Technical Meeting — 24 February 2021

Asif Ghauri, National Manager—Marine and Diesel, Alfa Laval Australia, gave a presentation on *Ballast Water Treatment: Challenges, Solutions and Operations* as a webinar hosted by RINA using the Zoom software platform with the Secretary of the ACT & NSW Branch of the IMarEST, Geoffrey Fawcett, as MC on 24 February. This presentation attracted 23 participating on the evening.

Introduction

Asif began his presentation with a short introduction to Alfa Laval, a leading global provider of specialised products and engineered solutions. They have 39 production units plus a number of minor production and assembly units, more than 100 service centres, sales companies in 55 countries and other sales representation in 45 countries. They have been operating in Australia for over 95 years.

Over 100 years ago, in 1917, the US Navy asked Alfa Laval to develop a centrifugal oil-cleaning separator, which was delivered later that year and kick-started the growth of the company.

Alfa Laval has been a pioneer in ballast water treatment systems since 2003. They have achieved compliance in all waters, and type approval with all major classification societies and the US Coast Guard. Their PureBallast system has seen more than 6000 systems sold with more than 3000 retrofit installations.

In all, Alfa Laval now has 17 product groups for ship installations, including oily waste treatment, ballast water treatment, inert gas systems, gas combustion, cargo pumping, tank cleaning, oil treatment, filtration, fuel conditioning, crankcase gas cleaning, exhaust gas cleaning, EGR water cleaning, waster heat recovery, steam and heat generation, thermal fluid heating, cooling and heating, and desalination.

Ballast Water Treatment

The United Nations recognizes the spread of aquatic invasive species as one of the four greatest threats to the world's oceans. That is why the IMO Ballast Water Convention has been in force since 8 September 2017. This convention applies globally (signed up to by 86 flag states covering 91% of world gross tonnage), and there are now some 70 type-approved systems.

In addition, a shipowner or ship operator who intends to deballast within US Waters must also have a US Coast Guard-compliant BWTS latest before the vessel's compliance date. This is a stricter requirement, and has been in force since December 2013. There are now 17 USCG type-approved systems, including Alfa Laval's PureBallast which received approval on 23 December 2016.

In addition to IMO and USCG type approvals, Alfa Laval's PureBallast 3 system also has revised IMO G8 certification for zero-day holding time in all water salinities.

IMO Ballast Water Treatment Convention

The IMO Ballast Water Treatment Convention was ratified by 86 flag states and 91 % of world gross tonnage, coming into force on 8 September 2017.

Under the convention, new vessels should be equipped with a BWMS at delivery. Existing vessels should install a BWTS over a 5 years period between 2019 and 2024. Revised G8 test guidelines have been in force since October 2020. The MEPC 75 Committee has approved revised guidance for the commissioning and testing of ballast water management systems, and these amendments are expected to enter into force on 1 June 2022. Operational experience, and sampling and analysis will be in focus now under the experience-building phase.

USCG/EPA Regulations

The US Coast Guard/Environmental Protection Agency regulations have been in force since December 2013, but several extensions have been issued. There are now some 30 type-approved systems. The old 2013 Vessel General Permit will be substituted by the VIDA act (Vessel Incidental Discharge Standards Act). The aim of the US authorities has been to introduce national standards and not to regulate waterways on a state-by-state basis. States though have a say, and e.g. California and Great Lakes states gain some provisions for stricter regulations in the national standard. The act calls for approval of the MPN method [*Most Probable Number method is a method used to estimate the concentration of viable microorganisms in a sample* — Ed.] by IMO. This approval by IMO of the MPN method is way overdue!

Water Characteristics

For treatment of ballast water, the three primary characteristics to keep in mind are the salinity, temperature and ultra-violet (UV) transmittance.

Salinity

Electro-chlorination (EC) systems require high-salinity water. Most ports are exposed to river run-off, which means that their average salinity levels are generally lower. In order to be effective in brackish or fresh water,

EC systems require the addition of salt or high-salinity water, which must be stored on board, in order to be effective. UV systems are not dependent on water salinity.

Temperature
Optimal water temperature for the operation of EC systems is above 15°C, with normal low-end temperatures in the range of 10–17°C. Water below 10°C significantly reduces the formation of chlorine, and colder seawater therefore needs preheating in order for the system to perform effectively and ensure compliance.

Ultra-violet Transmittance
UV transmittance is the main parameter for UV systems. It is important to know the UV-T value of the water which will be treated. UV-T levels in harbors usually range from 90% down to 60%, but can sometimes fall to 50% or below. When UV-T is low, more UV power is needed to treat the water in order to meet the discharge standards. High UV-T is from clear water, low UV-T is from poor-quality water.

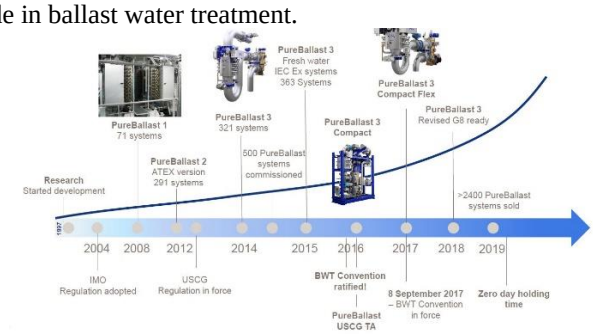
Ballast Water Treatment Technologies
The three main technologies for treatment of ballast water include electro-chlorination, chemical dosing, and ultra-violet (UV) treatment.

