SALTWATER
Custom naval engineering solutions

WHITEPAPER

BWTS Explained

Everything you need to know about Ballast Water Treatment Systems

Including rules, guidelines and deadlines

Contents

Colophon | Whitepaper BWTS

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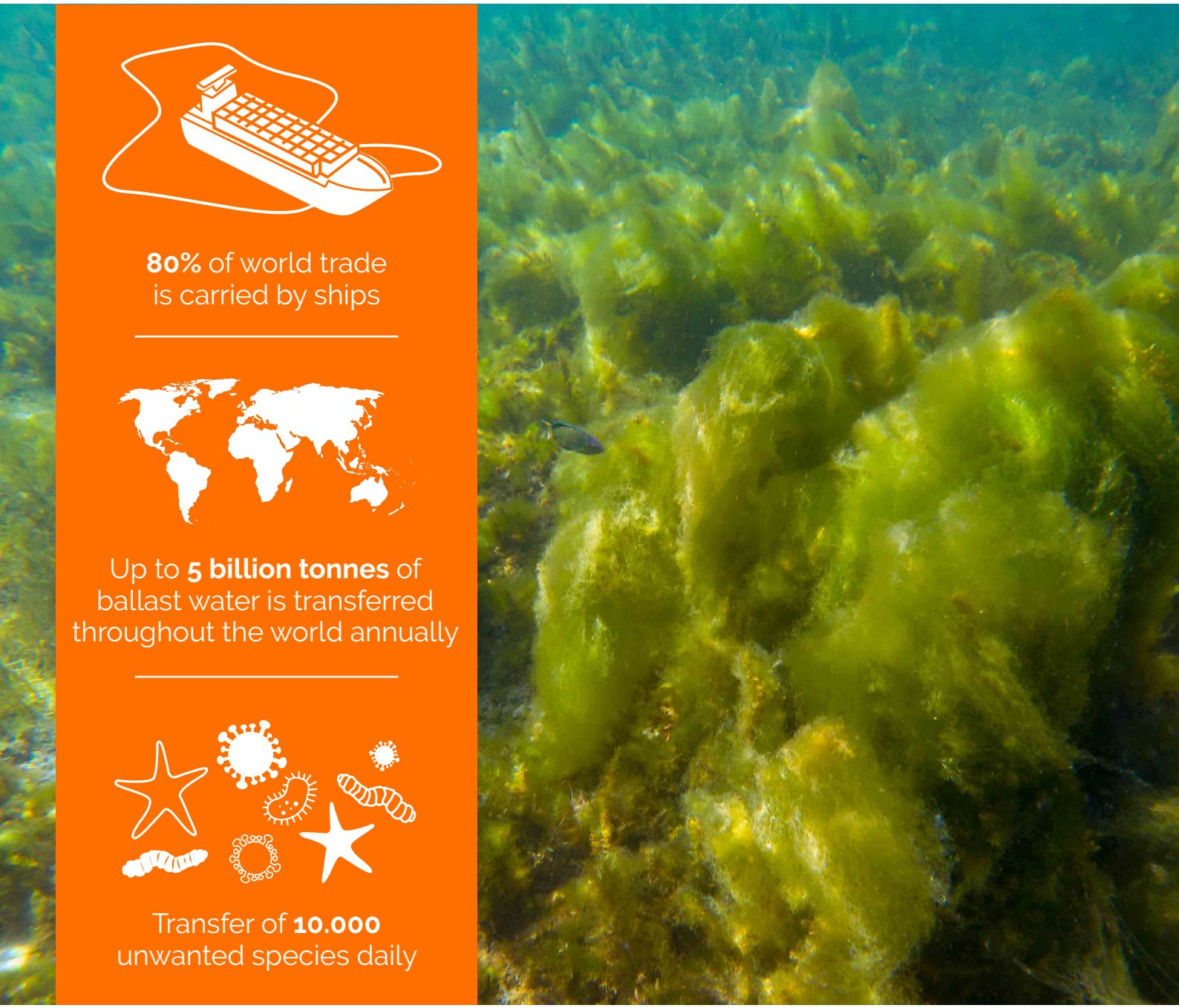
BWTS what?!

Ballast water has been used in shipping for decades. It has proven to be an effective way to provide more stability, reduce stress on the hull and ensure better maneuverability.

Besides the benefits however, the use of ballast water also poses some risks. As ships move across the globe, the inevitable transportation of marine organisms living in ballast water could potentially disrupt or destabilize ecosystems in other parts of the world.

