



PureBallast

Ballast water treatment system



Alfa Laval's compact PureBallast system effectively neutralizes organisms in ballast water.

Application

When ships take on ballast, they take on more than water. Microscopic organisms, eggs, cysts and even the planktonic larvae of larger organisms are small enough to pass through the intakes and pumps.

If these organisms survive transport to other parts of the globe, their impact can be devastating. In seas that are weakened by overfishing and pollution, non-native species can reproduce quickly and deprive local species of food and living space. Such invasions can jeopardize local economies and even human health, and their effects are usually irreversible.

IMO has identified the introduction of species via ballast water as one of the four greatest threats to the world's oceans. In 2004, the organization adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments, which will phase in requirements for ballast water treatment over the coming years.

PureBallast from Alfa Laval

PureBallast is an easy-to-use ballast water treatment system that meets the new IMO requirements. Unlike many proposed systems, which rely on chemicals or are too large to implement in real life, PureBallast involves no environmental or operational compromises.

Using a unique, chemical-free technology, PureBallast produces radicals that neutralize organisms in ballast water. The process is effective, automated and self-contained, as well as harmless to the ballast tanks and crew. PureBallast is the first ballast water treatment system without chemicals to have received full Ballast Water Type Approval, having consistently demonstrated the necessary biological efficiency in land-based and onboard trials.

Since PureBallast is also remarkably compact, it can be installed even in cramped engine room conditions or in areas that are otherwise difficult to utilize. By combining space-saving design, chemical-free technology and full automation, PureBallast is the clear choice for both installation and operation.

Features and fits

- *IMO compliance*

PureBallast is an IMO-compliant system, having completed all of the necessary approval stages and received full Ballast Water Type Approval. These stages comprise land-based and onboard tests, as well as the two stages of Active Substance Approval.

- *Green operation*

PureBallast meets the requirements of IMO legislation without the addition or generation of chemicals, and without the creation of residuals. PureBallast was the first system to complete both stages of the Active Substance Approval process, thus proving that PureBallast poses no risk to the environment, the vessel or the crew.

- *Compact installation*

PureBallast is a modular system that allows compact and flexible installation. By fitting between existing pipes and utilizing the ballast pumps that are already installed, it can be adapted to the conditions that already exist on board. A single system can handle capacities from 250 m³/h to 2500 m³/h, and ships with larger requirements can be fit with duplicate systems.

- *Full integration*

PureBallast is completely integrated with the ship's ballast water system and does not interfere with existing ballast operations. No additional time is required for ballasting or deballasting, no route changes are needed, and there is no extra holding time in the tanks.

- *Easy, automated operation*

PureBallast is fully automated and easy to operate. The system starts and stops at the push of a button, continuously monitors the ballast water flow and can be operated via local or remote control. There are no chemicals to be stocked or handled by the crew.

- *Minimal maintenance*

PureBallast is chemical-free and has no moving parts, which means there are few consumables and no service hazards. Maintenance is minimized by a built-in automatic cleaning system, which ensures maximum performance at all times. These features also contribute to a low lifecycle cost.

- *Global support from a leading supplier*

PureBallast comes with the backing of a truly global supplier. Alfa Laval has a century of experience in serving the marine industry, as well as a worldwide network of harbour support. Technical support, onboard service and genuine spare parts can all be obtained at short notice.

IMO approval

PureBallast has received full Ballast Water Type Approval in accordance with the procedures established in IMO's International Convention for the Control and Management of Ships' Ballast Water and Sediments. These procedures are summarized to the right.

- *Active Substance Approval (G9)*

Active Substance Approval shows that a ballast water treatment system has no negative impact on the treated water, the vessel itself or the vessel's crew. Both a basic and a final approval are given.

PureBallast was the first treatment system to receive Active Substance Final Approval.

- *Approval of biological performance (G8)*

A ballast water treatment system's ability to meet IMO's biological efficiency standards is established in a two-phase testing programme. The first phase is conducted on land, while the second phase is conducted at sea under real-life operating conditions. Both of these phases are conducted at full scale.