Electro-chlorination
Electrolysis of sea water forms chlorine and hydrogen gas. Chlorine gas dissolved in the water produces sodium hypochlorite (NaOCl), which is a disinfectant. In fresh water, power consumption is significantly increased. Hydrogen traps, flame arrestors or other methods are required to safely handle the formed hydrogen gas. This method allows for ballasting treatment, but a deballasting operation requires neutralisation, for which neutralisation chemicals are also required, posing added risks to the crew and the environment. Cleaning of the electrodes requires acid wash or other external electrode-cleaning methods. A big disadvantage of the method is that often the holding time exceeds 24 h.
Efficiency varies according to the conditions of the water, such as pH, salinity and temperature. The process may affect the corrosion rate negatively for plain and stainless steels, and shorten the expected lifetime for polymers.
The IMO regulation does not permit the concentration of Total Residual Oxidants (TRO) to exceed 0.2 ppm (mg/L) in the discharge water.

Chemical Dosing
Chemicals from a tank are mixed with the ballast flow, and the most-common system is chlorine dosing using approximately 1–10 ppm (mg/L). The chlorine level is neutralised prior to discharge, i.e. neutralisation chemicals and monitoring are required. There is the potential for corrosion of plain and stainless steels. Chemical handling and the environmental impact must be considered. A holding time, typically 24 h or more, is required for the chemicals to work.

Ultra-violet Treatment
There are no hazardous chemicals, it is easy to operate, easy to install, has low maintenance costs, and is a safe and effective treatment method. However, it usually has higher power consumption than electrolysis.

Alfa Laval's PureBallast System
Alfa Laval's PureBallast system is equipped with medium-pressure UV lamps. These have very high output, typically 50 times higher output than low-pressure lamps, compared to lamp-length, making them very effective. The PureBallast system is type approved by all major class societies (e.g. DNV, Lloyd's Register, ABS etc.) and the US Coast Guard and, in addition, meets IMO's revised G8 standard.
Alfa Laval has over a decade in ballast water treatment.



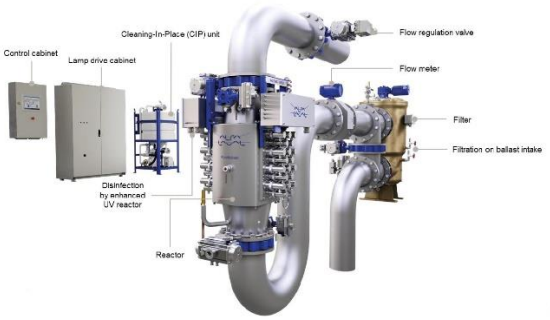
Alfa Laval's experience in ballast water treatment
(Image courtesy Alfa Laval)

Alfa Laval's PureBallast family of capacities
(Image courtesy Alfa Laval)

The reactor design has been optimised through research and real-life experience. It is highly-resistant to corrosion and uses SMO254, a high-alloy austenitic stainless steel which has been specially developed for sea-ware applications and has significantly-higher corrosion resistance than 316L stainless steel. It is available in Standard, Compact, Compact Flex, Explosion-proof and Deckhouse configurations.

Alfa Laval's PureBallast 3 family
(Image courtesy Alfa Laval)

PureBallast 3 Standard



PureBallast 3 Standard
(Image courtesy Alfa Laval)

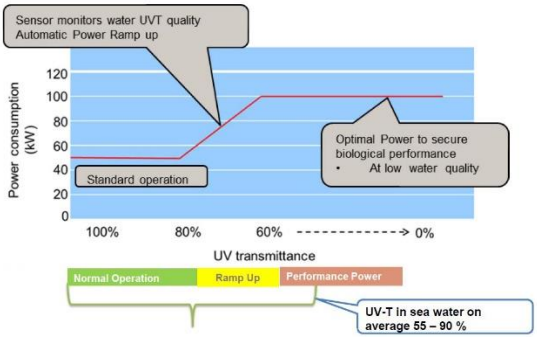
PureBallast 3 Compact

The Compact version has a smaller footprint to meet installation challenges, and comes either skid-mounted or with loose components. It boasts market-leading disinfection performance, and the best functionality in varying water conditions: three-water compliant and down to 42% UV-T in IMO mode. There is reduced power consumption through UV-dosage control. Available flow rates are from 85 to 300 m^3/h. The compact version is simpler to retrofit on existing vessels.

PureBallast 3 Compact
(Image courtesy Alfa Laval)

PureBallast 3 Compact Flex
The Compact Flex version addresses the specific challenges associated with retrofits on existing vessels, i.e. space and flexibility. The system is delivered as loose components, but all are plug-and-play, reducing installation cost and time. This has up to 20% reduced footprint compared to PureBallast 3 Standard, but builds on the successful design of PureBallast 3 Compact and has the same market-leading performance as the PureBallast 3 family. Available flow rates are from 85 to 1000 m^3/h.

