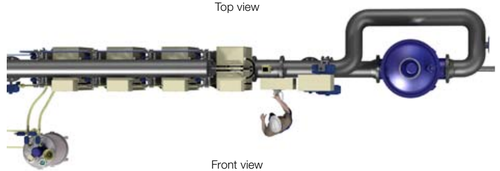
## System layout

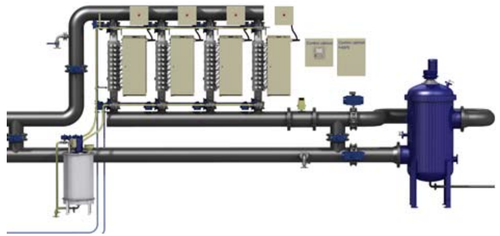
The PureBallast system is remarkable in its compactness and simplicity. The modular equipment fits easily into the engine room, thanks to a block-component structure that allows it to be installed between normal ballast water system components. This not only facilitates installation, but also simplifies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

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

Top view



Front view



## Features and benefits

- *Chemical-free technology*
  PureBallast meets the requirements of IMO legislation without the use of chemicals. This means its life cycle costs are low and there are no hazardous materials to be handled or stocked on board.

- *Space-saving design*
  PureBallast is a modular system allowing compact and flexible installation. The PureBallast components, which are small in themselves, are constructed to fit among the other parts of the ballast water system. With planning, they can actually be fit between existing pipes.

- *Easy, automated operation*
  PureBallast is fully automated and easy to handle. It starts and stops at the push of a button and can be operated via local or remote control.

- *Full integration*
  PureBallast is completely integrated with the ship's ballast water system. It causes no delays and does not interfere with ballast operations.

- *Minimal maintenance*
  Because PureBallast is chemical-free and has no moving parts, there are few consumables and no maintenance hazards. A built-in, automatic cleaning system ensures maximum performance at all times.

- *Sediment reduction*
  PureBallast features a 50-micron filter that both prevents the intake of larger organisms and reduces the build-up of sediment in the ballast water tanks.

*A Wallenius AOT unit, which forms the active stage of PureBallast treatment.*

- *Compliance with IMO*
  PureBallast provides results that comply with IMO ballast water treatment legislation. This has been established in both full-flow pilot tests and full-scale onboard trials.

- *Global support*
  PureBallast comes with the backing of a truly global supp lier. 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.

## Operations

- Maintenance intervals:
  - Filter inspection once per year
  - Lamp life of more than 1500 hours
  - Catalyst replacement every 6 years

- 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.

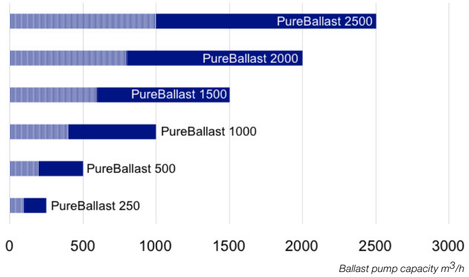
## Optional equipment

- *External control panels*
  One control unit is standard for the system. This can be complemented with additional control units in order to start, stop and monitor the sys tem from the bridge and/or control room.

- *Remote interface*
  This is a hard wiring interface in order to fully integrate PureBallast to the vessels control system.

## Capacities

The modular design of the PureBallast system accommodates a wide range of ballast water capacities, from 250 $m^3$/h up to 2500 $m^3$/h.




## Technical data

| PureBallast system | Size of AOT unit(s) (height x width x length) | Net weight |
|---|---|---|
| PureBallast 250 | 2m x 0.8m x 1m | 730 kg |
| PureBallast 500 | 2m x 0.8m x 2m | 1460 kg |
| PureBallast 1000 | 2m x 0.8m x 4m | 2920 kg |
| PureBallast 1500 | 2m x 0.8m x 6m | 4380 kg |
| PureBallast 2000 | 2m x 0.8m x 8m | 5840 kg |
| PureBallast 2500 | 2m x 0.8m x 10m | 7300 kg |

| | |
|---|---|
| Main supply voltage | 3-phase, 400 V - 440 V |
| Frequency | 50 or 60 Hz |
| Pressure drop | 0,8 bar |
| Working pressure | Max 6 bar |

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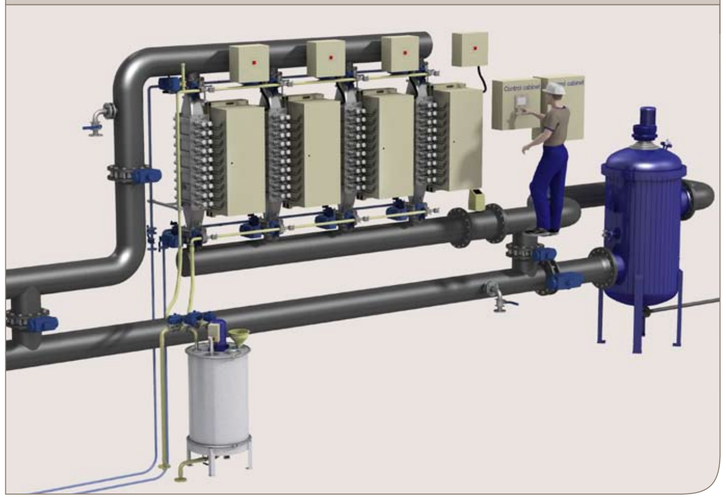
**How to contact Alfa Laval**
Contact details for all countries are continually updated on our web site.
Please visit **www.alfalaval.com** to access the information direct.

