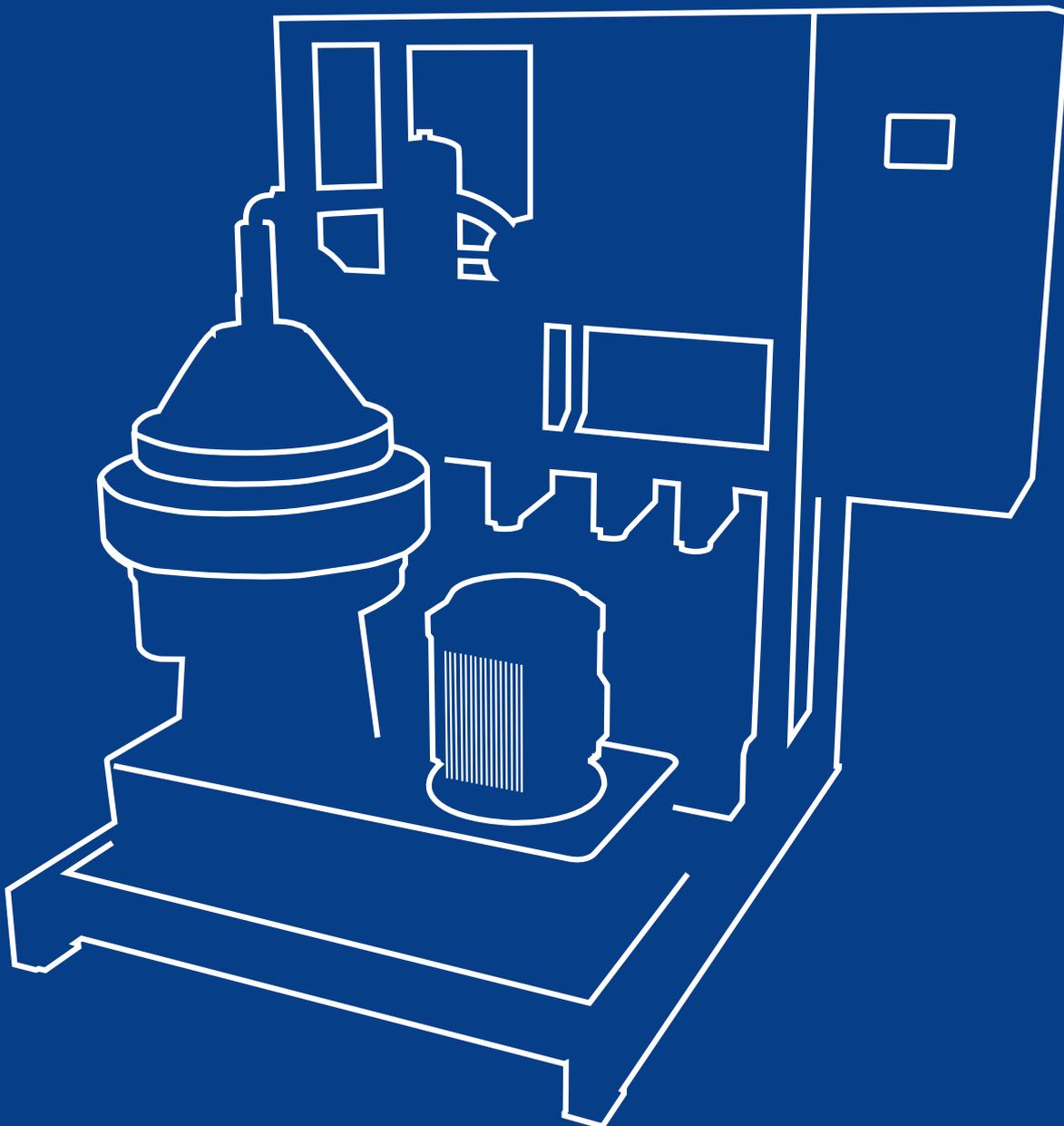




PureBilge

Technical information for bilge water treatment





Inside view

The PureBilge system from Alfa Laval is a reliable fully automated, single-stage centrifugal separation system to clean oily wastewater onboard vessels at sea and at land-based power plants.

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Summary

Bilge water must be treated to reduce the oil content to levels that meet international regulations for release into the environment. This is critical to keep the world's oceans and their vast marine ecosystems healthy and productive.

The Alfa Laval PureBilge system is a centrifugal separation system for bilge water treatment that is approved by the International Maritime Organization (IMO) and the U.S. Coast Guard.

This system is able to reduce the oil-in-water content of bilge water to less than 5 parts per million (ppm). It operates at flow rates of up to 5 000 liters per hour to handle even the toughest bilge water treatment applications.

As a major equipment and technology supplier to the marine industry, Alfa Laval understands the requirements of all treatment systems onboard vessels.

We use equipment and technology know-how to build solutions of the cost-effective and efficient operation of vessels – from engine room applications including oil treatment and fuel conditioning to waste disposal applications, including bilge water treatment.

Our aim is to work continuously to improve customer processes – time and time again.

This document provides technical information about the Alfa Laval PureBilge water treatment system. It includes information about the bilge water separation process, advances in system design, system benefits and a description of equipment.

Benefits for owners and operators

- *Reduced operating costs* thanks to low maintenance, automated control, minimal waste disposal, no use of chemicals or filters required as standard.
- *Reliable, always-available system.* Operates continuously without reduced performance regardless of variations in feed, oil shocks or rough weather conditions.
- *Easy to operate.* Automated control and monitoring system, the EPC 60 Bilge, which provides a user-friendly interface.
- *Safe operation.* A password switch can be set in manual or locked position to ensure that only the individual responsible for environmental compliance may authorize overboard discharge.
- *Flexible.* The modular design of PureBilge suits most shipowner requirements for performance, capacity, energy consumption, heating media and process security.

Benefits for designers of ships and power plants

- *Compact, modular, easy-to-install system* saves time, space and money.
- *Continuous, single-stage operation* requires less holding tank volume and provides more space for payload.
- *Easy integration* with existing communications systems.



Queen Mary 2 has two Alfa Laval centrifugal bilge water treatment systems onboard.

The Alfa Laval PureBilge system

Cleaning of bilge water poses distinct challenges. Not only does the composition and flow of bilge water constantly change, making continuous and efficient treatment difficult, but treatment onboard also presents another set of constraints.

Alfa Laval
PureBilge



Treatment methods must meet individual ship requirements and demands for safety, reliability, compactness, automation, low maintenance and the ability to withstand rough weather conditions. In addition, performance of the treatment system can vary depending on the oil content and the size of the droplets or particles present in the water and on various operating conditions.

