WÄRTSILÄ

WÄRTSILÄ **Emissions Reduction**

EXHAUST GAS CLEANING SYSTEMS

At Wärtsilä, we are passionate about optimising lifecycle value by offering precisely what our customers need. We can deliver on this promise because we provide the most complete offering of marine products, integrated solutions and services in the industry – worldwide. We help our customers find the shorter route to robust growth, efficiency and environmental excellence. This brochure is just a start in learning why Wärtsilä powers one in every three ships worldwide, and demonstrates how we are able to provide a comprehensive, environmental offering in order to give our customers peace of mind. What can we do for you?

THE ENVIRONMENTAL IMPACT

Shipping is a global industry and the harmful emissions created from shipping fleets affect many regions worldwide. As a consequence the marine industry will in the coming years face tougher legislation on emissions around the world. These rules and regulations will force the marine industry to make difficult choices, however the benefits are a much cleaner air, resulting in a greener future for us all.

The rules range from the International Maritime Organization's MARPOL Annex VI regulation 4 as detailed in resolution MEPC 184(59) to the European Union Directives 2005/33/EC and 1999/32/EC. Some areas may also be faced with national or local rules.

Business as usual is no longer an option. To comply with incoming rules, ship owners must switch to costly low Sulphur fuel, or choose abatement technology. The 2015 deadline for meeting 0.1% sulphur levels in Emission Control Areas (ECA) is fast approaching, and the marine industry needs to choose a path on how to achieve compliance.

1.2 MILLION TONNES OF UNTREATED EXHAUST GAS ARE EMITTED BY SHIPS EVERY HOUR

EXISTING & FUTURE REGULATIONS ON EMISSIONS TO AIR

S = Sulphur Emissions ECA = Emission Control Areas

EXISTING EMISSION CONTROL AREAS

Emission Control Areas

INTEGRATED COMPLIANT SOLUTIONS FOR ALL SHIP TYPES

Wärtsilä exhaust gas cleaning technology is an economical and environmentally friendly solution for tackling all new and existing rules and regulations and are designed to provide flexibility and reliable operations wherever you operate.

Exhaust gas cleaning meets the highest standards of compliance; recognised as a viable technology by the IMO, the European Union, the US Environmental Protection Agency and the British Parliament. Avoiding costly distillate fuel with a typical payback time of three years, depending on operational profile and trading pattern within ECA.

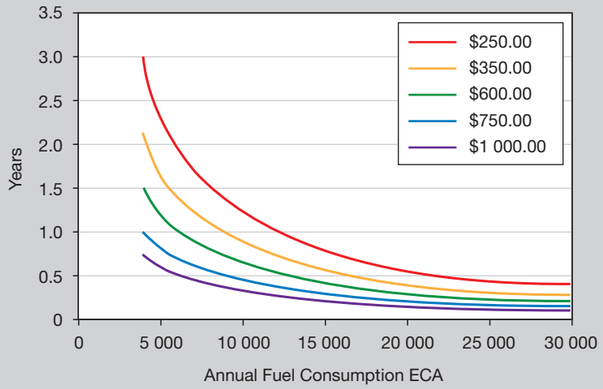
Wärtsilä's solutions are designed to provide flexibility and reliable operations wherever you operate. The systems are suitable for both new buildings and retrofitting of existing vessels having either 2-stroke or 4-stroke engines, as well as oil-fired boilers.

Wärtsilä have an unrivalled reference list, and data from operational exhaust gas cleaning units confirm sulphur oxide gas removal in excess of 98%. This means that with full installation, vessels are ECA compliant and the systems provide unparalleled reductions in harmful ship emissions.

Opting for Wärtsilä exhaust gas cleaning technology instead of switching fuel results in;