Ballast Water Treatment Systems (in short BWTS) play an important role in managing ballast water and reducing ecological and health risks. As per the BWM Convention of 2014 vessels are required to comply with certain guidelines and standards. In this whitepaper you will find everything you need to know on BWTS and the requirements for vessels.



BWM Guidelines

To address the situation, IMO and the Marine Environment Protection Committee (MEPC) adopted guidelines in 1991; International Guidelines for preventing the introduction of unwanted aquatic organisms and pathogens from ships' ballast water and sediment discharges.

Intense negotiations between members of the IMO resulted in the acceptance of a new resolution in 2014 called 'The International Convention for the Control and Management of Ship's Ballast Water and Sediments' (BWM Convention).

To comply with the convention, regulations of the technical resolutions described below must be met.

International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) 2004 and its guidelines:

• **MEPC.152(55)**	Guidelines for sediment reception facilities (G1)
• **MEPC.173(58)**	Guidelines for ballast water sampling (G2)
• **MEPC.123(53)**	Guidelines for ballast water management equivalent compliance (G3)
• **MEPC.127(53)**	Guidelines for ballast water management and development of ballast water management plans (G4)
• **MEPC.153(55)**	Guidelines for ballast water reception facilities (G5)
• **MEPC.288(71)**	2017 Guidelines for ballast water exchange (G6)
• **MEPC.289(71)**	2017 Guidelines for risk assessment under regulation of the BWM convention (G7)
• **MEPC.279(70)**	2016 Guidelines for approval of ballast water management systems (G8)
• **MEPC.169(57)**	Procedure for approval of ballast water management systems that make use of active substances (G9)
• **MEPC.140(54)**	Guidelines for approval and oversight of prototype ballast water treatment technology programs (G10)
• **MEPC.149(55)**	Guidelines for ballast water exchange design and construction standards (G11)
• **MEPC.209(63)**	2012 Guidelines on design and construction to facilitate sediment control on ships (G12)
• **MEPC.161(56)**	Guidelines for additional measures regarding ballast water management incl. emergency situations (G13)
• **MEPC.151(55)**	Guidelines on designation of areas for ballast water exchange (G14)

These regulations, amongst others, specify testing and verification protocols to determine if the ballast water has been sufficiently treated. In 2005, and updated in 2008, the IMO released Guidelines for the type approval of ballast water management systems (BWMS) by flag administrations. The guidelines are applied differently by flag administrations, and they do not require type approval testing to be conducted by an organization independent of the manufacturer. It is important to note that the ballast water discharge standards in the **flag administrations** and the I**MO BWM Convention** are similar, but not the same.

Please note that U.S. type approval testing procedures are mandatory, detailed, and specify testing that is independent from manufacturers. The discharge standard in regulation D-2 of the BWM Convention is written in terms of "viable" (meaning able to reproduce) organisms, while the Coast Guard's discharge standard is written in terms of "living" organisms. Also, as noted here, the testing requirements to prove that a BWMS meets the discharge standards, are different.

Deadlines

IMO & USCG

The convention was brought to life to prevent the spread of harmful organisms living in the sea, which are transported from one region to another using Ballast Water. This treaty requires all international seagoing ships under the convention to implement a Ballast water management plan. This plan will enable the ship to manage the sediment and the ballast water discharge. Besides the above IMO has also adopted several guidelines in the treaty.
These guidelines contain several procedures, norms and guidelines to which all vessels need to comply in the (near) future.
The US Coast Guard handles somewhat different dates as deadlines to meet the regulations.

D1 & D2 standards

- All new ships must comply to the D2 standard.
- Until the date when they have to meet the D2 standard, existing ships should exchange ballast water mid-ocean, to meet the D1 standard.
- Over time, all ships will have to meet the D2 standard.
- 'Renewal survey' refers to the OPPC renewal survey under MARPOL Annex I.

D1 standard requiring ships to exchange ballast water in open seas, away from coastal areas. Few organisms survive.

International Maritime Organization

2017 ✓ **Existing ships** built prior to 8 September 2017 must meet the D1 standard until their D2 compliance date.

All ships must have:
- ballast water management plan
- ballast water record book
- International Ballast Water Management certificate

D2 standard specifying the maximum amount of viable organisms allowed to be discharged, including specified indicator microbes harmful to human health. Usually involves installing ballast water management system.

International Maritime Organization

2017 ✓ **New ships** built on or after 8 September 2017 must meet D2 standard.

2019 ✓ **Existing ships** with renewal survey after 8 September 2019 must meet D2 standard by this renewal survey.

