



A time for revolution

The PureBilge system for bilge water treatment

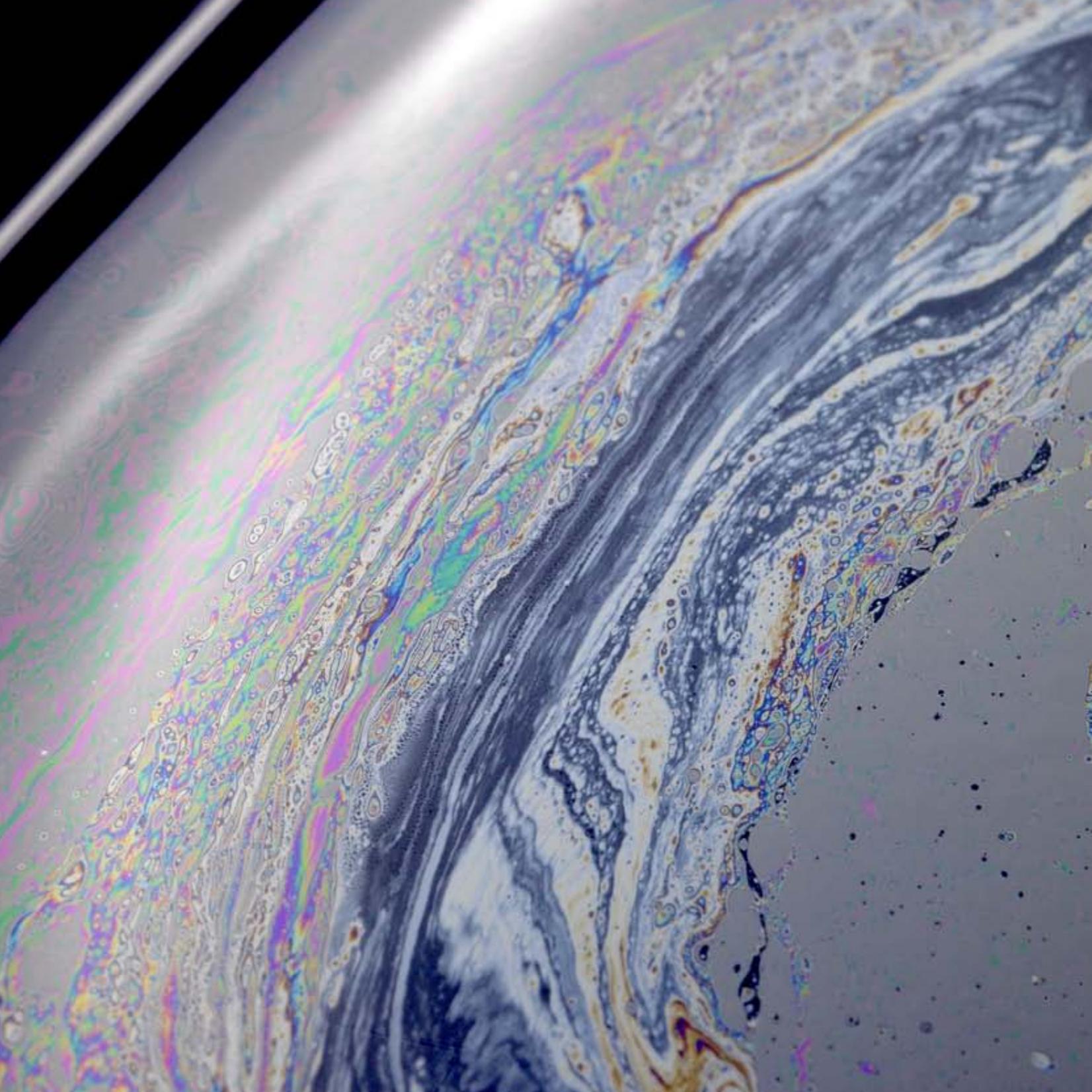






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for bilge water treatment**



Alfa Laval on board

Alfa Laval can be found on most ships and in most onboard processes. In the course of a century at sea, we have gained a thorough understanding of the complex and ever-changing marine environment.

That understanding is reflected in our PureBilge system for bilge water treatment. By means of centrifugal separation, PureBilge offers continuous environmental protection that adapts to the shifting conditions on board.

Even on the roughest of seas.

Similar technology has protected ships' engines for decades, which means the operating principle is well established. PureBilge is just as effective – and just as reliable – as the Alfa Laval separators you already know and trust.

Ships are not still

Traditional bilge water treatment systems rely on gravitational separation and other static methods to achieve 15 ppm oil in water. But when faced with today's bilge water mixtures – which contain far more than just oil and water – these static technologies seldom perform at sea.

Because in real life, the ocean is anything but static.

In a pitching and rolling environment, complex and emulsified bilge water compositions can seldom be separated through gravity alone. This means that bilge water must be stored in large tanks until conditions are right for treatment, and that chemicals and adsorption filters must be used to handle what does not separate naturally. In turn, this means time-consuming maintenance, oily waste and substantial operating cost.

