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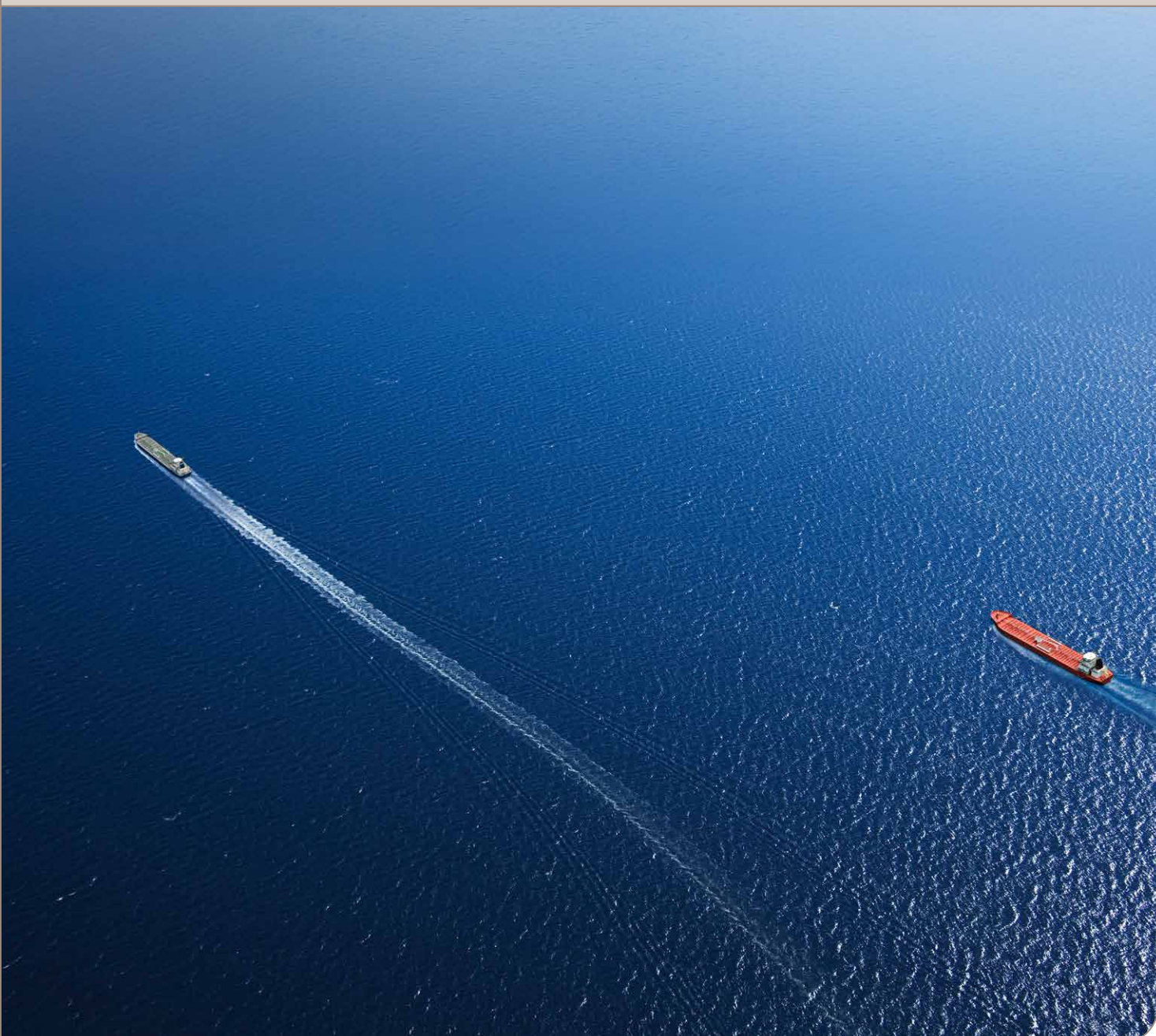
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# Always a step ahead

Alfa Laval PureSOx and SOx emission compliance



# Don't just comply – be a step ahead

You won't be alone in choosing a SOx scrubber. But you will be a step ahead, if you select the scrubber at the forefront: Alfa Laval PureSOx. At sea since 2009, PureSOx has the record others aspire to, with every system ever sold in operation and in compliance.

