DEADLINE-KEEPING

ALL INTERNATIONALLY TRADING SHIPS WILL NEED AN APPROVED BALLAST WATER MANAGEMENT SYSTEM BY 2024.

BY **DR. MIA BENNETT**

FOR AS LONG AS SHIPS HAVE SAILED AT SEA, THEY'VE NEEDED BALLAST TO REMAIN STABLE AND SEAWORTHY. CENTURIES AGO, VESSELS USED HEAVY, DURABLE MATERIALS AS BALLAST. EIGHTH-CENTURY PHOENICIAN SHIPS USED MASSIVE STONES. IN MEDIEVAL TIMES, BALLAST BECAME DUAL-PURPOSE, SERVING AS BOTH STABILIZER AND CARGO.

Ships sailing around Europe and later across the world's oceans relied on a combination of stones and heavy cargo, like broken glass or building material, which would be offloaded and used at the port of destination. Many of the cobblestone streets and houses of Savannah, Georgia – a cotton trading hub in the Atlantic triangular slave trade – were built using the English stones that kept ships steady on their voyages from Liverpool via West Africa, where they took on slaves.

The nineteenth century brought iron- and steel-hulled ships that could smoothly transport cargo across long distances. These vessels employed the first purpose-built tanks using water as ballast. Water represented an ingenious solution as it was everywhere a ship sailed. Yet it also harbored an insidious problem: invasive aquatic species, which could survive extended journeys in a ballast tank and establish themselves, once discharged, in the waters of a ship's destination.

Perhaps the most infamous of such stowaways are zebra mussels. The freshwater bivalve, native to lakes in southern Russia and Ukraine, expanded slowly across Europe beginning in the eighteenth century via river basins and shipping canals. As the mollusks could not withstand journeys across open oceans, their spread beyond the continent was limited.

But by the late 1980s, the mussels began appearing on the other side of the Atlantic, in the Great Lakes. Their arrival has been traced to the ballast tanks of ocean-going ships sailing down the St. Lawrence Seaway. A single zebra mussel can lay over one million eggs a year, a fecundity that has impaired power plants, municipal water systems and countless other infrastructure. Their pipes, once clogged by mussels, quickly become useless.

TAKING ACTION

To curtail the problem of biofouling, the world's two most influential maritime regulators – the U.S. Coast Guard (USCG) and the International Maritime Organization (IMO) – began taking action in the 1990s and 2000s. In 2004, the IMO adopted the International Convention for the Control and Management of Ship's Ballast Water and Sediments.

Known as the Ballast Water Management Convention, it became effective in 2017. Some 80 countries have signed on, representing over 80 percent of world tonnage. Its rules apply to all of their internationally operating vessels carrying ballast water.

The Convention has two standards: D-1, which mandates that ships undertake ballast water exchange at least 200 nautical miles from shore in waters at least 200 meters deep, and the tougher D-2, which requires ships to use an approved ballast water management system (BWMS). Beginning in 2017, all newbuild vessels had to meet the D-2 standard. With the D-1 standard now being phased out, all vessels will have to meet the D-2 requirements by 2024.

To meet the deadline, shipowners are rushing to retrofit existing vessels. An estimated 4,500 ships will need to be equipped with a BWMS each year. Among the solutions approved by the IMO and USCG to eliminate microorganisms, there are three main technologies:

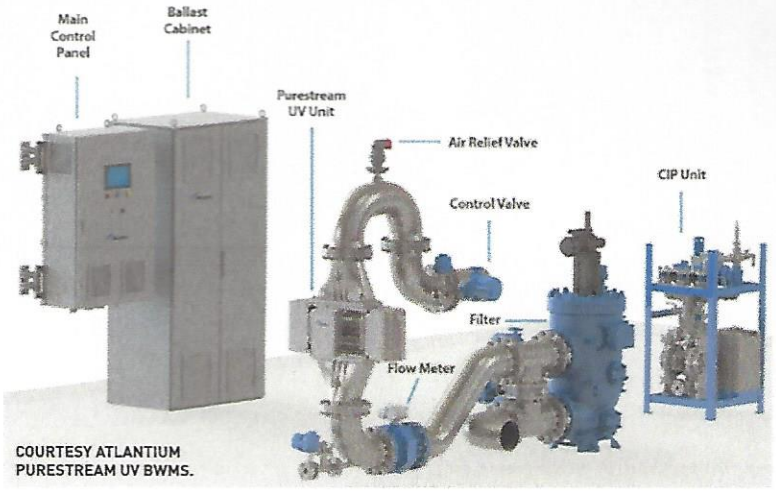
- Ultraviolent (UV) light, which uses high-energy electromagnetic radiation to sterilize the water;
- Electrochlorination, which combines salt water and electricity to produce microbe-killing chlorine, and Chemical injection.
- UV and electrochlorination are the most widely adopted methods, yet for very large vessels chemical injection offers certain benefits. The appropriateness of each solution depends on a number of variables.

UV TECHNOLOGY

One exciting UV-based BWMS on the market is Atlantium's Purestream™ system, which uses medium-pressure UV technology and a unique approach to effectively operate even under poor water quality conditions.