Powerful and natural

Only a dynamic treatment system can cope with the constant motion of a vessel and the complexities of modern bilge water. Not only is such technology readily available, it has also demonstrated its worth aboard virtually every ship at sea.

High-speed centrifugal separators, which greatly multiply the effect of gravity, have been the natural choice for decades when it comes to protecting ships' engines.

Applied in bilge water treatment, centrifugal separation succeeds where static technologies fail. Whereas static systems operate in batches and require frequent filter changes or chemical dosing to do their job, a centrifugal



bilge water separator can operate continuously with little assistance at all.

Varying bilge water feed, oil shocks and even the toughest emulsions pose no difficulty when centrifugal separation is used.



PureBilge from Alfa Laval

Put simply, Alfa Laval's PureBilge is the most efficient and reliable separator available for bilge water treatment. Operating at flow rates of up to 5000 l/h, it provides fully automatic single-stage operation and easy compliance with the 15 ppm oil-in-water limit set by IMO MEPC 107 (49).



PureBilge treats bilge water through centrifugal separation – the same technology used to protect ships' engines. By multiplying the effect of gravity, it avoids the use of chemicals and filters.

In fact, PureBilge generally reduces oil in water to less than 5 ppm – without the use of filters or chemicals.

A key to the superior performance of PureBilge is the system's patented XLrator disc inlet, which gently accelerates the bilge water as it enters the separator bowl. Based on Alfa Laval's extensive fluid-handling expertise, the unique XLrator inlet prevents the splitting of oil droplets and the formation of additional emulsions. This gives PureBilge a substantial edge, even over other centrifugal separation systems.





From deck to hull

Bilge water is the collective name for the contents of a ship's bilge wells, which are located just above the hull in the lowermost part of the vessel. While the name itself is simple, however, the composition of bilge water is anything but.

What collects in the bilge wells can come from practically anywhere on board. To begin with, the wells receive water and fluids from operational sources, such as technical rooms, propulsion systems and various equipment throughout the ship. In addition, they take in fluids from machinery spaces, internal drainage systems, sludge tanks and a wide variety of other areas.

Some of these flows are relatively continuous and predictable, such as the water coming from the separator sludge tank or from cleaning processes in the vessel's engine room. But others are intermittent at best. Soot, particles and fluid from leakage and spills all make their way into the bilge wells, yet their concentration can vary from one moment to the next.

This constantly changing nature makes bilge water difficult to define.

The modern mixture

Fifty years ago, bilge water was easier to deal with. Back then, what collected in the bilge wells was mainly diesel oil and water, which could easily be separated by means of gravitational force. This is the reason for the traditional settling tanks that are still so common today.

Modern bilge water, however, is a far more complicated challenge. In addition to diesel oil and water, it may contain lube oil, hydraulic oil, oil additives, chemicals and detergents. Not to mention particles such as catalytic fines, soot and dirt.

All of these substances are channeled into the bilge water holding tank, which is kept at an elevated temperature that facilitates separation into three distinct phases. The top phase is a thin layer containing most of the oil and organic solvents, which should be skimmed off for separate treatment. The bottom phase, which is also removed for sepa-

Flocculation of particles



Coalescence of droplets



Flocculation and coalescence are two common and effective processes for breaking down emulsions. Both can be induced mechanically by means of high centrifugal force.

rate treatment, consists of solids and heavy sludge. In between is the phase to be handled by the bilge water treatment system, which contains water polluted by oil, chemicals and particles.

While gravity is enough for this primary separation, it can seldom provide the secondary treatment needed before bilge water can be discharged.

Inseparable difficulties

A major reason why gravity fails to separate modern bilge water completely is the presence of emulsions. Emulsions are smooth and even mixtures of liquids that do not dissolve in one another, such as the mixture that occurs when pump agitation or valve throttling blends small droplets of oil into the aqueous phase of bilge water.

Emulsions can be difficult to break down in normal circumstances, and they are often stabilized by the presence of

particles and surfactants. Surfactants, which lower the surface tension of liquids and facilitate spreading, have become increasingly common in the detergents and chemicals used for cleaning and maintenance.

To destabilize emulsions, methods that induce flocculation or coalescence are most often used. Flocculation is a process in which particles aggregate without losing their individual identities, whereas coalescence is a process in which smaller droplets combine to form larger ones. These two processes can be encouraged by raising the temperature and pH value of the bilge water, or by adding chemicals that cancel out the repulsive electrostatic forces between particles and droplets.

In addition, there is a simple and chemical-free alternative. Both flocculation and coalescence can be induced mechanically by means of high centrifugal force.







Taking chances

All ships must have systems for bilge water treatment. IMO resolution MEPC 107 (49) allows only separated bilge water with an oil-in-water content of 15 ppm or less to be discharged into international waters.

In some parts of the world, additional requirements or stricter limits have been set by national or regional authorities. In US waters and in the Baltic and North Seas, for example, even treated bilge water can only be discharged at a distance of at least 12 nautical miles from shore. An oil-in-water limit of 5 ppm already exists in the Great Lakes region, and as environmental awareness increases, lower limits and even “zero-discharge” areas may be applied in sensitive waters.

