Clean sweep

Ship owners are under increasing pressure to comply with regulations on sulfur emissions and new rules on ballast water, creating a variety of opportunities for maintenance suppliers

Barry Parker, *Marine Maintenance Technology International*

As restrictions on vessels' emissions of sulfur are tightened, the first scrubbers deployed on commercial ships in worldwide trades have now come online. Regulatory timetables for sulfur emissions have the global cap on sulfur content now set at 3.5%, slated to be lowered to 0.5% in 2020. Within areas specially designated as Emission Control Areas (ECAs) by the International Maritime Organization, a 1% cap presently in effect will ratchet downward to 0.1% in 2015. Annex VI of the Maritime Pollution convention (MARPOL) already designates Northern European waters as an ECA, with North America set to become an ECA this summer.

A 2010 directive from the European Union (EU) further complicates matters: vessels at berths in EU countries are limited to emissions of maximum 0.1% sulfur (even lower than the current ECA requirement); and also stipulate that vessels must switch over to a low sulfur fuel when in port, or plug into a shoreside electrical grid.

To comply with the restrictions, vessel owners have multiple choices. One path, for vessels now on the water, will be the continued use of an existing main power plant and auxiliary engines, purchasing a fuel with a compliant sulfur content, now 1% in the ECAs and 3.5% elsewhere. Another emerging path is the installation of a scrubber.

Hamworthy Krystallon has announced that an Italian owner, Linea Messina, has installed a scrubber system on its container/ro-ro vessel Jolly Diamante, the first of four sisters delivered from Daewoo, under the carrier's US$300 million new-build program. The vessel is presently trading between Italy (Naples and Genoa) and ports in East Africa – one of several of Linea Messina's regular north-south runs (not within an ECA).

Hamworthy, acquired at end January by Wartsila, a leading engine manufacturer, has scored other significant victories. In early January, it announced that the Norwegian owner Solvang ASA would be installing a scrubber system on an LPG carrier, also a new build, under construction at Hyundai. The new-build vessel will be fitted with two scrubbers: one for the main engine; and one combined scrubber for three auxiliary engines. The scrubbers and washwater treatment will be situated in the funnel, in a modular design. The system will vary the washwater amounts depending on the load and sulfur content of the fuel oil, while an additional particulate matter (PM) capture system will help reduce PM emissions by more than 90%.

Within the world of scrubbers, there are multiple solutions. An alternative technology – a closed freshwater system – has been demonstrated by Wartsila with a 2011 retrofit on the 2002-built 965 TEU Containerships VII, which trades in the North European ECA.

Another vendor, Aalborg Industries (part of power systems stalwart, Alfa Laval, since its mid-2011 acquisition), brings a marine background from deploying scrubbers integral to inert gas systems on tankers. Aalborg's Pure SOx scrubber solution, using either seawater or freshwater, has been successfully deployed on a DFDS ferry shuttling across the North Sea within the Northern European ECA.

MAIN IMAGE: **First stage - filtration vessel close-uo; disk filters are inside**

"By 2015, ship owners and operators operating in ECAs will have a simple choice – either pay the US$300 to US$400 price differential for costly distillate fuel, or install a scrubber," says Sigurd Jenssen, managing director of Hamworthy Krystallon. Jenssen points to a two-year payback period.

The availability of compliant fuel is not a 'given', reflecting uncertainties that abound concerning the abilities of refiners to produce sufficient quantities of low sulfur marine fuels. Potentially, the MARPOL implementation of the worldwide 0.5% cap could be shifted forward to 2025.

Retrofit opportunity

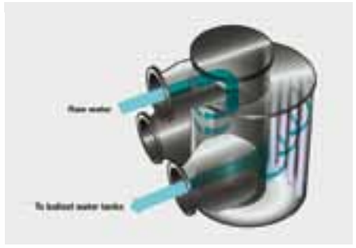
As the fuel supply availability (and likely pricing patterns) gains clarity, spurring a clear business case for scrubber retrofits, installations will likely coincide with periodic dry dockings and special surveys. A 2011 report on Exhaust Gas Cleaning (EGC) by Glosten Associates, prepared for the US Maritime Administration, offered multiple considerations in identifying vessels where a scrubber retrofit made sense. One such criterion, in addition to an ECA-intensive trading pattern, was that, "The ship passes a technical survey ensuring that an EGCS can be integrated with ship arrangements, stability, and operations." Glosten also notes that additional crew may be required to operate an EGCS, and adds that the technologies have not reached maturity yet. "The most experienced EGCS suppliers have only a handful of shipboard installations, and most only have a single pilot project," Glosten wrote.

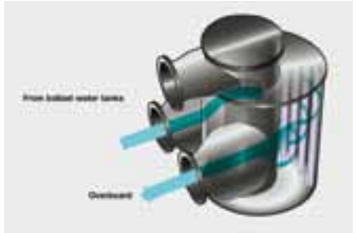
The class society Germanicsher Lloyd was involved in testing a dry scrubber aboard the 6,400dwt vessel Timbus in 2009, deployed in the Scandinavia/North Continent forest product trades. According to its owners, installation of the scrubber, by German vendor Couple Systems, took less than a week.

