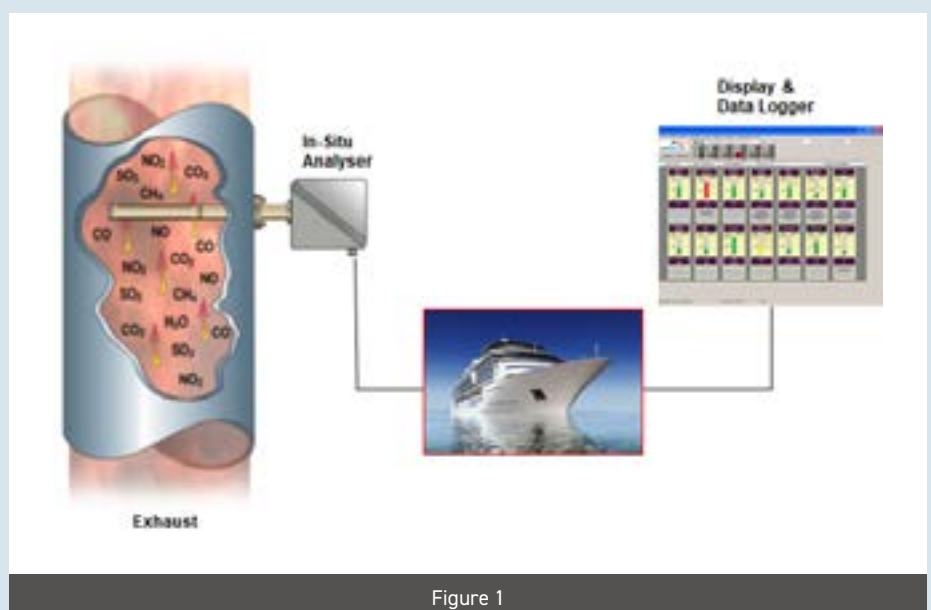


Figure 1

The solutions are as follows:

Capable of monitoring lower levels of Sulphur Dioxide (SO₂) in a background of relatively high water vapour

The P2000 is an infra-red analyser, monitors SO₂ in a region of infra-red where there is interference from water vapour, in many marine applications involving monitoring post wet scrubbers, and inevitably the water vapour is high and variable.

CO₂ is monitored in a part of the infra-red spectrum unaffected by water vapour. As part of the maintenance procedure for the existing installed base of P2000, the visiting service engineer is required to verify that the analyser monitored concentration are unaffected by water vapour. To achieve this, the engineer is required to use a sophisticated water vapour generator, which inevitably adds time and expense to a routine service visit.

PROTEA'S SOLUTION

Develop a highbred UV/IR analyser to monitor the SO₂ using Ultra violet (UV), which is unaffected by water vapour. CO₂ cannot be monitored in the UV and therefore is still monitored in infra-red.

Capable of monitoring post scrubber (EGCS) with liquid phase water vapour carryover

The analyser probe is mounted within the duct and therefore subject to the emission flow, which if mounted post scrubber in certain designs of EGCS meant liquid water droplets were present. This caused the probe to be "chilled", resulting in condensation forming and errors in the monitored concentrations.

PROTEA'S SOLUTION

Design an enhanced analyser probe with thermal barriers, which increases the probe temperature, thus ensuring any liquid water is vaporised before coming in contact with the system in-situ optics.

Enhanced support to enable vessels engineers to identify and rectify performance issues

PROTEA'S SOLUTION

Develop an integrated software application that automatically runs a routine that collects data under all the

phases of operation. These include zero (instrument air), certified test gas and process. The data is collected in a file which is then e-mailed to Protea support for analysis. Findings including any remedial actions are then reported back to the vessel's chief engineer. This approach has been invaluable during the current pandemic, which has enable Protea to support installed systems remotely.

PROTEA'S SUPPORT

In addition to acquiring the Procal Kittiwake products, Protea has also taken over the support of the installed base of marine installations. Protea is the only organisation able to support the Procal Kittiwake P2000 installed instruments with marine Clarification Society Certified spares.

Protea has also entered into contracts to update existing installations to the latest standard with the current uses of the P2000 analysers. This includes system software upgrades, enabling the operator to take advantage of the remote diagnostic capability of Protea's customer support team.

In addition, Protea operates an extensive worldwide network of factory trained sales and service partners strategically located to support the marine industry.

Protea would like to invite all users of the Parker Kittiwake Procal P2000 to enter into a conversation of ongoing support and cost-effective upgrade of their current Exhaust Emission Monitoring analysers.

Protea would also like to thank and recognise the input from our valued marine engineering end-users for their undoubted expertise in improving our products for installation in their challenging application.

For more information, visit:
protea.ltd.uk

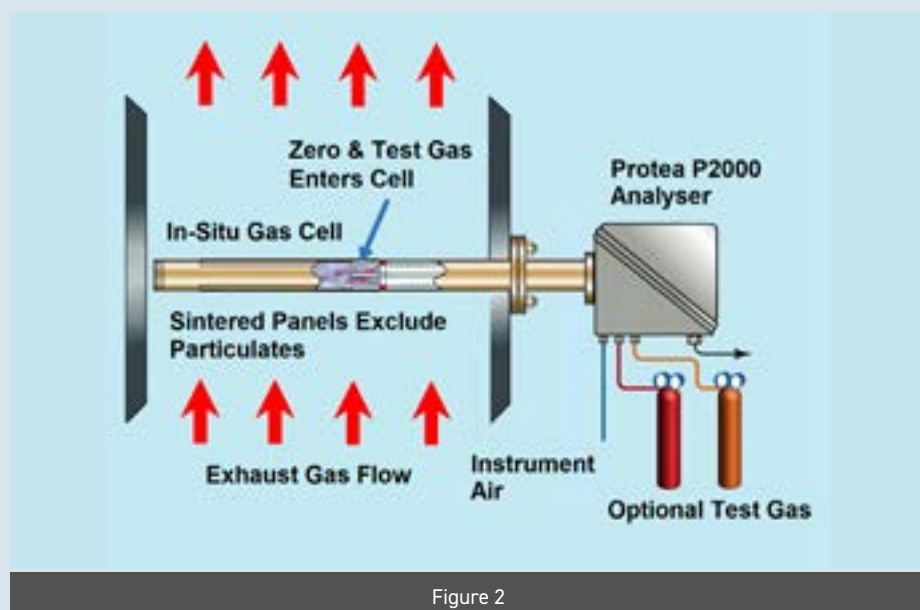


Figure 2

SAACKE MARINE SYSTEMS: BREAKING NEW GROUND

SAACKE Marine Systems is breaking new ground in methane combustion on LNG tankers with its new product – the GCU evo.

The further development of its existing Gas Combustion Unit (GCU) consists of a cost-effective combination of the combustion unit with a modified grid burner. The abbreviation evo stands for "evolution".

Due to the limited space on LNG tankers, SAACKE has

designed this system solution incorporating significantly smaller dimensions with the same or even improved performance.

In addition to saving space, the new model offers many further advantages for marine engineering. For example, nitrogen oxide (NOx) emissions are reduced in the range of 60-80mg/m³ thanks to special cold flame technology. For any assistance, digital remote support can be used, too.

STANDALONE SOLUTION AND EASY HANDLING

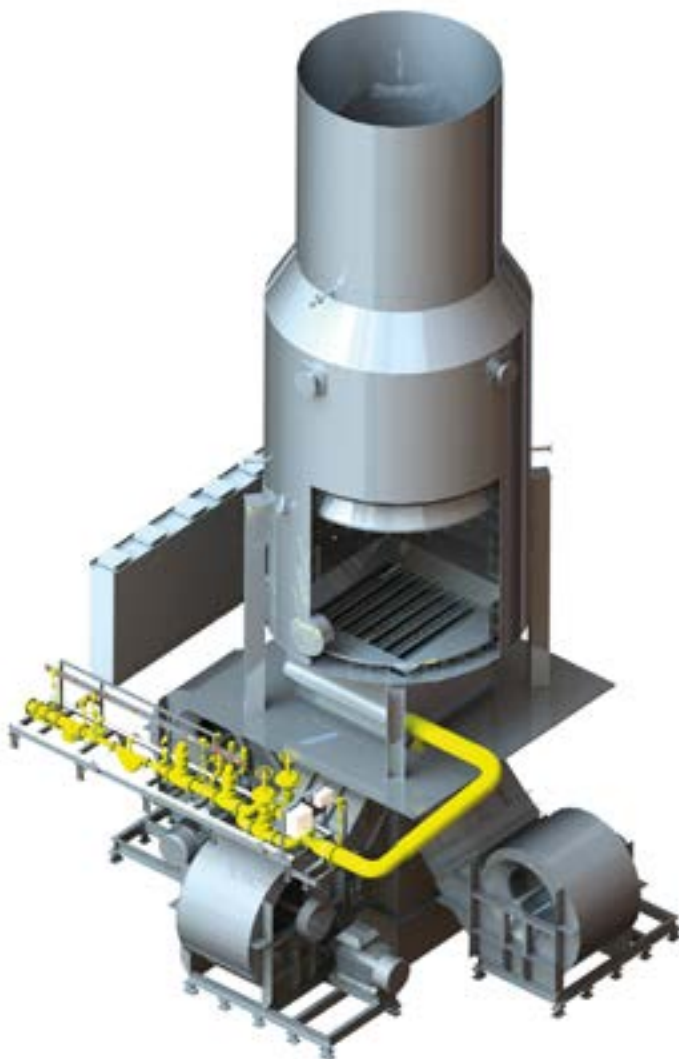
The optimised design not only reduces the required space on board, but also installation costs and thus the effort for customers when using a SAACKE GCU.

In addition, maintenance costs can be reduced due to the lower complexity of the system. No special foundation is required for the GCU evo with an output of 5.5 to 63MW. The system can be mounted directly on the deck as a standalone unit with simple installation.

In addition, due to its compact design and functionality, the grid burner offers a short flame and requires a smaller number of blowers. The further development does not forego the proven strengths of the existing GCU – such as fail-safe control, electric ignition and the 100 % free-flow solution for combustion of the methane components in the climate-damaging boil-off gas without a compressor and at very low pressure.

The GCU evo, which is ready for series production, is available in different output sizes from 0.4-4.5t/h methane combustion with various size gradations.

Based in Bremen, Germany, SAACKE GmbH specialises in thermal processes and systems for industrial and maritime energy management and is one of the world market leaders in this field. Since its inventing and patenting in 2003, SAACKE has sold more than 110 Gas Combustion Units.



The GCU evo

SAACKE MARINE SYSTEMS

For more information contact:

Email: marine@saacke.com

Tel: +49 421 6495-0

saacke.com



Corvus Energy has tapped into Toyota's 30 years of fuel-cell experience to form a partnership that will enable large-scale production of fuel-cell systems for the maritime industry



Geir Bjørkeli
Chief Executive Officer,
Corvus Energy

CORVUS ENERGY IN TOYOTA TIE-UP

Bergen-based energy storage company Corvus Energy is to start the development and production of large scale maritime-certified hydrogen fuel-cell systems.

Production will be located in Bergen in a tie-up with Toyota as a key partner, which has the ability to supply mass-produced fuel-cell technology.

Corvus is heading up the collaborative project with Norwegian partners Equinor, shipowners Norled and Wilhelmsen, ship design company LMG Marin, the NCE Maritime CleanTech cluster and R&D institution The University of South-Eastern Norway (USN) to develop and produce modularised and cost-effective proton exchange membrane (PEM) fuel-cell systems for the marine market.

The project has received €5.2m in funding from Norwegian state agency Innovation Norway. The first marine fuel-cell system is scheduled to be fitted on a vessel in 2023 and the product will be marine certified and available for commercial delivery from 2024.

Fuel-cell modules will be supplied by Toyota, which boasts 30 years of experience

in the development and production of fuel cells for the automotive market and other land-based applications.

Corvus and Toyota signed a partnership agreement in December last year, which gives Corvus access to mature fuel-cell technology while enabling large-scale production with competitive pricing, Corvus CEO Geir Bjørkeli said at a recent presentation.

Interest in hydrogen for maritime applications has been increasing rapidly and is seen as an important step to reach shipping's ambitious goal to cut greenhouse gas emissions by 50% by 2050, Toyota's senior manager strategy and business development, Fuel Cell Business Group, Freddy Bergsma said.

Reducing the cost of fuel cells and increasing access to the technology is crucial in accelerating the transition. Corvus claimed that this initiative was an important step towards achieving both goals by producing modularised systems not available on a large scale today. "Adding fuel-cell modules to our product portfolio is

a natural step for Corvus and advances our vision to be the leading supplier of zero-emission marine solutions, said Bjørkeli. "Fuel-cell technology has reached a maturity level where scale-up of systems will be the next step. Toyota is in the forefront of the development and is by far the best partner for us to make this a success."

"De-carbonisation is inevitable and at Toyota, we are convinced that hydrogen will play a central role in creating a better future, both environmentally and economically," added Thiebault Paquet, Toyota Motor Europe's director of the Fuel Cell Business Group. "Our recently established Fuel Cell Business Group in Brussels is looking forward to working with Corvus Energy and the consortium members to offer fuel cell solutions for marine applications. This project will play an important role in the development of the hydrogen society."

DEDICATED DIVISION

Corvus has set up a dedicated fuel-cell division to design and certify the marine fuel-cell system using the Toyota fuel-cell technology as a building block for larger systems. A specific marine control system to join the battery and fuel-cell operation will be developed for easy integration with power management systems from a range of system integrators.

Backed by stakeholders, such as Norsk Hydro, Equinor, Shell and BW Group, Corvus plans to scale up production. The development partners USN and NCE Maritime CleanTech will contribute knowledge regarding hydrogen safety, while Equinor, Norled, Wilhelmsen and LMG Marin will bring in experience gained from ongoing hydrogen projects, Corvus said.

At the presentation, Corvus explained that this propulsive energy system was ideal for prime movers fitted on board smaller coastal and short sea-type ships, but the system could also be used for powering auxiliaries in larger deepsea vessels.

Corvus' executive vice president and project director Kristian Holmefjord explained that pure hydrogen necessitated the use of a fuel cell, which will be converted to electric

power; a liquid organic hydrogen carrier and a vessel using synthetic fuels would use an internal combustion engine (ICE) to convert the energy to rotating power, while ammonia would need a heater to convert to heat power.

He also revealed that the company had fuel cell management systems under development to optimise the integrations with power management systems.

Outlining the development timeline, Holmefjord said that the system is being launched in the first quarter of this year with pilot system trials due to take place during 2023, followed by formal type approval a year later together with the scaling up of an automated factory to manufacture the cells. A second Corvus fuel system — called SOFC/HTPEM — is to be launched in 2025.

"Fuel-cell technology has reached a maturity level where scale-up of systems will be the next step"

In addition, Corvus' chief commercial officer, Halvard Hauso gave a breakdown of the fuel cell versus the battery size in three different scenarios. He also explained that the company started with just one battery but now has seven.

Explaining the breakdown, he said that a 90% fuel cell against a 10% battery, which is ideal for short distance ferries and the like, would incur electricity, hydrogen and possibly other fuels costs.

A 50:50 ratio between the fuel cell and battery, ideal for the majority of vessels, would involve costs, such as fuel cells, an ICE, a battery system and

auxiliary equipment. A 10-90% ratio for long distance shipping would need to take into account degradation — wear and tear — servicing and dual energy.

He also said that the batteries would need charging and the fuel cells would need feeding.

At the presentation, Toyota's Bergsma stressed that hydrogen will pay a central role in creating a better future. He said that Toyota's fuel cell technology can be re-packaged in a standard modular approach for the marine industry. In addition, the next generation of systems would be lighter, more compact, higher powered and more dense.

Modularisation would help the companies with mass production, Bergsma explained, thus giving economies of scale, as seen in the automotive industry.

He also thought that there would be a market for combusting hydrogen and ammonia, but these alternatives were not as efficient as fuel cells.

"They (fuel cells) are easily 50% more efficient," he stressed, adding that over the next 20 years, fuel cell efficiency would be much greater. "There is no doubt that the cost of an energy carrier will be higher in the future, but as the production ramps up, so the costs will come down. The cost of fuel is going to be vital."

He thought that a fuel cell was "very scalable", anywhere from 200-300 kW to 5-10 GW, so would fit the operations criteria of a lot of vessels.

Bergsma agreed that today's market would be near shore, short sea and cross channel type ropaxes. As mentioned, deepsea shipping could make use of the technology for auxiliaries.

He also advised shipping companies thinking about opting for fuel cell and battery technology to act now. "A wait-and-see attitude is very dodgy," he said. "You had better be first."

The co-operative has already persuaded classification society, DNV GL, soon to become DNV, to become a support partner and all of the major class societies will become involved going forward.

Bergsma said that other projects are currently underway, including Equinor's liquid hydrogen development





The Bergen manufacturing facilities

along the West Coast of Norway, while Japan, California and Rotterdam are making moves towards the use of hydrogen as an alternative power source.

"It will take time to get there, but countries are pushing forward, so we will get there," he concluded.

