RWO

Sewage Treatment

MARINE WATER TECHNOLOGIES

CleanSewage-BIO Biological Sewage Treatment

RWO

Sewage Treatment With Minimal Efforts

CleanSewage-BIO is a compact, type approved marine Sewage Treatment Plant (STP) for cargo vessels. With an incorporated Moving Bed Bio-reactor (MBBR), the CS-BIO requires minimal pro-cessvolume, still meeting the IMO MEPC.227(64) discharge criteria.

CS-BIO is designed for easy maintenance and ope-ration. With the intuitive status control, operators can check at a glance, whether the system is run-ning smoothly or intervention is necessary. The hygienic no-touch-cleaning system for sludge dis-charge makes maintenance nearly effortless.

The accessibility from one side allows ship desig-ners to plan space in the engine room on a whole new level.

CS-BIO compact biological sewage treatment

How it Works

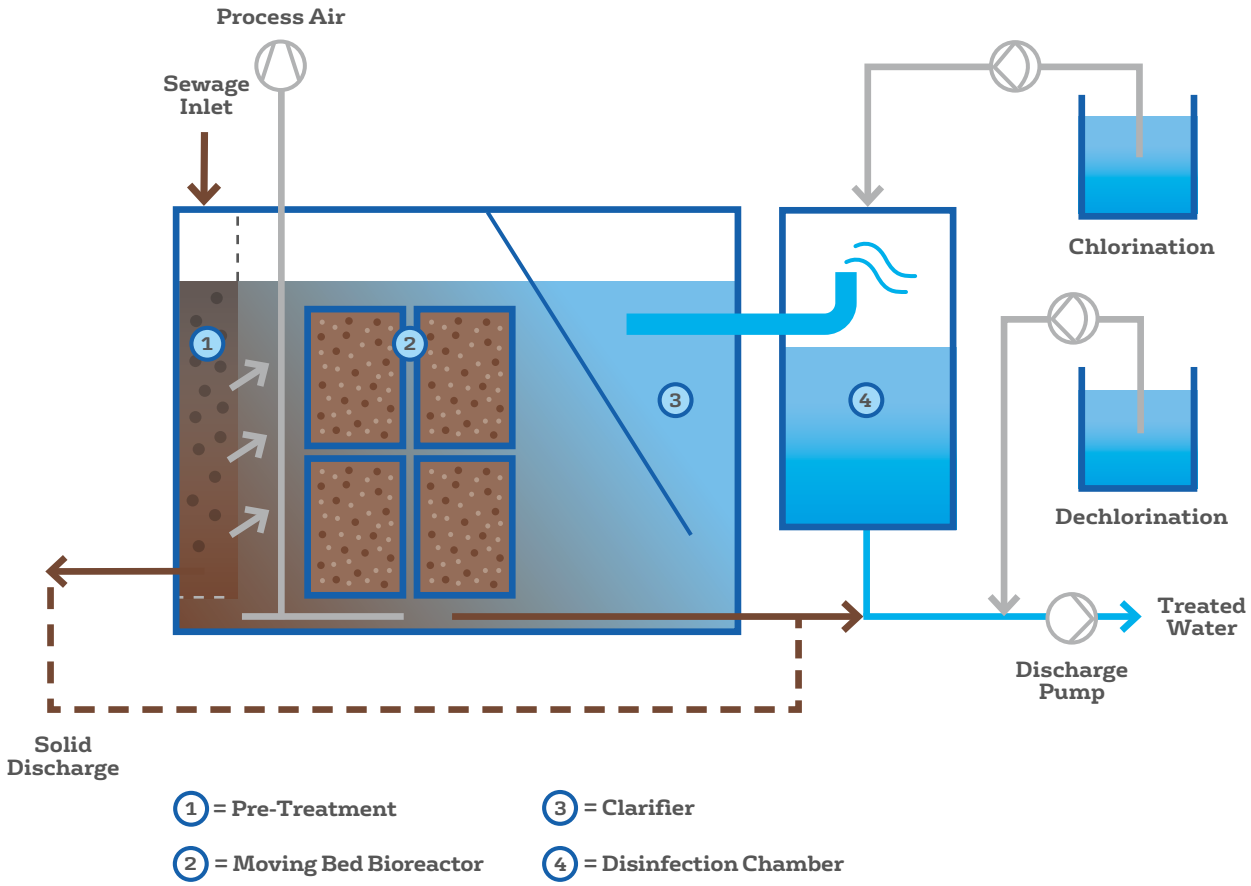
CleanSewage-BIO combines mechanical pre-treatment (screening), biological treatment by activated sludge (AS) with moving bed biofilm technology (MBBR) and solid separation via clarifier in the same tank. Compared to an activated sludge system, CS-BIO is a high efficiency solution for the removal of organic matter with very low sludge production due to the biofilm technology.