2024 ✓ **All ships** must meet D2 standard by 8 September 2024.

United States Coast Guard

New ships constructed on or after 1 December 2013 must meet D2 standard on delivery.

2014 ✓ **Existing ships** with a ballast capacity between 1.500-5.000 m3 must meet D2 standard by first drydocking after 1 January 2014.

2016 ✓ **Existing ships** with a ballast capacity less than 1.500 m3 must meet D2 standard by first drydocking after 1 January 2016.

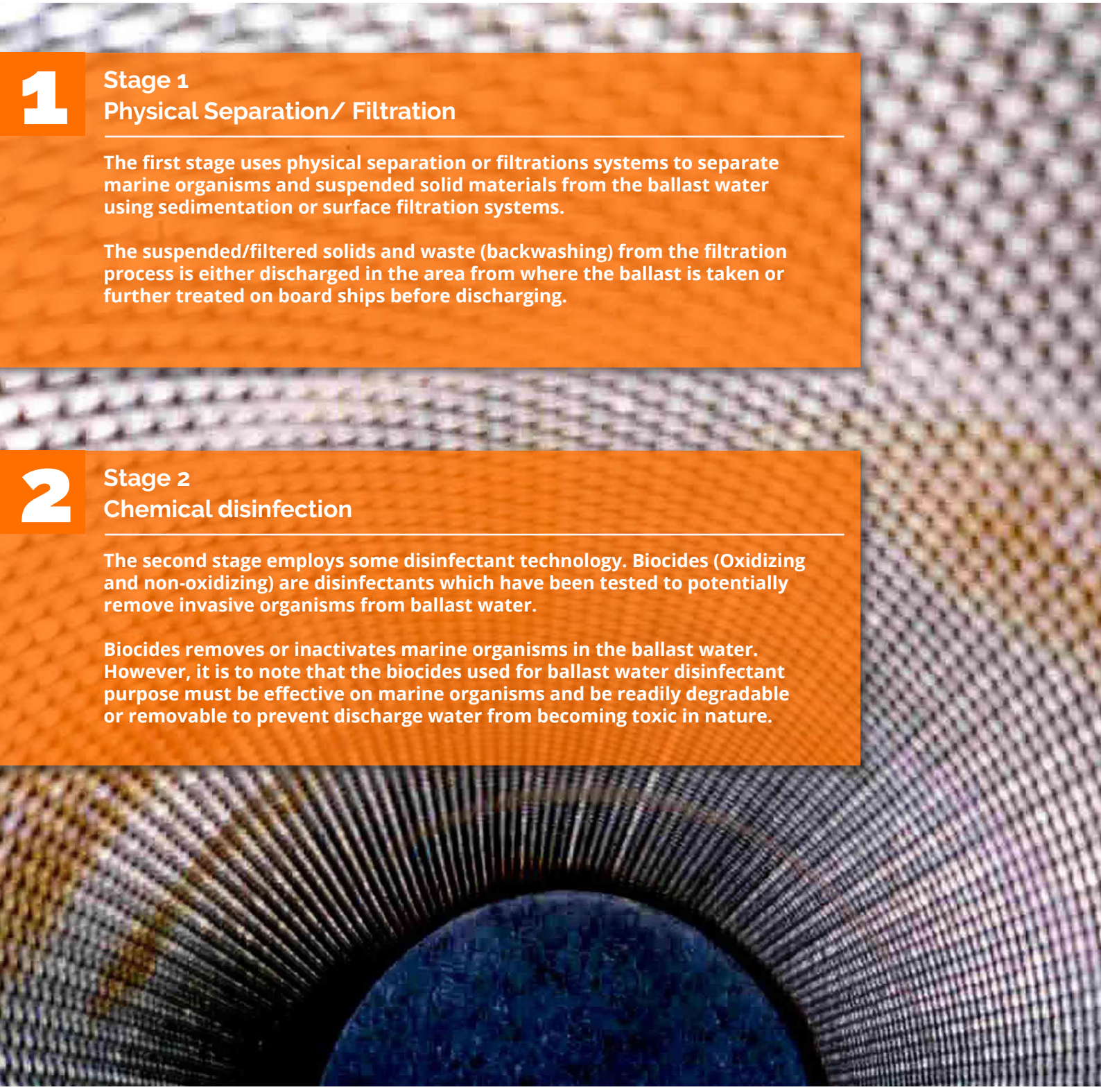
Existing ships with a ballast capacity greater than 5.000 m3 must meet D2 standard by first drydocking after 1 January 2016.

