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Global Ballast Water Treatment

TRENDING TOWARD COMPLIANCE

Source: ABS

A new state-of-the-industry report has identified the pathways to the successful operation of ballast water treatment systems, as well as the complex challenges that lay ahead for owners who seek compliance with new and emerging regulations. The report, published by ABS, was compiled from information-sharing workshops in some the world's primary maritime centers, and a survey of more than 60 shipowners and about 500 vessels with installed ballast-water management (BWM) systems.

While the report showed an industry broadly trending towards compliance, it also revealed concerns among owners about the operational reliability of the treatment systems, insufficient crew training and post-sales technical support from vendors.

The survey, which was conducted throughout December last year and January this year found the proportion of systems that were 'operationally problematic' to have doubled, to 59% from 29% a year ago. While the trend may cause concern, it could also show the effect of a rush of new BWM systems coming online to meet compliance.

About 35% of the BWM systems were deemed to be fully operational at the time of the survey, suggesting that the majority of owner/operators were having reliability-related challenges. Feedback from the workshops – held in New Orleans, Athens,

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Hong Kong and Shanghai – indicated that the inability of some vendors to respond globally to technical issues had caused prolonged system outages, in some cases compromising charter opportunities.

Seven types of systems were examined in the survey, including those using:

- Filtration + Side-stream Electro-Chlorination (EC) + Neutralization (used by 29% of respondents)
- Filtration + UV Treatment (20.7%)
- Ozone Treatment + Neutralization (19.9%)
- Filtration + Full Flow (In-line) EC + Neutralization (17.8%)
- Full Flow (In-line) EC (7.5%)
- Filtration + Chlorination via chemical addition (5%)
- Filtration + Deoxygenation (0.2%)

The survey and workshops examined a wide range of vessel types, including: bulk carriers, container ships, gas carriers, general cargo carriers, heavy load carriers, LNG carriers, product carriers, tankers and vehicle carriers (see chart below).

Finding the Path to Compliance

In general, strict attention to plans for most problematic areas – installation, crew training, commissioning, operations, maintenance and repair – improved the chances of efficient and compliant operation for whatever BWM technology an owner chose. The workshops identified best practices to support smooth systems integration and operation, including post-operational experiences with problems that arose during retrofitting. Key Insights included:

- The importance of advance planning, including the creation of detailed timelines that anticipate delays, to help control the cost of retrofits
- Incorporating ship-specific contingency measures into the BWM plan to help avoid in-service downtime and financial penalties
- System-specific training for shore-side support and ships' crews proved critical for effectively operating and maintaining any system
- Monitoring data and operational trends to better understand the system design limitations can help the crew to predict the challenges of the vessels' operational routes, and
- Working closely with the vendor's after-sales support team helped to achieve an uninterrupted operation of the system, globally.

In general, the process of retrofitting BWM systems proved more complex than installing systems on new ships, one that required careful planning to fully integrate with existing water ballast systems. For example, because retrofitting systems can be more time-intensive than installation on a newbuild, the requirements of the engineering contractor and class approval needed to be carefully considered to keep plans on track.

To save time, pre-packaged components and some equipment for the system should be, if possible, pre-manufactured locally, closer to the shipyard. The engineering of the retrofit process needed to be carefully planned – and the installation rehearsed – before dry-docking the vessel.

Industry Concerns: Operational Reliability

Aside from compromising regulatory goals of preventing the transfer of invasive species in ships' ballast tanks, a lack of dependability of any BWM system could result in non-compliance and financial penalties, port state detentions or commercial losses for the owner.