- *Land-based tests*

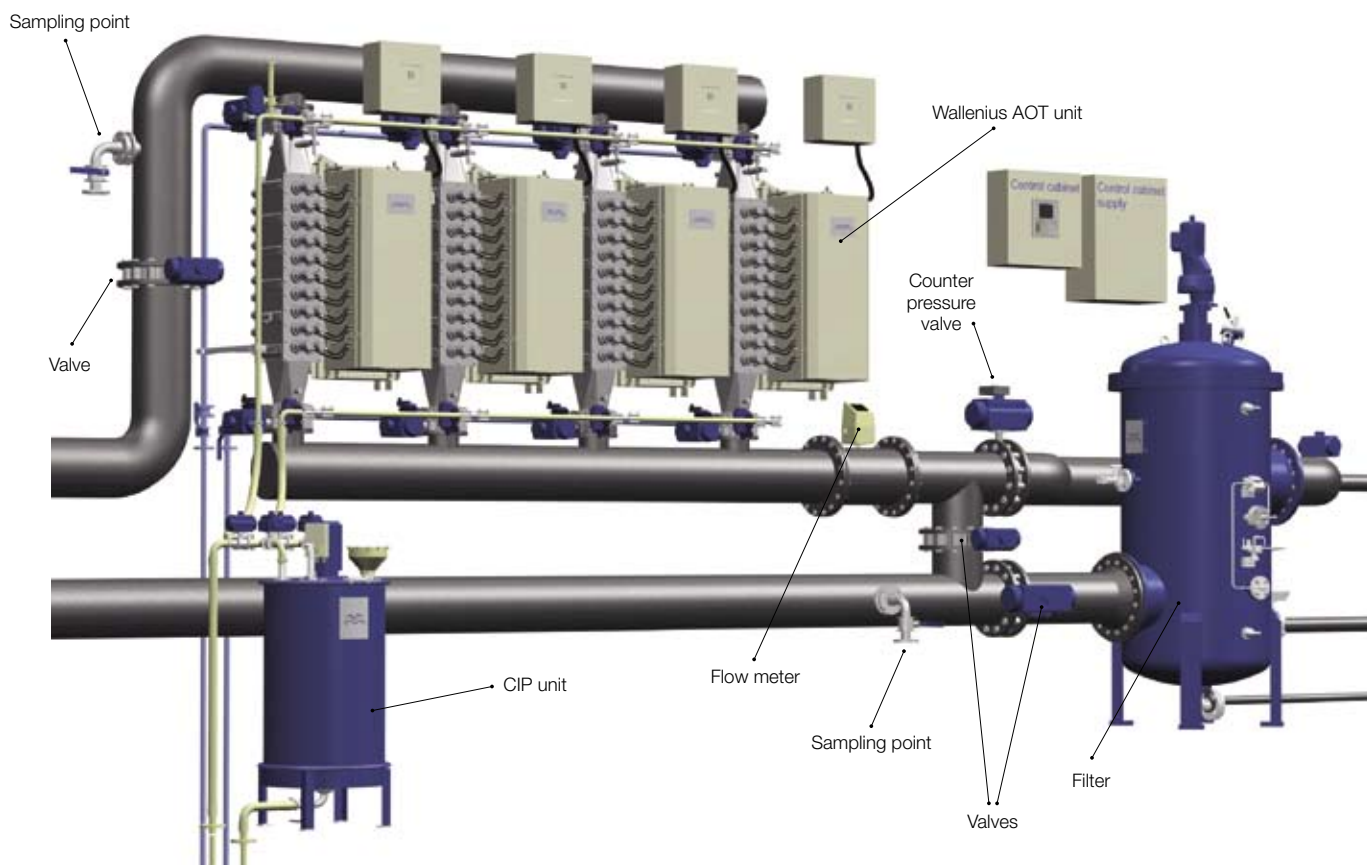
PureBallast successfully completed land-based tests that involved challenging conditions with extreme micro-organism levels and water of varying salinity and turbidity. Samples were taken and evaluated directly after treatment, but also after five days of storage in order to ensure that there was no regrowth of microorganisms. The system was tested at a scale of 250 m³/h.

- *Onboard tests*

PureBallast received full Ballast Water Type Approval after completing six months of testing at sea, during which its biological efficiency was demonstrated under actual operating conditions. The tests were conducted aboard an ocean-going car carrier vessel with a ballast water treatment capacity of 1000 m³/h.



PureBallast was issued a certificate of full Ballast Water Type Approval in June 2008.



System components

- *Filter*

A 50 µm filter is used during ballasting operations. (During deballasting, the filter is bypassed.) This not only blocks the intake of larger organisms, but also reduces the amount of sediment in the ballast water tanks. The filter is cleaned via automatic backflushing, which requires a system pressure of 2 bar between the outlet and the backflush discharge line. Only a small part of the system flow is used for backflushing, whereas the majority of the water continues through the ballast water system.