Centrifugal separation has been used for decades onboard vessels due to its superior efficiency in cleaning liquids. The engine room crew is familiar with the operation and maintenance of centrifugal separators.

Now centrifugal separation for bilge water treatment has also proven to be the most efficient, reliable and flexible way to continuously remove oil and other contaminants suspended in the bilge water onboard ships and at landbased power plants. Centrifugal separation is not only the most efficient way to treat bilge water, but also provides the lowest operating cost.

Overview

The PureBilge system from Alfa Laval is a centrifugal separation system for treatment of large bilge water volumes at sea. PureBilge operates at flow rates up to 5,000 liters per hour.

PureBilge is easy to install. It does not require large bilge water holding tanks, which increases payload capacity. Compared to conventional bilge water systems, PureBilge significantly reduces operating costs because no chemicals or filters are required and maintenance requirements are low.

PureBilge enables cleaning of bilge water under a wide range of real operating conditions. It is certified according to the Marine Environment Protection Committee Resolution, MEPC 107(49), of the International Maritime Organization (IMO), MED 96/98/EC and USCG document 46 CFR 106.050. PureBilge has also proven its high level of performance under real operating conditions. It generally reduces the oil-in-water content of bilge water below 5 ppm – even when subjected to oil shock or rough weather.

System benefits

Compact, modular and flexible design

This provides great flexibility to install the unit in a convenient location. A wide range of options for functionality, remote control and other features adds greater flexibility.

Easy to install

This simple, plug-and-play installation of this factory-tested module makes installation simple. All pipe connections are located at the back of the module – making PureBilge easy to install.

Faster, more secure commissioning

Pre-tested, pre-installed and pre-approved components for all system functions make commissioning quick, easy and much less expensive than buying separate components and designing a bilge water treatment system.

Easy to operate

Automation and remote control make PureBilge a user-friendly, start-and-forget system.

More uptime, less maintenance

Maintenance-free components, automation and remote control increase operating time and decrease service disruptions. Durable components contribute to longer service intervals between inspections.

Lower installation and operating costs

Thanks to pre-testing, installation requires less time and money than installation of separate components. Automation and remote control reduce operating costs.

Technical support

All spares, service and sales engineers are available through the Alfa Laval International Service Network.

Technical data

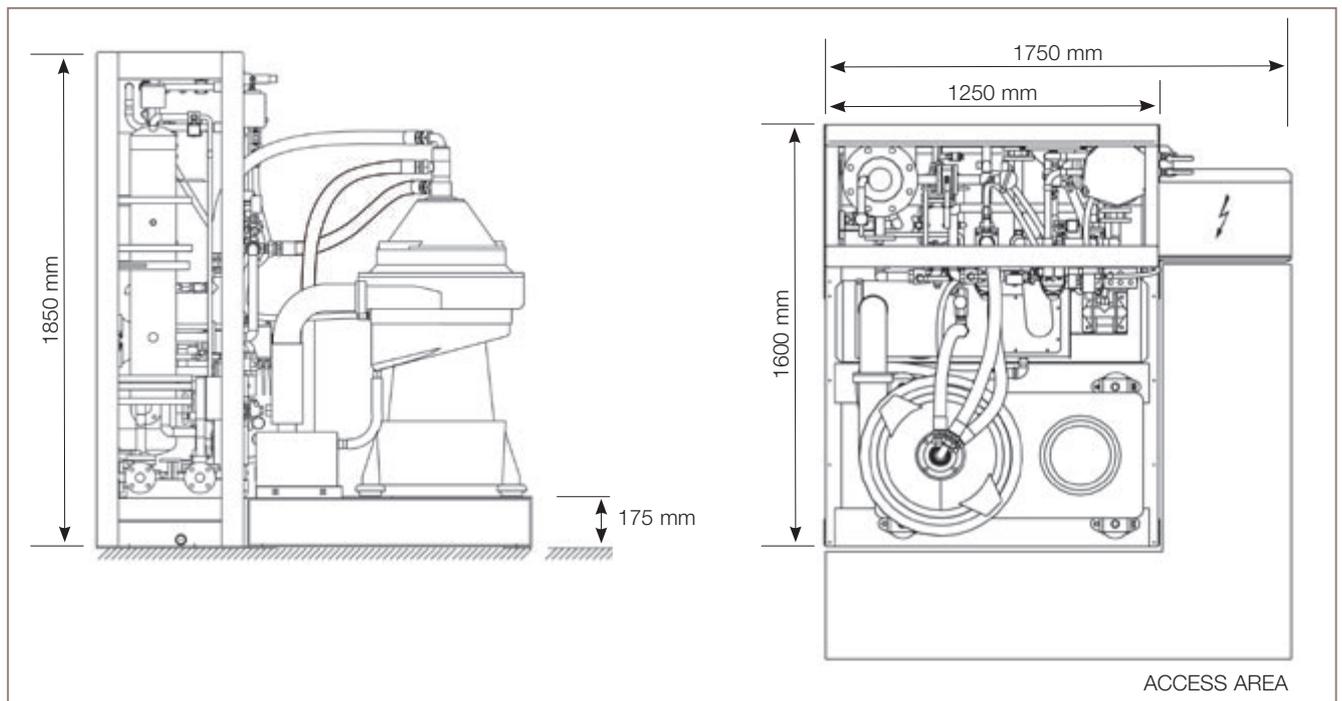
Power and connections

Supply voltage	Three-phase, 220V up to 690V	
Frequency	50/60 Hz	
Power consumption	12 kW	
Instrument air	G 1/2"	500–800 kPa
Operating water	G 3/4"	200–800 kPa
Cooling water	G 1/2"	200–800 kPa
Oil/water	DN 25	100–400 kPa
Steam	DN 25	700 kPa saturated
Thermal oil	DN 25	300–600 kPa, 220°C max

Net weight

Module complete	1 880 kg
Feed pump skid	150 kg
Dosing pumps skid (without liquid)	40 kg

Dimensions



Towards cleaner oceans

Bilge water generated onboard ships is a major environmental concern for the shipping industry.

Regardless of its source, bilge water must be treated to reduce the oil content to levels that meet international regulations for release into the environment. This is critical to keeping the world's oceans and their vast marine ecosystems healthy and productive.

Efficient bilge water treatment minimizes the impact of ship propulsion on the marine environment as well as the heavy fines that ship operators can face for pumping oily bilge water overboard.