Power Consumption
The power consumption depends on the UV transmittance of the water, ramping up significantly when the UV-T falls below 80%. In sea water, on average the UV-T is between 90 and 55%.



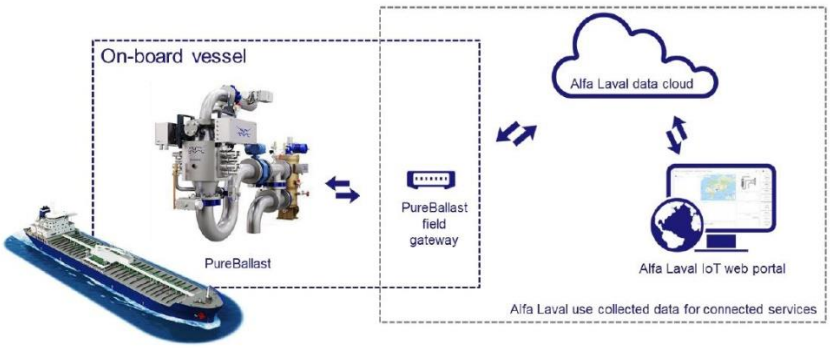
PureBallast 3 power consumption
(Image courtesy Alfa Laval)

Retrofit Process
Alfa Laval has a global pool of engineering partners and these assist customers during the design and engineering-review phases. They then provide ongoing assistance, pre-installation checks, installation checks, commissioning and training, after-sales support, compliance service packages, and international marine service. The compliance service packages are currently available in four ports around the world and, from March 2021, will also be available in Australia.

Alfa Laval's Retrofit Experience
Alfa Laval has over 6000 systems sold worldwide, with more than 3000 of these being retrofit systems installed. Their policy is that "No customer is the same, no ship is the same, and no project is the same".
In Australia, systems have been sold to the Royal Australian Navy (12 systems, including HMA Ships *Choules*, *Canberra* and *Adelaide*), Sea Swift, Inco Ships and Teekay Shipping (Australia).

Lessons Learned from Retrofits
It pays dividends to invest time in the very beginning to set up the project team. Similarly, involve a professional engineering company to do the engineering design review with respect to location and integration. Plan the project well ahead and minimise changes in the scope of supply which affects delivery time. Good preparation is the key to success. Installation supervision is crucial for successful installation. Commissioning and training must be provided. It is always better dealing directly with the OEM (original equipment manufacturer) rather than a sales agent.

PureBallast Connect
Alfa Laval can also supply remote monitoring of the system as an option.



PureBallast Connect for remote monitoring of the system
(Image courtesy Alfa Laval)

Critical Success Factors

Choice of the most-suitable system for a vessel requires careful evaluation and analysis of the operating routines, i.e. voyage duration, operating route, water salinity, etc. Based on operating routes, beware of water salinities in ports as some systems require a minimum holding time, thus restricting the vessel's operation. Early planning and formation of the project team involving all the key partners, including the vessel's crew, is critical for retrofits. Consider ease of operation and maintenance, as this impacts on the crew workload. Be mindful that, for ongoing compliance, the supplier must have good after-sales and service back-up in the regions where the vessel operates.

Conclusion

Alfa Laval has been in the ballast water treatment business for a decade now. Their PureBallast UV treatment system has achieved compliance in all waters, and type approval with all major classification societies and the US Coast Guard. They have many systems installed worldwide, both new and retrofits, and the experience and after-sales service to back it all up.

Questions

Question time elicited some more interesting points.

The PureBallast system applies to the flow of the incoming ballasting or outgoing deballasting water; there is no holding time outside of the USA. In the USA, Alfa Laval PureBallast 3 was awarded an updated certificate from the USCG on 4 April 2019, granting the system type approval with zero-day holding time in all water salinities. PureBallast 3 owners in USA waters now have the option of discharging ballast water just 2.5 hours after taking it on. The holding time of 2.5 hours, which is due solely to a technical testing procedure, is only applicable if the vessel crosses over into another Captain of the Port Zone within this very short time.

The annual compliance certification is an IMO requirement placed on the OEM.

Other ballast water treatment systems can be affected by the temperature range of the water. The PureBallast system can operate in water up to 50ºC as sometimes (but rarely) occurs in the Persian Gulf.

With the system on split skids, there are limits on how far apart the components can be placed; e.g. there is a maximum distance between the reactor and the filter. The limits are spelled out in the *Design Guide.*

Remote monitoring can be retrofitted if required. The ongoing cost for monitoring is of the order of a few hundred euros per month.

The lifespan of the UV lamps is of the order of 3000 h. In CIP (clean-in-place) systems, the UV lamps are cleaned after each operation. However, single lamps can be replaced at any time if broken or faulty.

The certificate was subsequently posted to Asif, and the "thank you" bottle of wine delivered via an eGift card.

Asif's presentation was recorded, and is now available on the RINA YouTube channel.