BWTS different systems

A variety of factors such as type of vessel, available space and cost limitations can have an impact on the choice of treatment system.

Most ballast water treatment systems combine multiple treatment methods which are divided into several stages. Four different treatment methods will be explained in depth in the next chapter 'BWTS methods explained'.

In most systems the treatment process typically comprises two stages: physical separation / filtration and chemical disinfection.



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Stage 1
Physical Separation/ Filtration

The first stage uses physical separation or filtrations systems to separate marine organisms and suspended solid materials from the ballast water using sedimentation or surface filtration systems.

The suspended/filtered solids and waste (backwashing) from the filtration process is either discharged in the area from where the ballast is taken or further treated on board ships before discharging.

2

Stage 2
Chemical disinfection

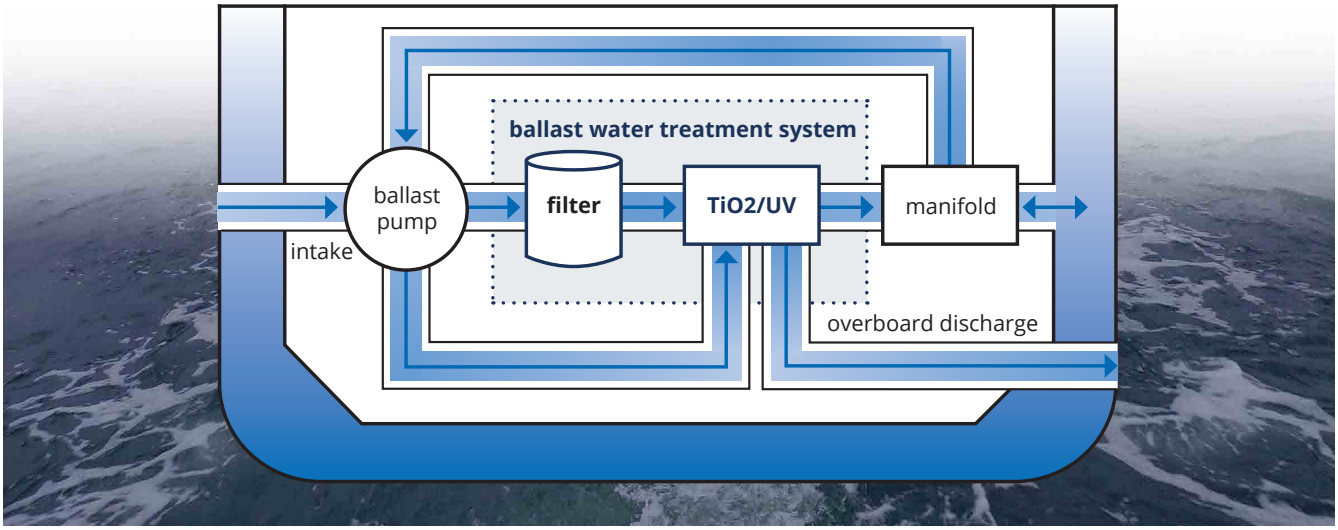
The second stage employs some disinfectant technology. Biocides (Oxidizing and non-oxidizing) are disinfectants which have been tested to potentially remove invasive organisms from ballast water.

Biocides removes or inactivates marine organisms in the ballast water. However, it is to note that the biocides used for ballast water disinfectant purpose must be effective on marine organisms and be readily degradable or removable to prevent discharge water from becoming toxic in nature.