Efficient treatment also reduces the need for and cost of waste disposal ashore. Over the years, waste disposal costs have continued to climb as local authorities enforce stricter laws for the land-based companies that process this waste.

Alfa Laval's bilge water treatment solution is superior to many competing technologies with respect to the volumes of waste generated.

What is bilge water?

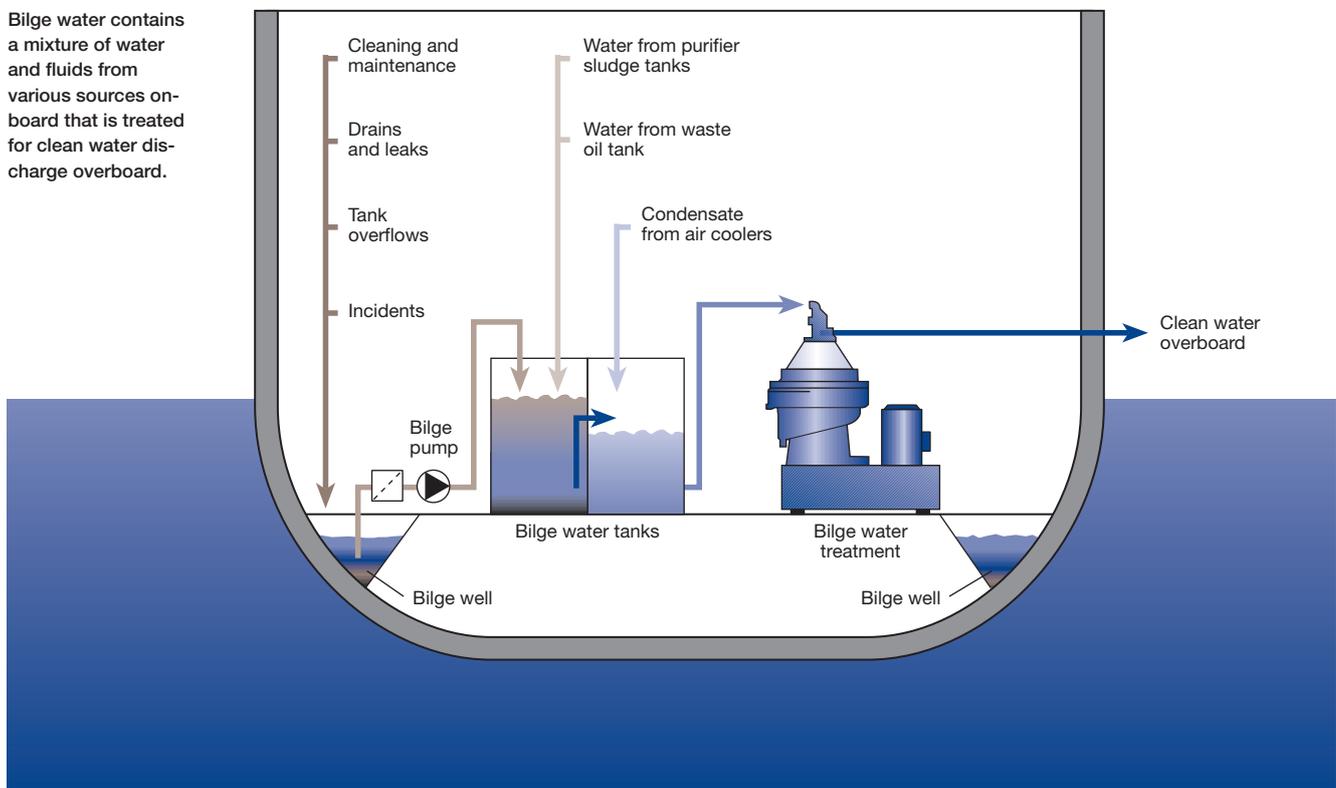
Bilge water collects in a ship's bilge wells, which are located in the lowermost part of the vessel just above the hull. The wells receive water and mechanical fluids from operational sources, such as technical rooms, propulsion systems and different machinery.

Bilge water also contains fluids from machinery spaces, internal drainage systems, sludge tanks and various other sources.

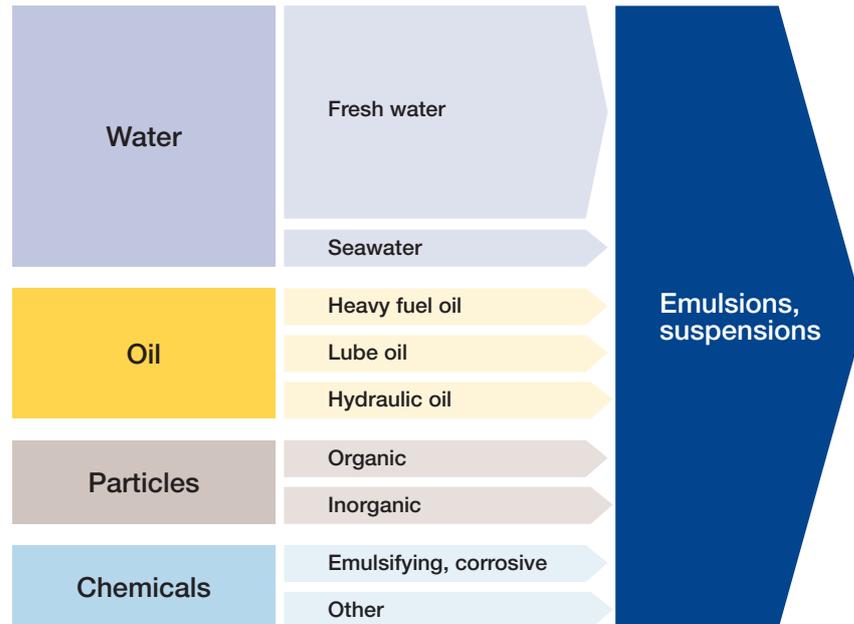
The definition of bilge water is thus much wider in scope than merely the contents of a ship's bilge, the enclosed area between the frames where the sides of the vessel curve in to form the bottom.

In simple terms, bilge water contains two types of sub-streams: (1) flows that are reasonably continuous and predictable, and (2) flows that are intermittent in nature and difficult to

Bilge water contains a mixture of water and fluids from various sources onboard that is treated for clean water discharge overboard.



Bilge water composition.



foresee. The first category includes water from the separator sludge tank and water from cleaning activities in the ship's engine room. The second category may include soot water, leakage and incident spills from tanks and machinery spaces.

