



BALLAST WATER MANAGEMENT SYSTEM



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Background



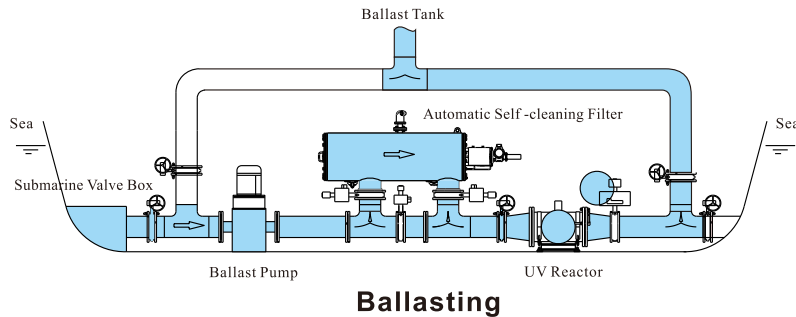
PACT is a multinational water treatment company with Marine & Offshore as well as Onshore Water Treatment Divisions, focusing on areas such as marine & offshore water treatment, seawater desalination, municipal wastewater, industrial wastewater and potable water treatment, with the majority of clients coming from Fortune 500 enterprises.

Leveraging on its rich water treatment, mechanics, automation expertise and experience, PACT MARINE™ Ballast Water Management System (BWMS) was developed in-house, utilizing a 40µm self-cleaning filter combined with Medium Pressure Ultraviolet (MPUV) disinfection technology, with simple structure, superior performance, with design allowance capable of meeting more stringent discharge standards. As a result, it can offer a wide-range (50-4,000 m³/h) ballast water management solution to clients. In addition, we can supply Ballast Water Port Reception and Treatment Facilities for port clients (For more details, please refer to the catalogue).

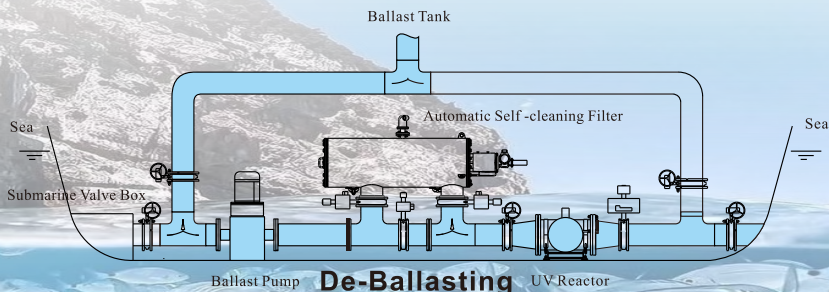


System Principles

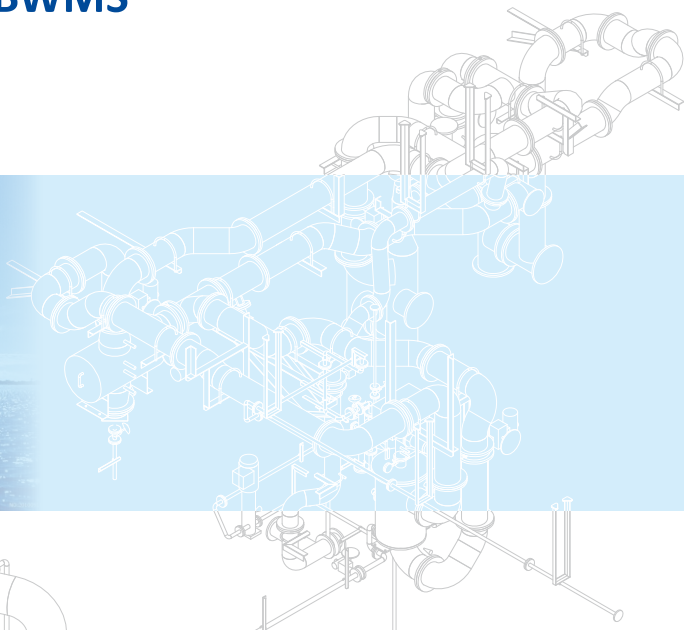
During the ballasting process for vessels, ballast water enters into the BWMS via the ballast pump, passes through the self-cleaning filter and MPUV reactor successively for treatment, and finally flows into the ballast tank. Large-size inorganic particles, most of the zooplankton and phytoplankton (such as alga) can be removed in the filter, to ensure the effectiveness of downstream MPUV disinfection. Thereafter, 200-280 nm wavelength UV irradiation of the MPUV reactor achieves disinfection and inactivation of the residual plankton, bacteria and viruses in the ballast water by damaging the genetic materials.