## **PureSOx leads the way**

There are many good reasons for choosing a scrubber to comply with the 2020 global sulphur cap, or the even stricter SOx limits that already exist in Emission Control Areas (ECAs). Whatever your own reasons, no choice of SOx scrubber is more secure than PureSOx.

Built on 100 years of marine experience, PureSOx has been chosen for hundreds of vessels to date. But what matters more are the returning customers, convinced by smooth installations, proven results and first-rate global service. They know PureSOx will keep them ahead – today, in 2020 and beyond.

## **Why Alfa Laval and PureSOx?**

- >98% SOx removal plus 80% reduction of particulate matter
- Over 100 years of marine industry experience
- Over 50 of years of marine scrubber experience
- Strong delivery logistics and project management
- A truly global network for service and support
- Proven performance and many returning customers



# Built for the way you sail

PureSOx is a reliable and flexible solution that can be configured in three different operating arrangements. Which one is right for you depends on where and how your vessel sails.

## Open-loop arrangement

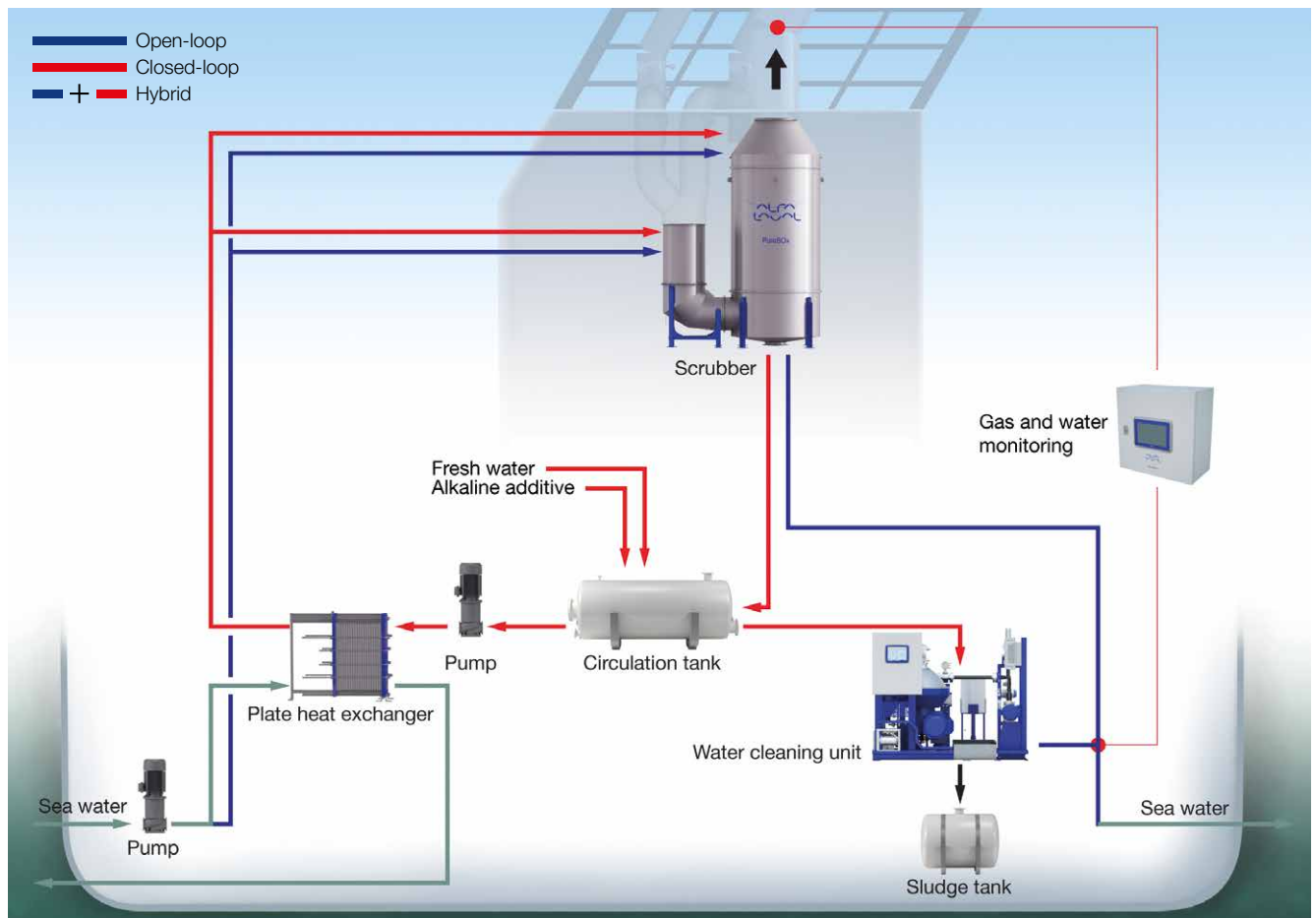
In an open-loop arrangement seawater is used to scrub the exhaust gas, after which it is legally discharged back into the sea. Though the investment and operating costs are lower, the scrubber's use may be limited by low water alkalinity or local legislation.

