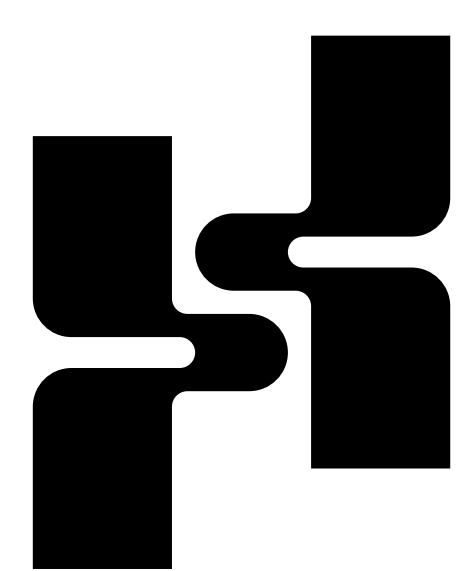


WASTEWATER TREATMENT

MEMBRANES BIOREACTOR (MBR) TECHNOLOGY



Hamworthy®

MEMBRANES BIOREACTOR (MBR) TECHNOLOGY



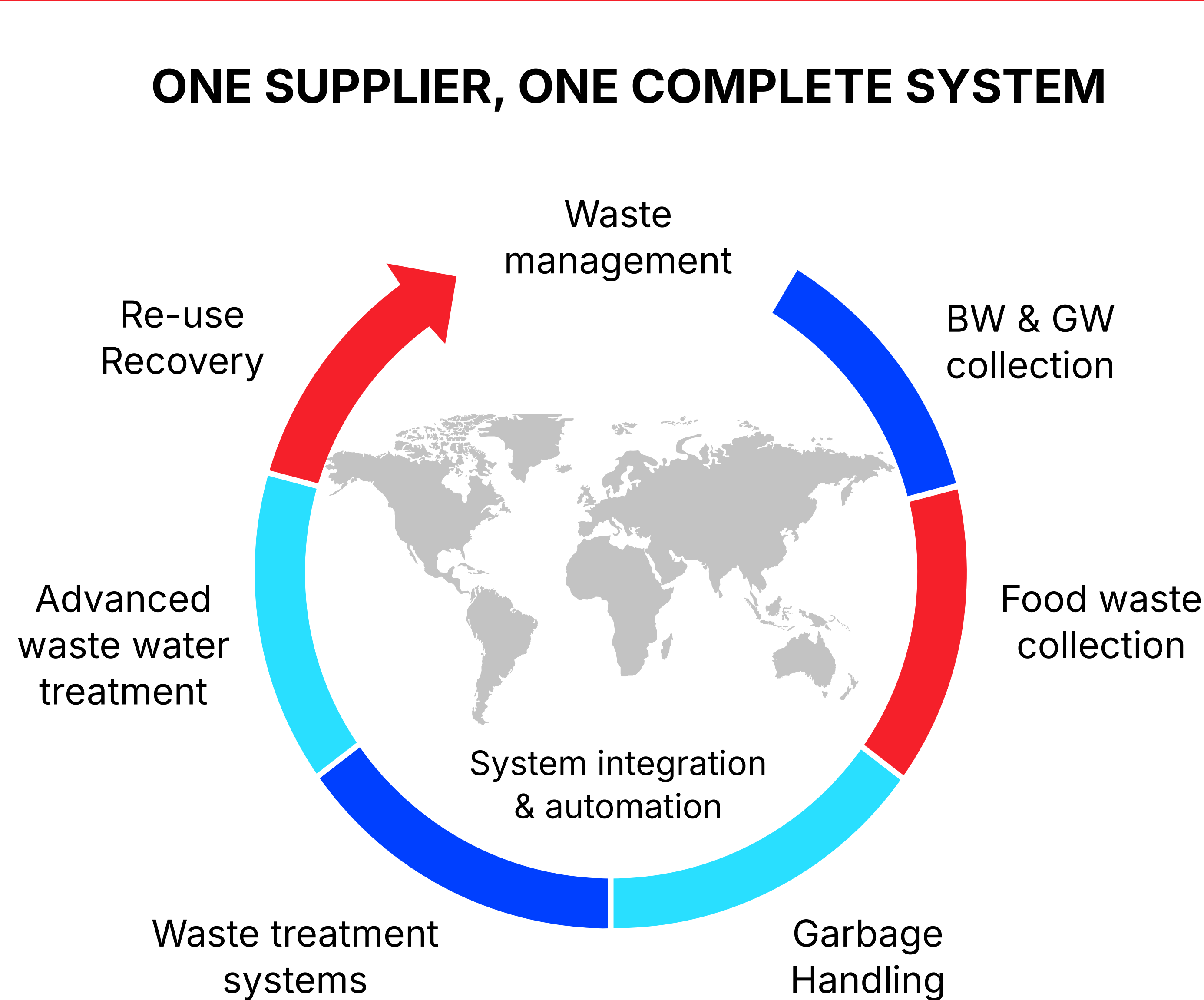
Hamworthy has supplied wastewater treatment systems to the marine & offshore market for over 50 years.