Whereas most systems treat water once while taking it into the ballast tanks and then again while discharging it, Purestream can treat water in just one pass – when it takes water in. It can also operate in difficult conditions, specifically at minimum retention times and even when UV transmittance – an indicator of overall water quality, referring to the percentage of UV light that passes through the water – is as low at 40 percent.

Atlantium's Chief Technology Officer, Ytzhak Rozenberg, says, "We're able to treat the worst water conditions compared to other solutions in the market." So far, the system has been awarded approval from the IMO for two passes for all water types (sea, fresh and brack-



COURTESY ATLANTIUM PURESTREAM UV BWMS.

ish) and one-pass treatment of seawater. It's awaiting IMO approval for one-pass use on freshwater and brackish water as well as for USCG approval.

While Atlantium may be a relative newcomer to the world of ballast water management, its solutions have already been proven onshore. "Part of our traditional market is associated with the same issues and organisms that are under the maritime regulations," Rozenberg explains, "meaning we have installations on land to deal with aquatic invasive species."

Atlantium's UV solutions have been chosen by federal agencies to protect hydroelectric plants in the U.S. from zebra and other mussels – a situation where, as Rozenberg notes, "You need to make sure that 100 percent of the mussels will be eliminated and not transferred from one place to another."

Atlantium's onshore experience puts the company in a strong position to offer innovative water biosecurity solutions to the maritime industry as it faces more stringent regulations.

ELECTROCHLORINATION SOLUTIONS

Electrochlorination, typically combined with filtration, is appealing to shipowners looking to reduce the footprint of their BWMS while also reducing power needs, although UV solutions have lately been competing more on these same parameters.

China's Headway Technology holds a patent for an electrochlorination method called electro-catalytic oxidation. The company's OceanGuard BWMS, which has received approval from the IMO, USCG and even more stringent California regulators, consumes relatively small amounts of power, requiring 17kW to treat 1,000 m3 of ballast water. One unit can treat up to 4000 m3/hour while larger volumes can be treated by using multiple units in parallel.

Coming from China, which has emerged from the pandemic stronger than most other countries, endows OceanGuard with another advantage. Zhiqiang Qiao, Headway's Marketing Manager and Team Leader of American, African & European Markets, says, "Headway performed very well even during COVID-19 because of its complete industrial chain – short delivery time for filters along with independent spare parts and services that do not rely on third parties."

Greece's Erma First is also pioneering electrochlorination solutions. Its First Fit BWMS is popular among buyers seeking to shrink their carbon footprint.

Konstantinos Stampedakis, Managing Director, explains, "With low power consumption and no need to operate the main system when deballasting, the First Fit system delivers reduced operating costs. Based on electro-chlorination technology and filtration, we're one of a small range of manufacturers able to supply a USCG- and IMO-compliant system that allows for the same operational mode in all waters."

First Fit also has a 5000-hour system warranty, which is relatively unique among manufacturers.

Stampedakis is confident the company will fulfill all orders on time and on budget. Yet he cautions, "Erma First urges shipowners to maintain focus on early project decisions to allow for design and planning of retrofits and avoid a mad rush in delivering services and equipment."

CHEMICAL INJECTION SYSTEMS

While injection technology represents a minority of BWMSs, the solution can be useful for ships whose routes take them through turbid waters (where it might be harder to use UV) or freshwater (where it might be challenging to obtain the correct salt content needed for electrochlorination).

It can also be ideal for very large vessels. With UV and electrochlorination systems, the larger a ship gets, the more bulbs and electricity – respectively – are required. In contrast, dosing systems don't change much in size as a vessel scales up.

That's one reason why products offered by companies like U.S.-based Echochlor have proven very popular with VLCCs, Suezmaxes, and Capesize bulkers. Their BWMSs rely on chlorine dioxide (ClO_2) to treat ballast in a single pass at uptake – the only such system so far approved by the USCG.

Echochlor CEO Steve Candito explains, "It's a much more environmentally friendly disinfectant that only interacts with organic matter, like the zebra mussel and crabs that can be invasive. Chlorine can interact with anything in the water, even nonorganic matter, which can create byproducts that can be harmful not only to the environment but to people, too, by forming cancer-causing agents."

Candito adds that an increasing number of shipowners are turning to Echlochlor's easy-to-use system after realizing the difficulties of using other options. He recalls, "I brought a customer in and let him push the buttons. After we did that for a few minutes, he said, 'What's next?' That's really the beauty of the Echlochor product. It's very easy to use, reliable and environmentally friendly."

WHAT'S NEXT?

Adhering to IMO and USCG standards will not come cheaply. But hopefully it will lessen the number of invasive species transported via the world's waterways and save the global economy billions of dollars in the long run.

Nevertheless, policy and operational challenges lie ahead. Candito notes the potential for the U.S. EPA's Vessel Incidental Discharge Act, which opened for comment at the end of 2020, to

mandate operations that might not be entirely feasible, such as requiring both the treating and exchanging of ballast water.

Speaking in a broader sense, Erma First's Stampedakis says, "The patchwork of requirements introduces an undesirable complexity that could have significant impact on regulatory implementation. Severe confusion will ensue due to lack of Port State Control procedures for ballast water discharges unless the IMO addresses these requirements in time."

Clear seas require clear legislation too.

MarEx

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