## Closed-loop arrangement

In a closed-loop arrangement the scrubber water is dosed with an alkaline additive and recirculated. As it becomes dirty, the circulation water is cleaned, discharged and replenished to retain capacity. The scrubber can be used anywhere and at any time, but has higher operating costs.

## Hybrid arrangement

A hybrid arrangement is often the perfect compromise, as it provides both open-loop and closed-loop modes. Open-loop operation reduces costs whenever possible, but a switch to closed-loop operation can be made whenever demanded.



# Designed for your needs

PureSOx is engineered for reliable and efficient compliance with a minimal amount of equipment – and minimal impact on the vessel's structure.

## The PureSOx scrubber

The PureSOx scrubber itself is designed for robustness and reliability. In most cases the jet and absorber sections are physically independent, with the absorber forming the main bulk and the jet section a smaller additional unit.

This configuration provides optimum weight and stability, as well as forming a natural water trap that prevents water backflow to the engine without any additional equipment. The scrubber performs with high efficiency, achieving compliance regardless of roll, pitch, temperature or alkalinity.



The PureSOx scrubber

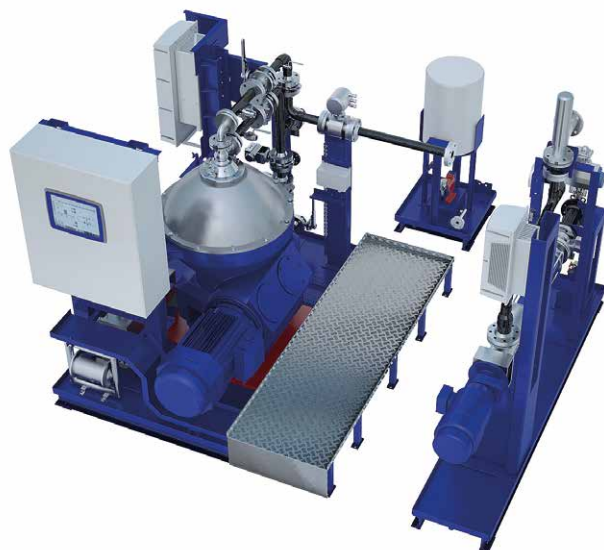
## Inlets for multiple exhaust gas sources

PureSOx can be configured with multiple inlets. This allows one PureSOx scrubber to clean exhaust gas from both main and auxiliary engines, as well as boiler exhaust gas.