1. As a first step the sewage is separated from heavier solids and particles by a screen, thus preventing clogging or damages in further process steps.

2. In the biological stage, bacteria degrade organic matter into carbon dioxide and water. These bacteria grow as a biofilm on the carriers in the so-called moving bed. Aeration is applied both for the suspension of the biofilm carriers and the oxygen supply of the bacteria. As a natural process, bacteria accumulate in the system and form sludge flocs (also called excess sludge) which can be collected and disposed according to national and international laws.

3. In the clarifier residual solids and suspended activated sludge are separated by sedimentation and turned back into the biological chamber. The clean sewage flows into the disinfection chamber.

4. In the disinfection chamber a chlorine-based chemical is added to reduce bacteria to a minimum level. The clean water is then pumped overboard. To meet the limit values set for the chlorine content, a neutralising agent is dosed prior to the discharge pump.



Key Features & Benefits

Safe
- Integrated mechanical pre-treatment
- No harmful or flammable chemicals
- Certificate of Type Approval for Sewage Treatment Plants according IMO MEPC.227(64) issued under the authority of the Federal Republic of Germany by BG Verkehr

Small
- No holding tank necessary
- Up to 25 % less space demand through unique one-side access

Easy to operate
- No-touch-system for hygienic sludge discharge
- 100 % control through individual switches for every component
- Fast restart after maintenance due to biomass carrier in cages

- **Suitable for black & grey water**
- **Compatible with all vacuum systems**

CS-BIO	Organic Load	Hydraulic Load	Dimensions L x W x H	Weight	
Size	kg/d BOD_5	m^3/d	mm	Net kg	Wet kg
02	1.38	2.16	2095 x 1250 x 1480	859	2923
03	2.07	3.24	2608 x 1346 x 1612	1149	4134
04	2.76	4.32	2559 x 1646 x 1618	1335	5293
05	4.15	6.48	2781 x 1656 x 2058	1627	7407
06	5.53	8.64	3365 x 1656 x 2058	1885	9278
07	6.91	10.80	3365 x 1986 x 2058	2121	11719

Grease Interceptor for CleanSewage-BIO

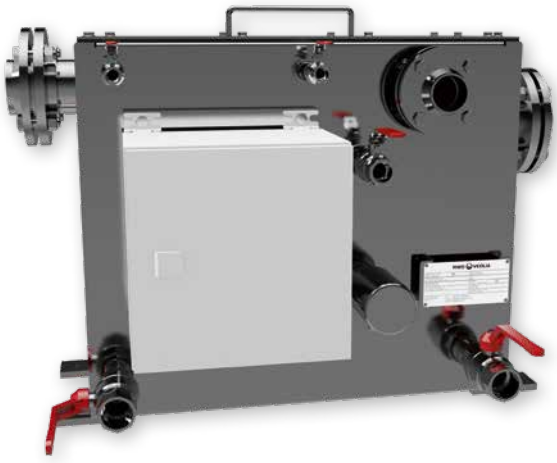
RWO

State-of-the-Art Galley Water Pre-Treatment

Waters originating from ship galleys contain grease, fats, oils and food waste. The Grease Interceptor works using the principle of gravity; Substances heavier than water settle down while lighter substances, such as grease and oil, rise. Galley water pre-treated in the Grease Interceptor can then be fed to RWO's wastewater treatment systems for further treatment. The system is part of RWO's **Total Water Management** offer.