Jad Mouawad, senior engineer at class society Det Norske Veritas (DNV), told *Marine Maintenance Technology International* that the DNV was coming around to the view that

BELOW: **Wartsila ballast water treatment plant**

RIGHT: **Rendering of seawater intake, Wartsila BWT**





RIGHT: **Rendering of deballasting outflow, Wartsila**

the scrubbers would be powered from the auxiliary engines, where redundancy was possible through doubling up. "You can't shut down the main engines if there's a problem with the scrubber," he says, "but you can use the auxiliaries to provide power to the scrubber."

Fuel for thought

The vicissitudes of fuel markets are a selling point for scrubbers, with business cases modeling scenarios where owners continue to burn high sulfur fuel, but install a scrubber to meet restrictions on emissions. The Solvang LPG carrier will burn more readily available high-sulfur fuel, which represents the first commercial contract for a full vessel system, allowing the vessel to operate while burning only heavy fuel oil, according to Hamworthy.

Owners' investment calculations involve a cost comparison (appropriately discounted) of the upfront investment in a scrubber, versus the price premium for possibly scarce low-sulfur fuel. With a greater 'sulfur premium' over time avoided by installing the scrubber, the calculation will tilt in favor of a quick payback on the investment. A Hamworthy presentation from November 2011 shows a US$3 million scrubber that might be installed on a ferry working full time within the Northern European ECA. Forecast differentials offer a comparison with marine gas oil, or MGO, (over IFO 380 fuel) using a notional premium of US$330/ton.

A Wartsila presentation, using differentials between MGO and HFO ranging between US$221/ton to US$732/ton, reveals aggregate savings ranging between US$33 million and US$165 million on a new-build vessel, over a 25-year economic vessel life, with paybacks on the initial investment estimated at two years or less. An Aalborg business case, looking at a US$200 sulfur premium of MGO over IFO 380, also yields a quick paybank, with timeframes of 1.3 years - two years for engines ranging from 5MW to 21MW. In a presentation of Aalborg's Pure SOx scrubber, a matrix of investment returns shows that larger engines (up to 44MW) and increased usage (6,000 yearly hours, in the ECA) can produce paybacks in less than one year in a vessel burning heavy fuel.

Vessel owners must also consider physical constraints. In recent testimony in front of the UK Parliament, Don Gregory, who oversees the Exhaust Gas Cleaning Systems Association, told questioners, "We would argue that not every ship will be able to be fitted with a scrubber because there is not the space on some ships, but the large majority could be fitted with a scrubber."

A third set of alternatives brings a different set of challenges. A group of early-adopter owners have now already begun the switch over to LNG fueling – this practice will grow with increased availability of LNG for marine use. Wartsila, in a paper titled *Gas is Coming of Age* discussing dual fuel solutions, tells readers, "The bunkering of LNG may be a problem in some parts of the world. Traditional shipping fuels could, in that case, seem the better solution. Alternatively, one could compromise the space needed for onboard LNG storage capacity by using LNG for fuel only when sailing in emissions sensitive areas."

Mindful of the coming North American ECA, Wartsila is cooperating with Shell to create infrastructure for gas supply, initially in the USA. In northern Europe, the Gasnor consortium (whose backers include Statoil, Shell, and Total) is distributing LNG for ships' fuel.

Wartsila recently converted a W46 engine aboard the Bit Viking, a tanker in the Norwegian coastal refined product trades, designed for burning heavy fuel oil, into a DF50 installation consuming clean-burning LNG. A portion of the owner's return on investment comes from reduced taxes in Norway's NOx fund program. Rolls Royce has also penetrated this sector, with the LNG-powered ferry MF Boknafjord, operated by Fjord 1, which has commenced service deep within the ECA, along Norway's west coast.

Ballast water treatment

Ballast water management (BWM), designed to eliminate the spread of non-indigenous marine organisms through ballast water transfers, is subject to a whole other regime. Regulatory expert Admiral Robert North, recently retired from the US Coast Guard, told *Marine Maintenance Technology International*, "The BWM Convention will come into force 12 months after ratification by 30 countries representing 35% of world tonnage. To date, 32 countries, representing 26.46% of tonnage have ratified. So, expectations are that a country or countries representing the remaining percentage of tonnage will ratify in 2012 with the Convention coming into force in 2013." Admiral North's North Star Maritime, works closely with ship owners on compliance issues.

Under the BWM Convention's rules, vessels built prior to 2009 will need to install treatment systems by 2014-2016 (depending on their ballast tank capacity) that would render harmful organisms non-viable. Ships built in 2009 onward will be required to comply immediately once the Convention becomes effective – presumably sometime in 2013. The precise date depends on the considerable vagaries of the ratification process. Market researcher Frost & Sullivan had estimated a capital spend of US$30 billion during 2009-2020, spread over 57,000 vessels – implying an average spend in excess of US$500,000 per installation. A pair of environmental scientists, Dennis King and Patrick Hagen, of the Center for Environmental Science at the University of Maryland, came up with a US$1 million per vessel estimate, in spring 2011.