Multiple inlets greatly reduce the footprint and weight of the scrubber system overall, along with the cost of the equipment and installation.

## Reliable water cleaning

In closed-loop and hybrid arrangements, the patented PureSOx water cleaning unit ensures effective removal of particles in all conditions. Using centrifugal separation technology, it minimizes sludge and allows instant bleed-off of cleaned circulation water.



The PureSOx water cleaning unit

# Connectivity to take you forward

PureSOx is at the forefront of SOx scrubber technology, but also of marine connectivity. A growing range of data-driven services aims to further simplify compliance and bring you new ways to save time and money.

## **Simplified reporting**

PureSOx connectivity builds on the Alfa Laval Remote Emission Monitor (ALREM), a data reporting and storage device. At its most basic, the ALREM enables simplified compliance reporting on any vessel where it is installed.

Rather than analysing scrubber compliance data themselves, operators can use the Alfa Laval Touch Control system to access user-friendly, graph-based reports – which can be handed over to authorities directly. Compliance data for a vessel or fleet can also be accessed via an online portal, available on a monthly subscription basis.

## **Tools for optimization**

The possibilities of connectivity are enormous, because the capabilities of the ALREM go far beyond reporting. The system can log not only the required compliance data, but also PureSOx diagnostic and performance data that can be sent to the cloud for processing by Alfa Laval analysts. This lays the groundwork for further services to come, including condition-based maintenance and operational fine-tuning based on best practices within a fleet.



# Service to keep you

The choice of PureSOx is always a secure one. Standing behind PureSOx is a global supplier with the skills, resources and comprehensive service offering to support your needs – today and tomorrow.

## Truly global service

Alfa Laval has an extensive global service network, dedicated to keeping you in compliance and helping you get the most from your PureSOx scrubber system.

You can reach our Alfa Laval service experts 24/7, no matter where you sail. By taking advantage of their skills and support, you can rely on your PureSOx system for cost-effective compliance throughout your vessel's lifetime.

## Alfa Laval 360° Service Portfolio

PureSOx is a smart choice, backed up by smart services. The Alfa Laval 360° Service Portfolio contains a wide range of services that secure its performance.

## Performance Agreements

You get the most value by combining services from the Alfa Laval 360° Service Portfolio in a tailor-made Performance Agreement. This flexible solution gives you the ideal service for your needs at a fixed, budgeted cost.

## Service examples

### • Training

Ensure optimal scrubber performance with improved crew skills in operation, maintenance and basic troubleshooting.

### • Performance Audit

Ensure your PureSOx scrubber system is operating according to expectations through system updates and careful evaluation of all functions.

### • Exchange Programme

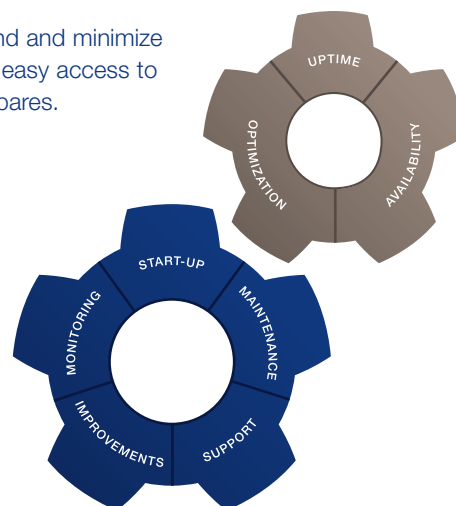
Ensure compliance at all times through the regular replacement and recalibration of crucial PureSOx system sensors.

### • Condition Audit

Ensure uptime and reduce the risk of unscheduled repairs with expert insights into the actual condition of your PureSOx equipment.

### • Spare Parts

Ensure peace of mind and minimize downtime with fast, easy access to high-quality, OEM spares.