Design

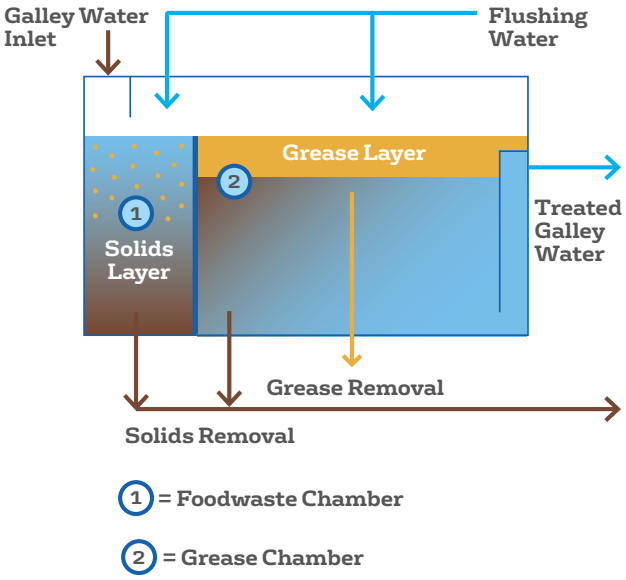
- Compact and robust design in stainless steel 316Ti
- Two-chamber process, designed in accordance with DIN EN 1825-1:2004
- Cleaning-in-place (CIP) philosophy
- Optional: An electrical heating system for grease removal and a 360° spraying system for flushing for minimal maintenance effort



Grease Interceptor for galley waste water pre-treatment

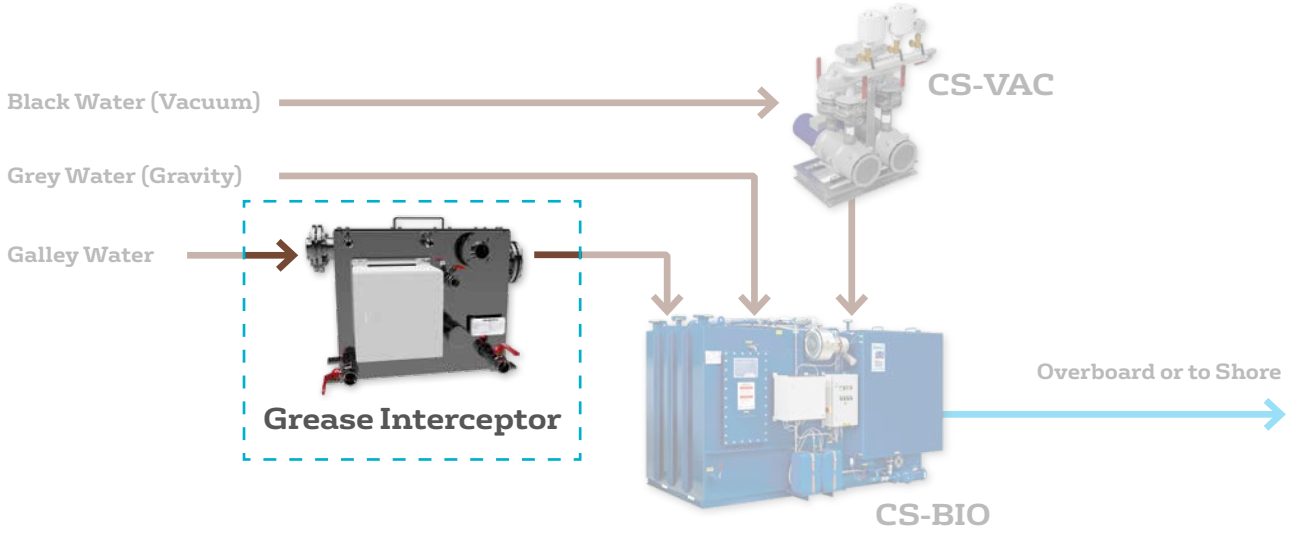
How it Works

The Grease Interceptor separates particles, fat, oil and grease (FOG) acc. to their density. It consists of a foodwaste and a grease retaining section. While heavier particles settle down and are collected in the lower section of the foodwaste chamber, grease and oils float on the upper part of the grease chamber.