- *Wallenius AOT unit(s)*

Depending on the system flow rate, one or more Wallenius AOT units comprise the active stage of PureBallast treatment, in which generated radicals neutralize microorganisms and other organic matter. Flow rates of 250-2500 m³/h can be achieved, with individual AOT units handling a flow of 250 m³/h. The AOT units can be placed in a number of configurations, including the linear configuration shown above.

- *CIP unit*

Performance is safeguarded by an automatic Cleaning-in-Place (CIP) system, which circulates a cleaning solution to prevent seawater scaling within the AOT units. This solution is non-toxic and 100% biodegradable, which means it can be discharged overboard without safety or environmental pre

cautions. The cleaning cycle, which takes 15 minutes per AOT unit, occurs automatically after each ballasting or deballasting operation.

- *Flow meter*

A flow meter ensures that the PureBallast system does not exceed its certified flow rate. The meter also provides the main control system with valuable data regarding the amount of ballast that has been taken in or discharged.

- *Sampling points*

In accordance with IMO guidelines, sampling points are installed both before and after the PureBallast system. This allows for the removal of water and the evaluation of its quality.

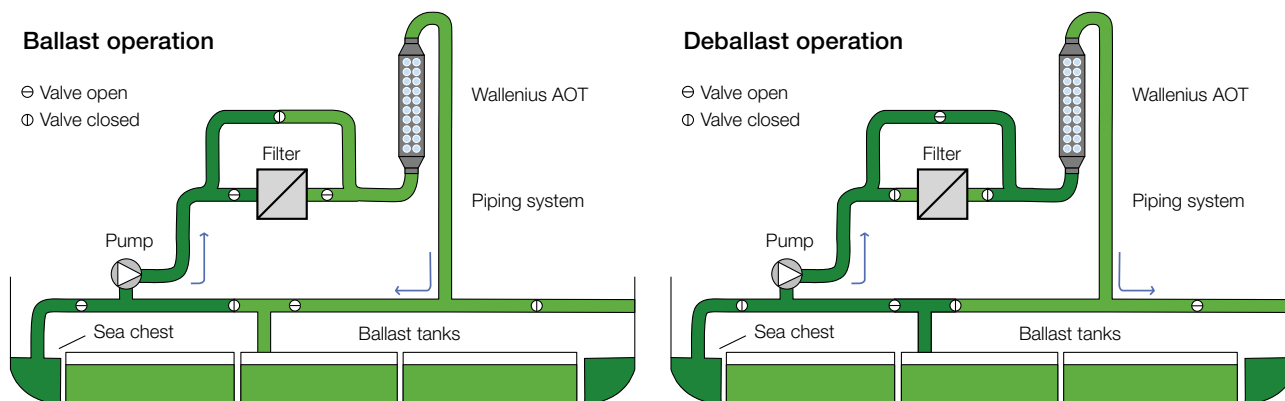
- *Valves*

A PureBallast system incorporates five main valves, which are supplied according to the dimensions of the connected pipework. In addition to one valve at the system inlet and one at the system outlet, there is a valve for bypassing the filter, a valve for bypassing the whole system, and a valve for controlling the system pressure over the filter (a Counter Pressure Valve, or CPV). The CPV automatically safeguards the system pressure between the outlet and the filter's backflush discharge line, ensuring a pressure difference of at least 2 bars.

Operating principle

Designed for start-and-forget operation, PureBallast is chemical-free, fully automated and possible to start or stop at the push of a button. A flow meter monitors the process flow to ensure that the certified rate is not exceeded.

Because PureBallast is fully integrated with the ship's ballast water system and does not depend on chemical reactions, it creates no delays during ballasting and deballasting. Its operating sequence is summarized below.



• *Ballasting*

In preparation for ballasting, the lamps of the Wallenius AOT units undergo a four-minute initialization process, during which they are cooled by a flow of seawater. During actual ballasting, fresh water is used to cool the systems' electronic components.

When ballasting begins, the incoming ballast water first passes through the filter, which removes organisms and particles larger than 50 μm . The water then continues through the Wallenius AOT units, which treat the water to IMO-established limits before it enters the ballast water tanks.

Once ballasting is complete, the AOT units are cleaned via an automated Cleaning-in-Place (CIP) cycle, which takes around 15 minutes per unit. This cycle can be automatically initiated directly after ballasting, or manually initiated from the control system within 30 hours. The AOT units are automatically rinsed with fresh water before the CIP cycle begins and filled with fresh water upon its completion.