During the de-ballasting process, ballast water from various ballast tanks flows into the BWMS via the ballast pump by way of the valve and pipe system, directly enters the MPUV reactor, and then is discharged overboard. During the process, water does not enter the filter, so as to prevent the inactivated microorganisms from photoreactivation repair or secondary reproduction in the ballast tanks.



Features



◆ *Simple & Flexible*

The system has a simple structure, and is easy to install, operate and maintain. According to the space requirements, different delivery ways can be adopted.

◆ *Stable & Reliable Performance*

The system has stable and reliable performance, because of its advanced backflush filtration technology, core parts made of high-grade materials and critical components of the first-tier brands.

◆ *Design Allowance to Meet More Stringent Discharge Requirements*

The system has sufficient UV design allowance and can meet higher regional discharge standards when operating in high-power mode.

Power-saving mode, which allows the system to automatically adjust the ultraviolet radiation intensity according to the incoming water quality.

Suitable for various vessel types (bulkers, container ships, passenger ships, oil tankers, chemical tankers and other special purpose vessels).

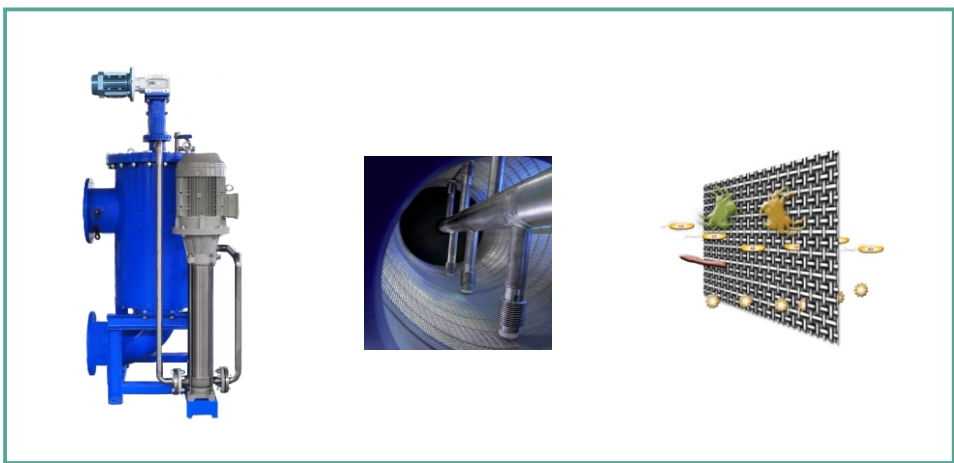
Self-Cleaning Filter

The operational stability and the treatment capacity of the BWMS largely depend on the performance of the filter. The system is equipped with a 40 µm high-precision self-cleaning filter. On one hand, the design ensures excellent filtering performance of the filter and minimizes the entry of plankton and sediment into the ballast tank. On the other hand, high-precision filtration ensures the efficient use of subsequent UV sterilization, greatly improving the treatment performance of the entire system ultimately. The filter housing and the mesh screen are made of duplex stainless steel 2205 and 2507, respectively, with a service life of over ten years under normal maintenance and servicing conditions. The unique mesh screen structure and sewage mechanism design greatly enhance the self-cleaning function of the filter under the backflush action of the high-pressure backflush pump, thereby enabling the entire system to cope with the challenges of poor water quality.