# 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, contaminants and pollution, non-native species can reproduce quickly and deprive local species of food and living space. Such invasions can jeopardize the health and economy of the local population, 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. In pilot tests, onboard trials and the initial stages of IMO certification, PureBallast has demon-strated the necessary biological efficiency.

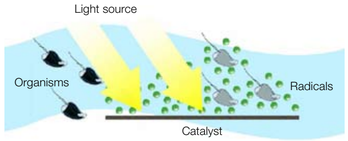
Since the system is also remarkably compact, it can be installed even in cramped engine room conditions or in areas that are otherwise difficult to utilize. By combining space-saving design, chemical-free technology and full automation, PureBallast is the clear choice for both installation and operation.

## Active mechanism

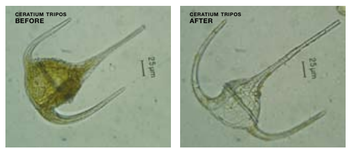
PureBallast is based on AOT (advanced oxidation technology), which is a chemical-free process similar to that used in many of today's "smart products". The self-cleaning windows of skyscrapers and cars, for example, prevent the growth of organisms through an AOT reaction that occurs when sunlight strikes titanium dioxide.

The PureBallast version of this technology, Wallenius AOT, has been specially developed by Alfa Laval in cooperation with Wallenius Water AB. Wallenius AOT is highly efficient with all types of water and is insensitive to water turbidity or salinity levels.

Depending on the ship's ballast water volume, a PureBallast system involves one or more Wallenius AOT units, which treat the water during ballasting and deballasting operations. These units contain titanium dioxide catalysts, which generate radicals when hit by light. The radicals, whose lifetime is only a few milliseconds, break down the cell membrane of microorganisms without the use of chemicals or the creation of harmful residuals.




*PureBallast treats organisms in ballast water with radicals, which are produced when light strikes titanium dioxide catalysts.*




*Radicals produced within the PureBallast system disrupt the cell membrane of microorganisms, such as the dinoflagellate pictured here. After passing through a Wallenius AOT unit, the dinoflagellate has lost its chlorophyll, making it unable to reproduce.*

## Regulatory compliance

To be approved by IMO, a ballast water treatment system must reduce the number of viable organisms in ballast water to a maximum number per unit of volume. Organisms larger than 50 microns must be reduced to 10 individuals per cubic metre, while organisms smaller than 50 microns must be reduced to just 10 individuals per millilitre. Even bacteria must be dealt with effectively.

PureBallast's ability to meet these requirements without the use of chemicals has been shown in both onboard trials and third-party pilot tests. The results presented here were obtained in 2006 by the Norwegian Institute for Water Research (NIVA) under the supervision of Det Norske Veritas (DNV).
The carefully scaled tests were performed at full flow and in accordance with IMO testing guidelines.

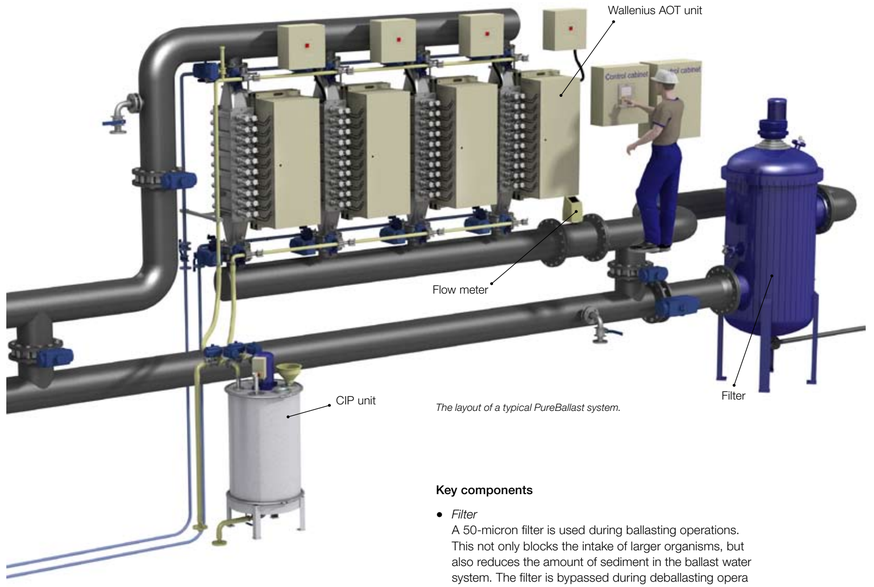
Additional tests, supervised by Stockholm University, have shown that PureBallast produces no residual compounds or toxicity. Alfa Laval's application for Active Substance Basic Approval was submitted in April 2006.