Bilge water is thus composed of a mixture of water, detergents and other chemicals, fuel oil, lubricating oil, hydraulic oil, cat fines, oil additives, soot and dirt. This mixture is collected in the bilge water holding tank, which generally is maintained at an elevated temperature. This high temperature facilitates primary gravity separation, preferably of the two- or three-stage type, in the bilge water tank. Here, oil rises to the top and particles settle on the tank bottom, generally dividing bilge water into three distinct layers in the tank:

- **Top layer**

This contains most of the oil and organic solvents and constitutes a small portion of the total tank volume. Skimming this top layer for separate treatment is recommended.

- **Middle, or main, layer**

This aqueous phase contains water polluted by oil, chemicals and particles in emulsified form. This is fed to the bilge water treatment system.

- **Bottom layer**

This contains solids and heavy sludge, which should also be removed for separate treatment.

Bilge water legislation

Bilge water treatment is an environmental application that must meet stringent requirements of international legislation. Disposal of untreated bilge water into our oceans is strictly prohibited by international law and subject to heavy fines, especially in sensitive waters.

Current MARPOL legislation stipulates that separated bilge water containing 15 ppm or below oil in water can be disposed into international waters. Some national, regional and local authorities, especially those governing sensitive waters, have more stringent regulations. In the United States and in the Baltic and North Seas, for instance, disposal of separated bilge water is only permitted at least 12 nautical miles from shore.

The International Maritime Organization (IMO) resolution MEPC 107(49) specifies how to type approve equipment used onboard ships. The resolution complies with the European Marine Equipment Directive, MED 96/98/EC.

Many manufacturers have succeeded in meeting the specified requirements for equipment certification, but much of this static equipment falls short of delivering the high separation efficiency required under real operating conditions for bilge water discharge.

Stable emulsions in bilge water

Separation of oil and particles from bilge water is becoming increasingly challenging, due to the presence of stable emulsions and suspensions. Emulsion and suspension formation and stability are of major concern in the context of bilge water treatment.

What are emulsions and suspensions?

By definition, an emulsion is a mixture of two immiscible liquids. An oil-in-water emulsion consists of small oil droplets dispersed in a continuous water phase. A suspension is a mixture in which solid particles are dispersed in the continuous water phase.

Emulsions, or small droplets of one liquid (the dispersed phase), can form in the other liquid (the continuous phase) under agitation, such as during pumping or throttling in valves. Droplets of oil dispersed in water generally coalesce, or combine, into larger droplets because oil is not soluble in water.

Increasing the droplet size helps facilitate separation. The presence of surfactants, such as detergents, soaps and other surface-active compounds, however, may contribute to stabilization of small oil droplets. This makes separation very challenging. High centrifugal force is then required to separate the small droplets that do not spontaneously separate when subjected to gravitational force.

Emulsion stabilizers may consist of:

- *Low molecular weight surface-active compounds, or surfactants*, that reduce the surface tension of the oil-water interface and thereby create small droplets that contribute to emulsification.
- *Polymers and other macromolecules* form a film around the emulsion droplet to establish a physical barrier to coalescence and thereby stabilize emulsions further.
- *Fine particles* can accumulate and adsorb at the oil-water interface to form a physical barrier around the emulsion droplets.

Chemical usage aids stabilization

Emulsion stabilizers may originate from a variety of sources in the engine room – from the use of cleaning detergents, from lube oil additives and so on. Clearly, the use of chemical substances onboard is excessive.

Chemicals onboard are used for: cleaning and maintenance, treatment of water, improving fuel quality, and improving the quality of lubricating oil.

What used to be lubricating and hydraulic oils of relatively elemental composition, based on simple mineral oils, are now complex formulations, sometimes based on synthetic oils and incorporating a variety of additives.

Modern lubricating and hydraulic oils have a greater ability to take up water due to the action of detergents. Likewise, cleaning chemicals have a great ability for oil and dirt uptake.

Stabilizers may also occur naturally in the oil. These stabilizers concentrate at the oil-water interface and lower the interfacial tension, thus stabilizing the liquid mixture.

Some chemical residuals generally end up in a vessel's waste treatment system or holding tank. The bilge water treatment system, in particular, processes a heavy load of chemical residuals.

Chemical usage in the engine room inevitably causes the formation of stable emulsions and suspensions as well as some form of environmental impact. Most chemical manufacturers claim that their products do not stabilize emulsions in bilge water. But the use of surface-active chemicals make many products contribute to the formation of stable emulsions.

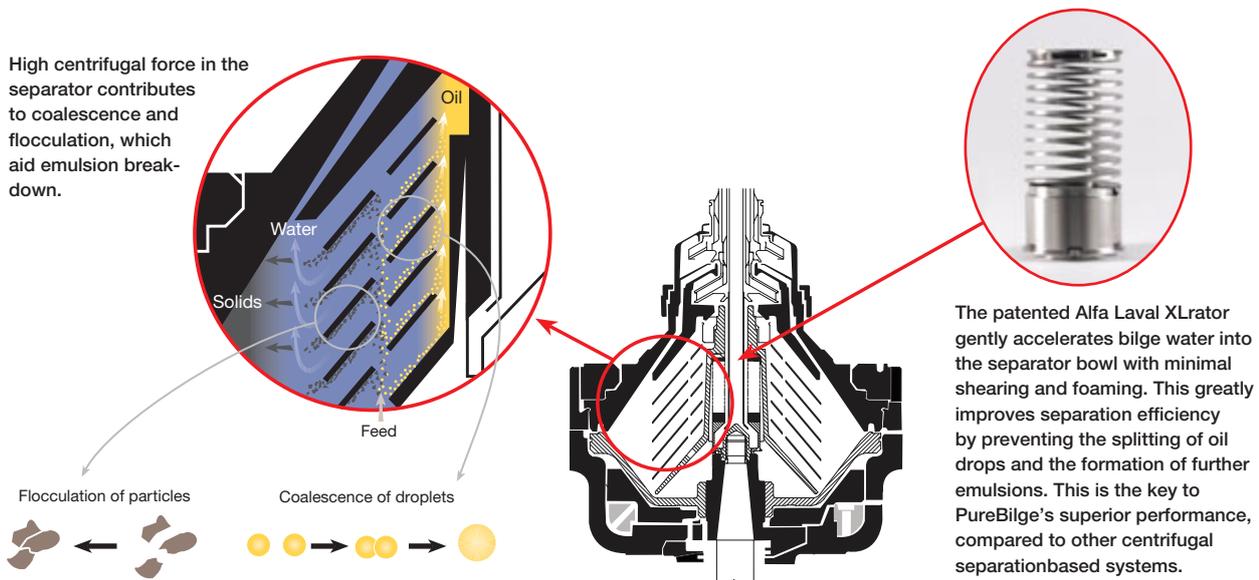
Usage of chemicals always causes some type of compromise between cleaning efficiency and separation efficiency on the one hand and environmental friendliness on the other.