BWTS methods explained

1 UV Treatment method

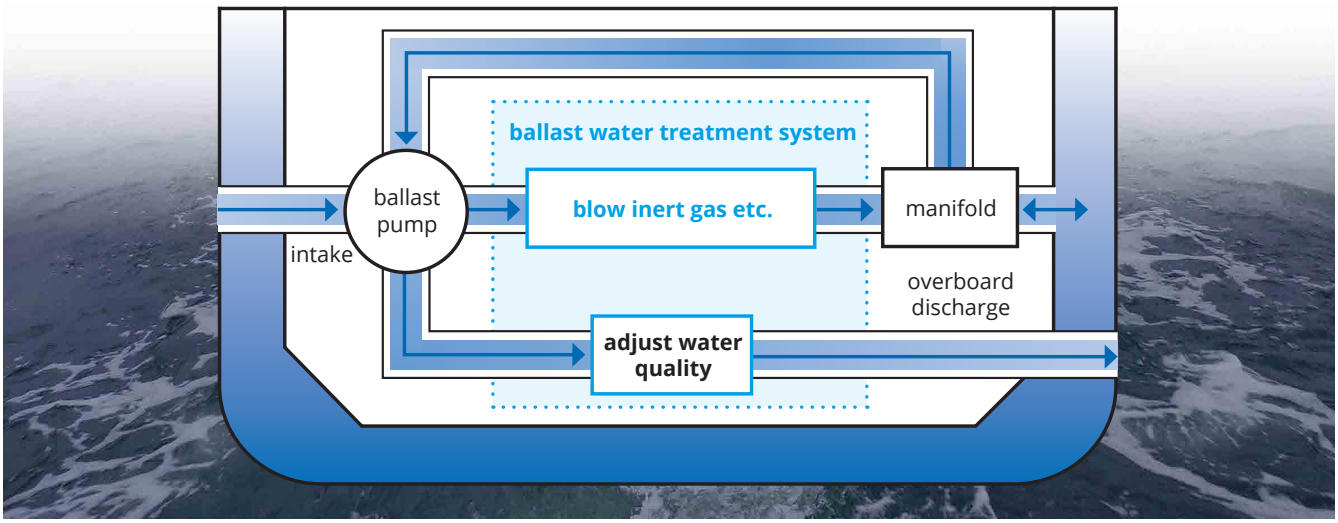
The Figure below shows an overview of the UV treatment method. Large aquatic organisms are removed together with dirt in the first stage filter. Ultraviolet ballast water treatment method consists of UV lamps which surround a chamber through which the ballast water can pass.
The UV lamps (Amalgam lamps) produce ultraviolet rays which acts on the DNA of the organisms and make them harmless and prevent their reproduction. This method has been successfully used globally for water filtration purpose and is effective against a broad range of organisms. However, micro-organisms, fungi, etc. may regenerate in the tanks since this treatment system does not use chemicals.
Therefore, ballast water needs to be treated by the BWT system again before it is discharged.



UV treatment system

2 Gas Treatment method

Another system is the gas treatment method. When filling ballast water, Inert gas is blown into the ballast water using a Venturi tube, the oxygen concentration of water is reduced, and ballast water is sterilized. The oxygen concentration of inert gas is lower than 0.1%. In addition, some systems also use ozone which has strong disinfection. These treatment methods require a neutralization process to extract the harmful substances (such as ozone) from the treated ballast water prior to discharging.



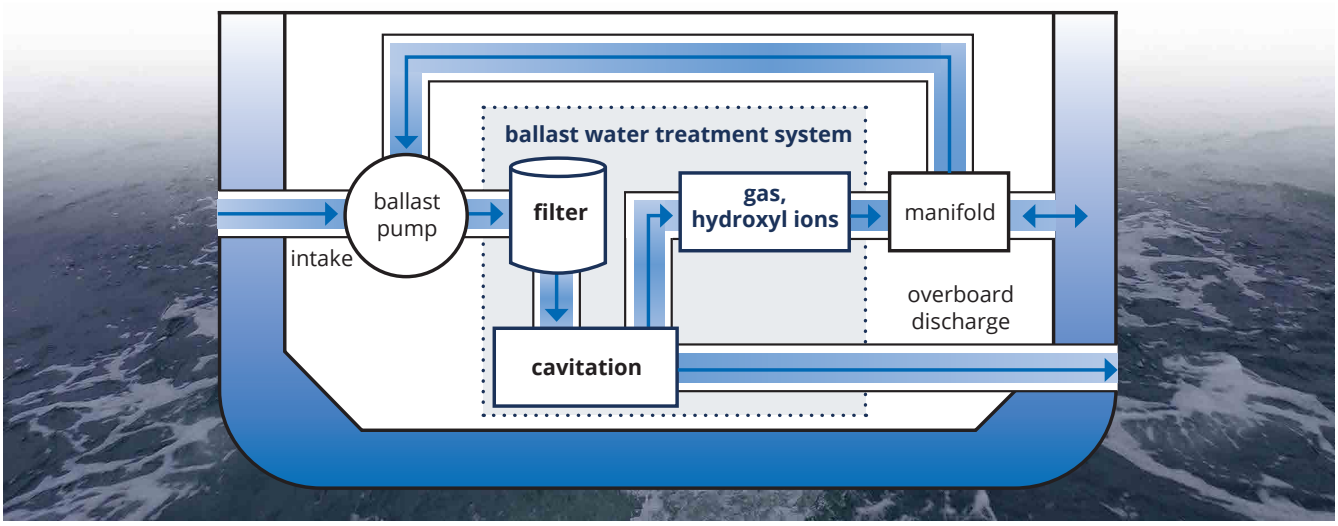
Gas treatment system

BWTS methods explained

3 Electrolysis method

This treatment method uses filtration & cavitation. The uptake ballast water is passed through filters and large aquatic organisms and dirt more than 50 microns are removed. Screens (fixed or movable) or discs are used to effectively remove suspended solid particles from the ballast water. Screen filtration is effective for removing suspended solid particles of larger size but is not very handy in removing particles and organisms of smaller sizes. Another method of removing solids is the application of a hydrocyclone. A hydrocyclone does not have a moving part, it is easy to install, operate and maintain on board ships. It uses high velocity centrifugal forces to rotate the water to separate the solids.