ETANKER AWARD

Illustrating the potential, Corvus Energy recently won a contract from Kawasaki Heavy Industries (KHI) to supply the energy storage system (ESS) for the first zero-emissions electric "e5 tanker", currently under construction for Asahi Tanker Co of Tokyo, Japan.

This battery-powered coastal vessel was designed by e5 Lab Inc, a consortium of Japanese shipping and maritime services companies, including Asahi Tanker, which was set up to build infrastructure services focused on electrically powered ships. She will

be the first of two all-electric vessels to be built from the e5 Lab initiative and is expected to enter service as a bunker tanker in Tokyo Bay by 2022. The ships will be built by Japanese shipbuilders, KOA Industry Co and Imura Shipyard Co.

KHI awarded the contract for the ship's propulsion system in September of last year and will integrate a Corvus Energy 3,480 kW/h Orca ESS to power the vessel.

Asahi Tanker, which operates 137 vessels, claimed that the e5 tanker design will achieve zero emissions of CO₂, NO_x, SO_x, and particulates.

In addition, reduced noise and vibration will create a more comfortable work environment for the crew and limit noise pollution in the bay and its surroundings. The vessels will also be able to make their battery power available to emergency services in the case of a natural disaster in and around Tokyo Bay.

"There is no doubt that the cost of an energy carrier will be higher in the future, but as the production ramps up, so the costs will come down. The cost of fuel is going to be vital"

ABB: MARINE MONITORING TO REDUCE EMISSIONS

ABB is helping the marine industry fight air pollution and prepare for the battle against climate change. "The launch of our new CEMcaptain helps shipping operators improve air quality according to the IMO2020 regulations. It also incorporates the technology to support operators in their desire to reduce carbon dioxide emissions in line with the Paris Agreement," according to Stephen Gibbons, describing the impact of its latest maritime continuous emissions monitoring system.

In line with the IMO2020 marine emissions regulations, many ships have installed scrubbers to remove pollutants from the exhaust gases. From a public health perspective, port cities and coastal regions have benefitted from air quality improvements since the implementation of the IMO 2020 standards.

"IMO 2020 shone the spotlight on sulfur dioxide and nitrogen oxide emissions", says Gibbons, who is the global market manager, continuous gas analysers at ABB's Measurement & Analytics Division. "There is now an equally strong focus on monitoring and reducing carbon dioxide emissions to combat climate change."

LAND-BASED TECHNOLOGY

The IMO regulations have brought maritime air pollution control closely in line with shore-based power plants, cement works and oil refineries, where more than 60,000 ABB continuous emissions monitoring (CEM) systems have been used for decades.

The selection of instrumentation for ocean-based emission monitoring can draw from lessons learned in land-based CEM applications. Gibbons adds: "Simplicity is the key for continuous emissions monitoring at sea. On the oceans, gas analysers are exposed to the roughest possible conditions. Cruise ships on the Caribbean confront 10m waves during the hurricane season."

"Knowing that, we incorporated our robust Uras26 infrared gas analyser into our CEMcaptain marine emission monitoring system. It uses light in the IR wavelength to analyse sulphur dioxide and carbon dioxide concentrations." Carbon dioxide emission monitoring, and reduction will be essential as shipping plays its role in decarbonisation.

The gas analyser is designed with busy maritime engineers in mind. It is fitted with optical cells that are filled with gas mixtures of a known concentration that enable automated calibration of the analyser. The solution is ideal for shipping operators because they can achieve regulatory compliance without the need for test-gas bottles on board.

An industrially proven non-dispersive ultra-violet Limas gas analyser can also be integrated into the CEMcaptain. It uses light in the UV wavelength to

analyse NOx concentrations. Gibbons says: "We are thinking of the future, when NOx emissions measurement will be equally as important as SO₂ is today. Our equipment is ready for the coming decades."

EFFECTIVE SOLUTIONS

Meeting the IMO 2020 targets can be achieved using clean burning fuels such as low sulfur fuel oil. Modern alternative fuels such as methanol, LNG and even ammonia are also emerging. But the prices can be high and availability is not universal.

Retrofitting flue gas scrubbers is therefore a popular solution to achieve regulatory compliance at lowest total cost. And for each scrubber retrofit, an emission gas analyser such as CEMcaptain is required to monitor and report SO₂ and CO₂ concentrations.



ABB CEMcaptain: a new powerful emission monitoring solution for the marine industry

Fuel switching is not an issue for the CEMcaptain. Sample preparation of the exhaust gases is optimised to cope with the full range of typical maritime liquid fuels. The oily carry-over from the engine means that hot-wet analysis systems that are used on some land-based CEM systems would quickly get fouled. Therefore, the ABB CEMcaptain uses a cold-dry sample handling system as a robust solution to this problem.

Cost of ownership is also a major consideration for the gas analyser. Working with a proven solution such as CEMcaptain minimises the maintenance effort and simultaneously eliminates the stress and workload caused by non-compliance. Reliability of the gas analyser optimises processes onboard and reduces ownership costs.

"The surge in the use of marine exhaust gas cleaning systems is driving a peak in the demand for our CEMcaptain," confirms Gibbons. "And ABB is 100% ready to support marine exhaust gas scrubber manufacturers and maritime operators with the transition that is in full swing. In addition to having the best products, we also have the best production: to ensure worldwide availability of the CEMcaptain, we have invested in world-class manufacturing centres in China and Germany."

Type approval certification is also highly sought after in this sector. In recognition of that, both ABB factories produce CEMcaptain with certification according to DNV GL, Lloyds Register, ABS, Bureau Veritas, NK, and CCS. Certifications are a fundamental part of ensuring emissions measurement compliance.

DIGITALLY ENABLED

Dynamic QR codes are integrated into CEMcaptain display panel. This is one of the digitalisation features that helps shipping operators get closer to 100% uptime availability for their gas analysis instrumentation and emissions data reporting. That supports the tough compliance requirements and removes the complexity of dealing with compliance failures.

The Dynamic QR code displays the latest system configuration data and can be scanned using a smartphone or



Compliance with maritime emissions regulations becomes easy with ABB's new analyser solution

industrial tablet computer. The QR code can communicate the real-time analyser status to a proprietary ABB App called "my Installed Base (myIB)". If required, the maritime instrumentation technician can send status information to an ABB service expert to get immediate guidance on any maintenance that might be recommended.

SERVICE AS YOU SAIL

Despite advances in digital technology, hands-on maintenance is occasionally required to maintain the CEMcaptain, and any other ABB emission monitoring system, in prime condition.

With a team of 600 certified service technicians worldwide, ABB's reach is unparalleled. Whether the ship is in port at Barcelona or Bangkok, the right spare parts and a competent expert will be on hand to execute any required maintenance procedure.

On the topic of services, Gibbons confirms that "end users of our gas analysers are requesting more services with deep integration to digital solutions. They are also looking for flexible service bundles." ABB Measurement Care service packages are built up from a modular framework which allows each operator to customise a package to meet their needs.

HASSLE-FREE COMPLIANCE

Gibbons sums up the ABB Measurement and Analytics business line's overall approach as "working in the sweet spot". He says: "It means

combining three ingredients to create synergy for customers: the right hardware, the best services, and leading digital innovations. The right marine emissions gas analyser can make a big difference and the kit inside the box really matters. That's why our products are continuously evolving to ensure that our gas analysers are ideally suited to the application."

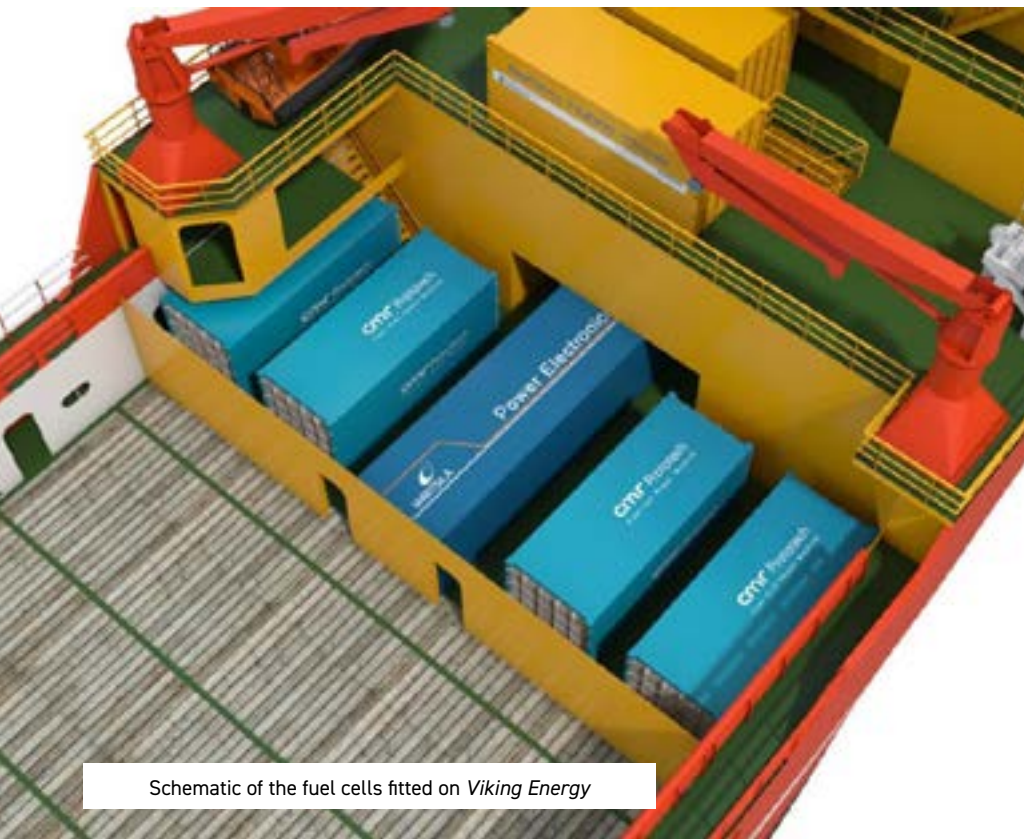
Maritime operators sometimes require support for their gas analysers. Gibbons continues: "We are exploiting the latest digital innovations to link our expertise to the end-users on the ocean. We're on a mission to control our customer's costs, cut complexity and make their CAPEX go further. CEMcaptain is a powerful new emission monitoring system designed to help guarantee compliance to emission regulations today and tomorrow."

Author: Carolin Seubert

For more information, contact:

Carolin Seubert,
Global Product Manager
Email: carolin.seubert@de.abb.com
Melinda Dörrschuck
ABB Marketing Communications
Email: melinda.doerschuck@de.abb.com
de.abb.com
abb.com





Schematic of the fuel cells fitted on *Viking Energy*

Several high-level studies are examining the safe use of ammonia for marine propulsion, while several industry consortia are gearing up to embrace its use

AMMONIA: THE FUTURE OF FUEL?

The use of ammonia as a future fuel is currently gaining traction with several high level studies ongoing aimed at testing various solutions. In addition, there are a growing number of Approval in Principles (AiPs) being awarded to ammonia-powered vessel designs by the major classification societies.

Of course, the use of ammonia is not without its challenges, as highlighted by a recent study published by classification society American Bureau of Shipping (ABS).

Ammonia is in the early stages of development for marine propulsion. For example, ammonia-fuelled engines are under development and the use of ammonia in fuel cells is also being explored.

Two major barriers exist — the cost of producing ammonia-based fuels and the need to ensure that they are safe to use on ships. Apart from the cost of adapting the infrastructure, ammonia is toxic to humans and aquatic life. Therefore, considerable safety measures must be taken, ABS warned.

When used as an IC-engine fuel, ammonia

combustion predominantly produces water and nitrogen. Unburned ammonia must be closely controlled and guidance on acceptable limits to avoid plume formation or human health hazards can be drawn from other regulatory requirements, where limits of 2-10 parts per million (ppm) may be applied. IMO NO_x limits would also be applicable upon its combustion.

Fuel containment, distribution and supply systems can be based on existing technologies and prescriptive requirements. In a liquid state, ammonia is not flammable and cannot ignite. However, it vaporises rapidly and this vapour has a narrow flammable range.

The main concern is toxicity and additional measures are needed to control normal and abnormal discharges.

Understanding the requirements of ammonia gas, including low-temperature service, pressurised storage tanks, flammable gases and working with corrosive and toxic materials, is key to addressing the safety hazards involved.

Ammonia tanks need to be designed for temperature and/or pressure control if it is stored in a refrigerated condition, as it continuously evaporates and generates boil-off gas (BOG), due to heat gain, which increases the pressure in tanks if not managed. Alternatively, ammonia can be stored in Type C tanks.

New challenges apply to ammonia. These will typically include crew training, bunkering availability, port discharge limit compliance, tank venting and planning for human exposure beyond permissible limits. These challenges need to be addressed during the Hazard Identification (HAZID) study when designing the vessel.

ABS outlined the advantages and challenges to using ammonia as a marine fuel:

Advantages

- » Carbon free — no CO₂ or soot.
- » Low flammability risk — 15.15% to 27.35% in air
- » Can be produced from electrical energy — renewable
- » Easily reformed to hydrogen and nitrogen
- » Can be stored and transported as a liquid at a practical pressure and temperature
- » Established commercial product.

Challenges

- » Toxicity
- » Fuel infrastructure
- » Lack of regulations
- » Engine development at design stage
- » Cost
- » Corrosiveness to certain materials
- » Poor combustion characteristics for IC-engine application
- » Possible need for high percentage of pilot fuel
- » Possible increased NOx emission
- » Possible ammonia slip.

Marine engines are currently being developed by applying existing dual fuel (DF) engine technologies to ammonia.

Designs for ammonia-fuelled feeder ships have also been unveiled by consortia involving designers, classification societies and shipyards.

Ammonia has greater prescriptive requirements for containment and equipment than most of the other alternative fuels currently under

consideration. It is a globally traded commodity and there are many smaller gas carriers that may be suitable to be used bunkering vessels.

However, for ammonia to become a commercially-viable long-term fuel option, comprehensive supply-side infrastructure would need to be built and stringent new safety regulations developed and implemented. This also applies to all alternative fuels under consideration, ABS stressed.

When measuring the net carbon impact, "tank-to-wake" only considers the emissions from burning or using an energy source, not the process of sourcing the fuel or getting it to the ship. As a result, "well-to-wake" emissions should be considered for alternative fuels because this encompasses the lifecycle of a fuel, including production, transportation and use.

Interest is growing in the use of ammonia as a feeder to hydrogen-fed fuel cells by owners operating liquefied petroleum gas (LPG) carriers carrying ammonia as cargo.

When used as a fuel, hydrogen is zero carbon at point of use (tank-to-wake). However, if it is produced from non-renewable feedstock, such as non-renewable natural gas through a process using energy not from renewable source, the process (well-to-tank) could produce significant emissions. Alternatively, it can be produced by water electrolysis with renewable energy to eliminate the emissions from feedstock and the production process.

Once cracked, the hydrogen from ammonia can be an abundant resource for fuel cells to generate electric power. However, ammonia's advantages should be weighed against the energy losses and additional equipment required for conversion to hydrogen before it is used in fuel cells.

ABS warned that an issue with using ammonia as a fuel is its concentration in the product gas. Although the concentration may be less than 50ppm, this is still enough to damage fuel cells with acid electrolytes, so an acid scrubber is needed to remove the final traces of gas from the cracker.

Storage of liquid hydrogen requires at least five times more volume compared to petroleum-based fuels,

while ammonia requires about 2.4 times more volume. Therefore, as a long-term solution, zero carbon fuels would require new vessel designs and optimisation of operational factors to avoid compromising sailing distance, refuelling needs, or cargo volume.

Ammonia has a higher volumetric energy density than liquefied hydrogen, closer to that of methanol, which reduces the need for larger tanks. The volume of NH₃ storage tanks will be significantly less than of those for liquid hydrogen for the same energy requirement — even more so considering the volume of insulation required.

Its fuel characteristics enable the use of Type C or prismatic tanks and require significantly lower re-liquefaction energy compared to hydrogen or LNG. Ammonia can be stored in liquid form at 8.6 bar and at ambient temperature (20° C) on board a vessel.

In its 2020 Energy Prediction report, the International Energy Agency (IEA) forecast that the use of ammonia and hydrogen as vessel fuels will expand and will account for 60% of marine fuels by 2060.

Similarly, BP announced in its 2020 energy forecast that the percentage of non-hydrocarbon fuels, such as ammonia, hydrogen, biofuel and others, will increase to 85% of 2018 total energy amount by 2050.

AMMONIA-READY VESSEL

ABS also recently classed the world's first ammonia-ready vessel. This was a Suezmax ordered by Avin International, the lead vessel of a potential three ship order. The 274m long tanker (Hull number 0315852), is under construction at New Times Shipbuilding. Options exist for another two vessels.

To be conventionally fuelled, the vessel will comply with the ABS Ammonia Ready Level 1 requirements, indicating it is designed to be converted to run on ammonia in the future. All of the ships in this project will also meet these requirements.

This indicates that the vessel conforms to the requirements outlined in the ABS Guide for Gas and Other Low-Flashpoint Fuel Ready Vessels.