Already today, there is little tolerance for bilge water pollution. Governments and authorities use aerial and satellite methods to detect unlawful discharge, with the result that severe fines and lengthy prison sentences for chief engineers are becoming more frequent.

Thus it is surprising that many bilge water treatment systems still do not perform adequately at sea.

Questionable standards

Strangely enough, the widespread inefficiency of bilge water treatment systems is partly due to the type approval process that regulates them.

Prior to 2005, the type approval process was governed by IMO resolution MEPC 60 (33), which required only that treatment systems be tested with a mixture of oil and water. Today's MEPC 107 (49) is substantially stricter, since it also requires testing with a stable emulsion that contains fine



Modern satellite methods of tracking bilge water discharge have led to severe fines and prison sentences. Yet the tests associated with type approval are behind the times.

particles and a surfactant chemical. Likewise, the new resolution requires an oil-in-water monitor that records date, time, oil content and operating status, which must be stored for a period of 18 months.

However, there is still substantial room for improvement. Whereas MEPC 107 (49) requires testing with one chemical, real bilge water is a complex and ever-changing cocktail of chemicals. Moreover, the new resolution stipulates a duration of just 2.5 hours for emulsion testing, which can successfully be managed with nothing more than a simple filter.

Most disturbingly, the specified testing is conducted in stable conditions on shore, without the pitching and rolling that causes complications at sea.

Frequent shortcomings

Since the tests laid out by MEPC 107 (49) do not involve real-life conditions or a realistic timeframe, a range of ineffective static technologies have been able to receive type approval. These include chemical treatment, absorption filtration, membrane filtration, and conventional coalescers.

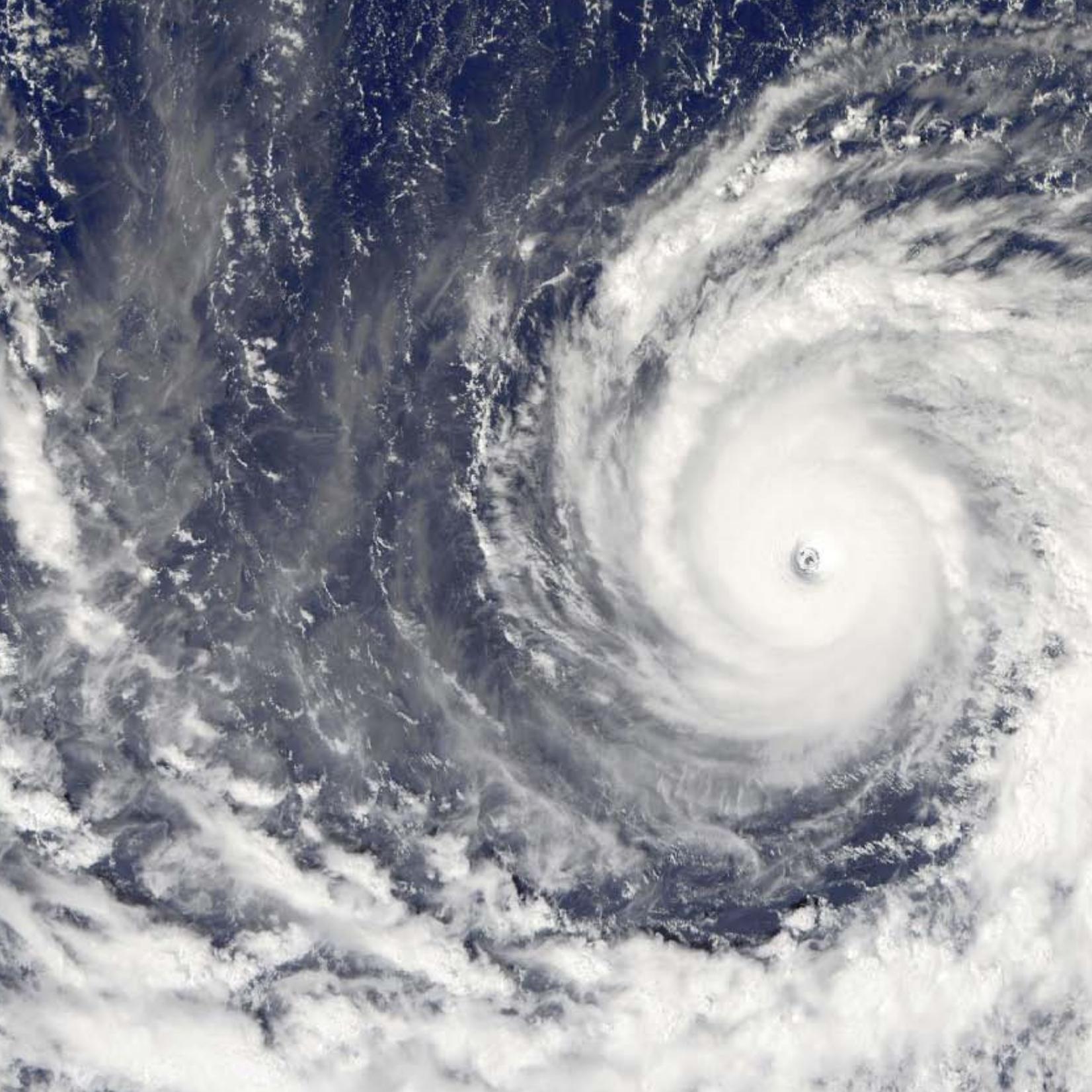
Systems based on these technologies are sensitive to oil shocks and are designed for “batch” operation, which means that they process large volumes of bilge water for a short period of time. As a result, they require frequent backflushing and generate large volumes of waste, either in the form of saturated filters and coalescer elements or in the form of reject. In a system based on flocculation chemicals, for example, 25% of the treated volume becomes reject for onshore disposal.