The filter is also rinsed with fresh water once ballasting is completed.

• *Deballasting*

The deballasting process is essentially the same as the ballasting process. However, the filter is bypassed during deballasting since the water has already been filtered.

After leaving the ballast water tanks, the outgoing ballast water passes through the AOT units to eliminate any regrowth of microorganisms that may have occurred in transit. Having thus been treated to the limits set by IMO, it is then discharged into the receiving water at the deballasting site.

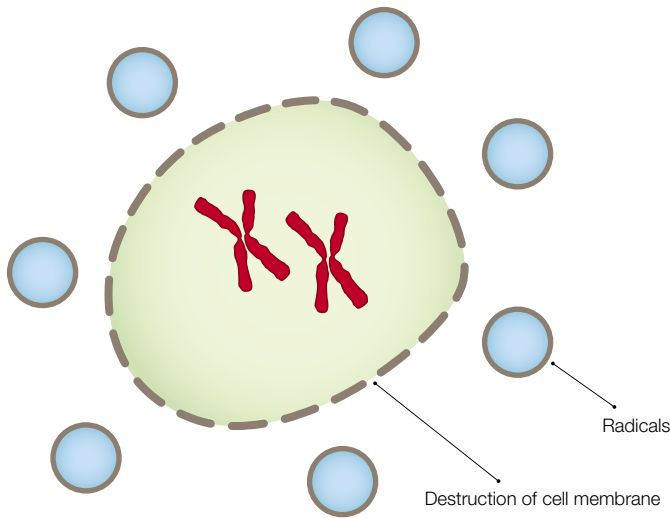
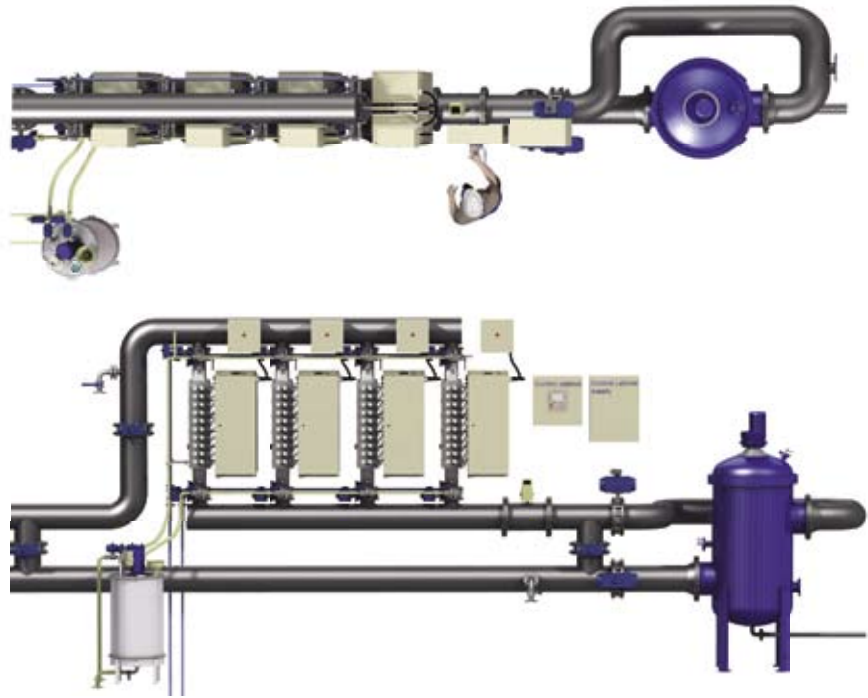
The same start-up and shut-down sequence is employed during both ballasting and deballasting (see left).

System layout

PureBallast is remarkable in its compactness and simplicity. The system's modular equipment fits easily into the engine room, thanks to a block-component structure that allows it to be installed between normal ballast water system components. This not only facilitates installation, but also simplifies day-to-day operations.

Because there are no moving parts and few consumables, the system can be maintained with minimum effort.

Flexible PureBallast components enable many layouts, including the one shown here.



Short-lived radicals break down microorganisms within a closed reaction chamber.

PureBallast treatment

The PureBallast treatment process is a patented form of advanced oxidation technology (AOT). Related technologies can be found in many of today's smart products, such as the self-cleaning windows of skyscrapers and cars, which prevent the growth of organisms through an AOT reaction that occurs when sunlight strikes titanium dioxide.