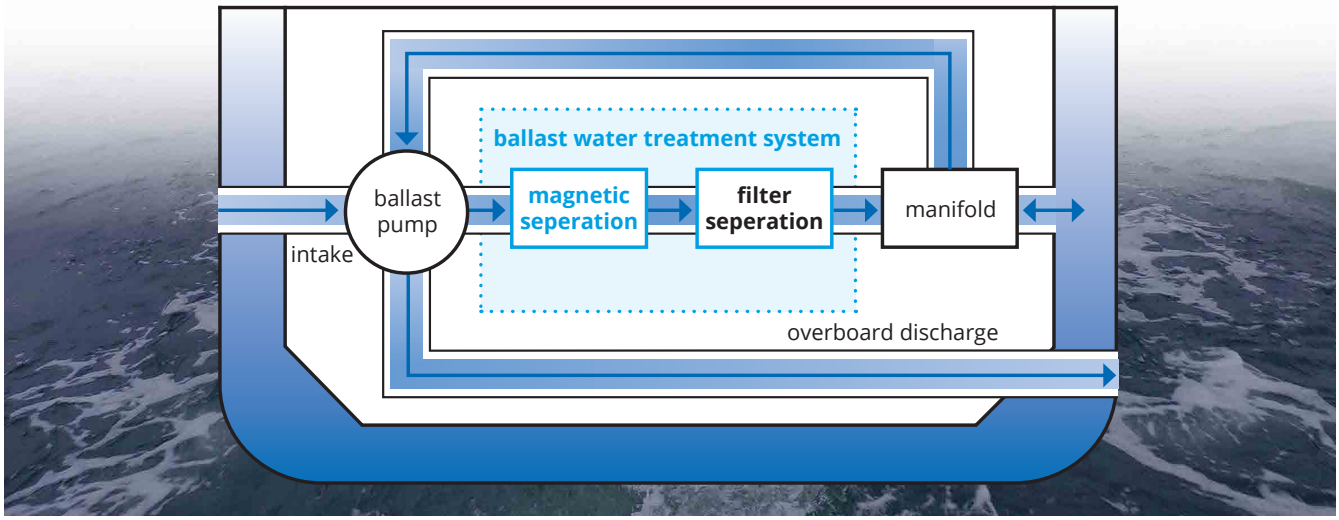
Cavitation damages the cell membranes of organisms and nitrogen gas purified onboard and hydroxyl ions generated by electrolysis are added to sterilize and to kill aquatic organisms and fungi.



Electrolysis method

4 Magnetic seperation method

This treatment system is designed against aquatic-, micro-organisms, and microbes in which magnetic powder is fed to the ballast water during its filling, the water is agitated, and magnetic separation is performed. No chemicals for sterilization are used. The aqueous ingredients in ballast water are also unchanged, and re-treatment of discharged water, neutralization, etc., is not necessary.