This means both frequent supervision and extensive maintenance.

The most serious drawback, however, is the fact that static systems (unless they are membrane-based) lose their efficiency in rough weather or the presence of difficult emulsions. This is because they make use of unaided gravitational force, which is easily defeated by the motion of the vessel itself.

If real-life conditions had been a part of today's type approval testing, the majority of systems in operation would never have been able to pass.







A dynamic force

The most efficient means of dealing with bilge water – and the only one that works consistently at sea – is dynamic treatment in the form of high-speed centrifugal separation. This technique is well established in the marine industry, where it has been used for decades to remove water and solids from diesel fuel and lubricating oils.

In contrast to static systems, which merely utilize existing gravitational force, a high-speed, disc-type centrifugal separator multiplies the force of gravity many thousands of times. To achieve the same result as a single separator of this type, a conventional gravity-based system would have to possess a settling area of 20 000 m².

At the same time, a centrifugal separator counteracts the constant motion of the ship. Pitch and roll are overcome by the gyroscopic effect of circulating the liquid in the separator bowl, such that separation efficiency is ensured in any operating conditions.

Of the centrifugal bilge water treatment systems available today, the one with the highest efficiency of all is Alfa Laval's PureBilge.



Ongoing protection

Alfa Laval's PureBilge is certified not only according to IMO resolution MEPC 107 (49), but also according to US Coast Guard document 46 CFR 106.50. In general, it provides a cleaning performance in real-life conditions of less than 5 ppm oil in water – without the use of chemicals, adsorption filters or membranes.

In addition, PureBilge operates continuously, even when confronted with oil shocks, high solids content or a violently heaving ocean. Its consistent high performance leaves no reject to be pumped ashore, and there is no waste to be deposited in the form of filter elements, coalescence elements, active carbon or flocculation deposits.

Nor is there a need for excessive supervision. With no backflushing required and no filters to change, PureBilge is designed for unmanned and uninterrupted operation.

Gravity accelerated

PureBilge is a fully automatic, all-in-one system with stages for pumping, preheating and centrifugal separation, as well as equipment for process control and monitoring. It comprises a BWPX 307 high-speed separator, a control cabinet, a valve and pipe rack, and a feed pump module.

Within the system, a rotation speed of 8000 rpm produces a gravitational force of 6000 g, which separates water, particles and oil droplets with extreme efficiency. This process is further enhanced by the separation channels in the disc stack, in which the flocculation of particles and coalescence of oil droplets occur under normal conditions.

With these mechanical characteristics alone, PureBilge can process large volumes at a flow rate of up to 5000 l/h. In addition to the premium separation of oily water, the system is capable of handling large amounts of solids, which are intermittently discharged at preset intervals.



The PureBilge technology can be found aboard vessels of all types. Even in rough weather conditions, it generally achieves an oil-in-water content of less than 5 ppm by mechanical means alone.

Space and time saved

Given its compact and modular construction, PureBilge is easy to install in any engine room. Since the system's continuous operation eliminates the need for large bilge water holding tanks, it frees up space and increases payload capacity as compared to conventional bilge water treatment systems.

This makes PureBilge an attractive solution, not only for newbuilds with unmanned engine rooms, but also for existing vessels, where it can operate as a stand-alone system or as a backup for an existing bilge water treatment system.

For a crew already acquainted with centrifugal separators for fuel and lube oil treatment, the system offers familiar operation and a very short learning curve.

Results in real life

Ship operators who use the PureBilge technology confirm its consistent performance in real-life conditions. In addition, at least one major operator has pushed the BWPX 307 separator to the extreme.

Whereas type approval testing involves a simple mixture and an onshore emulsion test of just 2.5 hours, this operator processed a complicated mixture in rough sea conditions for weeks. The process fluid was an impressive cocktail: sea water, compressor oil, diesel oil, heavy fuel oil, hydraulic oil, corrosion inhibitor, carbon remover, solvent-based oil cleaner, air-cooler condensate from the main engine, mud, rust and soot. In addition, it was thoroughly emulsified, having been stirred extensively by a diaphragm pump.

Even with this complex mixture – processed under difficult conditions – the separator achieved a result of as little as 0 ppm oil in water.