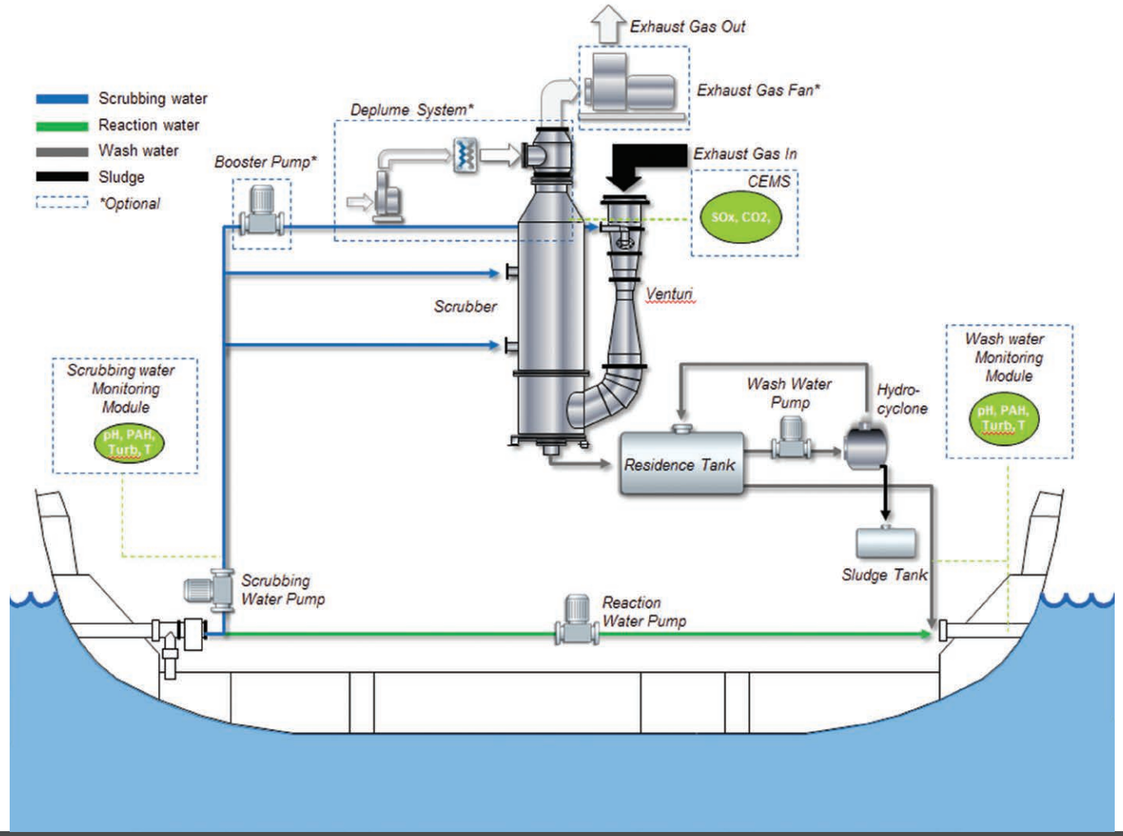
- Lower operating costs through access to less costly fuel
- Avoiding fuel switching, storage and availability and technical issues
- Reducing your operational impact on the environment