Alfa Laval strongly recommends the use of quick-separating, environmentally friendly and non-toxic detergents. Choosing chemicals that are compatible, non-toxic, biodegradable and non-emulsifying, helps prevent problems downstream.

Effect on separation performance

The formation of stable emulsions and suspensions affects separation efficiency. Many conventional technologies fail to split stable emulsions and remove suspended colloidal particles from the water phase. This often results in equipment malfunction because separation of oil below 15 ppm is not achieved or because of clogging from excessive solids.

Understanding the factors that contribute to the formation and breakdown of stable emulsions is essential to understanding why centrifugal bilge water treatment systems can efficiently separate bilge water, despite a high concentration of stable emulsions.



Mechanisms for emulsion breakdown

There are different mechanisms for emulsion destabilization and breakdown, including coalescence and flocculation.

- **Coalescence** is a process where two or more droplets collide, resulting in the formation of one larger droplet.
 - A *high centrifugal force* induced in a centrifugal separator greatly contributes to the coalescence of small droplets.
 - *Elevated temperature* accelerates the rate of coalescence by increasing the probability of the droplets to collide and by decreasing the viscosity of the continuous phase.
 - *Chemical demulsifiers* decrease or cancel the repulsive electrostatic forces between droplets in an emulsion, causing droplet coalescence.
- **Flocculation** is a process by which two or more particles aggregate without losing their individual identities.
 - A *high centrifugal force* induced in a centrifugal separator greatly contributes to the flocculation of small particles.
 - A *high alkaline pH value* promotes flocculation. The pH value provides a measure on a scale from 0 to 14 of the acidity or alkalinity of a solution.
 - *Chemical flocculants* decrease or cancel the repulsive electrostatic forces between particles in a suspension, thus promoting flocculation.

What parameters affect separation efficiency?

Centrifugal separation relies on the difference in density among the various components present in emulsions or suspensions.

Stokes' Law (below) describes the settling velocity (v_g) of a particle or droplet when subjected to gravitational force, such as static settling in a tank, which in turn determines the separation efficiency. The general formula is:

$$v_g = \frac{d^2 (\rho_d - \rho_c)}{18 \mu_c} g$$

- v_g the sedimentation velocity due to gravity
- d the diameter of the dispersed droplet/particle
- ρ_d the density of the dispersed phase
- ρ_c the density of the continuous phase
- μ_c the viscosity of the continuous phase
- g the gravitational acceleration

The expression states that the greater the difference in density, the greater the efficiency. However, the density difference is not the most important parameter affecting the separation efficiency.

The sedimentation velocity increases exponentially with the droplet, or particle, size. This means that the smaller the droplet or particle, the more challenging the separation task.

For separation of small droplets and particles, which are found in the stable emulsions and suspensions in bilge water, gravity alone is not sufficient. In a centrifuge, the term (g) in the expression is replaced by (w^2r), the centrifugal force, which is several thousand times greater than the acceleration due to gravity. Therefore, even droplets and particles that are only a few micrometers in size can be efficiently separated.

Another important factor that has a positive effect on separation efficiency is low viscosity. The viscosity of the continuous phase affects sedimentation velocity, which increases in inverse proportion to the viscosity. Therefore, any medium with low viscosity, such as a continuous water phase, facilitates separation.

Equipment

Environmental protection requires reliability. This is how Alfa Laval has met the bilge water treatment challenge.

Capacities

PureBilge is available in two standard versions:

PureBilge 2515: 2 500 l/h, 15 ppm

PureBilge 5015: 5 000 l/h, 15 ppm

Operating principle

A feed pump with variable frequency drive control directs oily water from the bilge water settling tank or equivalent to the system.

Bilge water then passes through a strainer which traps large particles from the fluid before entering a heat exchanger, which raises the fluid temperature to required levels, generally between 60° and 70°C, for optimum separation efficiency.

A three-way changeover valve then directs the fluid to the separation stage if all process conditions, such as feed temperature, feed pressure and separator speed, fall within preset process values. If any process condition is not met, the valve re-circulates the fluid back to the bilge water settling tank.

A high-speed centrifugal separator continuously processes large volumes of bilge water. The oil outlet continuously discharges separated oil and emulsions. Solids that collect at the separator bowl periphery are discharged intermittently. Discharge occurs at preset intervals, which is generally set at 20 minutes, depending on the installation. Solids are then directed to a sludge, or waste oil, collecting tank.

A built-in water pump, or paring disc, continuously discharges separated bilge water through the clean water outlet. The destination of the separated bilge water depends upon its oil content, which is continuously monitored at an isokinetic sampling point by an oil-in-water monitor.

If oil content is below the pre-set ppm alarm limit (which can be set between 0-15 ppm), the separated bilge water can be pumped either directly overboard or to a 'clean' bilge water holding tank for discharge overboard later. If oil content exceeds the ppm alarm limit, the effluent is re-circulated, preferably to the cleanest part of the bilge water settling tank for re-processing.

Components in the system

Pump unit

The pump unit consists of a stand-alone compact pump module, which is designed for ease of installation and ease of accessibility for maintenance.

Thanks to its variable speed control, this progressive cavity pump easily handles variations in fluid capacities and enables adjustment of the feed rate setting during operation. The feed rate ranges between 1 000 to 2 500 or 1 000 to 5 000 liters per hour.

To protect the pump from dry running, the unit is equipped with a water-priming device, which is automatically activated upon startup. The pump has a pressure relief valve and a non-return valve on the discharge side.

Strainer

To trap large foreign particles suspended in the bilge water that may cause unnecessary operational disturbances, a strainer with a mesh size of 0.5 mm is installed as a safety measure.

Heat exchanger

The shell-and-tube heat exchanger uses steam or thermal oil as the heating medium. All heater parts that come into contact with the bilge water are made of a corrosion-resistant alloy. A proportional integral (PI) temperature controller accurately maintains the temperature set point within $\pm 2^{\circ}\text{C}$, even under variable bilge water feed conditions. This is especially important to achieve high separation efficiency.