As environmental regulations continue to evolve, ensuring that your ship's effluent is clean and safe is an operational priority. Understanding and keeping up with these new, legislative requirements can be a challenge. Hamworthy has a proven track-record in developing technology that meets anticipated

environmental standards and has set the global benchmark in shipboard wastewater management.

The Hamworthy Membrane BioReactor (MBR) system is advanced, innovative technology which allows for the high purity treatment of black and grey water, satisfying the highest level of marine and offshore standards.

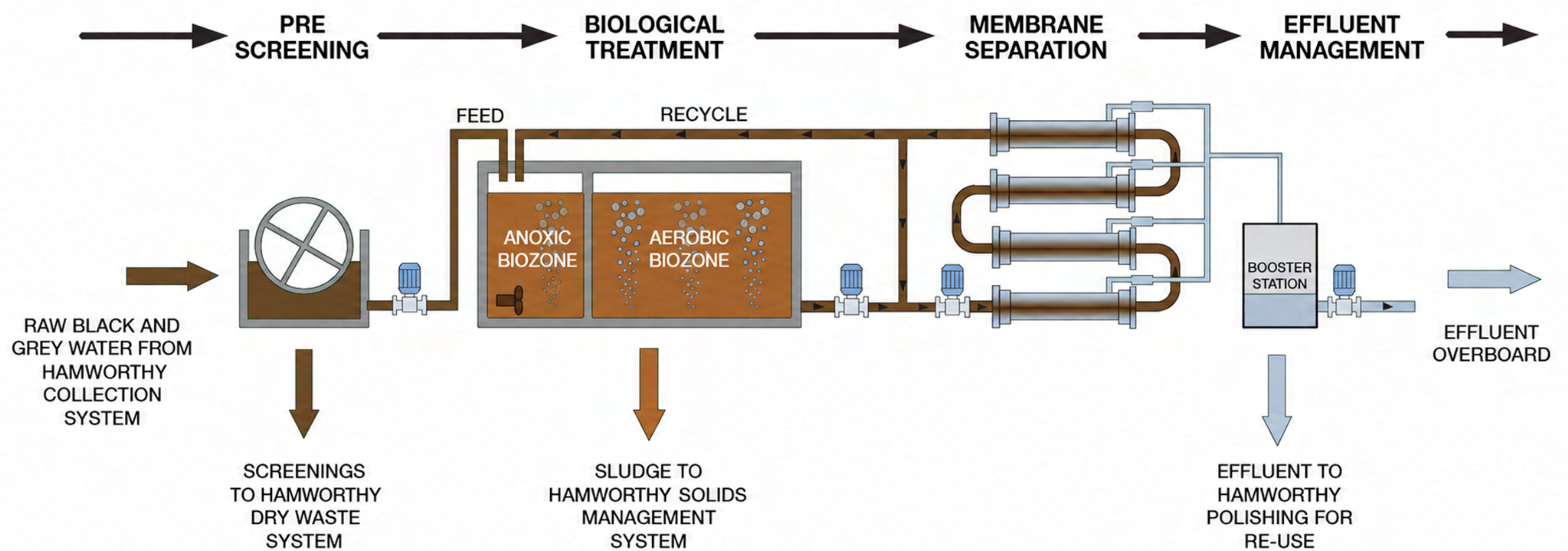
The system is based on biological degradation and membrane separation that allows for the treatment of black and grey water to satisfy the most stringent standards. The process produces the highest quality discharge, without requiring any addition or generation of chemicals.