# PureSOx in practice

How a SOx scrubber and its supplier perform in reality is more important than any specification. Alfa Laval and PureSOx have a solid record of success, not only on board but in the whole process of getting there.

## Returning customers

Nothing says more about a scrubber than its references, and repeat orders are the best seal of approval available.

Alfa Laval PureSOx has more references than any other single SOx scrubber technology, many of which are repeat orders. All PureSOx systems ever installed are still in compliant operation today.

*“Hybrid scrubbers are among the most efficient alternatives to using expensive low-sulphur fuel oil. Based on our previous experience, PureSOx has proven to be a reliable and efficient retrofit solution. We have been very pleased with the cooperation with Alfa Laval.”*

Kasper Moos, Vice President Technical Org., DFDS Seaways

### DFDS RoRo and RoPax vessels

- Four hybrid PureSOx systems with multiple inlets
- Nine hybrid PureSOx systems with single inlets



# Smart engineering

To be a lasting solution, your scrubber must be engineered to suit your vessel and sailing profile. PureSOx provides a high degree of system flexibility, with different operating arrangements, support for multiple inlets and many other options.

The possibilities allow almost any challenge to be overcome, even on vessels with space and stability issues.

*"The PureSOx solution was well engineered and allowed a sophisticated integration of the scrubber system into our container feeder ships. The custom construction let us avoid major modifications inside the vessel, which together with the pre-outfitting gave us a short installation time. All those factors contributed to a competitive price."*

Christoph Meier, Project Manager, Buss Shipping



## Buss Shipping container vessels

- Two hybrid PureSOx systems with multiple inlets

# Core technology

It takes considerable knowledge to optimize a scrubber, especially in a closed-loop or hybrid system where compliant cleaning of the circulation water is needed.

Alfa Laval has over 50 years of experience with marine scrubbers specifically, as well as over a century of experience with centrifugal separation – the most reliable method of water cleaning.

*"[Our vessels'] area of operations requires a closed-loop mode with reliable water cleaning. This is where Alfa Laval's separation expertise comes into play."*

## RCL cruise ships

- Three hybrid PureSOx systems with multiple inlets
- One hybrid PureSOx system with a single inlet





## Project management

A solid delivery track record and a structured method of preparing scrubber installations offer insurance against expensive delays and difficulties in class approval.

Alfa Laval has not only many years of experience and a strong delivery infrastructure, but also well-documented procedures and clear project management that facilitate class approvals. Your project's skilled engineering team is led by a dedicated Project Manager, who acts as a single point of contact throughout the process.

*"Alfa Laval has made things easier in our work with EXMAR so far, and we anticipate that will continue as the EXMAR projects progress. We expect a lot from Alfa Laval as an experienced marine supplier, and when it comes to the professional level of support regarding PureSOx and exhaust gas cleaning, the company delivers."*

Lee Dong-hoon, Senior Manager, Hanjin Heavy Industries & Construction (HHIC-TMS)

### **EXMAR LPG carriers built by Hanjin Heavy Industries & Construction (HHIC-PHIL INC.)**

- Two hybrid PureSOx systems with multiple inlets



## Finnlines and ACL RoRo and ConRo vessels for Grimaldi Group

- Five open-loop PureSOx systems with multiple inlets
- Five hybrid PureSOx systems with single inlets



## Global service

Your scrubber will be with your vessel for many years and will also affect its resale value. This makes it important to choose a stable supplier with a strong global network, who can offer assistance wherever your vessel sails.

Alfa Laval has served the marine industry for a century, providing service and support both worldwide and 24/7. The Alfa Laval 360° Service Portfolio offers all the services you need to ensure top performance, uptime and operating efficiency from your PureSOx system throughout its life cycle.

*"PureSOx was an obvious choice for us. But Alfa Laval is more than an equipment supplier. In Alfa Laval, we have a reliable partner who can make sure our vessels are always in compliance and that we get the most out of our investment."*

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