Securing performance

Simply by means of its centrifugal separation technology, PureBilge offers efficient, reliable operation that cannot be matched by any static bilge water treatment system. In addition, PureBilge has performance-enhancing features that make it more efficient and reliable than other centrifugal separation systems.

These include the separator's emulsion-preventing XLrator inlet, a deceptively simple-looking spiral whose flow characteristics stem from decades of Alfa Laval fluid handling expertise.

Combined with the filter-free operation and low-maintenance design of PureBilge, features like the XLrator inlet ensure that crewmembers spend less of their valuable time in the engine room. PureBilge adapts to varying feed, oil shocks and even violent pitch and roll, which means supervision of the bilge water treatment system is unnecessary.

In short, PureBilge does what it is intended to do – consistently, effectively and automatically.

The revolutionary XLrator

A key reason why PureBilge performs better than other centrifugal bilge water separators is the system's patented XLrator inlet. Despite its uncomplicated appearance, the XLrator is a laminar-flow device with extremely refined flow characteristics.

It may look like a simple spiral, but the inlet is a cutting-edge innovation, based on Alfa Laval's many years of work with fluid dynamics.

What makes the inlet so unique is its ability to prevent the splitting of oil droplets and the formation of further emulsions. As bilge water enters the separator bowl, the XLrator gradually accelerates it with a minimum of shearing and foaming. This means less complicated bilge water processing, which results in a much higher degree of separation efficiency.

Intuitive control

All aspects of the bilge water treatment process can be managed via the EPC 60 Bilge controller. This easy-to-operate unit provides advanced monitoring capabilities and offers fully automated control of all PureBilge functions.

Part of the latest generation of Alfa Laval process controllers, the EPC 60 Bilge is based on the same user-friendly hardware found in many other Alfa Laval systems. Operators familiar with Alfa Laval equipment will find its operation easy and intuitive, in part because of its clear digital display and simple push buttons for menu navigation and process control.



Multiple levels of security

While an oil discharge limit of 15 ppm is most common, The EPC 60 Bilge controller can also be set for lower levels of oil-in-water content, such as 12, 5 or 2 ppm. This enables safe discharge in environmentally sensitive waters, where a lower oil-in-water content may be required by regulatory bodies.

In an alarm situation where the proper separation cannot be achieved, the separator is automatically shifted into recirculation mode. This fail-safe mechanism prevents the accidental discharge of non-compliant bilge water, even in the event of lost operating pressure or power.

For added certainty, the EPC 60 Bilge also features an overboard control button, which allows the operator to force recirculation when the oil-in-water level is below the alarm limit. Since a password is required to unlock this function and enable overboard discharge, the sole authority for discharging clean bilge water can be assigned to the Chief Engineer. Doing so minimizes the risk of violating non-discharge areas, such as harbours or other near-shore environments.

Finally, the EPC 60 Bilge contains a process recorder, which stores all operating data and alarms for an 18-month period in accordance with *Oil Record Book* regulations. For maximum data security, the oil-in-water monitor and sampling line that inform this recorder can be protected against tampering with an optional Safety Box.



Featuring a clear, four-row digital display and intuitive menu navigation, the EPC 60 Bilge controller offers advanced monitoring possibilities and fully automated handling of all PureBilge functions.

Remote control and monitoring

The unique capabilities of the EPC 60 Bilge controller let PureBilge respond smoothly to varying feed. When placed in self-adapting mode, the EPC 60 Bilge ensures consistent performance by adjusting the process flow and temperature to optimal levels for bilge water separation.

This means that minimum attendance is needed from the operator, even when conditions are harsh.

By means of Ethernet or Modbus communications, PureBilge can therefore be operated and supervised from the control room. The EPC 60 Bilge offers a wide range of standard alarm functions, and extra I/O boards can be added to enhance its operating and monitoring capabilities.





Extended possibilities

PureBilge is designed as a truly plug-and-play system. All of the necessary components are pre-tested at the factory, and the whole system arrives as a compact and optimized module.

However, there is also a wide range of options that can be used to enhance the function and convenience of PureBilge. These include options for further safeguarding performance in sensitive waters or extreme conditions, as well as options that further simplify installation and maintenance.

With the help of these alternatives, PureBilge can be more perfectly matched to the needs and existing conditions on board.

For peace of mind

The following PureBilge options provide additional security when sailing in sensitive waters or extreme conditions.

- **5 ppm certificate**

An oil-in-water content of less than 5 ppm can be guaranteed when PureBilge is used with an optional polishing filter.

This polishing filter, specifically designed for use with PureBilge, has been optimized for high performance. And since PureBilge already reduces oil-in-water content to less than 5 ppm in most conditions, the filter offers a substantially longer service life than other filters. By bypassing the filter when PureBilge is in recirculation mode, the service life can be prolonged even further.

- **Safety box**

In compliance with IMO resolution MEPC 107 (49), PureBilge has an oil-in-water monitor that registers oil content in the separated bilge water. To prevent unauthorized access to the monitor and sampling line, a tamper-proof Safety Box enclosure can be added.