Another classification society has recently awarded two AiPs for

ammonia fuelled ship designs – an ultra large containership and a tanker.

For the containership, Lloyd's Register (LR) has granted an AiP to Daewoo Shipbuilding & Marine Engineering (DSME) and MAN Energy Solutions (MES) for an ammonia fuelled 23,000teu ultra-large container ship design. This was a joint development project (JDP) launched earlier focusing on developing ammonia propelled ships.

As part of the JDP, DSME generated the basic design of the ammonia propulsion system and MES was responsible for the development and specifications of the ammonia dual-fuel propulsion engine.

LR said that its role was to review the suitability and risks of the design, which involved a HAZID workshop, a hazard and operability analysis (HAZOP) workshop and a design review in accordance with the Approval of Risk-Based Design (ARBD) process, which led to the AiP.

The certification constitutes the first phase of the JDP. The second phase will involve further design development for meeting market demand in terms of commercial viability, as well as technical and safety maturity. The design is expected to be commercialised by 2025.

LR has also granted an Approval in Principle (AiP) to Samsung Heavy Industries (SHI) for its ammonia-fuelled tanker design.

This was described as a key progress milestone in the JDP involving LR and SHI with industry partners MISC Berhad and MES, formed in January 2020. The JDP is aimed at commercialising the design by 2024.

Elsewhere, classification society RINA and the Shanghai Merchant Ship Design & Research Institute (SDARI) have signed a JDP agreement to develop a ship design capable of being fuelled by either ammonia or methanol.

SDARI is to focus on the ship concept development and design, while RINA will verify the compliance with the applicable rules, including those for the use of alternative fuels.

The selected ship type is a tanker but the project, which is claimed to be the first to investigate using both methanol and ammonia in this type of

vessel, will increase understanding of the application of both fuels within the shipping industry with opportunities to apply designs to different types of ships, RINA claimed.

External support to the project will be provided by MES.

DANISH INITIATIVE

MES is also leading a Danish consortium on the development of ammonia as a marine fuel.

This consortium is backed by Danish investment entity Innovation Fund Denmark and is aimed at developing a two-stroke, ammonia-fuelled engine (AEngine). It aims to specify and demonstrate an entire, marine-propulsion system that will pave the way for the first commercial order for an ammonia-fuelled vessel.

As well as MES, the consortium also includes Danish fuel-system supplier Eltronic FuelTech, the Technical University of Denmark (DTU) and classification society DNV GL. The development is scheduled for 2024.

Another initiative, the ShipFC project, was granted funding last year from the EU's Research and Innovation programme Horizon 2020 under its Fuel Cells and Hydrogen Joint Undertaking (FCH JU).

The offshore supply vessel *Viking Energy*, owned and operated by Eidesvik and on charter to Norwegian energy major Equinor, will be fitted with a 2MW ammonia fuel cell, allowing it to operate for at least 3,000 hours annually on clean fuel.

Following the completion of this phase, the project will ramp up to delivering 20MW fuel cell solutions for oceangoing vessels.

"The ultimate goal of the project is to demonstrate the feasibility of ammonia fuel cells for ocean going vessels and long sea voyages," explains Dr Michail Cheliotis, research associate at the University of Strathclyde, lead partner in the project. "The huge difference in scope makes ShipFC much more interesting than just a replication of *Viking Energy*. The similarities basically end with ammonia, because a 20MW power plant requires significantly different treatment."

The project will involve three vessel types: a bulk carrier, an

offshore construction vessel and a containership.

The technical and economic experience gained from the *Viking Energy* pilot project will be incorporated in a broader analysis of ammonia in the maritime sector and comparison with other alternative fuels.

"Ammonia presents certain technical challenges, but even though it is corrosive, the safety trade-off between ammonia and hydrogen favours ammonia," Dr Cheliotis says. "It is less explosive, requires less complex storage and transport solutions, and it is a well-known commodity from industry. Based on this experience, the necessary safeguards can be built in."

Experience with gas fuels will be a significant building block, he says. "We have seen that liquid ammonia is similar to liquefied gas in the handling process. Industry has a high level of maturity and an excellent track record in handling LNG and LPG, and this experience is proof that it can be done safely."

"We will be looking at the entire life cycle of ammonia, from production to transport and bunkering. One of the ShipFC partners is a major supplier of ammonia, and we will be working together with them to address these issues," he explains.

ShipFC's project partners are:

- » The University of Strathclyde (UK) and National Centre for Scientific Research Demokritos (GR) will assess safety criteria.
- » Norwegian members of the European consortium include NCE Maritime Cleantech, Eidesvik Shipping, Equinor, Prototech, Yara, and Wärtsilä Norway, responsible for fuel systems, ship's design and stability, and vessel energy management.
- » Fraunhofer IMM will assist Prototech in the development and construction of the ammonia fuel cell system, while Persee will provide expertise on energy management controls and data.
- » Vessel owners are StarBulk Management (bulk carrier), North Sea Shipping (offshore construction vessel) and Capital Ship Management (container vessel).





Clean Shipping International spoke to leading lube oil manufacturers to find out how they will have to adapt in the future as engines switch to using renewable fuels and advanced combustion techniques



Dr Luis Garcia
Technology Manager
– Marine & Power
Engine Lubricants,
Shell Global Solutions
(Deutschland) GmbH

POURING OIL ON TROUBLED WATERS

Dr Luis Garcia, Technology Manager – Marine & Power Engine Lubricants, Shell Global Solutions (Deutschland) GmbH, says that shipping is one of the harder sectors to de-carbonise and there will likely be multiple solutions across sub-sectors.

Shell's analysis points to hydrogen with fuel cells as the zero-emissions technology that has the greatest potential to help the shipping sector achieve net-zero emissions by 2050.

However, a zero-emissions fuel is not likely to be available on a commercial scale globally until the 2030s. The industry must take action to reduce emissions now with solutions available today, such as advanced engine lubricants and digital optimisation technologies, he says.

There is consensus in the industry that deepsea-going ships will continue to rely on the internal combustion engine for their main propulsion.

However, in recent years, significant gains in fuel efficiency have been attained by engine manufacturers (OEMs) in diesel, gas and dual fuel (diesel/natural gas) marine

engines. The latest engine designs operate at higher pressures and temperatures and aim for using less lubricant per unit of power produced. This has resulted in increased performance demands for marine lubricants and in response, additive companies and lubricant suppliers are currently developing higher performing oils.

As an example, MAN Energy Solutions (MES) 2-stroke division has recently introduced a two category system looking for higher performance cylinder oils and Shell and other players in the industry are currently working on developing category II oils at 40 BN level.

Lubricant solutions will also need to be developed at an accelerated pace in line with shortened hardware development cycles. Typically, developing a new engine lubricant can take a few years, from laboratory studies, bench and rig testing, lab engine testing to full-size engine testing. Added to this, the engine design involved might not be entirely mature, for example, the original equipment manufacturer (OEM) could still be making the first field

experiences with the design and fine tuning some hardware such as piston rings.

Looking at the near future, OEMs will face a great challenge to create engine designs capable to operate safely and even more efficiently with a variety of new gaseous and/or liquid fuels.

Future fuel prospects are fundamentally different from existing diesel fuels or natural gas, so it can be expected that combustion concepts and lubrication needs will differ from those already known for recently developed engines.

Whereas some of the lubricant performance needs and possible challenges can be estimated for the use of carbon-free or carbon neutral fuels, there is limited availability or still non-existing capacity to test with these fuels (eg ammonia) and so it is likely that different lubricant technology will be needed to cope with combustion products and operating conditions in future marine engine applications.

As development cycles for marine engines and lubricant solutions are currently not synchronised, this can lead to a difficult start on addressing lubrication needs and reliability for engines to operate with future fuels.

"It is of the utmost importance for OEMs and lubricant developers to closely collaborate in understanding the possible challenges and co-develop or even co-engineer solutions that will enable higher efficiency and reliable engine systems in which lubricants play a role as an important component.

"Collaboration can lead to a better definition of performance needs and to create more efficient ways to test reliably lubricants technology that will be required to cope with future fuels," Dr Garcia concludes.

FACING THE CHALLENGES OF SWITCHING

Speaking about the switch to very low sulphur fuel oils (VLSFOs) Chevron Marine Lubricants claimed that it had addressed their use given the distinctive engine condition challenge associated with the widespread switch.

The manufacturer said that some shipowners using VLSFO had reported a build-up of red deposits on piston crowns and top edges, sometimes

combined with red iron burrs in scavenge ports. The deposits are associated with abnormal liner wear — or scuffing — since the fuel switch, particularly on older two-stroke marine diesel engines.

Chevron used a four-step laboratory analysis to narrow down the likely causes. Deposits were found to include a compound of materials, including harmless detergent additive residue and iron oxide. The detergent residue was determined not to be a source of wear, as the deposits were only found in single cylinders rather than across the engine.

The fuels associated with the red deposit and scuffing incidents were also analysed. Chevron found that the VLSFO blends involved showed differences from others in two fuel characteristics, typically a lower calculated carbon aromaticity index (CCAI) and high estimated cetane number (ECN).

Although VLSFO has been found to offer a typically higher energy value content than heavy fuel oil (HFO), and therefore can offer value for money, its combustion engine density properties can result in harsher operating conditions and more stress on the engine components.

While most users transitioned smoothly, these properties can cause trouble for older engines, says Luc Verbeeke, senior engineer, Chevron Marine Lubricants.

"While newer ships do not have a problem using these fuels, engines



Piston with scuffing and deposits clearly seen
(©Chevron)

already closer to an overhaul did struggle sometimes," he says. "Cylinder units that could have run for another six months or a year on HFO did not survive the tougher conditions with the new fuels."

An engine maintenance programme recommended by Chevron, supported by routine testing using Chevron's Dot. Fast on-board testing kit, helped to provide protection against liner wear and damage.

Incidents of red deposits and scuffing that were relatively frequent in the early days of VLSFO operation have since reduced significantly, the company claims.

FUTURE PROOFING ENGINES

Jean-Philippe Roman, project manager at Total Lubmarine explains how the energy major claims to be ahead of the curve with its recently requalified Talusia Universal single cylinder oil and how the company's engine lubrication solutions are helping optimise engines of the future.

"Twelve months into IMO2020 and we are already seeing how the transition is shaping a cleaner industry," he says.

New internal combustion engines (ICEs) that are readily available across the shipping industry are being designed to match the targets on GHG emissions from the international shipping sector according to the IMO goals:

- » reduce carbon intensity of 40% by 2030 and of 70% by 2050
- » reduce GHG emissions of 50% by 2050

What about the current engines operating in today's ocean-going vessels? Advancements in the chemistry of lubes ensures engines can run cleaner and are optimised for better performance, says Roman.

However, any adaptation of an engine lubricant is influenced by two parameters, both of which are aimed at minimising greenhouse gas (GHG) emissions and to reduce fuel consumption:

- » The increase of the constraints in engine operation, for example,

increase of peak pressure, increase of temperature and the recirculation of exhaust gases

- » The diversity of the fuels available at the point of purchase, existing or renewables, and the way to use them in marine engines.

The first, and often more demanded adaptation, is related to existing engines. Whether they are diesel or dual-fuel engines running with either liquid fuels or LNG, these engines can accumulate deposits.

An example of this is underlined by the two-stroke engine manufacturers. Since the introduction of the IMO2020 regulation change on fuels, there is an imbalance between the low BN lube oils in use and the need for detergency to maintain clean engines.

Thus, the first action for the lubricant supplier is to adapt to this situation. This is what Total has been doing with its lubricants range.

Work continues on new alternatives to help further improve engine performance and cleanliness, but more importantly, to move the baseline to a higher level as required by the of ICE technology improvements.

The second approach, which in Romans' opinion is a priority, is linked to the alternative fuels that are, or will soon be on the market. The importance of this is shown by a huge number of projects gathering all the stakeholders together, from the technical specialists to the regulators, including the ship operators, at a level often above the shipping sector itself.

Engine technologies dedicated to these alternative fuels are being developed quickly and by 2030, Total estimates there will be many commercial applications of oxygenated fuels like methanol or ethanol, as well as mixtures of conventional fuel oils with biofuels. In addition, engines running on "no-carbon" fuels, such as ammonia and hydrogen, will begin to be seen.

Existing lube oils have been designed to achieve the reliability of engines running on conventional high and low sulphur fuel oils, so it is reasonable to expect increased

research and development into lubes that will handle alternative fuels of the future.

Even though the alternative fuels market is not yet at a level of maturity to accept the economic change that sparks the scaling-up of technology improvements, the industry must anticipate the demand and be ready to propose sustainable solutions in engine lubrication that will most likely be flexible enough to run on several types of fuels.

"Our work in this area with Talusia Universal is just one example of how we have created a single cylinder oil for multiple fuel use, including LNG with OEM endorsement from MAN ES and recently WinGD," Roman explains.

Total Lubmarine technicians are focused on identifying performance issues relating to the fuel and lubricants used by each ship operator in their engines.

Their chemical nature is assessed as are base assessments on the engine operating condition reported by the engine manufacturer, and the company works closely with the OEMs on all elements of lubricant development and options by sharing insight and knowledge on the product chemistry, engine inspections and recommendations, Roman says.

The manufacturer's product chemists address performance issues through the formulation and chemistry of the lubricant.

This process is complex because the lubricant has a critical role to play in achieving engine cleanliness in all conditions. And, Total's approach applies to any engine design (with any OEM) and to any engine technology (diesel or dual-fuel) — engine lubricants must handle the potential issues related to each fuel mix available to the operator, and they must also provide a level of qualification in the reliability of the emission treatment systems that are coupled to the engine.

All the solutions highlighted have to be tested, selected and validated in operation, which is a significant challenge when considering that the vessels using the very latest technologies and new fuels are also

providing a "test-bed" for industry as an early adopter.

"To achieve the planned goals of 2030 and beyond, we all have a responsibility to work in co-operation with various stakeholders in a project.

"The collective mindset of all the lubricant manufacturers including our own, is set on the ambition to develop viable technologies and to test it at scale. As an industry, we must also look to change our paradigm and thinking," says Roman.

"Lubricants are not just for a unique fuel type — the conventional fuel oils of the market — but for engines of various technologies, flexible enough to run on many different fuel types, from the 'here and now' solution of LNG to the future fuels such as biofuels, synthetic fuels, ammonia, or on mixtures and combinations of these fuels that at the end of the day, aim to match the IMO targets on GHG emissions of vessels running internal combustion engines," he stresses.

He claims that Talusia Universal is an example of this where a single cylinder oil was created for multiple fuel use, including LNG.

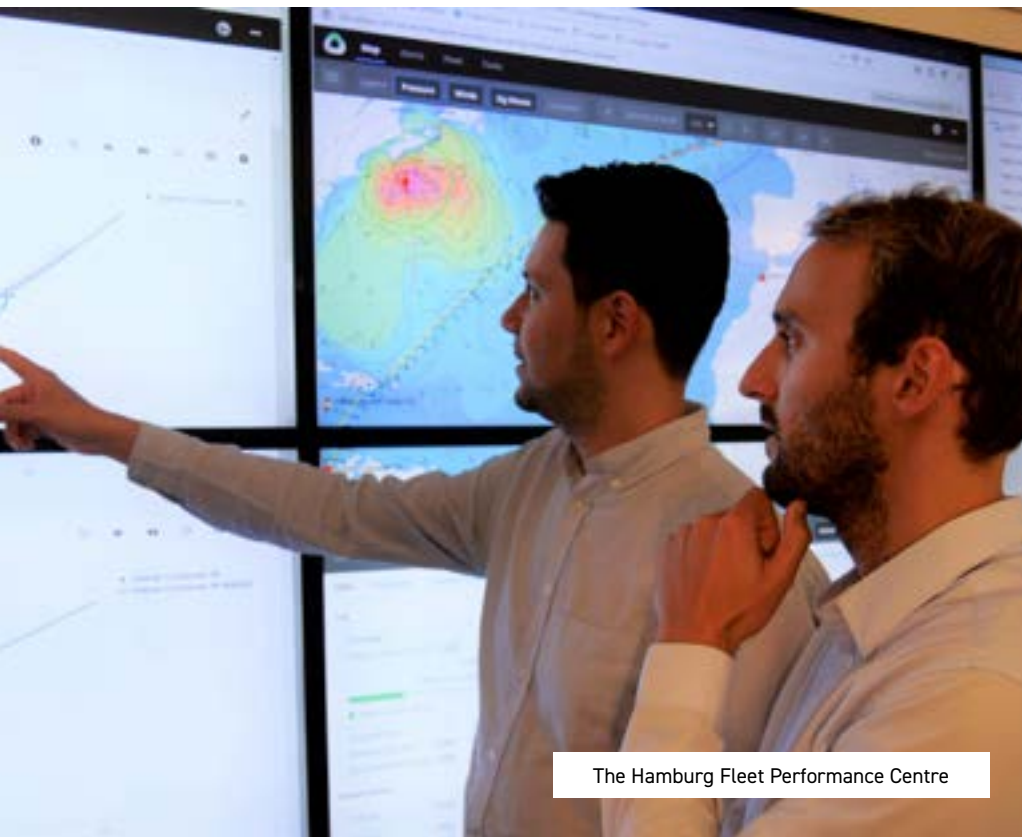
In terms of lubricant formulation, many more new advanced chemistries will enter the market, such as low- or no-ash components.