RETURN ON INVESTMENT – with a typical payback time of less than three years



10 MW main engine, 3 x 0.5 MW aux engines.
Total investment cost $3 million.

EXHAUST GAS CLEANING IS A COST-EFFECTIVE SOLUTION TO MEET EMISSIONS REGULATIONS



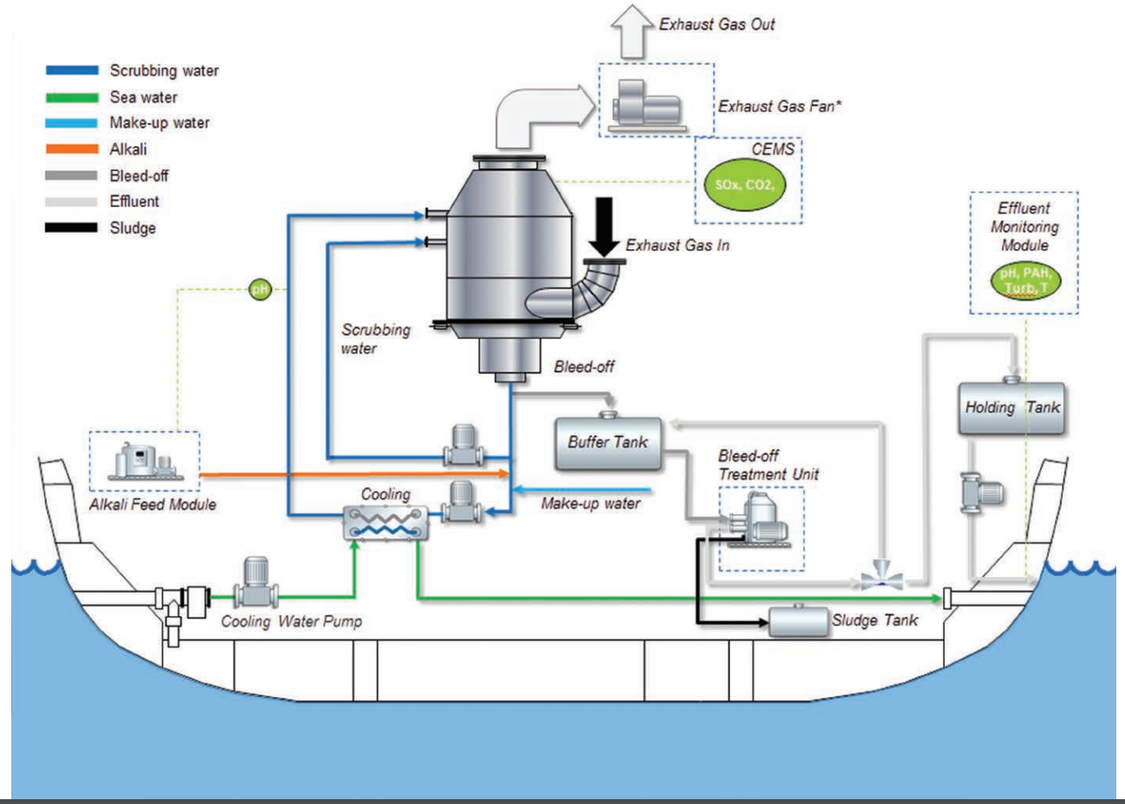
Our scrubber system is based on the same technology as that used in Wärtsilä Hamworthy's inert gas systems for more than 50 years. The system operates in an open loop utilising seawater to remove SO_x from the exhaust.

Exhaust gas enters the scrubber and is sprayed with seawater in three different stages. The sulphur oxide in the exhaust reacts with water and forms sulphuric acid. Chemicals are not required since the natural alkalinity of seawater neutralises the acid.

Wash water from the scrubber is treated and monitored at the inlet and outlet to ensure that it conforms with the MEPC 184(59) discharge criteria. It can then be discharged into the sea with no risk of harm to the environment.

JOLLY DIAMANTE

Wärtsilä supplies open loop scrubber systems to Korean yard STX Offshore & Shipbuilding for four new 45,000 dwt Ro-Ro ships for Italian owner Ignazio Messina & C. The vessels will burn residual fuel oil, and the scrubbers ensure that the 0.1% fuelsulphur content emission regulations can be met. These vessels are the first of their type to gain the RINA's Green Plus notation, and the Wärtsilä open loop scrubber systems are all MED certified.
Ignazio Messina's vessel Jolly Diamante was the first ever vessel to operate commercially with a scrubber system when it entered service in December 2011.



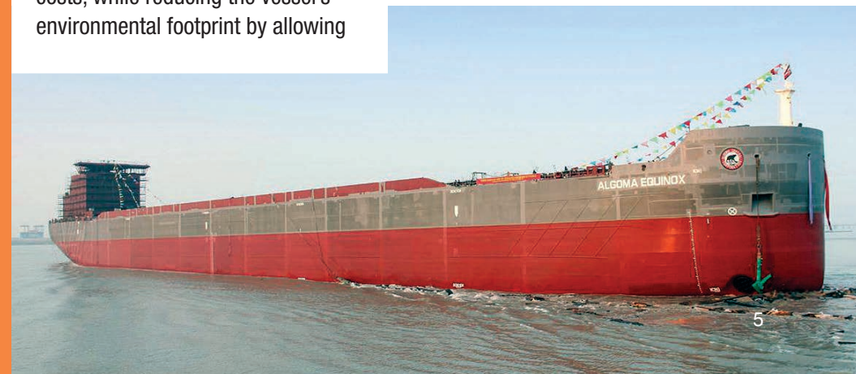
The system operates in a closed loop, i.e. the wash water is being circulated within the scrubber. Exhaust gas enters the scrubber and is sprayed with fresh water that has been mixed with caustic soda (NaOH). The sulphur oxides in the exhaust react with this mixture and are thereby neutralised.

A small bleed-off is extracted from the closed loop and treated to fulfil requirements stipulated by IMO.

Cleaned effluents can safely be discharged overboard with no harm to the environment. If operation in zero discharge mode is requested, the effluent can be led to a holding tank for scheduled and periodical discharge.