Magnetic seperation system

Saltwater & BWTS

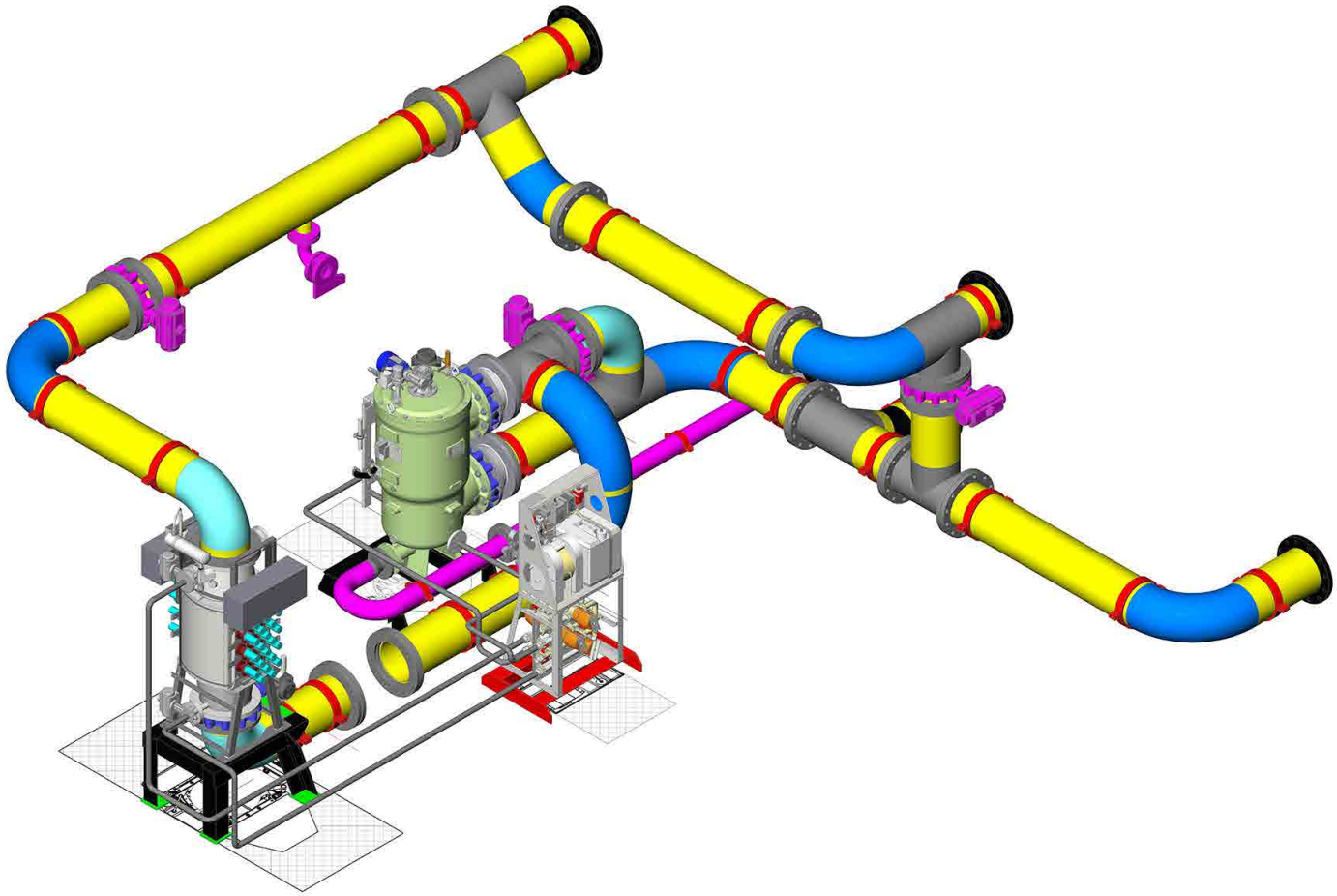
Although the push for guidelines on handling ballast water is broadly supported by the industry, many ship owners and operators are struggling to meet the set requirements and deadlines.

Over 68.000 vessels are impacted by the guidelines set by the BWM Convention and by 2024 all ships will have to meet the D2 standard (which in most cases require the installation of a ballast water treatment system).

Saltwater offers a turn-key solution for the placement of ballast water treatment systems on vessels. Our team assists in the selection of BWTS but also offers a complete engineering package needed to install the system. Our integrated, full-service solution ensures vessels are compliant while minimizing the hassle for owners and operators.

We support you in both the approval phase with the Class Societies as well as in the engineering and production phase with a complete engineering package for the machinery foundations, pipe spools (isometrics) and all other related items in the fabrication and installation.

BWTS system was installed on the 'Palmgracht'.



Custom BWTS design for Stout Technisch Installatieburo B.V.