As an example of this approach, Total has pioneered this strategy with Talusia Optima — a product that uses ash-free neutralising molecules.

Roman claims that this was a unique and patented technology that provides fast and effective acid neutralisation without mineral deposit build-up from the most demanding two-stroke engines. This lubricant was developed through intensive R&D at Total's Solaize Research Centre.

"Looking to the future, I believe every one of us has a part to play in the transition to a cleaner, better performing industry. It is a period in our time, which represents incredible evolution through innovation and advancement, and it's exciting.

"At Total Lubmarine, we are confident tomorrow's developments in marine lubricant chemistries will provide even better solutions for OEMs and operators — and not just on the lead up to 2030," he concludes.



The Hamburg Fleet Performance Centre

Data quality is often lacking in ship operations' reporting, with just the basics taken into account, Madeleine Engelhardt, product manager at weather intelligence and decision support services provider StormGeo tells *Clean Shipping International*



Madeleine Engelhardt
Product Manager,
StormGeo

HOW DATA REVEALS THE TRUE PICTURE

Drawing on her seagoing and shoreside experience with DNV GL, Offen Group among others, Madeleine Engelhardt, product manager at weather intelligence and decision support services provider StormGeo, is now advising on how to drill down into data to get the true picture of a vessel's performance.

She feels that part of the problem is the lack of a clear understanding of what is required, especially in the tanker and drybulk sectors, in terms of vessel operating efficiency, especially as we approach an era of new fuel types and emissions reduction initiatives.

For example, one of the main data criteria is fuel consumption, but it is difficult to calculate CO₂ emissions without knowing the consumed fuel type at the time of the report as this is elementary to the application the corresponding emission factor, she says.

Often, a report will convey whether the ship is in a laden or ballast condition, which in Engelhardt's opinion, is relevant for commercial charterparty terms, but doesn't

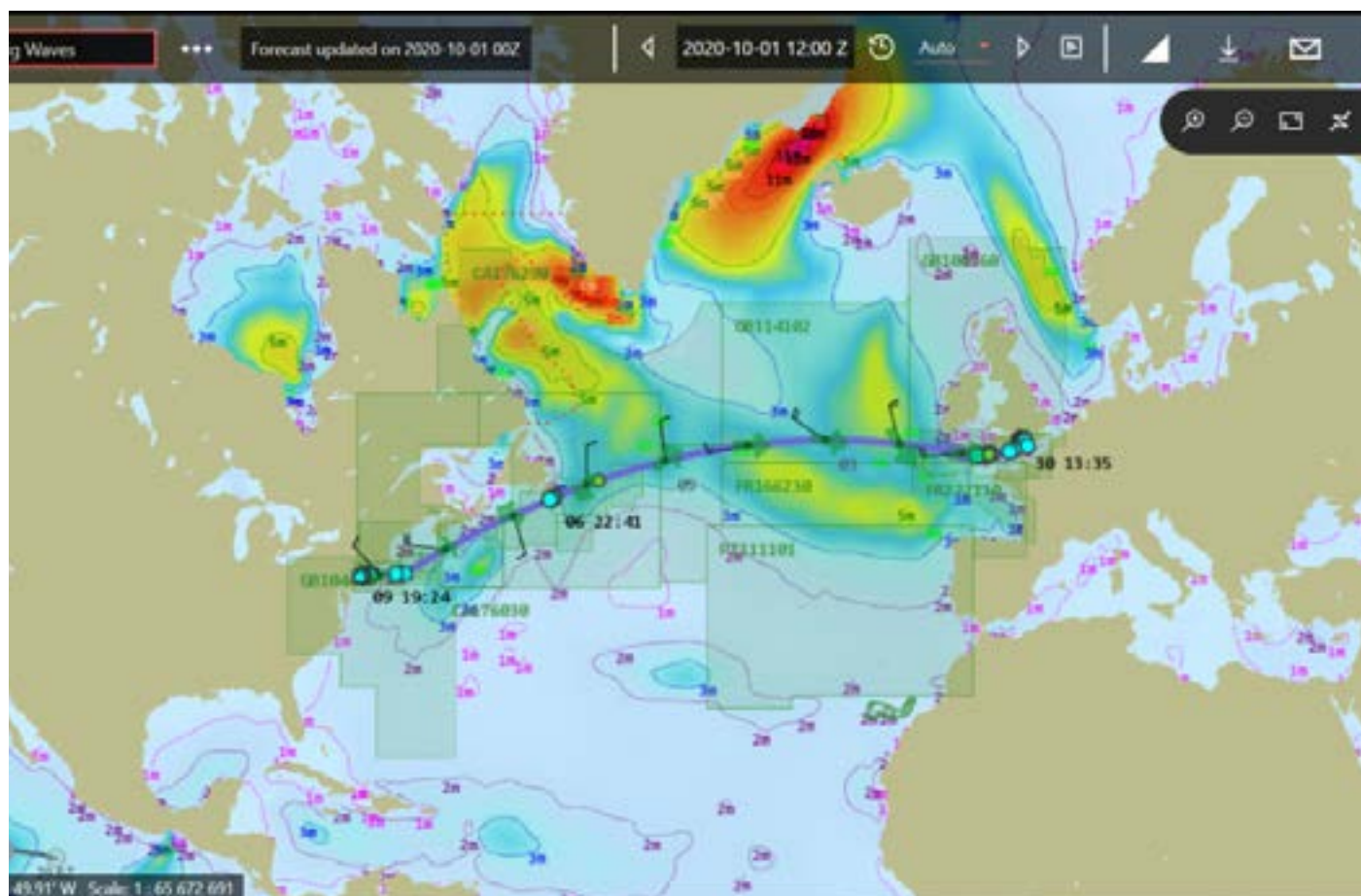
say much for technical and environmental performance analysis. The cargo weight also needs to be reported to create an accurate picture of the ship's performance.

She says that there is little motivation to increase the report's data quality as this is regulation driven in a conservative industry and is also subject to a company's bespoke management systems.

However, on a more positive note, she reveals that there are a lot of pilot projects underway. She points to the container sector as being much more advanced by way of having strong co-operation between shipowners and charterers.

Both parties see the benefits of fuel savings and thus less emissions emitted, especially in the case of the major shippers, who could claim a competitive advantage.

Charterers in the drybulk and tanker segment are accommodating and verifying that ships are meeting contractual stipulations, Engelhardt says. Parameters include speed, fuel consumption and weather conditions, with alerts given



Through S-Planner, electronic navigational charts (ENCs) can be downloaded to enhance voyage planning

to indicate that the vessel is over-consuming, respectively losing time.

The recently announced Sea Cargo Charter initiative was revolutionary, says Engelhardt, and she also mentions the financiers who were becoming much more environmentally aware with the Poseidon Principles scheme, which thus far has attracted 20 major banks.

On the back of the International Maritime Organization (IMO)-mandated initiatives, the shipping industry needs to reduce its carbon footprint, she says, stressing that accurate data was key.

SOFTWARE SUITE

Last October, StormGeo launched s-Suite, a software and services suite for the maritime industry. The software includes voyage planning, on board route optimisation, route advisory services and fleet performance management and is backed by the company's maritime experts employed in route advisory and fleet performance management.

All functions have been combined into a complete, one-stop solution. The flexible solutions can be used as an integrated package or as individual modules.

Promoting co-operation and faster decision making based on real-time data sharing to optimise vessel performance, s-Suite offers an all-in-one, optimised workflow where the ship and shore staff work from a common operational platform.

Three modules are available either separately or integrated: s-Planner, s-Insight and s-Routing:

- **s-Planner** integrates voyage planning, route optimisation, as well as charts and publications management in one user-friendly workflow for efficient planning and navigation.

Information on route, weather, charts and publication orders and inventory is shared in shore-based modules, improving collaboration to ensure safety, fuel efficiency and compliance.

- **s-Insight** is a fleet decision

support system matched to the individual needs of both, owners and operators, integrating different data sources within the applications of the s-Suite, for example intended tracks, manual event data reporting, sensor data combined respectively, superimposed with metocean data and other parameters, such as war risk areas, etc.

It provides tools for assessing commercial, technical and operational performance to reveal potentials for improvement or identify potential consumption claims. By improving ship-to-shore collaboration, the crew on board and the fleet manager are able to boost the voyage's performance.

S-Insight is a powerful application to ensure operational safety, reliability of service, compliance to IMO DCS/MRV and environmental initiatives such as Sea Cargo Charter and to improve fuel performance and thus to reduce GHG emissions.

The product is strengthened by StormGeo's Fleet Performance Centres (see below), which can assist in data validation, provide in-depth analysis and fuel-saving recommendations and assistance from the company's maritime professionals.

s-Routing combines experienced route analysts with StormGeo's advanced technology to enhance safety, save time and fuel while reducing emissions. Skilled route analysts and service teams help to ensure that commercial requirements are optimised through strategic guidance 24/7.

Today, StormGeo routes more than 65,000 voyages annually, saving clients nearly 1m tonnes of fuel and reducing CO₂ emissions by 3m tonnes, while more than 12,000 ships use the software or other services offered.

The company has 24 offices in 15 countries, including eight 24/7 global operations centres and two fleet performance centres located in Hamburg and Singapore.

PERFORMANCE CENTRES

The two fleet performance centres collect, collate and analyse data, which can be used for benchmarking. Some shipowners and operators do not have the resources or the time to analyse data, so rather than take on extra staff, the centres are there to help, she explained.

Each centre is based around the s-Suite software and they offer three main services:

1. A daily alert service, by which under-performing ships are identified using various key performance indicators (KPI) to monitor and grade a vessel's performance using green, yellow, or red colour codes. Daily alerts are company and ship specific, containing both the alerts and a proposed solution as needed.
2. A report service, comprising monthly and quarterly reviews.
3. Ad hoc investigations, which could relate to various issues or claims where the centres' teams address problems and recommend solutions.

Engelhardt explains that ships'

operational data will become even more critical that is why data quality is crucial. The data should be consistent and reliable with no gaps and should be always subject to verification. "We need this data to see what's going wrong and to understand the impact of measures," she emphasises.

"We conduct plausibility checks and validate the data already on board before it is sent to shore and reflect it in our tools to create awareness and trigger timely rectification. In s-Insight we combine and superimpose reported data with metocean data and calculate weather and current factors and performance speed, which increases the quality of performance evaluation by having normalised and hence comparable data," she adds.

Engelhardt expresses concern about the use of data collected by sensors on board ship as the signal could easily go down. The data source needs to be accurate and reliable, she says.

"Combining different data sources, such as manual event data and high frequency sensor data, does help to identify and differentiate between random and systematic errors."

She adds that as the emissions data needs to be published, this encourages transparency and at the same time, accountability for the vessel's carbon footprint. For the IMO's emissions reduction goals, joint ventures and collaborative initiatives will be needed involving all stakeholders.

As mentioned, although not the only parameter, one of the major baseline's to vessel performance is the fuel and its type. Fuel specifics are taken from the bunker delivery notes and the recognised fuel sampling laboratories.

Today and even more so in the future, the fuel is and will be even more diversified so, for example, biofuels and LNG will need engineers and crew with operational experience of using these fuels, she says.

Crew training plays an essential role and quality data reporting will come from those on board the ship. "There needs to be a common understanding on board plus feedback from those ashore together with a commitment from management," she says. Feedback is needed to reflect how shore

management processes the data and what information and action can be derived from it.

"Only crews that feel they are being taken seriously, continuously supported and which can see that their work creates a valuable output for the company, are open minded and act as a multiplier by sharing and promoting knowledge, which is important considering the crew changes," she explains.

"It can be observed that tankers and bulk carriers' speed and consumption reporting tends to be a flatline, reflecting commercial instructions but not the actual operation."

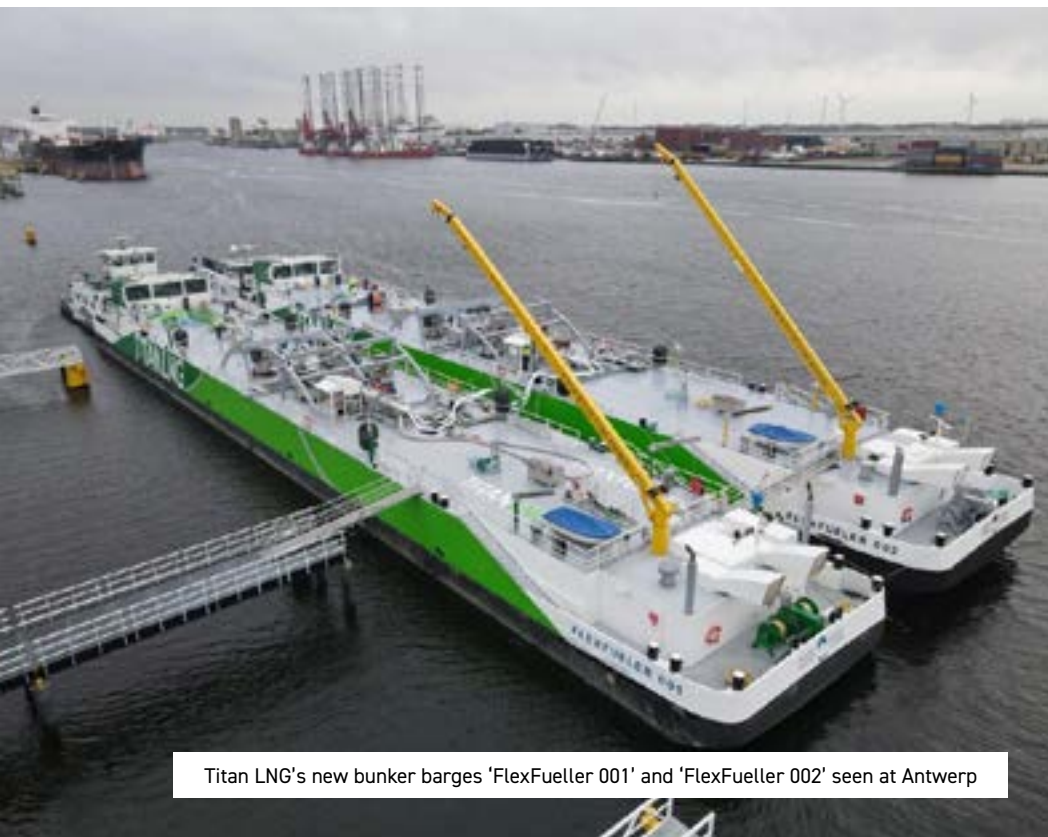
StormGeo can trace its history back to weather reporting. Today with the weather getting more extreme and climate change upon us, ship routing and voyage planning needs to include metocean data, which is becoming more complex. The company is using various models for forecasting weather and current conditions.

"StormGeo's duty of care and commitment for the environment is reflected as an integral part of the s-Suite applications. We actively support our clients by providing the respective framework and tools, as well as populating the requested documents and formats in alignment to the initiative or regulatory requirement.

"This facilitates the workflow and reduces the immense workload it's linked with for our clients. On the other hand, we also liaise with working groups from the IMO, EU or initiatives in order to ensure technical correctness, transparency and feasibility of workflow.

"Calculating climate alignment for shipping companies but also from an administrative and governmental point of view data should be accountable and reflects real operations because based on these new requirements a new trajectory is set for the future," Engelhardt says. "StormGeo is a UN Global Compact member and we strive to support not only ourselves. but also our clients to comply with environmental, social and governance criteria."





Titan LNG's new bunker barges 'FlexFueller 001' and 'FlexFueller 002' seen at Antwerp

Clean Shipping International talks to Titan LNG's Commercial Director Marine, Michael Schaap, about the burgeoning LNG market



Michael Schaap
Commercial Director
Marine, Titan LNG

A BRIGHT FUTURE AHEAD FOR LNG

Today, there is more LNG bunkering infrastructure in place than demand, according to Michael Schaap, Titan LNG's commercial director marine. "The chicken and egg situation has been fixed," he asserts.

This follows years of arguments and counter arguments over the use of liquefied natural gas (LNG) as a fuel on board ship, mainly concerning its availability worldwide.

He describes the orderbook for LNG bunkering vessels (LNGBV) as spectacular, saying that it was a clear demonstration of market interest in natural gas as a fuel.

Another positive was the variety of infrastructure in place or being planned to suit different ship type and sizes, operating on different trades — deepsea, coastal and inland. This infrastructure now includes road trucks and barges, as well as land storage facilities.

Titan LNG started its LNG bunkering operations with trucks and has now taken delivery of a 1,500m³ barge with another two to come, the latter being a much larger 8,000m³ "mother ship", which the company plans to order this year.

Schaap thinks that with LNG bunkering

achieving greater maturity, the authorities worldwide are generally more comfortable with the operations.

Although there are still relatively few suppliers, there are others entering the market, which creates healthy competition, giving customers more of a choice, he says.