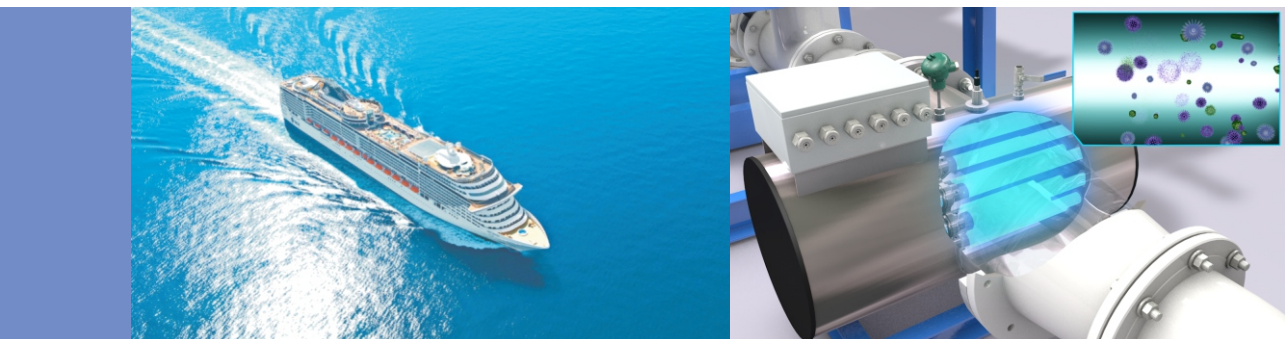
- ◆ High-grade material, long service life.
- ◆ Unique Filter structure ensuring high removal rate.

Specifically, 96% zooplankton (>50 µm) removal; 50% phytoplankton (10-50 µm) removal; 98% total suspended solids (TSS, 2,500 ppm influent) removal.

- ◆ Filter unit continues filtration even during the automatic backflush operation. The filter is not liable to blockage, thanks to the high pressure of the backflush pump.
- ◆ Short ballasting/de-ballasting time.



Medium Pressure Ultraviolet (MPUV) Reactor



Being a developed water disinfection technology, ultraviolet disinfection does not produce chemical substances or pose an occupational hazard to crews, and is safer and more economical and environmentally friendly than others. The UV design dosage reflects the biological inactivation ability of a UV reactor. There are many UV reactors with different UV dosage designs on the market. By adopting a UV reactor with a large UV dosage design redundancy, clients not only do not have to worry about sampling and inspection by the port state prosecutors, but also can avoid possible requests of subsequent system upgrades.

The BWMS system adopts a unique UV design concept to achieve the following two advantages. Firstly, in economical mode, the system automatically adjusts the UV output based on water volume and quality. In view of the design concept of high efficiency UV output, the system is more economical and power-saving when compared to ordinary UV reactors. Secondly, the UV dosage configuration of the system has redundancy, so that in high power performance mode, it can meet relatively stricter ballast water discharge standards. As a result, it can meet higher environmental requirements of certain sea areas without the need to upgrade or modify the system.

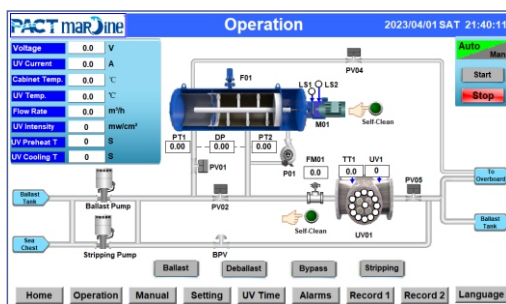
- ◆ High environment adaptability, not affected by water quality parameters such as temperature, pH or salinity.
- ◆ Equipped with a temperature monitor to set off an alarm and shut down the system in case of abnormal operation, so as to protect the system.
- ◆ Equipped with a second generation ultrasonic self-cleaning mechanism, which effectively prevents the formation of biological and inorganic scales on the surface of the quartz lamp sleeve, and has a significant removal effect on the water scale.
- ◆ Visual design of UV lamp working status in the Human-Machine Interface(HMI), allowing timely and accurate fault diagnosis and facilitating UV lamp replacement.
- ◆ Chemical-free operation, safe for the crews and the vessels.