- **Flow meter**

A highly accurate electromagnetic flow meter is available for measuring the overboard flow of separated bilge water. Positioned within the PureBilge module, the factory-calibrated meter sends data to the EPC 60 Bilge controller for storage.

- **Chemical dosing unit**

Though its performance is far superior to that of conventional technologies, centrifugal force alone may not always be sufficient in extreme operating conditions. This may be the case when large quantities of suspended solids, such as soot or detergents, are present in the bilge water.

To ensure separation efficiency in such conditions, a chemical dosing unit can be added. The unit, which efficiently handles strongly emulsified oil and suspended colloids, should only be used when a combination of high separation temperature (95°C) and low flow rate is insufficient to reach an oil-in-water content of 15 ppm.

Alfa Laval can provide safe, effective and environmentally sound Alpacon chemicals for use with the unit.

For installation

The following options generate savings or add flexibility to the PureBilge installation.

- **Heat recovery**

With the addition of a high-efficiency Alfa Laval plate heat exchanger (PHE), it is possible to save more than 40% of the heating energy needed to raise the PureBilge feed temperature. Instead of being pumped overboard, the warm water from the separator's clean water outlet is fed through the PHE to heat the bilge water feed.

- **Electric heater**

An optional electric heater allows PureBilge to be installed in locations where steam or thermal oil is not available. When this option is selected, the PHE for heat recovery described above is standard.

- **Sludge removal kit**

An optional sludge removal kit (SRK) is available for situations in which PureBilge cannot be installed above a sludge-collecting tank.

- **Automatic self-cleaning filter**

If the feed water is expected to have a high content of solids or fibres, such as when there is a risk of black and grey water tanks overflowing into the bilge wells, an automatic self-cleaning filter is recommended. This filter removes fibres and coarse solids to prevent the clogging of passages within the separator.

For maintenance

- **Cleaning-In-Place unit**

An optional Cleaning-In-Place (CIP) unit is available for PureBilge. This unit, which can also be used to clean other Alfa Laval high-speed separators, is connected to existing inlets and outlets on the PureBilge module.

Utilization of the CIP unit enables effective cleaning without having to dismantle the separator. This not only ensures top separation performance, but also reduces downtime and minimizes the potential risk of damaging vital bowl parts.



EXIT →





At your service

By mechanical means alone, PureBilge generally achieves an oil-in-water content of less than 5 ppm. This means there is no need to stock adsorption filters or flocculation chemicals on board, or to set aside space for oily residue and reject.

Likewise, it means that crewmembers can do better things with their time than performing maintenance or arranging the deposit of toxic, oily waste.

By choosing PureBilge, you thus get a system with minimal demands. Yet as an Alfa Laval customer, you get all the security of working with a global supplier. Having spent a century in the service of maritime industry, we can provide you with a well-developed offering of service and support.

Our network stretches around the world and encompasses every major harbour. So wherever you sail with PureBilge, our peace-of-mind specialists will be able to provide you with technical assistance, onboard service and genuine Alfa Laval spare parts.



A smooth start

PureBilge is designed for plug-and-play installation. The system arrives as a compact and factory-tested module with all of the pipe connections located at the back.

While Alfa Laval can provide a broad range of technical services to assist in starting up the system, commissioning is both quick and easy. The PureBilge components are pre-tested, pre-installed and pre-approved for all system functions, so there is none of the cost or installation hassle associated with design and construction from loose components.

Likewise, Alfa Laval can provide the crew with PureBilge operating advice and on-board training if desired. The many similarities between PureBilge and other Alfa Laval high-speed separators, however, make such involvement on our part a rare occurrence.

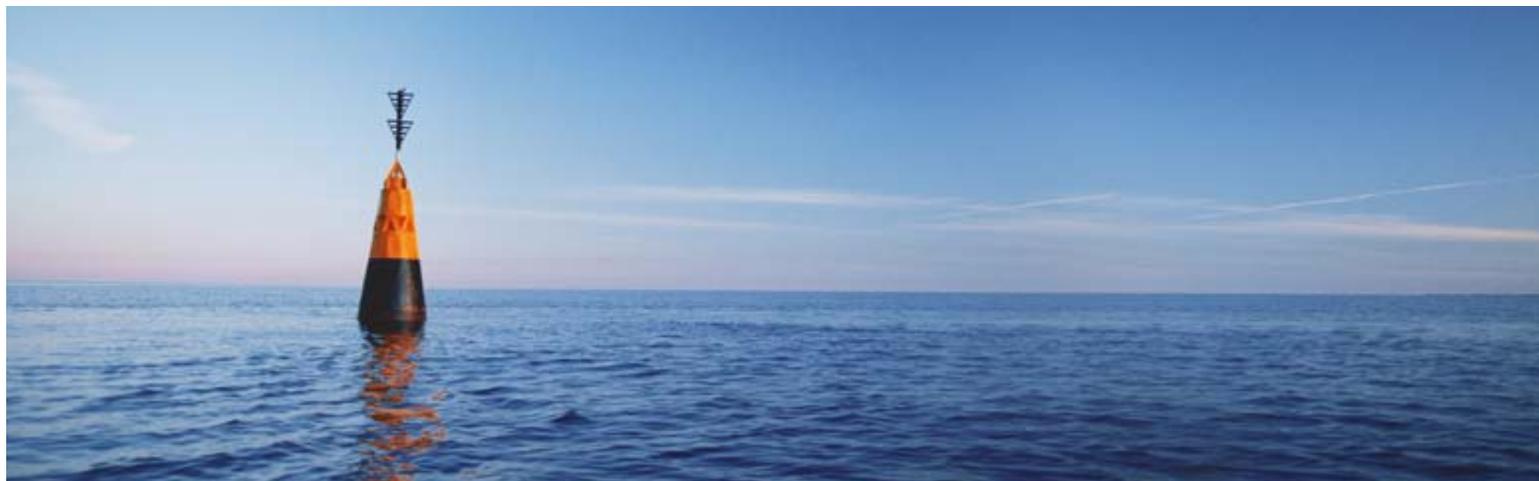
PureBilge is as easy to operate as it is to install, which makes getting underway both fast and simple.