PureBallast has also undergone the first full-scale tests for type approval, achieving preliminary results as positive as those from the pilot tests.

**Full scale test results - ended April 2007**

| Organism type | Unit | Initial | Treated Day 0 | Treated Day 5 | IMO Req |
|---|---|---|---|---|---|
| Organisms > 50 µm | Ind/$m^3$ | 160 000 | 0,0 | 0,0 | 10 |
| Organisms ≥ 10-50 µm | Ind/ml | 1700 | 0,7 | 0,2 | 10 |
| E-coli bacteria | cfu/100 ml | 6070 | 0,0 | 0,0 | 250 |
| Entrococcus | cfu/100 ml | 337 | 9 | 0,0 | 250 |

*Key results of PureBallast performance tests conducted by NIVA (Norwegian Institute for Water Research) under the supervision of DNV.*




*The layout of a typical PureBallast system.*

## Key components

- *Filter*
  A 50-micron filter is used during ballasting operations. This not only blocks the intake of larger organisms, but also reduces the amount of sediment in the ballast water system. The filter is bypassed during deballasting opera tions, which prevents contamination through backflushing at the deballasting site.

- *Wallenius AOT unit(s)*
  A PureBallast system contains one or more Wallenius AOT units, depending on the volume of ballast water involved. These units comprise the active stage of treatment and can be combined to achieve flow rates of 250-5000 $m^3$. During ballasting and deballasting operations, the units produce radicals that treat ballast water by breaking down the cell membrane of microorganisms.

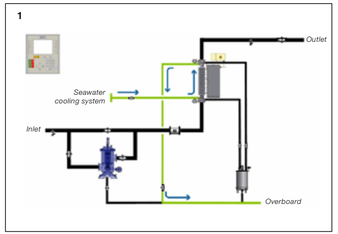
- *CIP unit*
  The performance of the Wallenius AOT units is safeguar ded by an automatic Cleaning-in-Place (CIP) system, which uses a biodegradable solution to prevent the build-up of seawater scaling. The cleaning cycle takes 15 minu tes per Wallenius AOT unit and is performed after each PureBallast operation.

- *Flow meter*
  A flow meter ensures that the flow within 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.

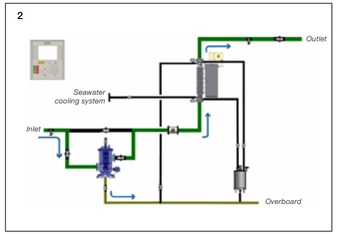
## Working principles

PureBallast is designed for start-and-forget operation.
The system is chemical-free, fully automated and possible to start or stop at the push of a button.

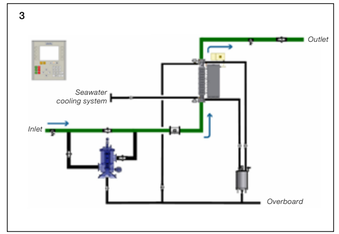
Because PureBallast is fully integrated with the ship's ballast water system and does not depend on chemical reactions, it creates no delays during ballasting and deballasting.
Its operating sequence can be summarized as follows:



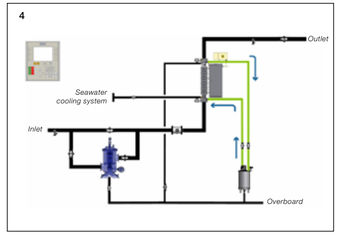

*1. Soft start*
Operation begins with a soft start, which serves two purposes. The soft start prevents pressure peaks that might damage lamps or other components, and allows the lamps to cool during their start-up period.




*2. Ballasting*
During ballasting, water passes through a 50µm filter to remove any larger particles or organisms. This helps reduce the amount of sediment build-up in the ballast water tanks. The water then continues to the Wallenius AOT units, which produce radicals that effectively break down organisms that have passed the filter. Any backflushing water is returned to the ocean directly at the ballasting site.




*3. Deballasting*
During deballasting, water passes the Wallenius AOT units a second time, neutralizing the water once again. The filter is bypassed at deballasting so as not to produce or discharge any backflushing water. This way there is no risk of contamination at the deballasting site.




*4. Cleaning-in-Place (CIP)*
After each operation, an automatic cleaning cycle takes place. During this cycle, the Cleaning-in-Place (CIP) unit circulates a biodegradable solution through the Wallenius AOT units to remove seawater scaling and ensure maximum performance. This process takes 15 minutes per Wallenius AOT unit.

## Automation and remote control

PureBallast's operation is fully automated. If the system is integrated into the ship's overall automation system, it can be controlled from the machine control room, the bridge or any other designated location on board. For truly remote control, it can even be handled via satellite units.

In all cases, PureBallast precisely logs starts, stops and other data in accordance with IMO guidelines. This makes it easy to act in accordance with the ship's ballast water management plan