Titan LNG operated its first barge, *FlexFueller 001* for around 18 months in the Antwerp/Rotterdam/Amsterdam (ARA) range, being based at a dedicated LNG transfer jetty at Amsterdam. The ARA range is interconnected via inland waterways, meaning that each port has easy access to barge traffic.

Also today, more terminals are comfortable with LNG bunkering vessels lying alongside, while working cargo. Before, a vessel taking on LNG had to switch to a layby with the added expense of the pilots and tugs involved. For ARA operations, Titan mainly receives the LNG from Rotterdam's GATE receiving terminal or Zeebrugge either by truck or transferred from small-scale LNG carriers.

The second barge, *FlexFueller 002*, was due to be delivered in February this year and she will be operated by Fluxys in Antwerp at another dedicated quay at which a truck-to-

ship transfer system operates, while Titan has an inland waterway barge bunkering operation.

The two companies agreed to co-operate in early 2019 to build the bunker barge and she was delivered from Koolman Marine. Before her delivery, she embarked on trials and crew training.

Titan has already bunkered several vessels in Antwerp, with the *FlexFueler 001* thus gaining experience in the large Belgian port in co-operation with the port authority. Schaap described the FlexFuelers as flexible in design and versatile assets.

Due to this flexibility, the Antwerp-based FlexFueler will be able to carry liquefied biogas from organic waste or liquefied synthetic methane from green hydrogen and captured CO₂ and supply the fuel to LNG-powered vessels in the future.

Schaap says that Titan LNG was confident in making available liquefied biogas (from organic waste) or liquefied synthetic methane (from green hydrogen and captured CO₂) to LNG-powered vessels soon after starting operations with the second barge in February.

LNG, combined with BLNG and later synthetic liquefied gas (SLG), offers a credible and cost-competitive path to de-carbonisation whilst immediately improving local air quality. The company is also looking at alternatives, such as hydrogen, according to Schaap.

The FlexFuelers are fitted with four tanks with separate pumping systems, so certain tanks can be allocated to hold biofuels under European inland waterway rules.

Late last year, Titan LNG finalised €11m funding from the European Union's Connecting Europe Facility (CEF) to expand a bio-LNG bunkering supply chain under the banner of the company's Bio2Bunker project.

The project's primary aim is to introduce another three bunker barges to be based at Zeebrugge, Rotterdam and in Luebeck, Germany. The Belgian and German barges will be similar to the two FlexFuelers.

However, for the ARA range, Titan LNG will build an 8,000m³ "mother ship" – *Titan Hyperion* – that will supply the smaller barges.

Schaap explains that Titan is looking to take delivery of *Titan Hyperion* at the end of 2023. The demand element is being finalised and an order is expected to be placed by this summer.

He also comments on the recent growth in interest for LNG-powered containerships, saying that this was a separate market as far as bunkering is concerned.

For example, the 20,000teu-plus vessels have a capacity to hold around 18,000m³ of LNG each, which would necessitate at least two bunker stems, although larger barges are under construction for other suppliers.

An LNG-powered car carrier is fitted with bunker tanks to hold around 3,000m³, which Schaap describes as a "more comfortable challenge".

Most of Titan's clients are European based, but the company is keen to forge alliances worldwide, illustrated by last November's joint venture with Malaysia's Petronas to bunker the Siem-owned, LNG-powered car carrier *Siem Aristotle* at Pasir Gudang.

This followed 2019's Singapore and Indonesia operations to service Heerema's self-propelled LNG-powered crane barge *Sleipner* – the world's largest.

For the Malaysian bunker operation, the LNG was purchased by Titan and transferred to the car carrier using Petronas Marine's chartered small-scale LNG carrier/bunkering vessel, *Avenir Advantage*.

She delivered around 3,000m³ of LNG to the *Siem Aristotle*. Apart from bunker deliveries, she can also be used as a feeder LNG carrier in and around Malaysia, calling at ports such as the Sungai Udang regasification terminal, Pengerang and Johor.

This is not the first time that Titan LNG bunkered a Siem car carrier with LNG.

In August last year, the company's chartered 5,000m³-capacity *Engie Zeebrugge* delivered just over 1,000 tonnes of LNG to the *Siem Confucius* at Emden in Germany. Titan LNG now operates the bunkering vessel on a long term charter basis.

She was described as a "step up" in size, before the delivery of the larger *Titan Hyperion*.

The car carrier is chartered to

Volkswagen and Siem claimed to be the first company to introduce LNG powered vessels in transatlantic trades.

Following the bunkering operation in Emden, the *Engie Zeebrugge* delivered 150 tonnes to the DEME-owned dredger *Scheldt River* at Brunsbuettel. The dredger is one of Titan LNG's regular customers.

Titan LNG has agreed to charter the 5,200m³-capacity *Green Zeebrugge*, ex *Engie Zeebrugge*, from NYK, which had become the vessel's sole owner.

The charter lasts for several years and commenced in February. She will be used to supply LNG to larger LNG-fuelled vessels in the ARA region.

Schaap says: "January has proved to be exceptionally busy, underlining the timeliness of our decision to secure this additional capacity." Titan LNG carried out seven LNG operations during one weekend using *Green Zeebrugge*, three of which were to large crude shuttle tankers from Equinor, a term contract partner of Titan's.

He also says that operational standards must remain high in LNG bunkering and platforms, such as the Society for Gas as a Marine Fuel (SGMF) and Sea/LNG, are key to raising standards.

In addition, the International Code of Safety for Ships using Gases or other low-flashpoint Fuels (IGF Code) must be included in a company's Safety Management System (SMS). Other areas, such as the flexible hose guidelines, should also be adhered to.

Titan LNG will also offer observers, such as LNG-powered vessels' crew to gain practical experience while undertaking an LNG bunker stem. Once they have witnessed the operation, they will receive a letter from Titan confirming their presence at the bunkering.

He says that Titan LNG has ambitious expansion plans to set up in other locations and taking on long term commitments.

Finally, LNG also significantly reduces quantity and quality bunker disputes, common with normal fossil fuel operations, he says, as the loading and discharge is measured using mass flow meters fitted on the barges, giving a closed system, which cannot be tampered with.





Coating and cleaning underwater sections of vessels' hulls — including niche areas — will help to ensure the ship is operating efficiently and not fouling the environment



David Loosley
Secretary General and
Chief Executive Officer,
BIMCO

COVERING A NICHE SUBJECT

Late last year, BIMCO issued an industry note advising that cleaning a ship's submerged parts from barnacles and other growths, while the ship is in the water, can transfer invasive species to local marine environments unless it is properly cleaned and the debris is captured.

To combat this problem and to provide clarity and quality assurance to shipowners, ports and government authorities, BIMCO and the International Chamber of Shipping (ICS) published the first industry standard on in-water cleaning of ships.

"This standard will help protect the environment in the port. Not only that, it will also help every organisation that is part of this process by raising the minimum standard of cleaning several notches higher and ensure that the end result is both a clean ship, and safe working practice," said David Loosley, BIMCO secretary general at the time of its release.

Organisms growing on the ship increase its drag through the water and can reduce fuel efficiency of the ship by as much as 35%, leading to higher fuel bills and higher

CO₂ emissions. It is therefore important to remove the growths every couple of years, BIMCO claimed.

A number of countries and regions have put biofouling management high on the agenda, with regional and national regulation on the drawing board or already in place. This includes the US, Australia, the Baltic Sea region, New Zealand, Hawaii and California.

John Stawpert, ICS manager (environment and trade), added: "This new industry standard establishes a benchmark for safe and environmentally sound underwater hull cleaning, an issue that is of increasing concern to the international community.

"We hope that this first step by industry bodies will allow cleaning companies to demonstrate that their products protect the marine environment and that shipowners can be confident that their ships are cleaned to a safe and effective level around the world.

"With these industry standards, port authorities can also have confidence



Underwater areas of a ship's hull can get badly fouled (credit: I-Tech)

that underwater hull cleaning can be completed with minimal risk to the environment by independently approved cleaning companies working to proven high standards," he said.

According to the industry standard, at least 90% of the macro fouling must be captured by the cleaning company, and effluent water coming back into the sea will have removed organisms and materials down to a microscopic size (0.000001m).

For BIMCO and the partners involved, the next step is to implement the standard on a small scale and several shipping companies have already signed up to participate, the organisation said.

"It is one of the typical, long-term, unglamorous, behind-the-scenes efforts that the industry undertakes, which will hopefully have a wide-reaching positive impact on the marine environment and the industry," Loosley said.

The industry is now working to implement the standards with a number of stakeholders, including paint manufacturers, in-water cleaning companies, shipowners, ports, and classification societies.

They will have to update their procedures, which will lead to successful cleanings, and ultimately — BIMCO and ICS hopes — to a general wide-spread acceptance of the standard and associated certification and in more ports allowing in-water cleaning.

The standard details planning, the documentation and assessment part of the operation, as well as the actual cleaning, the management of the effluent — the water involved in the cleaning — including the capture of particles, before it is released back into the sea.

The standard also includes:

- » Criteria for the cleanliness of water pumped back to sea

- » Methods to help shipowners act before the biofouling growth and coverage become severe
- » An approval procedure for cleaning companies
- » Minimum reporting requirements
- » Minimum requirements for an inspection, service and cleaning reports.

The standard was developed by a coalition of companies and organisations, which included Akzo Nobel, BIMCO, C-Leanship, CMA Ships, DG Diving Group, Fleet Cleaner, Hapag-Lloyd, Hempel, HullWiper, International Association of Classification Societies, ICS, Minerva Shipping, Portland Port (UK), Port of Rotterdam and PPG Coatings.

Also commenting on the subject, paint manufacturer I-Tech said that marine biofouling build-up on ships' hulls and submerged niche areas may be out of sight and out of mind, even though they represent a huge

environmental impact and a constant commercial threat building up under the waterline.

The negative impacts of biofouling are increasingly well-documented and the issue has been thrust into the spotlight in recent years due to the huge risk that ship hulls, as a vector for invasive aquatic species (IAS) transfer, pose to biodiversity in local ecosystems and economies around the globe.

Biofouling on a hull also decreases a ship's efficiency, since it creates additional hydrodynamic drag when the hull travels through water. This in turn creates greater fuel demand to maintain the same speed through water. Or, if a ship is operating on fixed shaft power or a set fuel consumption, speed losses result.

One type of biofouling organism has a particularly detrimental effect on ship efficiency and fuel consumption is the barnacle. Grouped with other hard-shelled organisms, this type of "hard biofouling" will create the highest levels of hydrodynamic drag on a hull.

A study conducted by I-Tech and independent coating consultants the Safinah Group last year revealed that barnacle fouling adds an estimated \$6bn to the shipping industry's annual bunker bill.

This huge figure is based on the study findings that out of 249 ships of most types and sizes inspected over a four-year period between 2015 and 2019, more than 40% were suffering from over 10% hard fouling coverage on the hull. This level of hard fouling and its impact was quantified using published data taken from a 2011 study by Michael P Schultz that examined biofouling impact on shaft power requirement.

The scale of barnacle fouling on the global fleet, as quantified in the study, also makes this type of biofouling a significant contributor to shipping's carbon footprint since even 10% barnacle fouling on just under half of the global shipping fleet would equate to around 110 mill tonnes of excess CO₂ emissions annually.

Shipping's carbon footprint is increasingly being scrutinised by regional regulators and the IMO, as well as outside commercial influences,

such as the Poseidon Principles and the Sea Cargo Charter.

Given that the biofouling challenge is only likely to increase as water temperatures rise, due to the impact of climate change, it should be of key consideration when tackling the de-carbonisation of ships for owners and operators, especially as warming waters temperatures increase the risk of barnacle fouling and many of the industry's key trade routes put ships directly in biofouling hotspots.

*"It is one of the
typical, long-term,
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undertakes"*

Yet, even among those that recognise biofouling on ship hulls as being a huge risk to the bottom line and to the environment, there is an additional sub-layer of sea blindness emerging.

While a significant amount of emphasis is focusing on biofouling on the flat surfaces of the hull, there are other areas within a hull structure that are not so well-known for their risk to the environment and ship operations if biofouled — niche areas.

Cumulatively, niche areas represent a significant proportion of the underwater surface area of the global shipping fleet — about 10% of the total surface areas available for colonisation by biofouling marine organisms.

While biofouling in niche areas — which includes sea chests, gratings, and box cooler inlets — may be a small percentage of a vessel's hull surface, these areas can cause a huge negative impact to a ship's operations.

I-Tech and Safinah's research study also found that hard fouling was present in 95% of niche areas in the 249-ship sample inspected and analysed.

Therefore, even if a ship has a barnacle-free hull, its niche areas could be heavily infested, putting the vessel at risk of spreading IAS and also putting the functionality of the niche area at risk of malfunction.

Although the main penalties of biofouling in niche areas lie within the regulatory efforts to limit the spread of IAS, particularly in certain regions of the world, there are also commercial drivers to dealing with niche areas head on.

For example, biofouling in box coolers can impede the engine cooling system, reducing their efficiency in cooling inlet water during the start-up process as part of the cold-water chain. In the worst-case scenario, heavy fouling of the sea chest grate can lead to a total failure of the box cooler.

Undoubtedly, current approaches to preventing the build-up of biofouling in niche areas are not up to standard, yet there are simple steps that the shipping industry can take to tackle this problem, the company said.

The first step is to pay greater attention during antifouling coatings application to niche areas. For example, taking greater care during the coating application process. This includes considering antifouling coatings with a higher polishing rate for specific use in the niche areas and those that include additional protection against barnacle fouling, such as antifouling coatings that contain the patented Selektop, an active agent which, when added to coatings, repels barnacles even under extended static conditions of 45 days plus.

When it comes to niche areas and preventing biofouling build up, it's time for greater attention to be paid to biofouling mitigation in these areas, and this isn't just a case of taking advantage of antifouling coating technology in the short term.

The application methods and the design of niche areas should be re-visited on a long-term basis, I-Tech recommended.



Shipowners need to be aware of the rules and regulations surrounding ballast water management systems, in what could prove to be a defining year for the industry, as leading BWMS players reveal



Simon Hodgkinson
Global Head of
Loss Prevention,
West P&I

ACT NOW OR FACE THE CONSEQUENCES

***Clean Shipping International* talked to several leading ballast water management system (BWMS) players to hear their views on testing, the G8 rules and the forthcoming International Maritime Organization (IMO) meetings later this year, which are due to address issues surrounding the use of BWMS.**

Opening the debate, Simon Hodgkinson, global head of loss prevention at West P&I, said that global ballast water regulations have created an inherently complex environment for shipowners, especially those operating across two different regulatory frameworks.

Both IMO and US Coast Guard (USCG) rules set strict standards for the treatment of ballast water, which means that a ballast water management system must be working as intended. For some shipowners, this is proving to be a complex task.

For example, many shipowners that Hodgkinson has spoken with – quite reasonably – assume that keeping logbooks, following paper-based rules and installing a certified BWMS on their vessel is enough to

comply with the regulations. Unfortunately, this is not always the case.

Since BWMS became mandatory there have been repeated concerns from regulators, as well as some owners, that BWMS have been installed incorrectly. Errors during the installation process, or during the manufacture of a system, could cause a system to fail to treat water properly.

It is common practice for shipowners to limit their risk contractually through indicative commissioning testing. However, recent research by certification company SGS showed that the majority of failures were due to the largest microbes, which are not currently measured by most indicative tests.

These risks were reduced under the IMO regulations at November's Marine Environment Protection Committee (MEPC 75) meeting. New commissioning testing standards were set, which required that a BWMS is tested before delivery for every regulated organism type, including the



largest. However, these new standards will only enter into force in October, 2021. Shipowners planning newbuilds or retrofits before this date should ensure that they have taken these risks into account when talking to suppliers, he warned.

BWMS FAILURE

There are a lot of reasons why a BWMS might fail. In most cases, a crew will be able to readily identify that there is an issue before a discharge.

If a BWMS fails while at sea, the crew must communicate the issue with the destination port prior to arrival. The ship may then conduct a water exchange offshore, or, if facilities exist, arrange to discharge the ballast water to an onshore facility.

Should a failure happen in port, there are fewer options open. Depending on where the ballast is situated, it may not be possible to load or unload cargo until specialist engineers have fixed the system, Hodgkinson said.

There is also the risk of an undetected failure, due to issues with filters or turbidity causing faults that could only be detected through lab quality testing. Indeed, a shipowner could have done everything by the book yet face fines and delays upon compliance testing.

PAPERWORK ISSUES

Despite the mechanical risks created by ballast water regulations, the majority of non-compliance issues so far have stemmed from paperwork issues. Lapses in paperwork currently account for most of these cases, where a vessel has been granted an exemption that has then been allowed to lapse. These are often caused by vessels travelling between IMO and USCG jurisdictions and neglecting to renew the required exemptions.

Certificates, logbooks, exemptions, and the ballast water plan must all be up to date – and specific to the vessel in question. The crew must also be aware of the contents of the Ballast Water Plan and able to answer questions about it. This can be a mystifying process for shipowners.

In some cases, however, a claim might stem from a faulty BWMS.