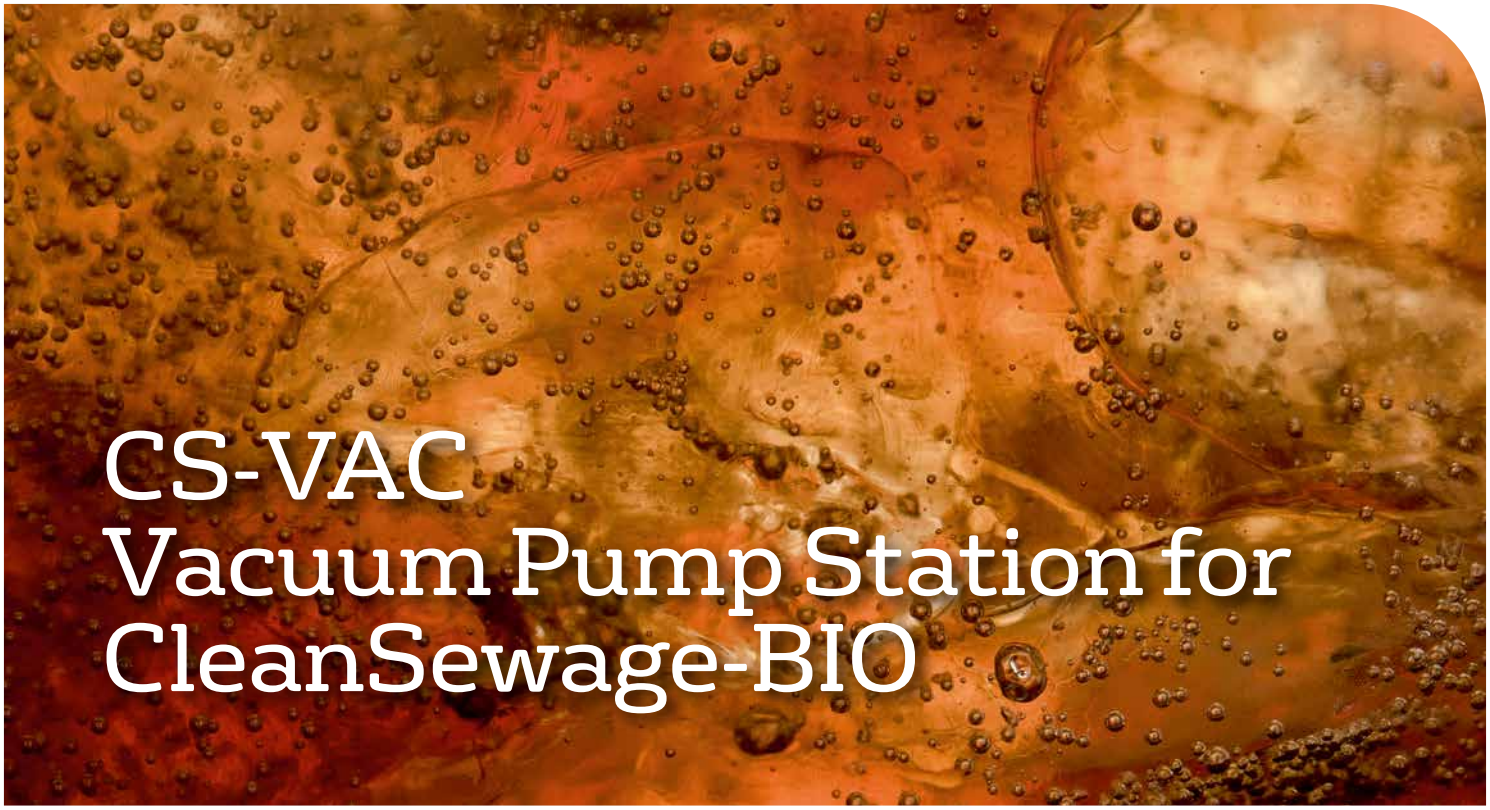
Key Features & Benefits

- Easy removal of solids and grease (dispose onboard or ashore)
- Legal and safe operation while discharging
- Expected lifetime exceeds industrial average even with difficult, acidic or super-alkaline waters
- No consumables required for operation
- No bad odour during normal maintenance
- Accessibility from one side only



Type	# People	Collection Capacity		Dimensions L x W x H	Weight	
GI	On-board	Grease l	Sludge l	mm	Net kg	Wet kg
20	up to 20	6.2	15.5	832 x 360 x 661	55	142
50	up to 50	13.4	33.5	902 x 460 x 661	73	213
100	up to 100	20.8	52	1132 x 580 x 661	91	296