Centrifugal separator

The BWPX 307 high-speed centrifuge utilizes the latest achievements in modern fluid dynamics technology. Designed for continuous, high-efficiency separation of large bilge water volumes, the centrifuge handles throughput capacities of up to 5,000 liters per hour. Its unique design provides reliable operations, even when subject to oil shocks and rough weather conditions.

The patented Alfa Laval XLrator inlet device gently accelerates bilge water into the separator bowl with minimal shearing and foaming. This greatly improves separation efficiency by preventing the splitting of drops and the formation of further emulsions.

The disc-stack design provides the maximum surface area possible for separation. Specially designed concentrator distribution holes and caulk configuration further optimize separation efficiency.

A speed sensor and an optional vibration sensor monitor the mechanical status of the separator.

Oil-in-water monitor

The in-line unit monitors the oil content of separated bilge water in compliance with IMO Resolution MEPC 107(49). It is capable of monitoring oil content from zero to 40 ppm at sample temperatures of up to 70°C.

To minimize response time, the isokinetic sampling point of the monitor is located as close as possible to the separation stage. Before processing occurs through the monitor, the sample passes through a cooler, which is used when separation temperature exceeds 70°C, to prevent damage to the monitor from excessive heat.

Two independent alarm circuits come with a factory setting of 15 ppm, but may be set independently to indicate oil content in water ranging from 0 to 15 ppm. Setting the alarm above 15 ppm is impossible.

Three-way changeover valves

Two pneumatically activated three-way changeover valves regulate bilge water at critical junctions. The first valve directs bilge water to the separation stage for treatment, and then re-circulates bilge water that does not meet pre-set conditions back to the bilge water settling tank. The second valve routes separated bilge water with oil content less than or equal to 15 ppm to a holding tank for discharge overboard later or pumps the water directly overboard.

During an alarm situation when any preset condition is not met, loss of operating air pressure or power failure, the three-way changeover valves automatically shift to re-circulation mode, thus making it fail-safe and preventing overboard discharge of any bilge water with oil content exceeding 15 ppm.

Constant pressure valve

This fast-acting, high-precision constant pressure modulating valve prevents the formation of air bubbles during the separation stage and thereby helps insure the accuracy of the oil-in-water monitor. It is installed after the separator.

Transmitters

Electronic transmitters provide accurate readings for pressure and temperature and improve control to achieve high separation efficiency.

Sampling cocks

Situated before and after the separation stage, these sampling cocks enable analysis of bilge water samples and provide an alternative way to measure the accuracy of the oil-in-water monitor.

CIP three-way valves

Two manual three-way valves are installed on the module to enable CIP (Cleaning In Place) of the entire system – heater, separator, piping and oil-in-water-monitor in series. CIP saves time and ensures top separation performance over time.

Control cabinet

The control cabinet monitors all PureBilge functions, and contains all electric power functions, such as a transformer, for power supplies in the range of 230 to 690V, all motor starters, pump unit speed control, power supply for all pneumatic control devices, as well as the Alfa Laval EPC 60 Bilge computer-based process controller and operator panel.



EPC 60 Bilge operator panel.

Operator panel

The EPC 60 Bilge is the latest generation of the Alfa Laval process controllers. Easy to operate, the unit provides fully automated advanced monitoring and control of all PureBilge functions.

The EPC 60 has a unique, self-adapting mode which ensures correct performance and minimum attendance from the operator. This is achieved by adapting the process flow and separation temperature to meet the required set point for the installation, for example, 2, 5 or 12 ppm.

In accordance with the *Oil Record Book* regulations, the EPC 60 has an internal process recorder that records all relevant data and alarms. This data is then stored for an 18-month period.

A proportional integral (PI) temperature controller accurately maintains the temperature set point for separation within $\pm 2^{\circ}\text{C}$, even under variable bilge water feed conditions.

The EPC 60 Bilge process controller is based on the same hardware used in other Alfa Laval units, making it easy to use for operators who are already familiar with this equipment.

The panel is simple and straightforward to use and provides the operator with an intuitive understanding of the process from the very first use.

Main features:

- Clear, four-row digital display.
- Simple push buttons for process control and menu navigation.
- Overboard control button which enables the operator to force recirculation even when the ppm is below the alarm limit. Unlocking the overboard control requires a password which we recommend is set and retained by the Chief Engineer. In the locked position the bilge water is recirculated regardless of the oil-in-water content. Entering the password enables overboard discharge with levels of 15 ppm or lower. This allows the system to be able to run the PureBilge continuously and safely without accidentally pumping bilge water overboard in non-discharge areas, such as harbours or close to shore. This also gives sole authority for clean bilge water discharge to the Chief Engineer.

It is also possible to set the limit for discharge lower than 15 ppm – at 5 ppm, for instance. This enables safe discharge in environmentally sensitive waters, where lower oil-in-water content is required by regulatory bodies.

The variable frequency drive feed pump is also controlled by the EPC 60 Bilge.

Optional equipment

The PureBilge system offers these equipment options to provide greater flexibility.

- **5 ppm certificate**

PureBilge offers a guaranteed performance below 5 ppm at all times when used with an optional polishing filter.

This polishing filter, specially designed for the Alfa Laval BWPX 307, is optimized for high performance. Because the high-speed separator already reduces the ppm level to a very low value, the polishing filter has a superior service lifetime compared to other filters currently available.

The filter can be manually bypassed as required by the operator. When operating the PureBilge in continuous recirculation mode, we recommend that the filter should be bypassed to prolong its service lifetime further.

- **Heat recovery**

With the optional high efficiency Alfa Laval Plate Heat Exchanger (PHE), more than 40% of the heating energy required to raise temperature levels of the feed for PureBilge will be saved. The warm clean water outlet from the separator passes through the PHE and heats the cold feed. Rather than pumping warm water overboard, the water is used to heat PureBilge feed.

- **SafetyBox**

The SafetyBox provides mechanical protection of the oil-in-water monitor and the complete sampling line to prevent unauthorized access.

- **Flow meter**

An optional high accuracy electromagnetic flow meter is available to measure the overboard flow. An electromagnetic flow meter has no moving parts, is totally maintenance free and does not require any recalibration. The flow meter is positioned inside the PureBilge module for optimum flow measurement accuracy and all parameters are preset from factory. With the optional flow meter you have full control of the process. Flow data is stored in the EPC 60 Bilge internal recorder, which records both the total flow and the instantaneous flow.