If untreated ballast water was accidentally discharged, or if a BWMS had an undetected fault that was discovered only through compliance action, it would be treated as a pollution incident. In most cases this will be covered by P&I cover.

However, a vessel that arrives at port with a broken BWMS and discharges untreated ballast water, where there has been no attempt to remedy the situation, will not be covered.

It is thus critical that shipowners work with ballast water suppliers and their P&I Club to ensure that they are following best practice at all times. From the commissioning of systems to operation, a shipowner must ensure that their systems are working as designed and their paperwork is up to date, he concluded.

"Indeed, a shipowner could have done everything by the book yet face fines and delays upon compliance testing"

STABILITY NEEDED

Looking into her crystal ball, Michelle Guy, Wärtsilä BWMS team sales manager, said that as shipowners, managers and operators need to be compliant with both international and localised rules, a period of regulatory stability is required for vessels to settle into their new operations.

Constant uncertainty with changing standards, compliance testing and so on makes a hard operational and economical decision even harder. She explained that the IMO's Sub-Committee on Pollution Prevention and

Response (PPR8) meeting, scheduled for 22-26- March this year, will look at a proposed protocol for the verification of BW compliance monitoring devices.

There is a joint submission from Canada, Denmark and Germany, as members of the International Council for the Exploration of the Sea (ICES) (PPR8/11), plus and independent comment on PPR8/11 from France.

As for MEPC 76 (10-17 June), no BWMS documents have been submitted as yet, as submissions for this meeting are due by 10 March, 2021.

Guy said she was encouraged to see the finalised adoption concerning BWMS commissioning testing at last year's MEPC 75 and the confirmation that the amendments will come into force 1 June 2022.

The finalisation of BWM.2/Circ.70-Rev.1 and its associated document, BWM.2/Circ.42/Rev.2, provided the industry with the vital instructions needed for implementation.

Further, BWM.2/Circ.42/Rev.2 showed significant progress, compared to the previous version in respect of its general approach for indicative and detailed analysis.

To ensure confidence in this emerging requirement, Guy said that she hoped the IMO will continue to build upon this document during MEPC 76 and MEPC 77 when it comes to a level of confidence, which today is largely still "to be determined" or to be internationally standardised.

With this clarity, a unified way of working can be implemented by Flag Administrations, Recognised Organisations and testing suppliers to bring piece of mind to shipowners and BWMS suppliers alike, she concluded.

TEST PROTOCOLS

Alfa Laval explained that when the work with the new revised IMO test regime G8 was initiated back 2014, the aim was mainly to make the testing protocol:

- » More robust and make independent
- » Bring transparency of test results and system design limitations
- » Last, but not least, harmonise the requirements and make sure a consistent review was conducted with all member states.

In practice, the USCG requirements had already set the technical bar for making the testing more robust and independent, but what has been of great value for vessel owners was the transparency of the system's design limitations.

Today, it is clearly stated on the certificates what associated limitations the systems have in terms of salinity, temperature, hold-times and UV-transparency. After a review, it can clearly be concluded that some systems are less suitable for global trades.

One example given was that more than half of the UV systems can't treat water below a UV Transmittance (UVT) of 60% without limitations – 60% of all UV and electrical conductivity (EC) systems have some in-tank ballast water hold-time limitation.

Of the EC systems, many have limitations in temperature or salinity, and without, for instance, power plugs that consume a lot of energy or supply of salt they will not be operable in many waters, Alfa Laval explained.

It is important for vessel owners to assess their fleet requirements, so they don't find out after an installation that the system is inoperable. Vessel owners should simulate their trades to give a compliance navigator. Then they can assess beforehand if the system design limitations will match the water conditions for the vessels' trading pattern.

Turning to the US Environmental Protection Agency (EPA), Alfa Laval said that the main purpose of its Vessel Incidental Discharge Act (VIDA) act was to implement a national standard in order to have vessels comply with various standards, as they pass state borders while sailing on the US waterways.

The act also states that the new standard must be as stringent as the Vessel General Permit (VGP) 2013. One very important new step in VIDA is the acceptance of type approval protocols that render organisms non-viable. This finally put the US authority's definition of live/dead versus the IMO's non-viable discussion to an end.

Once testing policies are released, this will enable UV systems to be

operated in one mode in US waters as in the rest of the world. Since UV systems generally have no temperature or salinity limitations, this new policy will enable the acceptance of usage of the system also in low UVT (turbid) waters this is of great benefit for UV technology, the company said.

As for the forthcoming IMO meetings, Alfa Laval explained that PPR 8 will be digitally held in March, 2021. The aquatic species (ballast

"It is important for vessel owners to assess their fleet requirements, so they don't find out after an installation that the system is inoperable"

water) will be tackled in a working group that also will manage topics related to anti fouling systems. A topic on the ballast water agenda is to finalise the protocol for the verification of ballast water monitoring devices.

For MEPC 76 and MEPC 77, it is expected that the regulatory activity will be low, but activity will increase once the building phase is seen to start to come to an end (MEPC 79).

At that time, it is expected that states and organisations will share their experience and the convention will eventually be amended to fix any common problems that were identified, the company concluded.

G8 GUIDELINES

Debra DiCianna, senior compliance manager, Choice Ballast Solutions explained the role of G8.

She said that the Guidelines for BWMS approval (G8) were established to support the Ballast Water Management Convention (BWMC) for the BWMS type approval.

The initial Guidelines G8 (Resolution MEPC.125(53)) were revised in a series of amended resolutions (MEPC.174(58), MEPC.279(70)) to improve type approval testing. In 2018, MEPC adopted the Code for Approval of Ballast Water Management systems (BWMS Code) through Resolution MEPC.300(720).

The BWMC was then amended to include the BWMS Code. There are many technical differences between the G8 and BWMS Code, which would be too lengthy to explain in this feature.

The Guidelines G8 were only recommended procedures for a type approval. The BWMS Code includes requirements for BWMS type approval and certification to ensure all BWMS testing undergoes the same, more rigorous testing.

Talking of the new testing regime, she said that its value has yet to be proven. From Choice Ballast Solution's experience, most BWMS installation issues could be resolved through more thorough surveys by class societies and/or flag administrations, which is required for a BWMS operation – not additional testing.

Commissioning testing to receive a International BWM Certificate (IBWMC) makes a BWMS installation and commissioning more complicated and creates many logistical problems. If the BWMS installation is undertaken in a shipyard and the IBWMC needs to be issued at that time, commissioning testing may be difficult to complete, due to the water quality in the yard and ability to get testing support. In addition, the cost of commissioning testing can be significant.

Currently, she said that Choice is supporting its customers that want a test to ensure their BWMS is operating



as promised from the manufacturer's purchase agreement. This type of testing usually occurs during the first year of operation.

Turning to the US Environmental Protection Agency (EPA) proposed Vessel Incidental Discharge Performance standards, DiCianna explained that these did not require an assessment of new environmental impacts on ballast water discharges.

The EPA proposed new type approval testing for low salinity ballast water, which would be a new challenge for BWMS suppliers.

One of the keys to compliance is simple regulations. The differences in type approval certificates (that is, USCG versus BWMS Code) are already complicated and confusing. Adding another different point could further confuse the ship's crew and complicate the ship's compliance.

Choice Ballast Solutions offers support for BWMS compliance – from scanning, surveys, integrated engineering designs, installation to post installation compliance.

The company has expanded its support to include many environmental areas, such as EPA Vessel General Permit, the upcoming Vessel Incidental Discharges regulations, biofouling and various MARPOL issues.

As for the forthcoming IMO meetings, she said that the main focus of PPR8 in March is biofouling, MARPOL Annex IV, the IBC Code and black carbon.

Choice's main attention will be directed at the review of the 2011 Biofouling Guidelines to ensure any changes are in line with the company's experience.

As it will be a virtual meeting, it will be difficult to address any topics that require extensive discussion at MEPC 76. She said she hoped that MEPC 77 will allow the full discussion of topics that need to be considered, such as an amendment to the BWMC to permit ballast water exchange (BWE) as a contingency measure if a system is not operable.

The BWMC is worded such that BWE is no longer an option after a ship's compliance date for Regulation D-2, she explained.

MORE ROBUST

Expanding on G8, Ecochlor CEO Steve Candito claimed that the BWMS Code type approval is more robust than earlier versions of G8 and is closer to the BWMS standards regulated by the USCG. Furthermore, the BWMS Code contains requirements for type approval versus G8 guidelines that were open to interpretation.



Ecochlor CEO Steve Candito

As of 28 October, 2020, it became a requirement for shipowners to install a system that has BWMS Code type approval in order to be compliant with the IMO BWMC. This requirement will negatively impact any vessel with trade routes outside the US that selected a BWMS without this approval.

In addition, the BWMS Code type approval process has a number of changes that are different from the G8 approval and these restrictions are now noted directly on the certificate. Requirements that vessel owners should keep a particular eye on are:

- » System operating parameters
- » System design limitations (SDL)
- » Bypass requirement records
- » General monitoring notations.

Analysing each of the above factors more closely starting with system operating parameters in relation to water quality, it typically focuses on the salinity and temperature of the water.

Prior to the BWMS Code, manufacturers could test their BWMS

in only two different salinities, but received an approval for all three water types – fresh, salt and brackish water. However, under the new requirements, manufacturers must test in all three salinities to receive approval.

A BWMS that has not been tested in all salinities will have limitations, included within the BWMS Code Type Approval Certificate.

The second change focuses on SDLs and, again, the certificate must identify each relevant operational parameter together with the validated low and/or high parameter values.

The system's design capacity is obviously a critical parameter since it must match the vessel's ballast flow rate. For example, the Ecochlor system is approved for 50-16,200m³ per hour, which is the highest approved flow rate in the industry.

This flow rate capacity must be noted on the type approval certificate and the vessel may not exceed the flow rate listed on the certificate.

The third factor in the BWMS Code is related to bypass requirements that requires manufacturers to have "...bypasses or overrides to protect the safety of the ship and personnel..." that are connected to the vessel's ballast system.

These bypass systems must activate an alarm and be recorded by the BWMS' control and monitoring equipment. The crew is required to record this information within the ballast water record book every time the system is bypassed or an alarm activates.

Finally, with regard to general monitoring, the system must monitor, record and store sufficient data on the various operating parameters to verify correct operation for at least two years. Alerts must automatically occur when the system is shut down or when an operational parameter exceeds the approved parameter.

As for the testing regime, Candito explained that a BWMS efficacy test at commissioning is a small but important step within the scope of a BWMS installation. It is critical to provide clear and concise evidence that the BWMS has been properly installed and is operating correctly so that it can meet

the compliance requirements at any port worldwide.

This testing process during commissioning is not dissimilar to the on-board testing that all BWMS have undertaken during their IMO/USCG certification processes. The owner must select an independent testing organisation to carry out the IMO BWMS commissioning test.

In most cases, according to the guidelines set in place by the flag administration, the manufacturer may be allowed to be present, but is not permitted to either operate the system or to assist the crew, as they are required to run the system from uptake to discharge.

TESTING ADVOCATE

Along with shipowners, Ecochlor has always been an advocate for testing after the installation. "The reason for our support is clear," said Candito. "It is just as important to us, the manufacturer, as it is to an owner, to be confident that our system is working effectively prior to the ship leaving the shipyard."

Expanding on the EPA proposal, Candito said that it contained a new set of regulations covering discharge of ballast water – among a list of 20 different types of discharge – under the new Vessel Incidental Discharge Act (VIDA).

The proposed standards are in the form of "numeric effluent limits and best management practices... that are at least as stringent as the 2013 Vessel General Permit (VGP), with limited exceptions".

Under the current Proposed National Standards of Performance, a national standard will pre-empt state and local laws, making it less confusing for shipowners sailing to multiple ports in the US – although there are procedures in place for States, working through the EPA or the USCG, to seek different discharge requirements.

In addition, VIDA has extended its jurisdiction for regulating incidental discharges out from three to 12 nautical miles at sea.

One interesting change relevant to US flag coastwise crude oil tankers is that the exemption for BWMS is removed, thus they will now need

to install a system to be compliant. While vessels operating exclusively on the Great Lakes will not be required to comply with the ballast water discharge standards, extra ballast water exchange requirements may apply to vessels operating in the Pacific region and those trading to and from the Great Lakes.

"Under the current Proposed National Standards of Performance, a national standard will pre-empt state and local laws, making it less confusing for shipowners sailing to multiple ports in the US"

Candito said that a long-awaited question that remains unanswered concerns the quantification of "non-viable" organisms in ballast discharge. Under the proposed VIDA standards, the EPA has taken the position that until the USCG has identified testing protocols based on best available science available for enumerating non-viable organisms as there are for "dead" organisms, the current testing requirements will remain the same. Many UV BWMS manufacturers were expecting the USCG to follow the IMO standards on this issue.

The next step in this process occurs when the EPA releases the publication

of the Final Vessel Incidental Discharge National Standards of Performance. From that date, the USCG has two years to publish its final regulations for implementation of the performance standards established by the EPA.

As for Ecochlor, the company had increased the number of chemical service resupply hubs and spare parts supply network and has further plans to develop more locations that align with the needs of the client-base.

The goal is to have these services located throughout the three main time zones – Asia, Europe and the US – and in multiple areas.

GREEN MARINE

Furthermore, Candito said that Ecochlor is continuing its ongoing plans for expansion and diversification through a "Green Marine" platform in collaboration with other maritime business providers that offer environmental products and services to the maritime industry.

Addressing future IMO meetings, Candito said that at MEPC 75, the committee adopted amendments to the BWMC in regard to commissioning testing along with a new 1 June, 2022 date for mandatory compliance.

The committee also approved "Revised Guidance for the commissioning testing of ballast water management system" (BWM.2/Circ.70/Rev.1); and "Revised Guidance on ballast water sampling and analysis for trial use in accordance with the BWM Convention and Guidelines (G2)" (BWM.2/Circ.42/Rev.2).

At PPR8, one item on the agenda for discussion is the "Evaluation and harmonisation of rules and guidance on the discharge water from EGCS into the aquatic environment, including conditions and areas".

The virtual meeting will also consider a draft protocol for verification of ballast water compliance monitoring devices (CMDs). If the sub-committee agrees to a final draft protocol, this would be presented for consideration/possible approval at MEPC 76.

This topic is of interest as it could provide insight of how use of CMD's may influence and be incorporated into compliance monitoring for ballast water regulations, Candito concluded.



STEP FORWARD

Dimitrios Tsoulos, De Nora's regional sales manager EMEA, said that the amendments to the BWMS Code introduced at MEPC 75 last year were a real step forward for shipowners.

After early reports of widespread operational issues in some systems, the authorities acted to update the standards that systems must meet to better reflect how they work operationally.

This very much chimes with De Nora's philosophy, he claimed, saying: "We designed our BALPURE system to meet these goals from the start. The system's original design and configuration has been rigorously and extensively tested throughout its development, and is still in use."

Testing has been conducted around the world in a range of natural waters with varying ecosystems and salinities in accordance with strict quality standards and the efficacy of the system is in line with the IMO BWMS Code and USCG regulations, he added.

"At the same time, it is not a panacea; there is ample scope for operational issue with many BWMS on the market right now.

"Shipowners and suppliers must work together closely to ensure that the compliance challenge is met consistently in operation. This level of collaboration must include supporting with an installation, but it must extend into the operational phase," he said.

ONETANK SUPPORT

Kevin Reynolds oneTank Managing Director said that he and his team supports the IMO's efforts, through MEPC and PPR committees, to clarify guidance and increase confidence in the effectiveness of BWTS technologies.

The implementation of the BWMS Code, also called Revised G8 last October, was a good example. This revision built on over a decade of experience to provide clarity to the testing process and added some important checks, such as regrowth.

"This is positive as it provided increased clarity to ballast water treatment makers on testing requirements and increased confidence to vessel owners in that the equipment

that they are selecting has met a standardised and rigorous testing process," he said.

"We note that these efforts take a great deal of input from many stakeholders. There are significant differences in technologies, water quality and vessel operating parameters that impact the use of these guidelines and protocols.

"We highlight here that the Ballast Equipment Manufacturers' Association (BEMA) is an important and co-ordinated voice in supporting the ongoing successful implementation of the Ballast Convention," he concluded.

KEY ELEMENTS

Filters are obviously a key element of any BWTS. There are two key considerations BWTS manufacturers should be aware of when selecting a filter, Mark Riggio, Filtersafe's head of marine explained.



Filtersafe head of marine Mark Riggio

First, the most important foundation for an efficient BWTS is the filter's ability to remove large organisms. This reduces stress on the treatment aspect of both chlorine and UV systems, reducing power and chemical usage.

Second, manufacturers should consider the filter's operational performance in heavy sediment loads. It is imperative that the filter does not clog, as this would limit or even prohibit water flow through the BTWS, ultimately impacting the

overall effectiveness of the entire system – and leaving manufacturers open to criticism from shipowners and operators.

The new requirements for commissioning testing, rather than G8 testing, are really bringing filters to the fore, he said.

This process is a critical test of filter performance, with less robust models unable to perform adequately in the challenging conditions at or near shipyards where water quality is poor, and the [water] depth is shallow.