According to: MARPOL 73/78 Annex V

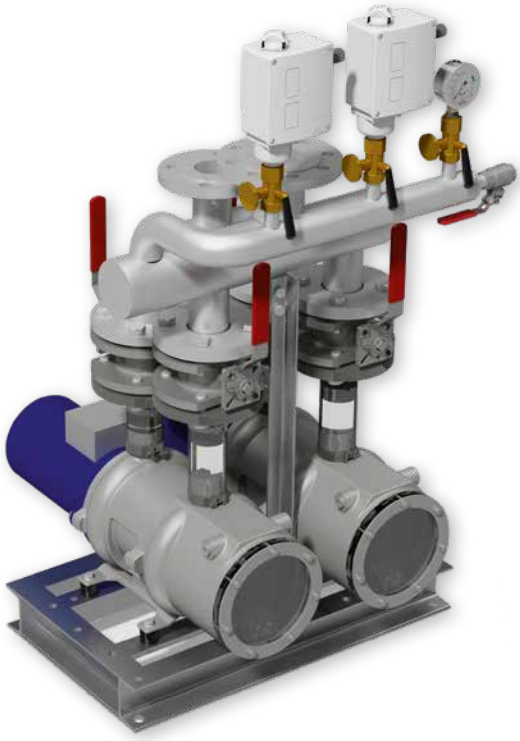


CS-VAC Vacuum Pump Station for CleanSewage-BIO

RWO

Efficient Solution for Sewage Pumping

The CleanSewage Vacuum Pump Station combines energy efficient vacuum creation, sewage maceration and pumping in one compact, skid-mounted device ready for installation on your vessel. The CS-VAC is the perfect match for RWO's CleanSewage treatment systems or any other STP, for new buildings as well as for retro-fittings. It has been developed for customers with a special demand on novel and sustainable sanitary systems.



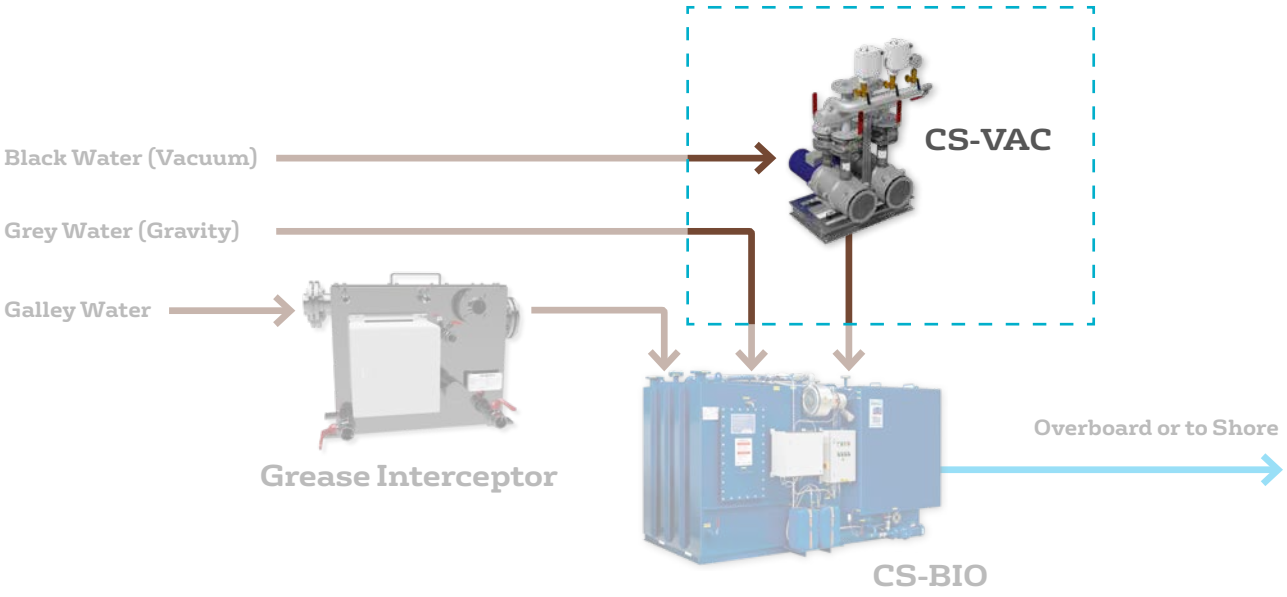
Vacuum maceration pump station for marine sewage treatment plants