- **Electric heater**

An electric heater is available as an option which allows the PureBilge to be installed at locations where steam or thermal oil is not available. The heat recovery PHE is standard when choosing the electric heater. The combination of the heat recovery PHE and electric heater reduces the amount of power required to heat bilge water by more than 40% compared to conventional electric heating systems.

- **Sludge removal kit (SRK)**

When installation of PureBilge on top of a sludge-collecting tank is impossible, an optional sludge removal kit (SRK) is available.

As part of the oily water pre-treatment stage, this small, intermediate sludge tank comes equipped with a pneumatically driven sludge removal pump, level controller and level switch.

- **Cleaning-In-Place unit**

An optional Cleaning-In-Place (CIP) unit is available to enable cleaning of the PureBilge system without dismantling the separator.

CIP connections are available on the PureBilge but the CIP unit itself is optional. (The same CIP unit can be used to clean other Alfa Laval high speed separators).

The CIP unit reduces downtime and maintenance man-hours, saves money and ensures top separation performance over time. It also minimizes the potential risk for mechanical damage of vital bowl parts.

- **Chemical dosing unit**

Under extreme conditions, centrifugal force alone may not be sufficient to deliver high separation efficiency for satisfactory treatment of the bilge water. This can be the case when large quantities of suspended solids, such as soot or detergents, are present in bilge water.

For these conditions, an optional chemical dosing unit efficiently handles strongly emulsified oil as well as suspended colloids.

Chemicals should only be added when a combination of high separation temperature (95°C) and low flow rate is insufficient to separate bilge water so that it contains 15 ppm or less oil-in-water.

Alfa Laval recommends the use of safe and environmentally sustainable Alpacon chemicals, MP 300/302. The combination of these water-based additives promotes demulsification and flocculation to achieve clean water with less than 15 ppm for more extreme feed compositions.

- **Automatic self-cleaning filter**

If the feed water is expected to have a high solids or fiber content, installation of an automatic, self-cleaning filter is recommended. This may be necessary, for instance, if the risk of overflow from black and grey water tanks into the bilge wells exists.

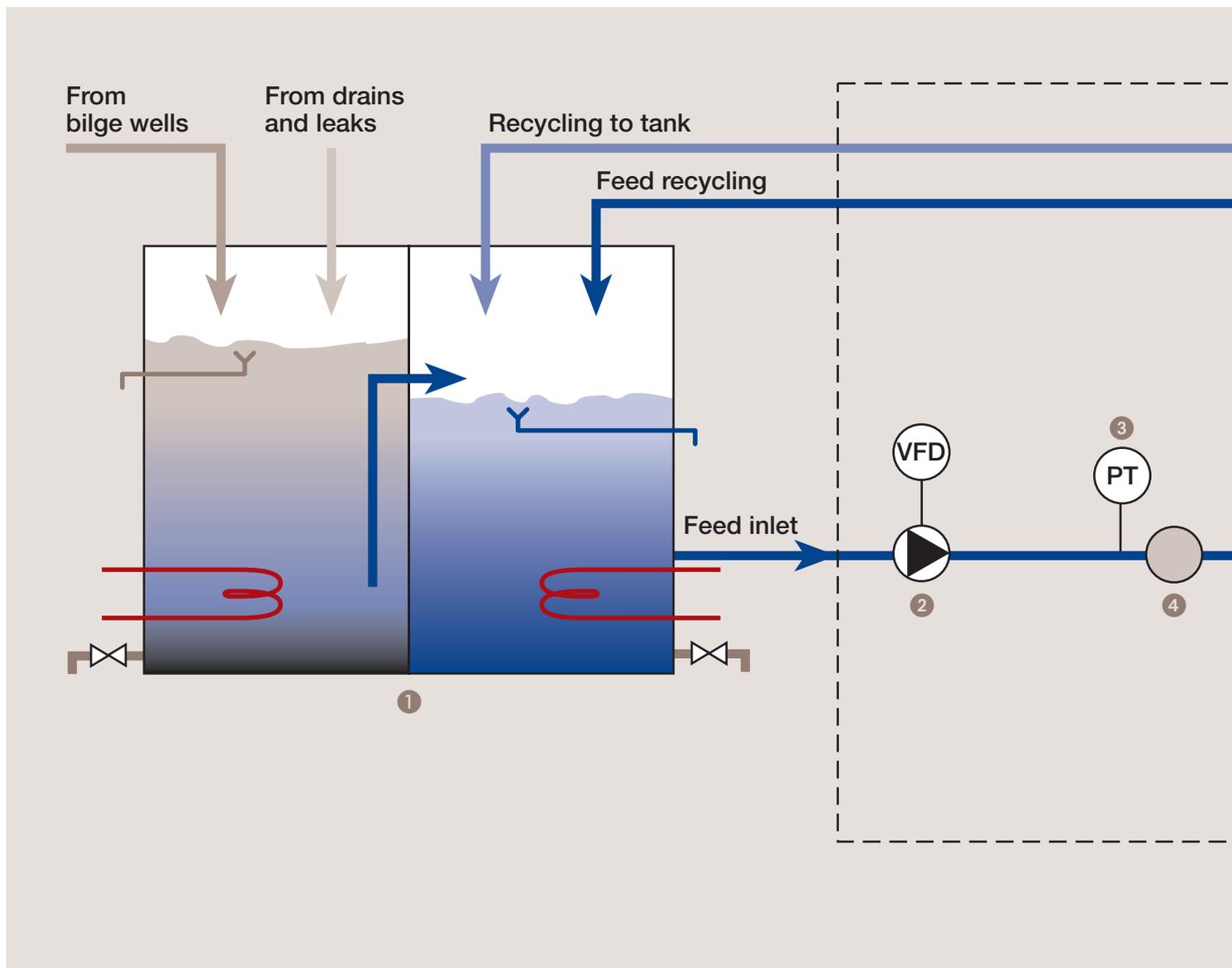
Removing fibers and other coarse solids helps prevent clogging of passages, such as the distribution holes in the separator disc stack. This prolongs service and maintenance intervals, which may otherwise be unacceptably short.

- **Remote control and monitoring**

Using Ethernet or Modbus communications, PureBilge can be remotely operated and supervised from the control room. A wide range of standard alarm functions is available and extra I/O boards can be added to the EPC 60 Bilge controller in order to enhance its operating and monitoring capabilities.