Poorly performing filters can return an "unsatisfactory" test, which must be repeated at a later date, triggering additional expense and inconvenience.

As a result, shipowners and end-users increasingly understand that to avoid problems with their BWTS they must select a system that comes with a strong and robust filter, Riggio stressed.

The current virtual IMO meeting format adds a challenging new dynamic to current MEPC meetings; in particular, placing additional time constraints on delegates.

This means many pressing agenda items are competing for the committee's attention and Filtersafe expects that items related to greenhouse gases, pollution and sewage treatment will be given priority over ballast water.

There are several ballast-related issues, including the experience-building phase, that still need to be addressed.

Riggio said that he expected to see the industry starting to look closely at replacement components and undertaking further work to look at the modification of type approvals as equipment continues to improve.

"This is critical for filter manufacturers including Filtersafe, as it opens up the opportunity for us to introduce product improvements based on our experience, such as new cleaning mechanisms and improved filter meshes," he said.

A new USCG policy letter (CG-OES Policy Letter 03-20) supports more defined testing regimes for product improvements, streamlining approval processes and enabling BWTS to evolve. This evolution can be realised

faster if the IMO steps in and follows the USCG's lead, he stressed.

As for the life of a filter, Riggio explained that it is designed for the life of the vessel, therefore has a roughly 20-year life span.

However, Filtersafe recommends the mesh screens are inspected every five years during routine BWTS inspections to ensure they are still operating effectively.

As the mesh filter screens are typically 20 or 40 microns in opening, they cannot be easily reverified visually and instead require special tools for detailed inspection.

He revealed that Filtersafe is currently developing its own tool to simply and rapidly verify mesh integrity. This aims not only to increase the lifespan of screens, but also to give owners confidence that the filter is still operating effectively.

Filter service packages are typically included in the overall BWTS service plan, with inspections completed by BWTS manufacturers every five years at the same time as disinfection equipment.

He added that the company has a highly collaborative relationship with BWTS manufacturers.

"It's absolutely essential for us to ensure that manufacturers are provided with a filter that supports the overall performance of the BWTS, ensuring it meets shipowner and end user expectations," he said.

"When a problem is reported to us, we aim to react quickly, even supplying free filter screens outside of the warranty period if the product doesn't meet our expectations. We're also actively investigating installations where problems have not been seen.

"We're making a huge effort to reach out to BWTS manufacturers, asking them to open their filters and assess their performance. If a filter has performed particularly well, we want to extract lessons learned and share them with others to increase standards across the industry.

"This outreach programme is only set to grow once the covid-19 pandemic subsides and international travel mobility starts to improve," he concluded.

OPTIMARIN CERTIFICATED

Norwegian-based BWTS provider Optimarin, meanwhile, has received a revised IMO G8 certificate.

This ensures complete global compliance for a growing customer base, which includes the latest orders received from Arriva Shipping, for its fleet of drybulk vessels, and Østensjø Rederi, for four newbuilds currently under construction at Spain's Gordan shipyard, the company said.

Optimarin's revised G8 certificate followed a successful testing programme conducted at Norway's NIVA facility, from September, 2019 to June, 2020, where 32 IMO and USCG tests were run in parallel using two filters – Filtrex and Boll & Kirch – simultaneously across three salinity conditions – fresh, brackish and marine water – with zero interruptions or mechanical issues recorded.

To gain a certificate, five tests are needed on the three salinities, which should take place consecutively on each. G8 testing can also be combined with a USCG type approval. A plan approval is required, Optimarin explained.



Optimarin CEO Leiv Kallestad

"Our simple, easy to install and environmentally friendly UV-based technology has a history of reliable operation, both at sea, with our customers, and in the most stringent testing environments," said Optimarin CEO Leiv Kallestad. "Market leading

compliance, reliability and performance have been central to building our reputation in the market, as it means more uptime for the shipowner. We're pleased to move forwards with a certificate for a top-class system that ensures our customers can enjoy flexible, worldwide operations with complete peace of mind."

"Shipowners and operators looking to select systems need to ensure that technology is future proof in terms of regulations," Kallestad warned. "Suppliers, like Optimarin, that can offer full USCG and revised G8 certification, alongside a long history of operational success, will provide that reassurance.

"It's important to identify suppliers that actually have the approvals in place now, rather than promising they will get it, to make sure installations and operations proceed with the minimal of disruption... or disappointment. In other words, choose a partner you know you can trust," he added.

Optimarin's technical sales manager Jurrien Baretta, speaking at a seminar, explained that, as the type approval is linked to all of the equipment's components as tested – the company is not allowed to remove or replace anything without losing the type approval – this new testing sequence was a good opportunity to carry out some improvements to the original design.

The original protocol still gave some room for interpretation, which was further detailed in the revised G8/IMO code, as DNV GL's Martin Olofsson explained.

Under the IMO D-2 rules, all new vessels built on or after 8th September 2017 must be in compliance with BWMC, while existing ships must comply at their first IOPP renewal survey after 8 September, 2019. All vessels must be in compliance by 8 September, 2024.

Olofsson explained that the USCG was the driving force in the type approval process. Today, some 37 different BWTS have gained USCG Type Approval with another five under test, according to the USCG. He agreed that installations would probably peak in the summer of 2022 with maybe up to 10,000 vessels involved, which will cause problems in the shipyards' scheduling.



Petter Heier, Grieg Green CEO



Sotiris Raptis, ECSA director
marine safety & environment



ICS' expert John Stawpert



Ilker Sari, President Rata Shipping



GMS head Dr Anil Sharma

A recent seminar revealed industry leaders' thoughts on the recycling industry and the standards that still need to be set

IS RECYCLING COMING UP TO SCRATCH?

Effective from 31 December 2020, ships above 500 gross tonnes flying the flag of an EU/EEA member state, or third-party flagged vessels calling at European ports, must carry an Inventory of Hazardous Materials (IHM) certification on board – the EU Ship Recycling Regulation (SRR).

To make the process as efficient as possible, IHM services are now provided through digital platforms.

There are several companies offering this service. For example, DNV GL, soon to become DNV, has developed software under the banner of IHM Green Server (IGS) in the "My Services" area on its Veracity platform.

IGS can be used for the initial IHM Part I preparation, for approval and certification and for further maintenance activities.

The software can be used by any interested party, such as a shipyard, shipowner/manager or hazardous materials (HAZMAT) expert company. When the relevant data is entered, the software generates IHM Part I in a digital format:

To create a more efficient and transparent IHM approval and certification process, DNV GL introduced a feature in June last year to "Request IHM approval" in "My Services".

PART I MAINTENANCE

IHM Part I should be properly maintained and updated throughout the operational life of the ship, reflecting new installations containing any HAZMAT referred to in Annex II of the EU SRR and relevant changes in the structure and equipment of the ship.

In case there is no procedure implemented on board the ship for the maintenance, a detailed inspection may be carried out by Port State Control.

DNV GL said that it was crucial an IHM maintenance procedure be established and implemented, and to identify products that fall into its scope. For these items, shipowners need to collect information in the form of Material Declarations (MDs) and Supplier Declaration of Conformity (SDoC).

The EU SRR states that "an IHM certificate shall cease to be valid, if the condition of the

ship does not correspond – with the particulars of that IHM certificate, including where IHM Part I has not been properly maintained and updated". If a valid IHM certificate is not held on board then a ship can be detained, DNV GL warned.

A real-time IHM is kept in the IGS software and can be generated at any time with one click. All the changes are recorded in the vessel's audit trail, which acts as an IHM Maintenance Log Book.

REMOTE SURVEYS

Gaining greater relevance since the COVID-19 pandemic restricted travel, remote surveys and sampling under the EU SRR are now being offered by several companies.

According to the flag state Marshall Islands' maritime administrator, when, due to covid-19 restrictions, on board attendance is not possible by an IHM expert company to conduct the sampling portion of the IHM Part I preparation, the ship's crew can undertake this task under the remote guidance and direction of an expert company.

This is on condition that all documented training and qualification records are provided for the crew, which cover the sampling procedures, hazard awareness, and safety measures to be implemented, including the requisite personal protective equipment (PPE).

The IHM expert company should ensure that on-board visual and sampling checks are carried out in accordance with the plan prepared by the expert company. The samples should then be packaged and sent ashore to the expert's appointed laboratory, and the IHM Part I process completed in the normal manner.

Where a vessel has a semi- or partially-completed IHM with an associated approved Statement of Compliance (SoC) that does not contain on-board (either targeted or random) sampling, the flag state will accept remote surveys provided that documentation is kept on board the ship indicating when it will be feasible for qualified samplers to complete the IHM.

When on-board attendance is not possible, due to covid restrictions and where an IHM Part I has been fully prepared, the administrator will agree to Recognised Organisations (ROs) conducting remote initial IHM surveys subject to their satisfaction with the contracted expert company's experience, and that the IHM Part I complies fully with the EU's SRR requirements and the guidelines contained in IMO Resolution MEPC.269(68).

Verification confirmation on board will be carried out at the next scheduled statutory survey where the RO surveyor's physical attendance is possible.

This Technical Circular should be retained on board the vessel to present as evidence to EU Port State Control should there be any questions on the Administrator's policy regarding this issue.

The circular is valid until 30 June, 2021, the date on which the "harmonised approach" by the EU on enforcing its SRR expires, unless otherwise extended.

ACCENTUATE THE POSITIVES

Despite still getting a bad press, the art of recycling ships has come a long way in the past 10 years.

Today, there are far more positives than there are negatives. Now, across the world, there is a mix of good and bad yard facilities worldwide, leading experts said at a recent seminar.

Many recycling yards have adopted compliance with the IMO's Hong Kong Convention (HKC), the EU RSS and are operating in a safe and responsible way.

Global green recycling consultant Grieg Green's CEO Petter Heier, part of the Norwegian family-owned Grieg Group, said scrapyard audits were being carried out based on EU regulations with other soft issues added, such as looking at the management of the recycling companies.

He thought that many yards were operating in "a good way", especially in India. The ones that are perceived to be below standard had a lack of understanding of today's issues and that includes some in Europe, Heier

says, although he admitted that the European yards were more involved in newbuildings and shiprepair, so hadn't taken recycling seriously.

Those yards embracing change, were mainly based in China – which has since banned the recycling of overseas ships, but could restart soon – Turkey and India. Bangladesh will hopefully come up to scrutiny in the not too distant future, he said.

It is not only the facilities that should pass audits, it is also the responsibility of the shipowner to send his or her assets to the right yards, he said.

Before the pandemic, Grieg Green had introduced a remote IHM survey capability. Heier believed that there are around 30,000 ships needing a hazardous material survey before the EU's deadline.

Heier said that the use of remote surveys helps to create crew awareness on board, with seafarers becoming engaged and taking ownership of the IHM regulations by conducting their own HAZMAT surveys.

He went on to explain that it was necessary for expert companies to have a representative at the yard continuously, while one of their audited ships is being recycled.

There are now 10 or more IHM auditing companies and, as a result, a big change could be seen in yard personnel training and the general awareness of safety, efficiency and compliance, he said.

Grieg Green monitors the world's top ship recycling facilities and audits them regularly. They must be ISO 9001, ISO 14001 and OHSAS 18001 certified, as well as adhering to the HKC and EU SRR.

Each yard must have developed a Ship Recycling Facility Plan where all technical and human aspects of the recycling process are described and covered ensuring that working and environmental conditions are met in a proper way.

The Basel Convention, which dates from 1992, was designed to control cross border movement of hazardous waste, especially from a developed country (OECD) to a non-OECD country.

A vessel sold for recycling is categorised as waste and a certain



process therefore needed to be followed if exporting the vessel from one country to its recycling destination.

The IMO's HKC was adopted in 2009, with the intention to address the working and environmental conditions in ship recycling facilities globally.

Until recently, the convention has been ratified by 15 countries, including Norway, Denmark, Japan, Malta, Panama and India.

Heier said that Grieg Green uses the HKC guidelines as a basis for the technical standards.

In addition to the international regulations, local national regulations must be followed by recycling facilities, he said.

As well as China re-entering the recycling arena soon, India has plans to double its recycling capability by 2024.

This was revealed in the Indian Finance Ministry's budget for fiscal year 2021 recently.

BILATERAL AGREEMENT

European Commission Shipowners' Association (ECSA) director marine safety & environment Sotiris Raptis explained that the EU's list of approved shipyards was updated last November.

He said that there was no agreement in place with India being a non-OECD country, but hoped that talks would take place on a bilateral agreement soon. The EU banning of Indian yards came under the 2019 Basil Ban agreement.

Discussions were underway at the EU regarding whether the EC should be allowed to negotiate the export of waste from an OECD to a non-OECD country. He confirmed that there would likely be a revision of the EU SRR in 2023 with possibly a financial incentive and an EU beneficial ownership scheme introduced.

AT THE CROSSROADS

The International Chamber of Shipping's (ICS) manager environment & trade John Stawpert warns that the proposed 2023 EU rule changes could put up barriers and was more likely to penalise the European-based ship operator. "Europe is at the crossroads on this issue," he said.

Europe must decide whether to adopt the HKC or go on its own path,

he stressed. The thus-far unratified HKC has been good news and had led to the upgrading of recycling yards, he says. Another positive sign was the number of IACS class societies that had gone into some of the yards to help bring them up to standard.

Yard improvements were accelerating, he said, adding that several yards had already gone beyond the HKC in terms of facilities.

He admitted that Pakistan still had problems, but had committed at least publicly to improve the yards. With China possibly opening up again soon, this would bring more compliant recycling yards onstream.

Stawpert believed China might also ratify the HKC, which would mean it could be rubber-stamped by 2023. Bangladesh could also be compliant by the same year, but like everywhere has been hit by covid-19.

He pointed out that a Bangladesh yard even recycled Greenpeace's *Rainbow Warrior* in a compliant way.

FACING ISSUES

Ilker Sari, President of Turkish-based Rata Shipping explained the situation from a Turkish viewpoint, saying that out of 26 plots available in the Izmir area in 800 acres of shoreline, 22 were active.

However, he said the Turkish recycling industry was facing issues, not least of which was that out of the 15 yards that applied to be listed with the EU, only seven were accepted when he thought around 10 would make it onto the list.

Recently both cruise ships and the offshore units had swelled Turkish yards with some cruise vessels having to layup in Europe to await space at a recycling yard, due to slot limitations.

He admitted that Turkey could not compete on a price per lightweight tonne (ldt) basis for a ship but that the yards could offer more of a quality recycling operation and proper management.

ALL ABOUT THE PRICE

Cash buyer GMS founder and CEO Dr Anil Sharma said recycling today was all about the price per ldt, supply of ships and regulations. He explained that GMS's modus operandi was to

take care of the entire logistics chain, including vessel deliveries to the yards.

"We execute deals based on the seller's wishes and are not married to any one particular shipyard," he explained.

Between January, 2020 and January this year, prices paid by the scrapyards have escalated by about 20%. There have also been a number of very large ore carriers (VLOCs) sold for recycling during the past year. These vessels can fetch up to \$20m on the demolition market, resulting in recycling becoming competitive with the secondhand market.

He explained that a 10,000ldt bulk carrier took around 45 days to dismantle, but a cruise vessel was more complicated, having a greater number of components and could only be demolished at a rate of around 4-5,000ldt per month, thus a 20,000 ldt cruise ship could take five months to dispose of.

Many years ago, asbestos proved to be a major problem with cruise ships, but the industry is now much more careful given the IHM Code. Bangladesh has totally banned cruise ships on HAZMAT grounds but generally paid higher prices for other vessel types, as the country does not import raw materials for its domestic steel industry.

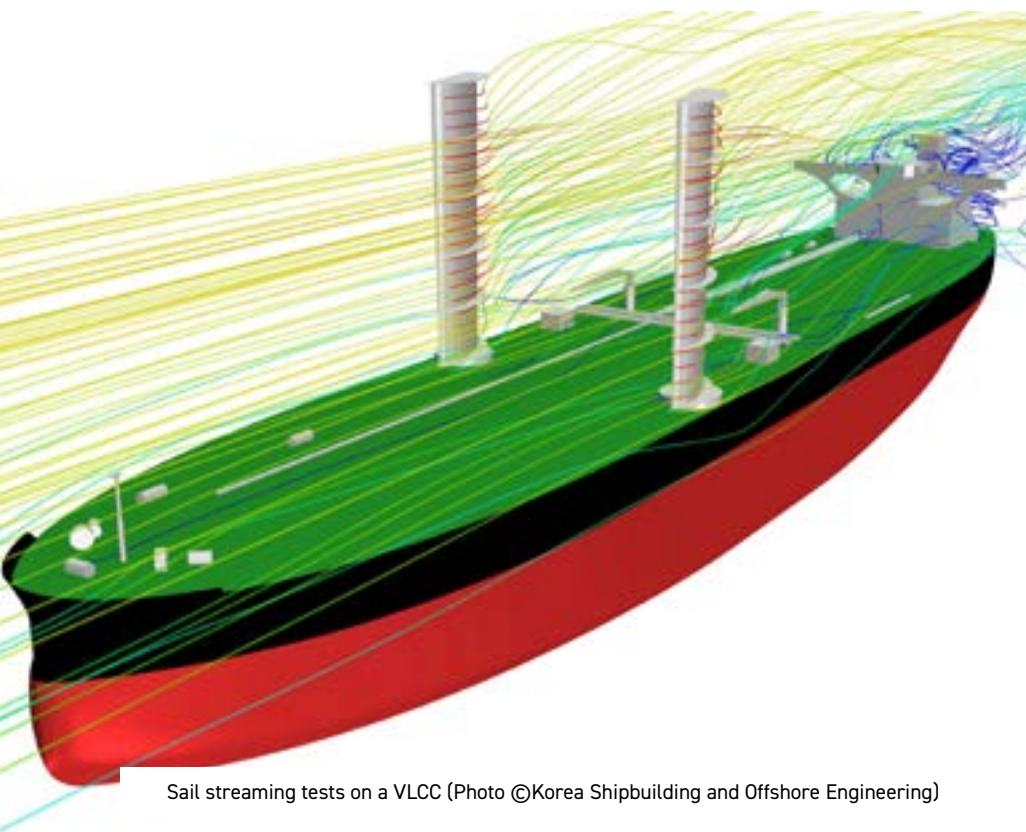
In general, he agreed that the yards were in a much better state than 10 years ago. There was a new generation of managers entering the sector and proper procedures were being put into place.