Operational reliability was influenced by many factors, such as software problems, using equipment or components not supplied by the original manufacturer (items such as filter elements, sensors, sampling pumps, valves, actuators, UV lamps, etc.), or the improper installation of a system by the shipyard. Common problems revealed by the report are:

- Fluctuating and unstable readings from total residual oxidant (TRO) sensors and monitors that are sensitive to environmental conditions. These sensors are used for active-substance-based BWM systems to control the chemical dosing during treatment (some makes) and to control neutralization chemical injection during de-ballasting to reduce the TRO for compliance with local regulations
- Frequent outages and replacement of UV lamps and clogged filters that require frequent or continuous backflushing (particularly in high turbidity water conditions), causing reduced throughput from the ballast pumps
- Inability to operate EC-based systems in fresh or low salinity water conditions, requiring alternative arrangements to carry salt water or brine solutions to achieve the minimum salinity requirements for the system's feed water
- Predicting low UV transmittance challenges (affecting all UV-based systems) caused by weather or other variables (i.e., shipping density or dredging operations, etc.).

Selecting the Right Technology

Another technical challenge for retrofitting is that no single BWM treatment technology met the demands and operational needs for all types of vessels. Indeed, there is 'no silver bullet.' The selection of the most suitable system depended on several factors, including:

- Vessel configuration, ballast capacity and pump sizes
- Trade routes and vessel-operating profiles
- Differences between high and low ballast dependent vessels (i.e., retention times)
- Ability of the system to support gravity ballasting or de-ballasting operations
- Ballast water treatment rated capacities (TRC), the maximum continuous capacity (expressed in cubic meters per hour) for which the system is type-approved
- Available space for installation and excess power capacity,

and

- Equipment installation and design issues when integrated with the vessel's machinery and piping systems

Vendor Support & After-Sales Service

Both workshop and survey feedback indicated that there was inconsistent global after-sales support from vendors. The limited ability of some vendor's to attend technical issues caused prolonged system outages, and caused problems with charter opportunities. Waiting for service technicians to correct small problems raised the prospect of interrupted cargo operations. Too often, technicians attending the vessels had to order spare parts to restore the system; sometimes, the attending technician was unable to conduct all troubleshooting requirements, or resolve software problems.

Software and Hardware Challenges

Feedback from the workshops identified cases where faults in control-system software and hardware failures caused unexplained alarms and interrupted the operation of the system, affecting cargo operations.

Some vendor-service technicians were unable to verify the authenticity of the control software or prove that the software updates for the systems had been approved by the USCG or the required Type Approval Administration.

There were problems downloading electronic logs (i.e., data retrieval). Often, operators were unaware of software problems until the vendor attended the vessel, or until they were challenged by a port state control officer.

Crew Training and Competency

Crew training to support reliable operations, maintenance, troubleshooting and repairs has proven problematic, according to workshop attendants. Transferring any experience with a specific BWM technology from one crew to another was challenging; training often proved not to be transferable between systems.

Operation, Maintenance and Safety Manuals (OMSM)

There was found to be a real lack of consistency among OMSMs, with some proving to be less useful than others; instructions regarding routine maintenance and troubleshooting were not always well defined. The manuals were found to be either too complicated (operators struggled to understand the vendor's instructions) or too generic (not ship-specific enough). Operators were unable to use them quickly to detect malfunctions, leading to prolonged outages.

The manual's shortfalls limited troubleshooting capabilities, potentially making operators more reliant on a limited number of vendor's technicians to resolve in-service systems problems. Other issues included that manual lists for spare parts and consumables were impractical or insufficient for in-service operations, potentially resulting in:

- Urgent requests for the delivery of spare parts, and

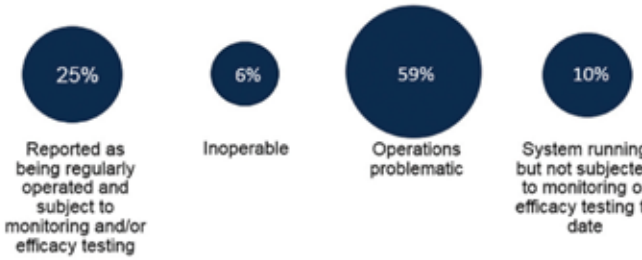
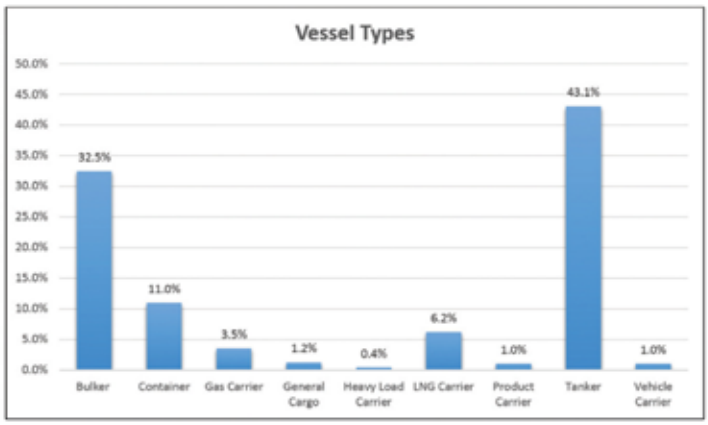


Figure 1 BWMS Operability

Source: ABS



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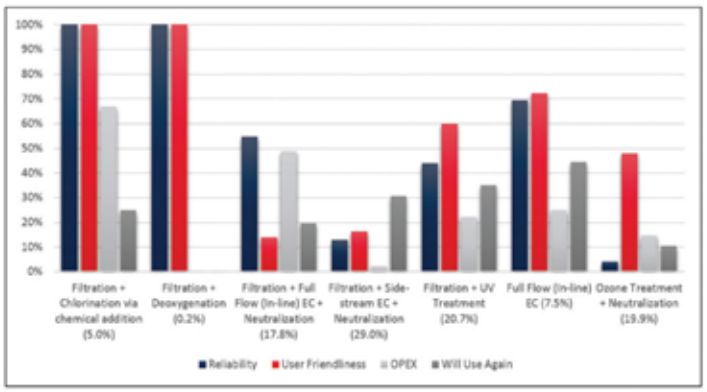

Source: ABS

- Inconsistent systems operation if the spares and consumables are not delivered to the vessel fast enough
- Insufficiently consolidated periodic maintenance schedules, and
- Manuals not being written in the working language of crew, making it harder for the crew to comprehend the instructions

Overall, and across all technologies, about one third of owner/operators were happy with the reliability of the systems they had installed; the owners themselves bore some of the responsibility for the underperformance.

The skill sets of the crews operating the systems were found to be insufficient; it is noteworthy that some the highest levels of dissatisfaction came from owners whose personnel had received training on the fly during commissioning, as onboard-acceptance testing was conducted. Finally, only about 40% of owners considered their systems to be 'user friendly,' a measure that spoke volumes about the industry's present overall comfort with the technology.

How to Engineer a Reliable Ballast Water Management System

By Pete Thompson, V.P. of Operations, Ecochlor

Electrical engineer performs FAT on the Ecochlor treatment system generators at the new ProFlow manufacturing factory in North Haven, Connecticut USA.

The ability of Ballast Water Management Systems (BWMSs) to operate reliably over the lifetime of the vessel is not something that happens by accident. In fact, reliability comes down to the choices that engineers make when designing and specifying a new BWMS. It's no secret that minimizing equipment failure and maximizing long-life means using high quality components in the build and simplifying the system operation so that there are fewer moving parts.

However, creating a well-constructed BWMS that will operate trouble-free over the long term means additional production costs – costs that manufacturers must justify so that shipowners fully understand the value of reliability against the very real risks and costs associated with breakdowns and non-compliance.

Build for the Life of the Vessel

"When we consider equipment design, the first criteria we look at is quality. We work with our supplier network and our customers so that we have the relevant operational data to ensure that the equipment will hold up to our strict durability and endurance standards," says Leif Melhus, Ecochlor Engineering Manager. Melhus continues, "We make sure that our suppliers understand the ship operators' requirements and the nature of the environment that the equipment must operate within. In this way we can ensure that our systems are 'fit for purpose' all the way down to the component level."