ALGOMA CENTRAL CORPORATION

Wärtsilä supplied closed loop scrubber systems for a series of eight vessels, with an option for another two, being built for Algoma Central Corporation to transport bulk commodities on North America's Great Lakes and St. Lawrence Seaway. The first vessel - the 'Algoma Equinox' was launched in December 2012. The full propulsion system with Wärtsilä's closed loop scrubber systems lowers operating costs, while reducing the vessel's environmental footprint by allowing the owners to use high sulphur fuels in ECA zones and still meet sulphur emissions restrictions. In addition to the unique integrated closed loop scrubber system, Wärtsilä provided engineering and project management support, highly fuel efficient engines, propulsion machinery and a bilge water separator, designed to reduce oily residues at source.



MV TARAGO

To prepare for impending regulations Wilh. Wilhelmsen ASA will retrofit their Mark IV RoRo, MV Tarago, with a Wärtsilä exhaust gas cleaning system.

Wärtsilä's solution is the world's largest multi-stream scrubber removing sulphur and particulates from the exhaust gases of the vessel's main and auxiliary engines. The innovative project is being verified by Marintek, the Norwegian Marine Technology Research Institute, and aims to endorse the viability of scrubbing as an efficient and cost effective solution for ECA compliance.

WE HAVE AN UNRIVALLED REFERENCE LIST, SHOWCASING THE EFFECTIVENESS AND VIABILITY OF OUR EXHAUST GAS CLEANING SOLUTIONS

WÄRTSILÄ HYBRID SCRUBBER SYSTEM - FLEXIBILITY IN OPERATION

Wärtsilä additionally provide hybrid solutions. These solutions have the flexibility to operate in both open and closed loop. This provides a flexibility of operation in low alkaline waters as well as the open ocean. The hybrid approach enables operation in closed loop mode when required, for instance whilst in port and during maneuvering using NaOH as a buffer. The system can only be operated in zero discharge mode for a limited period. When at sea the switch can be made to open loop using only seawater.

Wärtsilä can also provide complete ship design and a variety of pump systems.

Having the largest installed base of any marine scrubber supplier and a dedicated test laboratory, has enabled Wärtsilä to optimise their products to be reliable, easy to operate and easy to install.

A number of different features can easily be added to the design:

- Open loop
- Closed loop
- Hybrid system
- Integrated scrubber
- Mainstream scrubber
- Improved particulate matter capture
- Fan assistance for lower back pressure
- De-plume to avoid a potential steam plume
- Turn-key delivery with onboard modifications and fine-tuning of the system

THROUGH-LIFE SUPPORT FROM A CREDIBLE, WORLDWIDE SUPPLIER – WHENEVER AND WHEREVER YOU NEED US

AFTERSALES

Wärtsilä supports its customers throughout the lifecycle of their installations by optimizing efficiency and performance. We offer expertise, proximity and responsiveness for all our customers in the most environmentally sound way.

Our Services & Support solutions range from basic support, installation and commissioning, performance optimization, upgrades and conversions to service projects and agreements focusing on overall equipment performance and asset management.

We deliver aftersales support through our network of service centres in over 70 countries worldwide.

WÄRTSILÄ RETROFIT SOLUTIONS - TURNKEY SUPPLY

Wärtsilä can develop tailored retrofit turnkey solutions in close cooperation with the customer - from the very first enquiry - until the system is successfully delivered and the project complete. The main phases of a Wärtsilä turnkey project are:

Initial phase	Feasibility / concept engineering	Basic engineering; project planning; contractors' selection	Detailed engineering and procurement	Construction and installation	Approvals and commissioning
• Information collection: ship details and operating profile • Price indications (previous projects)	• Ship survey • Equipment configuration • Concept / GA Interfacing verifications • Feasibility report • Capex / opex estimates • Project outline	• Basic engineering • Preliminary approvals • Final project plan • Sub-contractors selection • Firm offer and contract for turnkey delivery	• Completion of basic engineering • Detailed engineering • Procurement • Drawings approvals from class • Installation preparations	• Equipment delivery for prefabrication / installation • Prefabrication • Installation works and site management	• Tests • Approvals from Flag/Class • Commissioning • Crew trainings • Hand over • Start of lifecycle support

WÄRTSILÄ

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Wärtsilä is a global leader in complete lifecycle power solutions for the marine and energy markets. By emphasising technological innovation and total efficiency, Wärtsilä maximises the environmental and economic performance of the vessels and power plants of its customers. Wärtsilä is listed on the NASDAQ OMX Helsinki, Finland.

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ENERGY
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