Ongoing convenience

In contrast to conventional bilge water treatment systems, PureBilge can operate efficiently without chemical additives or the use of adsorption filters, so there is little to be stocked on board. PureBilge can even be cleaned with the same Cleaning-In-Place (CIP) unit used by other Alfa Laval high-speed separators, which means the optional CIP solution is all that is required if such separators are already in use.

In addition, PureBilge demands far less maintenance than conventional bilge water treatment systems. The combination of centrifugal separation technology and the patented XLrator inlet prevent emulsion-induced clogging, and what little routine maintenance PureBilge requires is simple and convenient.

All of the items necessary for standard maintenance have been organized into service kits, which also contain instructions and tips for PureBilge maintenance checkpoints. These kits, which are easy to order and readily available worldwide, make it convenient and economical to perform the small amount of maintenance PureBilge requires.



PureBilge – equipment and operations

PureBilge is available in four versions:

PureBilge 2515: 2500 l/h, 15 ppm

PureBilge 5015: 5000 l/h, 15 ppm

PureBilge 2505: 2500 l/h, 5 ppm

PureBilge 5005: 5000 l/h, 5 ppm

The system's general operating principle is as follows.

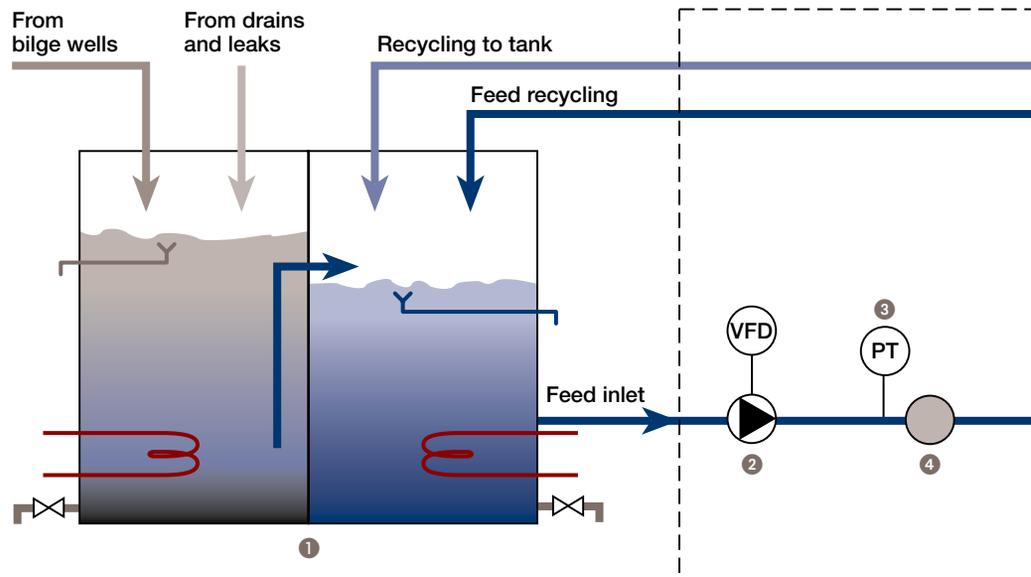
A feed pump with variable-frequency drive control directs oily water into the PureBilge system from the bilge water settling tank or its equivalent.

After passing through a strainer that traps large particles present in the feed, the fluid passes through a heat exchanger that raises its temperature to the required level for optimum separation efficiency (generally 60-70°C).

If all process conditions (e.g. feed temperature, feed pressure and separator speed) fall within preset values, a three-way changeover valve then directs the fluid to the separation stage. If any process condition is not met, the valve directs the fluid back into the bilge water separating tank.