CUSTOMER BENEFITS

- Minimal operation cost
- Modular designs
- Low chemical usage
- Simple operation
- Smallest footprint
- Low cost

Fig 1: Principle of operation



PRINCIPLE OF OPERATION

Black and grey water passes through the fine automatic pre-screen into the bioreactor where the active biomass degrades organic material. Biomass is circulated through ultrafiltration membrane

modules to produce a trans-membrane pressure and scouring velocity. Clean permeate is drawn from the membrane modules. The concentrated biomass is returned to the second stage bioreactor for discharge. Full automation delivers maximum efficiency and minimum man-hour input.

ULTRA FILTRATION MEMBRANE NODULES

Hamworthy utilises a side-stream cross-flow membrane configuration. The membrane module has robust GRP housing perfectly suited for the shipboard environment.

The module contains 336 ultrafiltration membrane tubes designed to achieve very high permeate production under the cross-flow scouring velocity with minimum risks of any blockage.

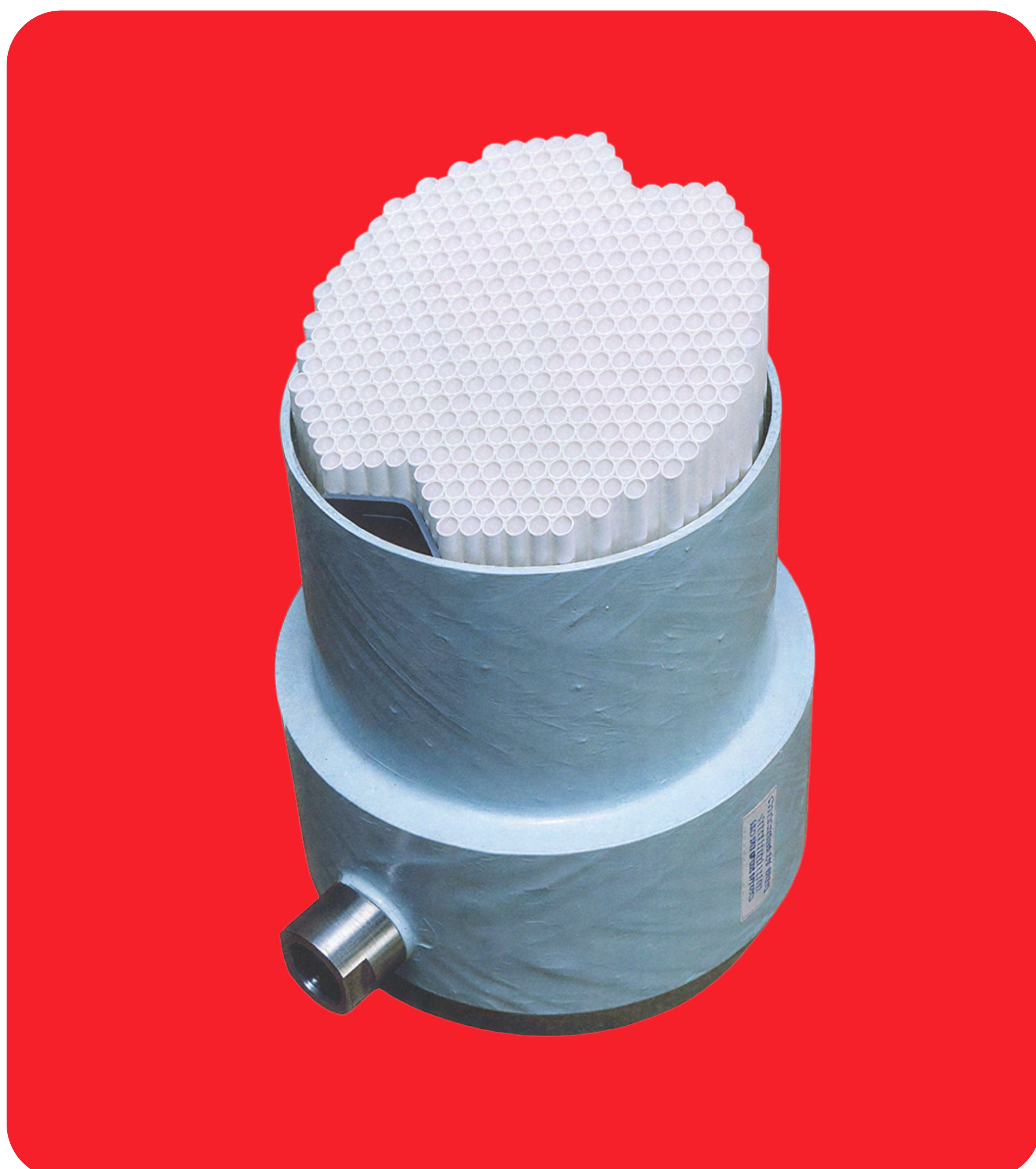
Continuous improvements in membrane flux rates now allow up to a 50% decrease in power requirement since 2010 designs, making the Hamworthy Water Systems MBR comparable in power to equivalent advanced waste water systems. Membrane integrity is visible and secured, with no odour emissions due to biological process.