Control Unit

Validated by stringent environmental and electro-magnetic compatibility (EMC) tests, the electrical panel is able to withstand various challenging ambient conditions, such as extreme temperatures, humidity, vibrations, inclination, and electromagnetic interference. The electronic components are of famous brands, stable and reliable, and purchasable worldwide for replacement. Its Human-Machine Interface (HMI) is designed with comprehensive functions, rich contents, clear logic, and beautiful and simple style, and is easy to understand and operate. The system can operate automatically or manually, automatically monitoring and recording all key operating data and parameters. In case of abnormal operation, the system will trigger an audible and visual alarm. In emergency, the system will automatically stop operation.

Functions including, but not limited to,

- ◆ Real-time monitoring of key parameters: voltage, current, temperature flow rate, UV intensity, filter differential pressure.
- ◆ One button startup of all operation modes (Ballast, De-ballast and Bypass and Stripping), for automatic running.
- ◆ Multilevel automatic control and protection design, that is, automatic system shutdown when the PLC program or sensors fail.
- ◆ Filter self-cleaning by Auto/Manual control.
- ◆ UV quartz sleeve self-cleaning by Auto/Manual control.
- ◆ UV power consumption being automatically adjusted to match the treatment capacity.
- ◆ UV lamps lifetime recording.
- ◆ Alarm and emergency shutdown in case of various abnormal operations.
- ◆ Key parameters settable for operation & maintenance.
- ◆ Operating BWMS with different limits of access.
- ◆ GPS signal accessing and processing for vessels.
- ◆ Automatic recording and alarming for bypass operation.
- ◆ External remote communication protocol and interface: Modbus RS 485, or Ethernet.
- ◆ Remote operation and remote data transfer.
- ◆ Critical data recording, storage time not less than 36 months (USB).
- ◆ Chinese-English language options on HMI.



System Models & Specifications

Model: P-50 ~ P-4000 (Explosion-proof Type as Optional)
Power Supply: 380-440 VAC/3 PH |50/60 HZ
Treatment Capacity: 50-4000 m³/h
Design Pressure: 8 bar
Influent Pressure: Over 1.0 bar
Pressure Drop: 0.1-0.5 bar
Valve Actuation: Electrical/Hydraulic/Pneumatic (Options)
UV Self-Cleaning: Advanced Ultrasonic Descaling Technology
Flexible Installation Options:
 -Totally Loose Components Supply (“L”) ;
 -Distributed Mounting Proposal (“D”)
 -One Skid Mounting Proposal (“S”)
 -Containerized Fitting-On-Deck Type Proposal (“C”)



Model	Rated Treatment Capacity (RTC m ³ /h)	Customized Design for Installation	UV Power Rating (kW)
P-50	50	L/S/D/C	12
P-100	100	L/S/D/C	18
P-150	150	L/S/D/C	24
P-200	200	L/S/D/C	36
P-300	300	L/S/D/C	48
P-500	500	L/S/D/C	72
P-750	750	L/S/D/C	84
P-1000	1000	L/S/D/C	108
P-1250	1250	L/S/D/C	132
P-1500	1500	2x P-750	2x P-750
P-2000	2000	2x P-1000	2x P-1000
P-2500	2500	2x P-1250	2x P-1250
P-3000	3000	3x P-1000	3x P-1000
P-4000	4000	4x P-1000	4x P-1000

How to Select A BWMS

Vessel Design Institutes, Dockyards & vessel owners are advised to consider the following factors when deciding on the type of BWMS:

◆ Suitability

By considering the spatial location of the engine room, the pump room, and the deck of the vessels, and the load capacity requirements, they can ensure that the vessel meets the space and power consumption requirements of the selected BWMS. In addition, they should ensure that the rated treatment capacity of the selected BWMS can meet the matching requirements of the ballast water pumps. For vessels such as oil tankers and chemical tankers, they must consider selection of explosion-proof BWMS, and whether both the engine room and the pump room need to be equipped with BWMSs at the same time, to meet with IMO BWM conventions.