To date, ship owners have played a waiting game – citing a combination of uncertainties about both timing and the efficacy of a wide spectrum of technologies, including ozone treatment, electrolysis, filtration, and chemical treatment.

Nearly two dozen systems have now gained IMO approval, beginning with the AlfaLaval's PureBallast system, which was approved in mid-2007. It is being deployed by Maersk on more than a dozen containerships being built in Korea. The second-generation PureBallast 2, which also features a version for use in explosive environments, offers improved power consumption and controls that can be interfaced with a vessel's main communications bus. Also in the fray are vendors from the landside water treatment world; these include the Bremen-based RWO Marine Water Technology, a unit of Veolia – a worldwide water treatment giant. Hyundai, Samsung, Hitachi, and Mitsui also offer ballast water treatment systems.

As with emissions, multiple technologies can do the job. Hamworthy has recently launched a package of BWM products dubbed Aquarius, which combine a first-stage filtration with a second step – either disinfection through ultraviolet rays (Aquarius UV) or

LEFT: **Wartsila scrubber on the side of the ship's funnel**

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RETROFIT OPPORTUNITY

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chlorination using electrolysis (Aquarius EC). Application for a type approval is now in front of the IMO's Marine Environmental Protection Committee. Wartsila, partnered by Canadian water treatment specialist Trojan, has been offering Trojan Marinex – an integrated system combining filtration of ballast water with ultraviolet irradiation.

Time to clean up

Besides the manufacturers, another group is anticipating benefits from BWM. The enticing retrofit market has figured into the strategies of repair yards seeking to diversify revenue streams at a time where sharp-penciled ship owners are carefully reviewing all expenditures. Although precise timing of the regulatory regime is still uncertain, the installations of ballast water management systems are not optional. In the next few years, owners will be deploying BWM equipment in conjunction with mandatory class survey work, coinciding with other scheduled repairs.

The ASRY yard, with a strategic location in Bahrain, has indicated publicly that retrofits of BWM is going to be a target market; originally targeting tankers trading into the Arabian Gulf when it opened in the 1970s, this yard can handle multiple VLCCs simultaneously, as well as smaller vessels transiting past its location.

Meanwhile, Mitsubishi Heavy Industries (MHI) established an in-house team last spring to concentrate specifically on BWM refits. MHI explained that the unit, located at its Yokahama dock, but also performing retrofits at three other MHI facilities, would handle the entire gamut of tasks, ranging from comprehensive planning of all work from design and engineering, to system installation.

The Japanese yard says an installation of a BWM system on a ship generally takes about one year to complete, beginning with system specification and selection, through actual installation. It also stresses that it is increasingly necessary to install BWM systems during periodical maintenance, especially in the case of major shipping companies.

DNV's Jad Mouawad described a process of several months' duration, explaining that a 3D scan would be used to enable the designers to develop plans for placement and piping, and then it could take several weeks, or perhaps a month, for the class society to approve the plans. He added that much of the piping could be prefabricated prior to installation, further speeding the process.

In late 2011, MHI announced that it had inked a deal with Japanese owner NYK, to retrofit the vessel Auriga Leader, a car carrier that had been built by MHI's Kobe yard, with 2008 delivery. Last summer, another Japanese yard, Sasebo Heavy Industries, announced that it had overseen the installation of an Alfa Laval Pure Ballast 250 system on the 850 TEU container vessel Hanjin Semarang, with the actual work conducted at a Malaysian yard.

Another vendor, US-based Severn Trent De Nora, has placed its Balpure system (described as an electrolytic disinfection treatment solution) aboard California Maritime Academy's training ship, Golden Bear, and performed seven months of testing by Glosten Associates. A Balpure system had previously been successfully installed in Exxon's tanker S/R American Progress, which trades along the US West Coast.

Careful planning is required for retrofits. According to Sasebo, following preliminary engineering work and manufacturing of customized piping, the actual installation on the containership took five days, followed by a two-day class inspection. Design data was collected during an onboard visit by engineers, well in advance of the installation, using a laser scanning system that fed a CAD package that generated 3D plans. DNV's Jad Mouawad described an installation at a Northern European yard that took eight days: "Everything went well because everyone knew the ship, including the captain, the superintendent, the yard and the maker's personnel. If you work together, and you know the ship, it's very easy." \\

About the author

Barry Parker is a New York-based consultant and writer covering industrial transportation, commodities, and energy markets. Barry's work experience includes brokerage of vessel charters, marketing, and analysis of transportation derivative contracts, and finance and deal structuring for maritime transactions.

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LEFT: **Second stage-EctoSys electrolysis disinfection unit**

RIGHT: **The Cleanballast BWT from RWO Marine Water Technology parallel filtration vessels**