The PureBallast AOT process occurs within a closed chamber known as a Wallenius AOT unit, in which radicals

are generated. These radicals are highly reactive, so they instantaneously neutralize microorganisms and organic contaminants. However, the short-lived radicals exist for only a few milliseconds, which means they have no possibility of leaving the reaction chamber.

No chemical substances are required or generated by the AOT process, and no toxic residuals are created.



Operations

- Maintenance intervals:
 - Filter inspection once per year
 - Lamp replacement every 1500 hours
 - Catalyst replacement every 3000 hours
 - CIP fluid replacement when the pH value reaches 3, or monthly
- The System Manual provides detailed information in electronic or printed format:
 - Installation instructions
 - Operating instructions
 - Alarms and fault finding
 - Service and spare parts
- Service spares kits contain all necessary spare parts for each service and tips for maintenance checkpoints:
 - Lamp kit
 - Catalyst kit
 - Filter kit
- Commissioning and technical services are available from all Alfa Laval offices to start up the system and to provide advice about operation and maintenance.
- Onboard training for the crew is available upon request.

Optional equipment

- Remote control panels

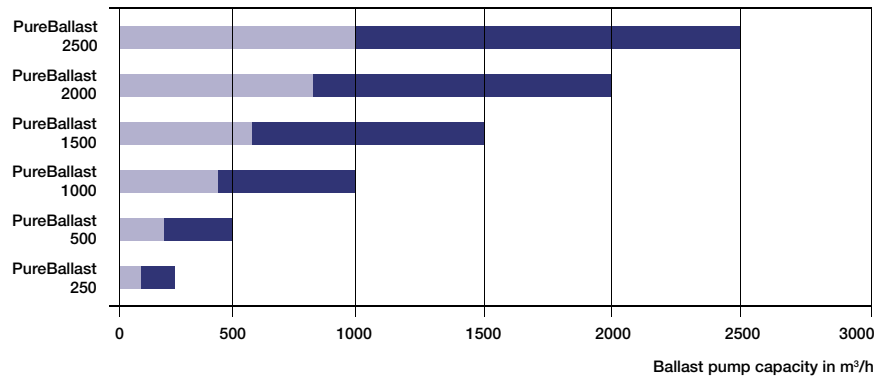
The main PureBallast control panel can be complemented with a maximum of four remote control panels per system. This allows PureBallast to be started, stopped and monitored from any location on board.
- Remote interface

This option allows hard-wired communication between the main PureBallast control panel and the vessel's general control system. If installed, PureBallast is run via a graphical user interface integrated into the vessel's control system.
- Drain Removal Kit

The Drain Removal Kit is an option for efficiently draining water from the Wallenius AOT units. The kit's primary components are a pump and a number of valves.

Capacity range

PureBallast's modular design accommodates a wide range of ballast water capacities, from 250 m³/h up to 2500 m³/h. One Wallenius AOT unit handles a system flow rate of 250 m³/h. For larger capacities, several AOT units are installed in parallel. One CIP unit is all that is needed for a PureBallast system up to 2500 m³/h. The size of the filter corresponds to the system flow rate.



Technical data for main components

| Component | Size (height × width × length) | Net weight |
|--------------------------------------|--------------------------------|------------|
| Wallenius AOT unit | 2 m × 0.8 m × 1 m | 730 kg |
| CIP | 1.7 m × 1 m × 1 m | 176 kg |
| Filter 250 m ³ /h | 2 m × 0.9 m × 0.9 m | 560 kg |
| Filter 500 m ³ /h | 2.6 m × 1 m × 1 m | 800 kg |
| Filter 750 m ³ /h | 2.6 m × 1.2 m × 1.2 m | 1200 kg |
| Filter 1000 m ³ /h | 2.8 m × 1.3 m × 1.3 m | 1400 kg |
| Filter 1250 + 1500 m ³ /h | 3.5 m × 1.4 m × 1.4 m | 2000 kg |
| Filter 1750 + 2000 m ³ /h | 3.6 m × 1.6 m × 1.6 m | 2300 kg |
| Filter 2250 + 2500 m ³ /h | 3.8 m × 1.8 m × 1.8 m | 2800 kg |
| Main supply voltage | 3-phase, 400 V up to 690 V | |
| Frequency | 50 or 60 Hz | |
| Component pressure drop | 0.8 bar | |
| Working pressure | Max 6 bar | |

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