The membrane permeate quality exceeds the most demanding coliform standards even without additional chemical or UV disinfection. The latest system optimisation further reduces energy consumption and operational man-hours.

BLACK AND GREY MANAGEMENT SYSTEM

The unique design of the Hamworthy MBR system enables an efficient black and grey water management system onboard cruise ships, allowing robust compliance operation worldwide, with future proof performance through a vessel's life.

This system offers even greater advantages in special areas such as the Baltic Sea, as compliant operation can be achieved with lower energy and chemical consumption compared to other alternatives.



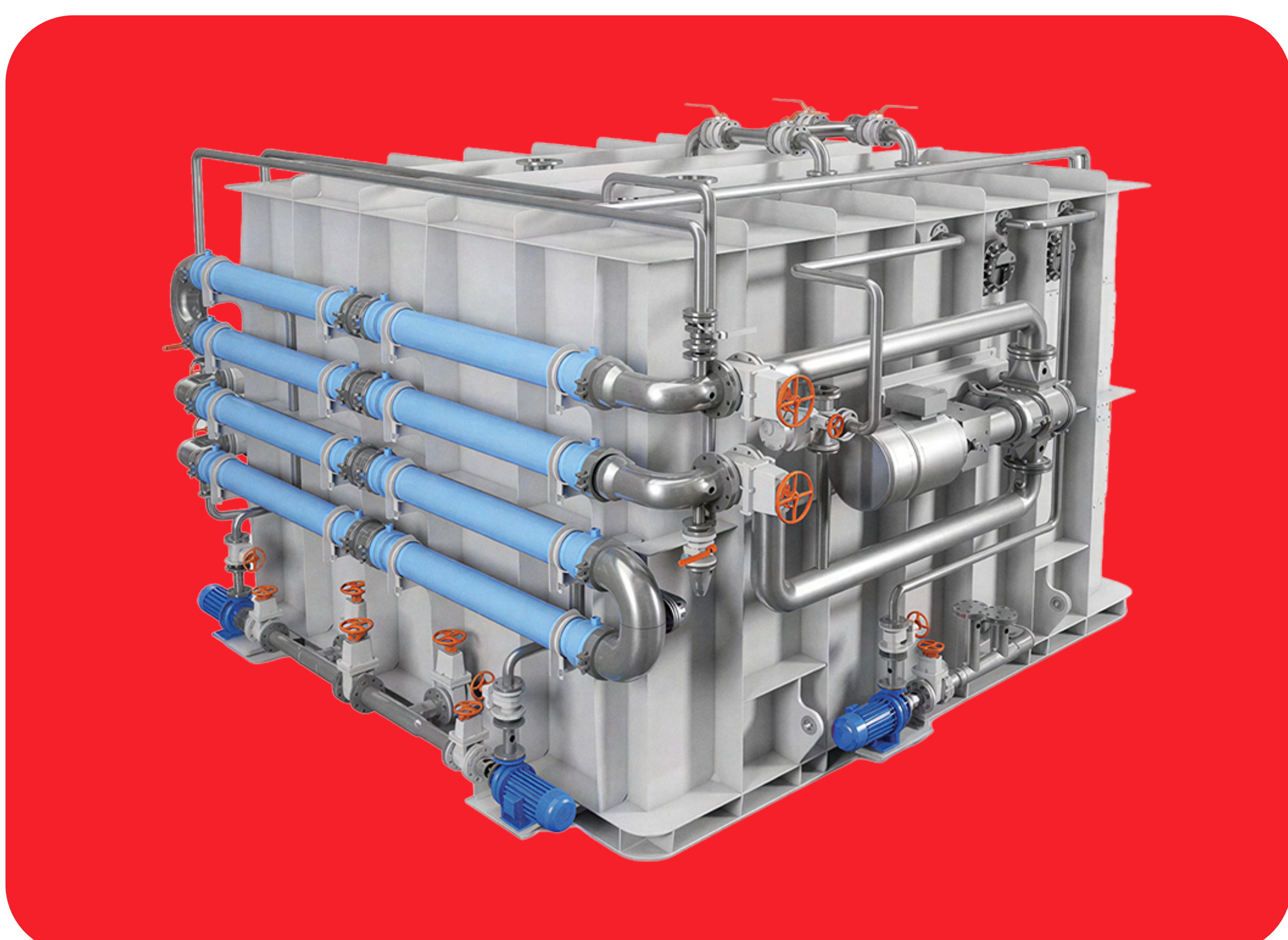


MARKET DRIVERS

- Environmentally clean.
- Lowest possible cost of ownership.
- Minimisation of size and weight.
- Meet and exceed the likely regulatory requirements for both new and existing installations.
- Maintain a more proactive public image.
- Ease of installation with modular designs.
- Simple design compared to submerged membrane or hybrid systems.
- Complete flexibility with newbuild, conversion and retrofit options.
- Remotely monitored by specialists.
- One supplier, one complete system.

REGULATORY

- Exceeds MEPC, USCG, HELCOM and Alaska effluent discharge standards.
- MED and IMO certified.
- IMO Regulations for the quality of black water discharges.
- EPA indications that grey water discharges will be regulated and monitored.
- MBR technology satisfies offshore discharge standards.
- Other national and regional regulatory requirements.



OPERATIONAL BENEFITS