Flow diagram

- 1 Two-stage bilge water settling tank**
For optimum performance, a two-stage bilge water settling tank with heater is recommended. Other tank arrangements may also be used.
- 2 Feed pump with variable speed control**
Transfers liquid to the pre-heater.
- 3 Pressure transmitters**
Measures the pressure in the water inlet and outlet and signals this information to the process controller, which monitors pressure to ensure it remains within acceptable limits.
- 4 Strainer**
Traps large particles from the fluid before entering the heater.
- 5 Pre-heater**
Raises temperature of the liquid to the required treatment temperature.
- 6 Temperature transmitters**
Measures the temperature of the liquid from the pre-heater and signals the process controller.
- 7 Temperature controller**
Alerts operator when the temperature exceeds, or falls below, a preset limit and acts as a backup to provide temperature control should the temperature transmitter fail.
- 8 Three-way changeover valves**
Directs bilge water from the tank to the separation stage and from the separation stage either to pump for discharge overboard if it contains less than the preset ppm alarm level or a maximum of 15 ppm oil in water, or back to the bilge water settling tank if these conditions are not met.



9 BWPX 307 high speed centrifugal separator

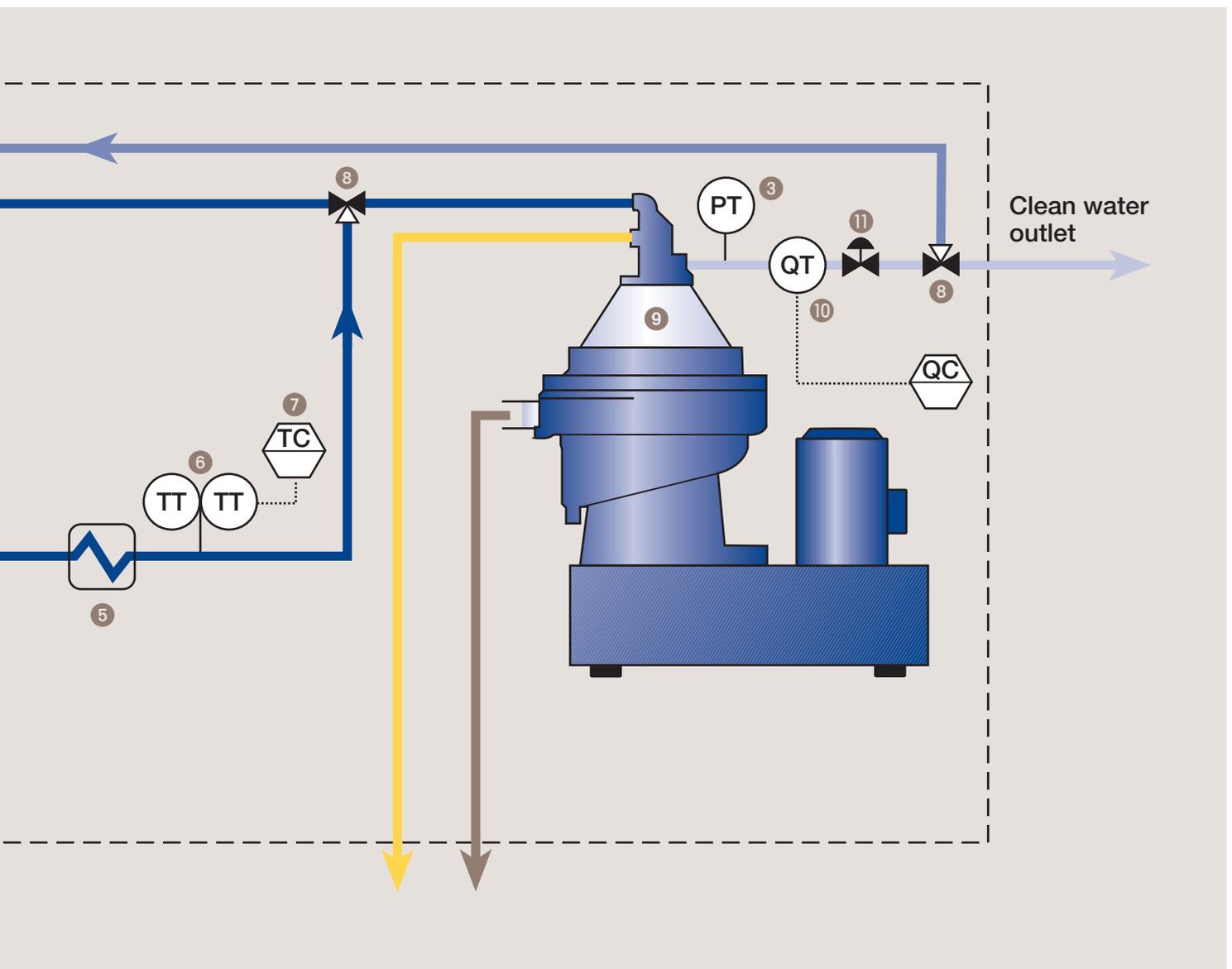
Continuously separates oil and particles from bilge water in large volumes.

10 Oil-in-water monitor

Continuously measures oil content of cleaned bilge water and compares these measurements to a pre-set value.

11 Constant pressure modulating valve

Prevents the formation of air bubbles during the separation stage and thereby helps insure the accuracy of the oil-in-water monitor.



Retrofitting

PureBilge is ideal for replacing older bilge water treatment systems. Its compact size easily fits into any available space.

To facilitate transport through small passageways, PureBilge can also be divided into these parts:

- BWPX 307
- Valve and piping rack
- Feed pump

Documentation

Alfa Laval supplies each PureBilge system with full documentation either as paper copies or as PDF files on a CD-ROM. The instruction manual, which can also be made available in most major languages, covers:

- Safety
- System description
- Operating instruction
- Parameter list
- Alarms and fault finding
- System reference/installation instructions
- Separator manual
- Spare parts catalogue
- Component descriptions



Classification society approval

Alfa Laval ensures that the PureBilge fulfills the requirements of all major classification societies. Upon request, Alfa Laval delivers the PureBilge with an individual test certificate. This includes approval by the society of the main components as well as workshop testing of the complete module. Several key components are also type approved by the leading classification societies.

Spare parts, service and support

Alfa Laval provides spare parts kits for all service and maintenance needs. Global technical service, training and support are available throughout the lifetime of the PureBilge.

Alfa Laval in brief

Alfa Laval can be found onboard most ships and provides support through a global organization. Our products include systems for fuel conditioning, separation, heating, cooling, tank cleaning, filtration, desalination, waste treatment and ballast water treatment.

As a leading supplier, we strive for the most efficient, reliable and environmental solutions. Our drive is the partnership with our many customers – together we set the standard.

For more information, please visit us at www.alfalaval/marine.