◆ Reliability

The material grade of components plays a crucial role in the long-term stable operation of BWMS, including but not limited to filters, UV reactors, various electrodes and sensors. All important components of our BWMS are of the world's leading brands, with a long service life and the same standard products for replacement available on the global market at any time. In addition, the design logic of the equipment operation mode is clear, internal units are linked intelligently, and the operation is simple, safe, and reliable.

◆ Ease of Operation

The BWMS has simple structure and composition, convenient and rapid installation, readily understandable operation, clear fault feedback, and convenient component replacement. The high degree of automation in equipment design reduces human intervention. The manufacturers can remotely provide online software modification and upgrade services for clients.

◆ Economic performance

In addition to one-time equipment investment costs, comprehensive consideration should also be given to the service life of the equipment, the degree of manual intervention, the consumption and cost of consumables, the global availability of spare parts, and other hidden losses caused by the high failure rate of the equipment.



Influencing Factors



Primary factors influencing the choice of BWMS are vessel & route factors.

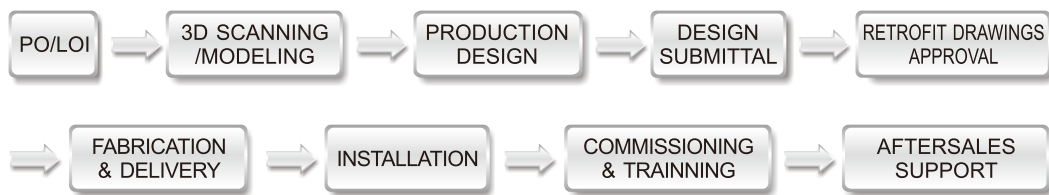
Vessel Factors: Different vessel types have varying dependence on ballast water. For ships with large-volume ballasting or de-ballasting requirement in a short time, equipment with instantaneous inactivation treatment should be selected. For some aging ships with small space in their engine rooms or pump rooms, clients should select BWMS with simple structures, few pipeline modifications, and small equipment footprint. If there is no suitable space in the engine room or pump room, we can also provide containerized BWMS to be installed on the deck. Many of our similar successful cases have been recognized and approved worldwide by relevant classification societies. Some BWMSs require a large amount of chemicals and consumables to be stored on board, which also requires the attention of the ship owners.

For special ships such as oil tankers and chemical tankers, it is necessary to consider whether to select explosion-proof equipment and determine the corresponding explosion-proof level. However, if the BWMS will be installed in the engine room, explosion-proof equipment may not be selected, because positive pressure explosion-proof BWMS not only consumes a large volume of compressed air, but also poses more challenges to crews during operations. In addition, explosion-proof equipment also has higher requirements for electrical installation on ships.

Route Factors: Compared to equipment with other principles, UV technology is not affected by changes in seawater temperature or salinity, and suitable for all route needs. PACT MARINE BWMS adopts advanced ballast water filtration and backwashing technology, and the UV reactor has sufficient UV dosage to deal with water quality with high turbidity. Due to unilateral actions taken by some countries or regions where requirements of ballast water management are higher than IMO standards, it is advisable to select BWMS that meets higher discharge standards or has sufficient sterilization capacity redundancy for ships that may dock at ports in these countries or regions. In addition, for ships with short voyages, it is not advisable to choose BWMS with a long hydraulic retention time.

Service & Installation

Service Flow



According to the client requirements, we can supply the service of 3D scanning and production design. Alternatively, according to the actual conditions of the ship, on-site manual survey and mapping can be conducted. Either way, an economical and feasible installation plan will be proposed by PACT eventually.

Normally, all the testing and commissioning work is finished in our workshop before each unit delivery. The higher the degree of modularity and integration, the easier the installation and commissioning work will be on the ship. However, high degree of modularity and integration will seriously affect the space demand for installation. Therefore, when considering requirements of the installation space, our clients should also take into account the convenience of installation and commissioning, so as to choose an appropriate delivery way of the BWMS.

The new generation BWMS has an advanced communication function, and we can provide remote commissioning and software upgrading services as per the client's requirements.





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