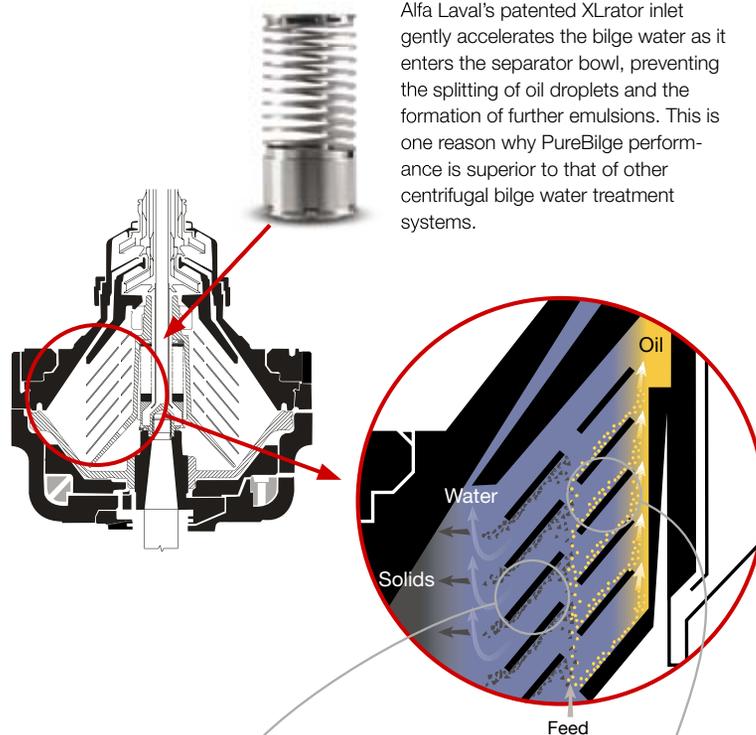
The bilge water feed is processed continuously by the high-speed centrifugal separator, from which separated oil and emulsions are discharged continuously via the oil outlet. Solids that collect at the separator bowl periphery are discharged intermittently at preset intervals and are directed to a collecting tank for sludge or waste oil.

- 1 Two-stage bilge water settling tank
- 2 Feed pump with variable-speed control
- 3 Pressure transmitters
- 4 Strainer
- 5 Pre-heater
- 6 Temperature transmitters
- 7 Temperature controller
- 8 Three-way changeover valves
- 9 BWPX 307 high-speed centrifugal separator
- 10 Oil-in-water monitor
- 11 Constant pressure modulating valve



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

If the oil content is below the preset alarm limit, which can be set from zero to 15 ppm, the separated bilge water can be pumped directly overboard or into a 'clean' bilge water holding tank for overboard discharge later. If the oil content exceeds the ppm limit, the effluent is returned for reprocessing – preferably via the cleanest part of the bilge water settling tank.



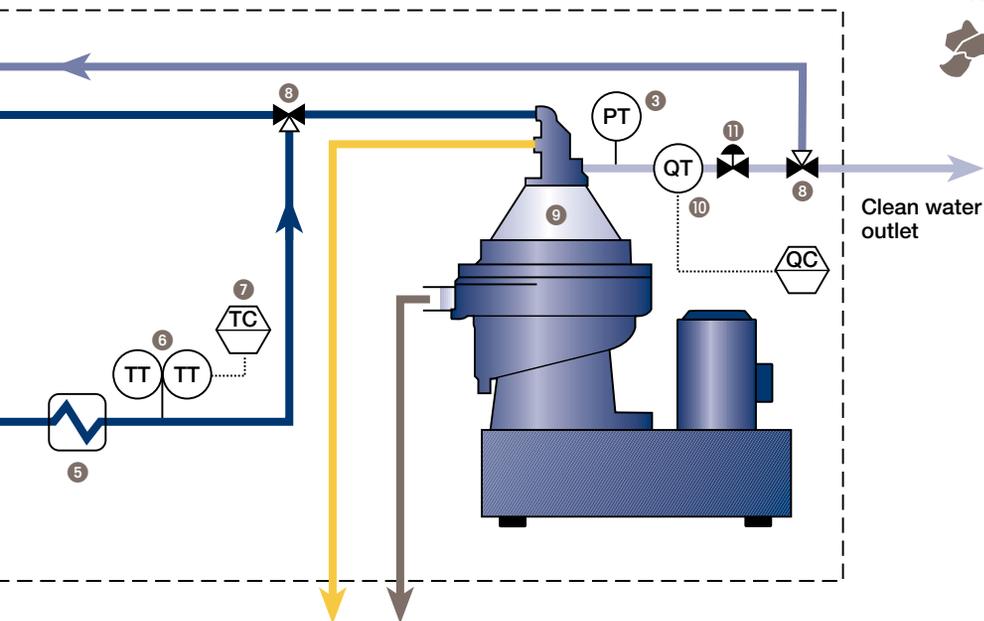
Flocculation of particles



Coalescence of droplets



High centrifugal force within the PureBilge separator induces coalescence and flocculation, which contribute to the breakdown of emulsions.







Greater depth

Lift the flap for a CD with multimedia content and additional PureBilge information.



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The PureBilge system for bilge water treatment

ALFA
LAVAL

Alfa Laval can be found on board 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.com/marine

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