How it Works

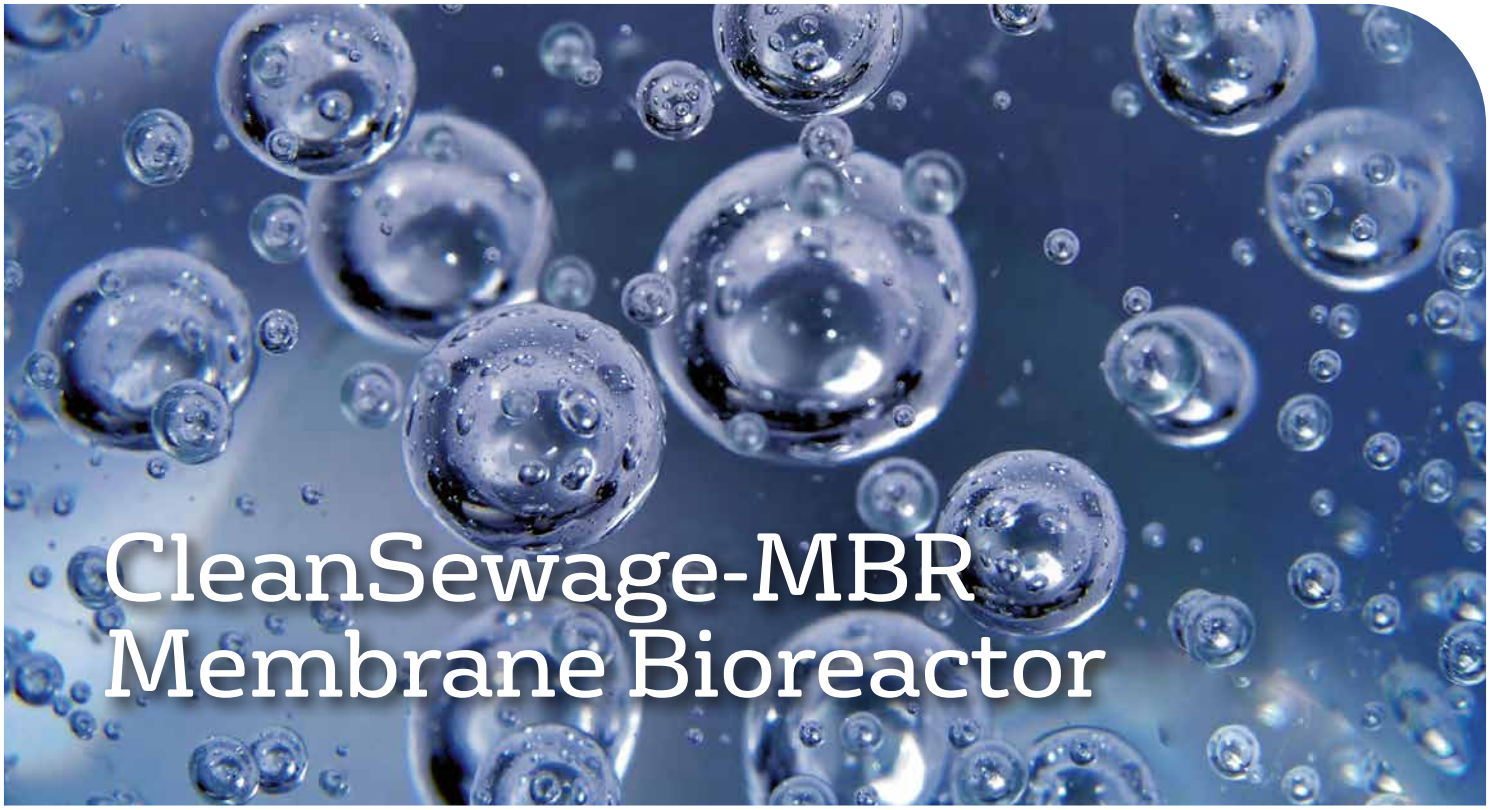
With it's integrated and proven cutting technologie CS-VAC is able to pump every combination of grey and black water. Insensitive to plait formation, the system only requires a minimum effort for operation and maintenance. Designed on the general principle of redundancy, the unit ensures a stable vacuum even if the installation on board is not directly close to the sewage treatment plant. An inspection glass at the pump's cutting system allows easy troubleshooting of the vacuum system. The pump station comes already mounted on a foundation with all internal piping, valves and wiring. Process control allows flexible adjustment of the system parameters based on the geometry of sewage collection piping system and user pattern.

Key Features & Benefits

- Compact, efficient solution for sewage pumping
- Proven cutting technology
- Swirler prevents plait formation
- Easy maintenance
- Easy troubleshooting due to inspection glass
- Easy replacement of wear parts
- Premium energy efficiency IE3



Frequency Hz	Air flow rate m³/h @ 0.5 bar	Max. flow rate water m³/h @ 2 m	Flushing rate 1/h
50	6	5	120
60	7.1	6.5	150