Dr Sharma said that he expected a lot more tankers to be circulated for recycling this year. He revealed that due to the rise in containership charter rates, GMS has sold several for further trading having purchased them originally for recycling.

He thought that the European Waste Management directive was just a paper exercise. It can take 60 days to organise exports, due to the amount of form filling needed, he claimed.

The number of HKC compliant recycling yards stands at around 92 in India, 14 in Turkey, two in China and one in Bangladesh. Thus far, no Pakistani yards have gained a certificate.





Sail streaming tests on a VLCC (Photo ©Korea Shipbuilding and Offshore Engineering)

There has been a certain amount of scepticism in some quarters following the failure of a few initiatives down the years, but auxiliary wind power is beginning to attract attention once again

SAILING INTO THE WIND

The world stood up and took notice when Maersk Tankers elected to trial Norsepower rotor sails on the LR2 tanker *Maersk Pelican*.

Following a year of operations, Norsepower's CEO Tuomas Riski claimed that the calculated fuel savings were 8.2%. Although this particular installation was a retrofit, he said there was a huge opportunity for fitting auxiliary wind power on newbuildings, as this would prove the cheaper option.

The *Maersk Pelican* was recently sold and it is not yet known whether the new owner will retain the rotor sails on board. However, Riski claimed that an installation and operation of rotor sails could save anywhere between 5% and 20% of fuel and thus emissions without changing the profile of the ship.

The installation costs will also come down, if shipyards built the concept into their designs at an early stage. Riski called for shipbuilders to include the possibility of fitting sails at an early phase of the design

stage of a newbuilding. In today's worldwide weather pattern, Riski claimed that an owner or operator could see a return on investment (ROI) after four years or less and the concept would work on most type of ships.

There were several practical elements that needed to be considered before locating the sails, such as structural criteria, including deck strength and vessel stability, sight of navigation from the bridge, control system automation integration and others. A risk assessment should be carried out again at an early stage of the design stage which could alleviate problems at a later stage.

Most of the initiatives on offer and others that are in the pipeline designed to achieve the severe reduction in carbon emissions called for in 10-20 years time will be market driven. For example, in the secondhand sale and purchase market, a ship's energy consumption and emissions will be taken into account going forward.

It was thought by some stakeholders that the potential for savings when using sails was higher in smaller and slower vessels. A

vessel's geographic trading area and service speed will need to be taken into account while doing the calculations.

In the future, compliance with regulations in force and those pending, will be key and stakeholders will need to see what's coming over the horizon. The rationale for fuel savings is ever more important as the shipping industry moves forward with new fuels.

Shipyards will also need to think outside the box with the new regulations and fuels being talked of. They will have to be more flexible and not try to charge a premium for new technology with their designs.

Financiers are now taking on board the need for more efficiently designed ships, as both the Energy Efficiency Design Index (EEDI) and Energy Efficiency Existing Ship Index (EEXI) reporting systems will mean that a ships must reduce their emissions and fuel consumption. EEXI is due to come online in 2023.

The Poseidon Principal grouping of leading banks willing to invest in new tonnage must see that they are operationally efficient to enable the assets to keep their value for the secondhand market.

Somewhat surprisingly, all of the stakeholders – shipyards, shipowners, financiers, designers and so on – were showing interest in this concept with enquiry reported as high. New initiatives, such as sails fitted on board, will be tackled by co-operation and joint ventures.

Norsepower has also installed two 35m tall rotor sails on a Sea-Cargo-operated vessel. This installation was claimed to be the world's first tiltable rotor sail, proving that vessels that need to sail on height-restricted routes can benefit from this fuel and emissions-saving solution.

CONSIDERABLE SAVINGS

According to the analysis conducted by Norsepower and Sea-Cargo, the installation – fitted on board the *SC Connector*, a 12,251 gross tonne (GT) side-door ro-ro – can achieve a fuel consumption, fuel cost and carbon emissions reduction of up to 25%. In good wind conditions, the vessel will be able to maintain her regular service speed by sail alone.

Norsepower's rotor sail solution is an updated version of the Flettner rotor, a spinning cylinder that uses an aerodynamic phenomenon known as the Magnus Effect to harness wind power to produce thrust for a ship.

SC Connector, which sails between Western Norway, Denmark, the Netherlands, Sweden and Poland, sails under multiple bridges and powerlines, requiring adaptation of the rotor sails to tilt to the almost horizontal when the vessel is required to operate at a low air draft.

Riski says of the Sea-Cargo installation: "Completing the installation has been extremely rewarding, as it reflects how, in taking a collaborative approach with a customer, we can innovate to create solutions that allow rotor sails to benefit almost any vessel type or trading route.

"As we get closer to 2030 IMO targets, we are seeing our technology gaining momentum – with the market seeing the flexibility we can provide to suit different vessel requirements. This installation demonstrates the technology can go a long way to future-proofing IMO GHG compliance, while ensuring significant emissions, and fuel reductions to a variety of vessel profiles today."

Ole Sæviold, Sea-Cargo managing director, adds: "We are focusing on utilising available renewable energy and using it for direct propulsion to design more environmentally friendly vessels. The rotor sail technology has been proven in the market for a while, but the size is unique for our project. The sails are far more efficient than conventional sails of the same size and the tilting function is essential to our voyage routes. Given the estimated emissions savings, we will use our experience of this full scale project, and proceed to develop it further for other vessels in our fleet."

Norsepower's rotor sail is fully automated and detects whenever the wind is strong enough to deliver fuel and emission savings, at which point the sails will start automatically.

Following the Sea-Cargo fitting, Norsepower announced it had won its first newbuilding order, for the installation of five tilting rotor sails on

board a large bulk carrier. Preparations are currently taking place with the installation on board scheduled for this year.

At present, the owner wishes to remain anonymous thus little detail has been released thus far.

TESTING TECHNOLOGIES

Elsewhere, a new research project focused on combining emerging technologies to promote low-carbon shipping will test its technologies on in-service vessels.

The project, which is named CHEK (deCarbonizing sHipping by Enabling Key technology symbiosis on real vessel concept designs), is receiving funding from the EU Horizon 2020 programme to accelerate innovation with tests of a sail on a drybulk carrier, as well as a hydrogen-powered ship engine on a cruise ship.

"No current or emerging 'silver bullet' technology alone will be able to reduce CO₂ emissions from maritime transport in accordance with the IMO's ambitious 2050 goals," explains CHEK project co-ordinator, Dr Suvi Karinne, who heads VEBIC, Finland's University of Vaasa's energy and sustainability research platform. "The shipping of the future must combine emerging technologies into a systemically symbiotic entity."

The CHEK project aims to reduce shipping emissions by bringing low-carbon energy forms and various technologies such as hydrogen, wind power, electric batteries, heat recovery, air lubrication and new anti-fouling technology to vessels, as well as developing the way vessels are designed and operated.

A symbiosis of new innovative technologies will be created that can reduce 99% of GHG emissions, achieve energy savings of up to 50% and reduce black carbon emissions by more than 95%.

Research efforts will be applied to current vessels. For example, a Cargill bulk carrier will be fitted with the wing sail technology under development by the UK's Bar Technologies.

BAR and Cargill will develop a solid wing sail system, based on racing yacht design, for a Kamsarmax type bulker, which will also feature automated,

optimised vessel routing, waste heat recovery, hull form optimisation and a gate rudder.

By designing the overall layout to optimise the benefits from the combination of technologies used, the efficiency savings will be maximised, the companies claimed.

"Wind propulsion will be a cornerstone of low-carbon shipping in the future, with the versatility to deliver efficiency savings regardless of the power train used," says John Cooper, BAR Technologies CEO. "However, it is most effective as part of a wider suite of de-carbonisation technology, and especially when designed into the vessel platform from the beginning."

Set to begin in June, 2021, CHEK will run for 36 months and will involve the University of Vaasa, World Maritime University, Wärtsilä, Cargill, MSC Cruises, Lloyd's Register, Silverstream Technologies, Hasytec, Deltamarin, Climeon, and BAR Technologies.

BAR is a spin-off from Ben Ainslie Racing (BAR), the British team formed by Olympic and World Champion sailor Sir Ben Ainslie. It was formed in 2016 to bring the design knowledge, technical skills and intellectual property developed for America's Cup yacht racing to the commercial world. The company is led by chairman Martin Whitmarsh – former McLaren team principal – CEO, John Cooper – former McLaren chief business officer – and former America's Cup designer and engineer, Simon Schofield.

ECO-TECH TIE-UP

Meanwhile, Kim Diederichsen, CEO, Anemoi Marine Technologies, tells *Clean Shipping International* that the key to achieving both EEDI and EEXI and, ultimately IMO's over-arching carbon reduction targets, is to integrate and optimise a range of eco-technologies that complement each other.

This is the reason that wind-power specialist Anemoi Marine Technologies has teamed up with maritime propulsion giant Wärtsilä in October last year.

Anemoi is a producer of on-board Flettner Rotors, known as rotor sails. These are tall, cylindrical sails fitted to the upper deck of vessel. A small

motor is used to rotate the sails and this harnesses the renewable power of the wind to propel the ship through the water. In essence, these are mechanical sails, but instead of using the wind in a conventional way, rotor sails capitalise on the Magnus Effect to deliver additional thrust to the vessel.

Anemoi's solution has been operating successfully on board ship for three years and is proven to deliver significant efficiency savings, Diederichsen claimed. Unlike other similar installations, Anemoi's rotors are designed to either fold from vertical to horizontal, or move position on a set of rails thus not interfering with the daily ship operations.

Depending on vessel type and trading pattern, Anemoi's rotor solution has the potential to reduce fuel use and associated emissions by as much as 30%.

To help newbuilding or existing vessels meet their EEDI/EEXI obligations, Wärtsilä offers a package of technologies that might include eco-efficient main engine and generators, rudder and propeller innovations, hull coatings, air lubrication systems, fuel mix, and alternative power sources, such as rotor sails.

Through its extensive experience, Wärtsilä is able to develop and optimise a combination of technologies that will best assist a particular vessel significantly enhance its efficiency rating.

From Anemoi's perspective, the tie-up with Wärtsilä is much more than simply integrating the physical technologies within the hull. By working together, added efficiency can be drawn from the technology.

It's generally considered that the larger vessel classes – such as VLOCs and VLCCs – find it more challenging to meet their EEDI targets. Anemoi believes that a 325,000dwt VLOC fitted with its rotors could achieve an 18% fuel and emission reduction. On a standard China to Brazil route, the savings can amount to 5,357 tonnes of carbon each year.

Similar calculations for a VLCC sailing from the US Gulf to China show a 17.3% fuel reduction, which equates

to 7,044 tonnes of carbon saved each year, Diederichsen says. Larger ships will generally take ocean routes where the wind tends to be stronger and more predictable, which makes them ideally suited to the rotor sail solution.

Diederichsen says that Anemoi is confident that its rotors are suitable for most vessel classes and has recently completed a feasibility study proving significant savings for a ro-ro trading in northern European.

Germany's Oldendorff Carriers has also signed a joint development project (JDP) agreement with Anemoi, Lloyd's Register (LR) and Shanghai Merchant Ship Design and Research Institute (SDARI). The JDP aims to break down significant barriers to the installation of rotor sail technology and pave the way for commercial-ready applications in the short-term.

Oldendorff says that by fitting vertical rotors on a Newcastlemax-type bulk carrier of 207,000dwt, wind propulsion can be tested on long-haul voyages and it will decide whether to proceed with the installation on board one of its vessels once the results of design and study phases of the JDP have been evaluated.

To ensure the Anemoi-patented vertical rotors do not interfere with cargo operations and air draft limitations, the sails are mounted with a folding system that enables them to be lowered from vertical into a horizontal position on deck.

"This JDP, together with other ongoing projects in our company, is a testament to our commitment to the development and application of green technologies across our fleet," says Torsten Barenthin, director innovation at Oldendorff Carriers.

"By partnering with the ship designer (SDARI), manufacturer (Anemoi) and classification society (LR), we seek to achieve a comprehensive functional application of wind technology that returns environmental and commercial benefits throughout our vessels' entire life cycle," he says.

There are several other initiatives to fit sails on vessels in the pipeline. *Clean Shipping International* will report on these in future editions, once they have been fitted on board ship.



During the middle of February, an International Maritime Organization (IMO)-run symposium looked at the various low- and zero-carbon marine fuels that will allow shipping to meet its emissions targets.

However, it was agreed that more work was needed to address availability, safety and other issues.

Fuel options' state-of-play were discussed and the technical aspects of various low-carbon and zero-carbon fuels were explored. Other issues, such as safety, regulation, pricing, infrastructural availability, lifecycle emissions, supply chain constraints, barriers to adoption and more were also aired.

Detailed research and solutions were presented on a wide range of alternative fuels. Strong candidates, which are already being trialled on ships, include hydrogen, ammonia and methanol. Wind-propulsion was also highlighted.

Information was also shared about practical lessons learned from the use of the currently available alternative fuels, such as liquefied natural gas (LNG) and biofuels, which also highlighted the potential of further reducing the greenhouse gas (GHG) emissions associated with their use, for instance, reducing methane slip or increasing the use of bio-gas.

"To reach a low- and zero-carbon future for shipping, we will need new technologies, new fuels and innovation," IMO Secretary General Kitack Lim said in his opening remarks. "Exciting research and development into low- and zero-carbon marine fuels is already underway. IMO wants to further accelerate such initiatives by providing the global forum for sharing knowledge, to promote R&D and to build partnerships between stakeholders and among public and private sectors, not only in the shipping industry and ports, but also private and development banks, and academia at international, national and local levels."

As for safety, the symposium highlighted the need to discuss and address concerns around the use, bunkering and storage of emerging fuels, given the different characteristics of each individual fuel.

Many participants highlighted the need for an intensified effort to further develop the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code), in order to keep pace with new fuels making their way on to the market.

IMO's Sub-Committee on Carriage of Cargoes and Containers (CCC) is responsible for the IGF Code. Member

states were asked to share information with the CCC Sub-Committee to ensure that technical discussions are robust.

Crew training on safe handling of alternative fuels was also emphasised, as individual fuels have different requirements for temperature, viscosity, on board storage and engine operations.

Partnerships among stakeholders, together with clear policy and international regulations, were recognised as key-factors in advancing towards shipping's de-carbonisation.

The IMO stressed that it will play an active role as the global regulator of shipping and also as a promoter and co-ordinator of initiatives related to low/zero carbon alternative fuels. "We should not forget that the energy transition of shipping has both sides, a necessity and an opportunity," said Sveinung Oftedal, symposium moderator.

"Shipping de-carbonisation is everyone's business and co-operation across the maritime community and beyond would be essential to success. IMO stands ready to continue to be a global platform for knowledge sharing and promoting alternative fuels," he added.

Most stakeholders *Clean Shipping International* has spoken to recently have agreed that the path towards zero emissions can only be achieved by a collaborative approach with safety and training at the top of the list when deciding on which route to take.

For example, Knut Ørbeck-Nilssen, CEO DNV GL – Maritime (to become just DNV on 1 March), said that the timeline towards zero emissions was underway and admitted that the IMO was under tremendous pressure. "Leadership is needed to meet the industry challenges," he said. "Use the IMO as the best vehicle of safety and the environment."

He saw this decade as one of innovation and collaboration and pleaded for a level playing field. However, he warned that de-carbonisation efforts would create a safety gap if left unmanaged, which could delay progress.

At the many presentations given by Ørbeck-Nilssen down the years, attended by *Clean Shipping International's* editor in one guise or another, he has called the next 20-30 years "tectonic shifts" in the way shipping is run. In his mid-February talk, he did not disappoint and made no apology for using this analogy again.

He has always been a staunch supporter of the IMO in being the body to take the industry forward against all the national and regional regulations that appear from time to time – not least from the European Union.



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