Engineered Reliability

This attention to detail has a downside in increased costs, with the final system prices potentially a little higher than the lowest market expectations. Melhus counters this by adding, "While cost is a consideration, it is not the primary factor when we are choosing components. This means that sometimes our production costs might be a bit more, but we know that our customers will see the benefit of the choices we make through increased reliability and the dependability of the Ecochlor BWMS to operate for years to come. This 'engineered reliability' ensures that our customers maintain compliance with the ballast discharge standards."

Unfortunately, not all BWMS manufacturers have followed this principle. Some systems have been built with cost rather than quality in mind, and whilst these might have been the least expensive option in the market many ship operators have found out the real costs when they turned them on. Not only did these systems not work, but in some cases the manufacturer didn't have the capacity to service the equipment to bring it back on line. In other cases, the manufacturer has left the industry completely! It has been a costly lesson for shipowners to replace these systems with more dependable options.

"The Ecochlor system was built to last the life of the vessel," shared Tom Perlich, Ecochlor founder. In 2006, we retrofitted the *Moku Pahu*, a U.S. flag, Jones Act bulk carrier with a route from Hawaii to San Francisco. With ballast operations in California, this vessel encountered some of the strictest regulations in the world. For 13 years this ship ran ballast operations using the original installed system until her last voyage in January of this year. As our longest continuously operated BWMS we enjoyed not only a highly collaborative relationship with the crew but also the ability to gather valuable data on the system's components over the years. That experience has been fed right back into the systems that we deliver to customers today."

Reliability is a Growing Concern with Shipowner/Operators

In March, the American Bureau of Shipping (ABS) released the 2019 *Best Practices for Operations of Ballast Water Management Systems Report*, a culmination of feedback from shipowners and operators with installed BWMS who participated in three conferences over a span of two years. The report is based on a survey, discussions and workshops that were used to review the "industry's progress toward compliance and identified best practices that supported successful BWMS installation and operation."

Through these channels, BWMS operational reliability was recognized as growing problem. Their concern was based on a history of system failures and the hardened stance of regulators in the enforcement of BWM compliance.

Some of the reliability issues addressed in the report were "the use of unreliable or non-OEM equipment or components (filters, sensors, sampling pumps, valves, actuators, electrolytic cell assemblies, dosing sub-systems, UV reactors, etc.)."

Other common problems included: "fluctuating and unstable TRO sensor and monitor readings that are sensitive to environmental conditions…; frequent outages and replacement of UV lamps and clogging of filters that require frequent or continuous back-flushing operations…; [the] inability to operate EC-based BWMS in freshwater or low salinity water conditions, requiring alternative arrangements to carry salt water or brine solutions…; and, predicting low UV transmittance challenges (affecting all UV-based BWMS) caused by weather (seasonal) or other variables…."

Overall, as summarized from 487 installations using seven BWMS treatment technologies on a variety of vessel types – 65% were either inoperable or had problematic ballast operations and only 25% ballasted regularly with a testing protocol for efficacy in place.

Planning for Reliability

Reliability can be determined by looking at the time between equipment breakdowns and system operation. At a minimum, BWMS manufacturers should be able to reference how many of their systems are operational at any given time. Ecochlor goes the extra mile with this thinking, using real-time data analysis to ensure that reliability and system uptimes are maintained at the highest possible levels.

Ecochlor Service Manager, Max Hasson said, "The ongoing monitoring of every Ecochlor system that is installed on a vessel, wherever it is in the world, is an important factor in helping us keep their system fully operational. The crew sends us operational data after every ballast operation and that information is incorporated into a weekly internal fleet update charting the vessel position, next port of call, last ballast operation, chemical tank levels, operational concerns, requested parts, and a preventative maintenance schedule. We don't sit back and wait for the next service call; we plan our way to increased reliability for the ship's crew."

Conclusion

There are many factors that come under consideration when engineering a BWMS for longevity, durability and reliability. With financial penalties, shipowner's reputation, port state detentions/barred entry or charter losses as consequences of BWM non-compliance, securing a reliable system is paramount to good business practices. Reliability costs money, but the unreliability of a BWMS will cost you even more.