- Simple design and operation compared to submerged membrane or hybrid systems.
- Safe, reliable operation with no coagulation, flocculation, chemical oxidants, or pH neutralisation.

EXPERIENCE & RECENT SUCCESS



MSC SEASIDE & SEAVIEW

With a complement of up to 6,592 people, both vessels saw the complete installation of two MBR24 plants.

Capacity: 1978 m3/day
Shipowner: MSC Cruises
Shipyard: Fincantieri



HMS OCEAN

Hamworthy won a contract to retrofit the UK Navy's landing platform, HMS Ocean. It was fitted with a single MBR12 plant, serving up to 1100 people on board.

Capacity: 302 m3/day
Shipowner: UK Navy
Shipyard: BAE Systems



SAFE ASTORIA

Prosaf awarded Hamworthy the contract to build an MBR4 plant for the accommodation rig, Safe Astoria, which is fully designed to operate in sensitive areas such as Russia's Sakhalin Island.

Capacity: 82 m3/day
Shipowner: Prosaf Offshore
Shipyard: Turnkey Retrofit

SUPPORT THROUGHOUT THE ENTIRE LIFECYCLE (AFTERSALES, SERVICE & SUPPORT)

Hamworthy supports its customers throughout the lifecycle of their installations by optimising 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 optimisation, staff training, 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 more than 70 countries worldwide and provide original spare parts for all of our waste management systems, ensuring prompt service and delivery to minimise downtime.

TESTIMONIALS

Hamworthy continues to optimise the MBR system design. By building on successful experience and working closely with customers, we have introduced the MBR Mk II and Mk III systems across the wider marine and offshore sectors.