CleanSewage-MBR Membrane Bioreactor

RWO

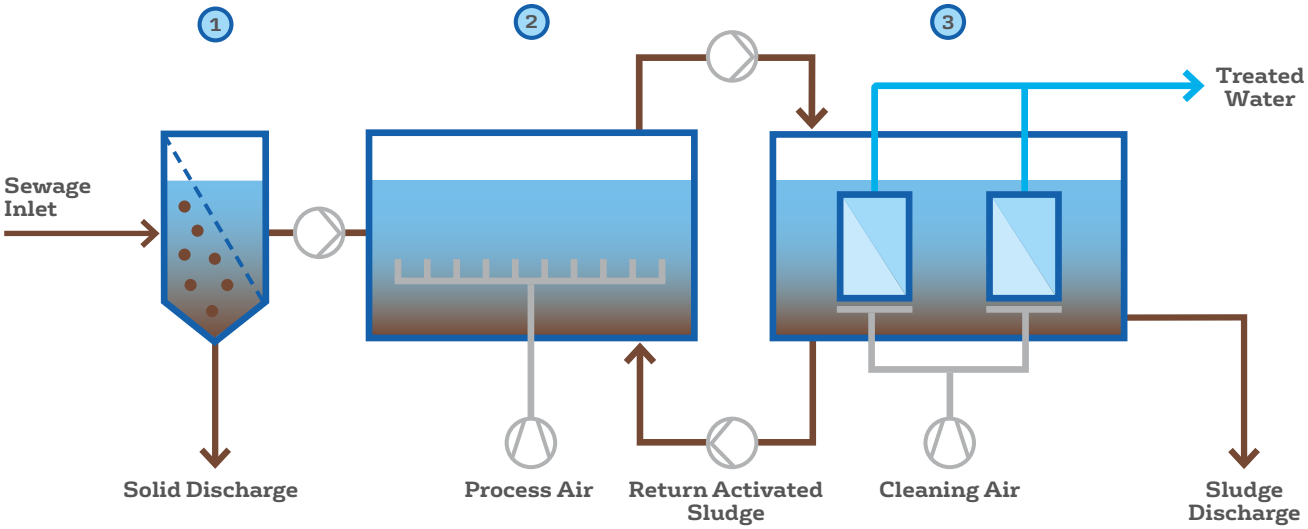
Advanced Wastewater Treatment for Passenger Ships

With the CleanSewage Membrane Bioreactor (CS-MBR) RWO Veolia has developed an advanced wastewater treatment (AWT) system fit for the requirements of sustainable passenger shipping as well as other high-standard applications. The CS-MBR is type approved according to the regulation IMO MEPC.227(64) including chapter 4.2 for nitrogen and phosphorus removal within special areas.

CleanSewage Membrane Bioreactor: Advanced Water Treatment from RWO

Sustainable Biological Treatment

CS-MBR is the successor of the MEMROD-Series, RWO's renown advanced water purification plant, with higher effluent quality and several operational advantages. The treatment process is divided into three steps: Solids are removed in the mechanical pre-treatment, pollutants are degraded in the biological stage and in a last step, a membrane barrier ensures absolutely reliable separation of solids, including microplastics. The submerged membrane system with extremely high mechanical strength and automated cleaning mechanism control make CS-MBR easy to operate and ensure long lifetime. The biological treatment process offers low OPEX due to low energy demand, low use of chemicals and thus a low production of solid byproducts/wastes.



1 = Mechanical Pre-Treatment

2 = Bioreactor

3 = Membrane Reactor

How it Works

The CS-MBR is based on a sustainable biological treatment technology that can be divided into three major process stages:

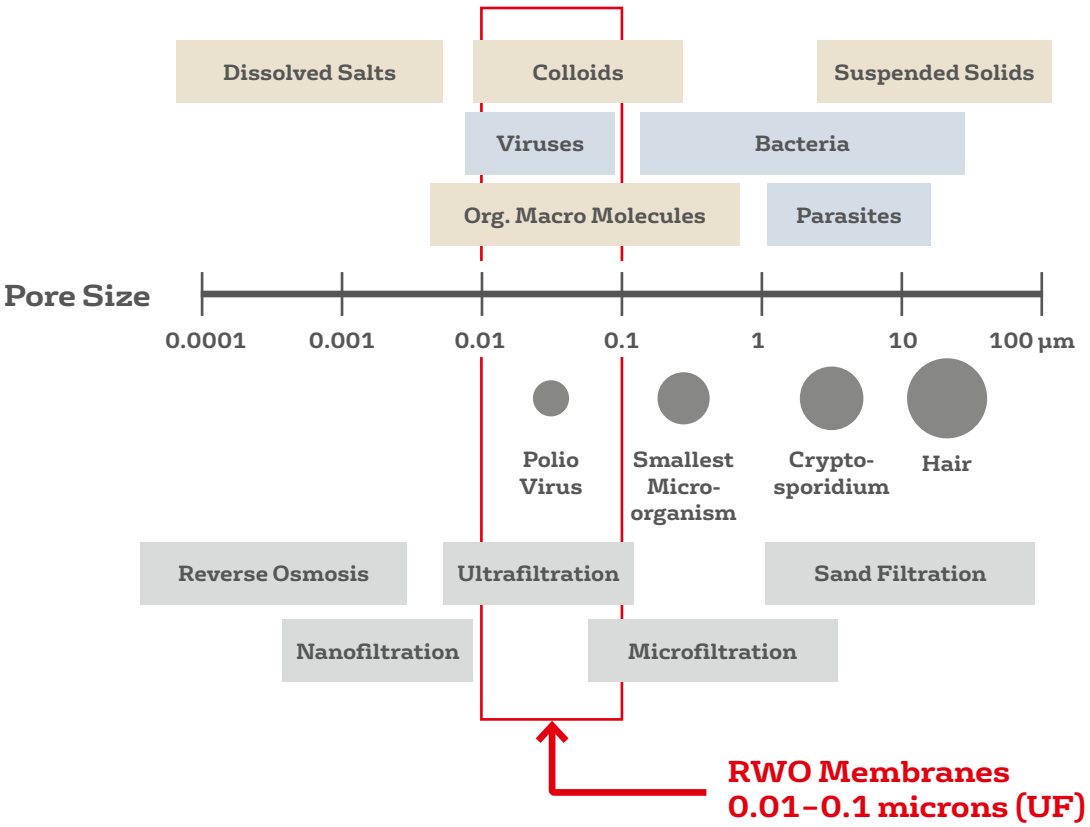
- Mechanical pre-treatment
- High Performance Activated Sludge Biological Treatment
- Submersed Ultrafiltration (UF)

These modular technologies can be combined and scaled to meet individual customer requirements.

1. In the first stage, solids are removed from all incoming waste waters (blackwater, greywater from galley, accomodation, laundry, etc.). Grease separation for the galley water treatment can be added on demand.

2. The second stage consists of a high performance activated sludge process: Controlled by intelligent aeration design, bacteria remove organic pollutants, nitrogen and phosphorus from the wastewater. To achieve minimum phosphorus concentrations in the effluent, excess phosphorus is precipitated by adding coagulant.

3. In the third stage of the process, the clean water is separated from the activated sludge via a submerged membrane. While the water can pass through the membrane, sludge, bacteria, viruses and microplastics are held back as shown below. The result in downstream water is clear, free of solids and already disinfected.



Key Features & Benefits

MEPC 227 (64) compliant including special areas

- Certificate of Type Approval for Sewage Treatment Plants according IMO MEPC.227(64) issued under the authoity of the Federal Republic of Germany by BG Verkehr

Low Footprint

- Due to high performance activated sludge process and integrated solid separation

Minimum Maintenance Work

- Automated membrane cleaning
- extremely high mechanical strength of the membranes
- Safe process design
- User-friendly and intuitive operation

Sustainability and low OPEX

- Membrane barrier removes more than 99 % of solids including microplastic
- Removal of bacteria and viruses – no chlorination needed
- No use of flocculants or chemicals for disinfection necessary
- Low energy consumption and decreased use of chemicals
- Low excess sludge production

CS-MBR is designed to minimize your vessel's impact on the marine environment. The advanced water treatment plant provides highest effluent qualities as described in table (see table) and thus exceeds the requirements of the International Marine Organization (IMO MEPC.227(64) incl. 4.2).

With our disinfection – add-on, even higher effluent standards as for example required for discharge in marine waters of the state ALASKA. Additional class notations like BV Clean, BV CleanSuper, DNV-GL CleanDesign and AWT-A/B can be issued on request.

Parameter	COD	BOD	TSS	TC	pH	TN	TP
Description	chemical oxygen demand	biological oxygen demand	total suspended solids	thermo-tolerant coliforms	–	total nitrogen	total phosphorous
Unit	mg/l	mg/l	mg/l	cfu/100 ml	–	mg/l	mg/l
Value	50	≤ 5	≤ 5	100	6.5–8.5	≤ 20	≤ 1

CS-MBR effluent quality exceeding IMO MEPC 227(64) requirements for special areas.