Practice what you preach

Frisiana M/V

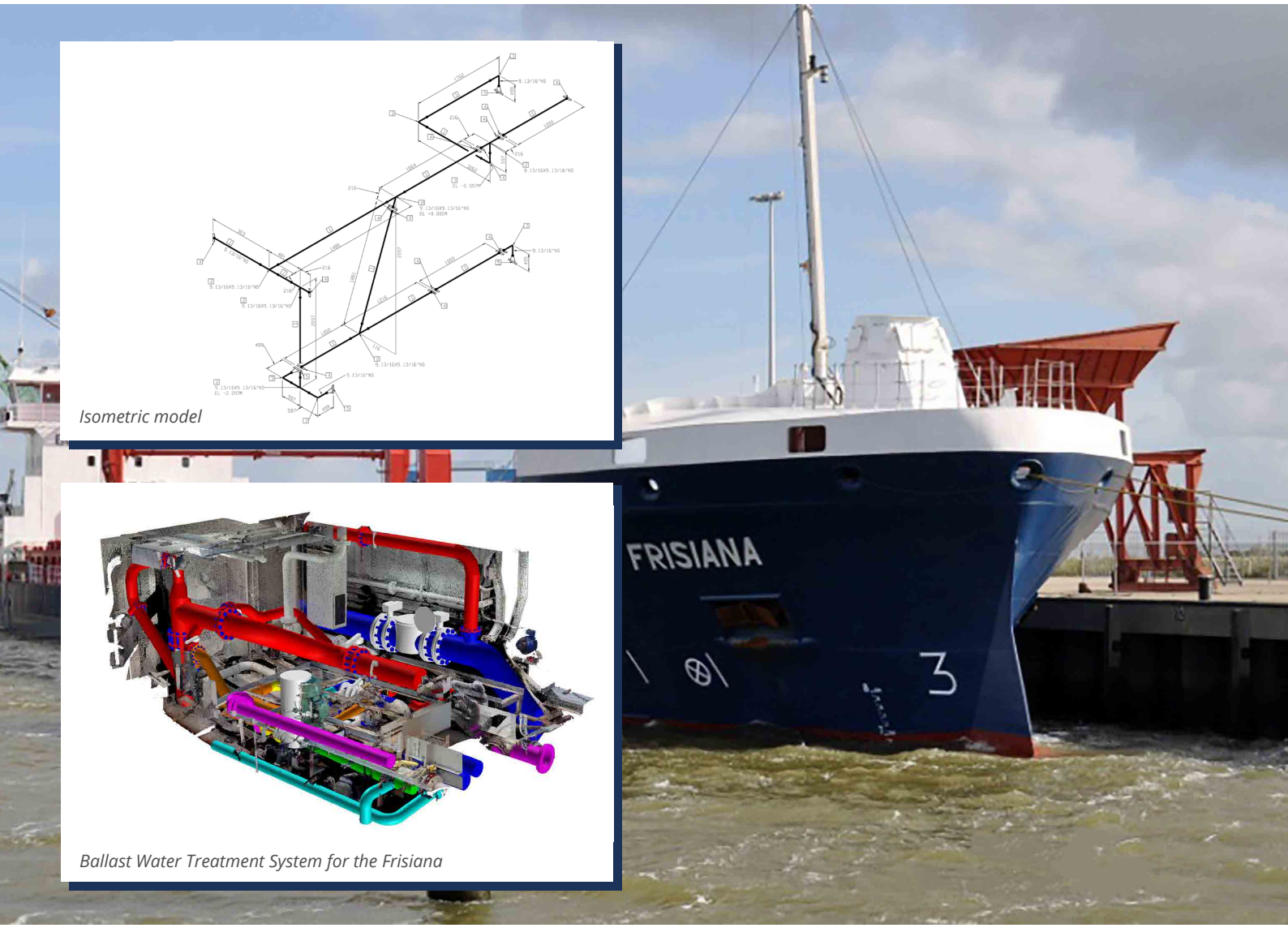
Saltwater Engineering assisted Damen Shipyard Den Helder to undertake the engineering for the conversion and placement of a ballast water treatment system (BWTS) on M/V Frisiana. The ballast water treatment system will be built in the vessel at two locations; one is in the engine room and the other is on the main deck just forward of the superstructure in a new to be designed deck house. The current layout of the engine room does not allow for a complete placement of the system, hence part of the new BWTS is located on the main deck. To design the piping system, the existing engine room layout isdigitized by means of a 3D scan of the rooms, captured in a point cloud and backed up by 3D pictures.

Designing the deckhouse

The newly designed deckhouse is to accommodate a number of items related to the BWT system. One of the large items in the deckhouse is the chemical dosing unit, due to the size this needed to be located to the new deckhouse. The height of the deckhouse is limited by the container stacks/hatch-parking location above the hatch coamings, therefore a cut-out is made in the HFO tank(s) below to accommodate the dosing unit.
A new piping duct was created to route the main piping through the HFO tanks to reduce the impact on the engine room between deck installations. The deckhouse furthermore accommodates the filter unit, drain tank and metering.

Piping

The vessel was fitted with new piping lines for the ballast system as well as the fact that all the existing lines in the ER are renewed and rerouted to guarantee a proper working of the BWTS.
The original piping system was mainly routed in situ by the shipyard and was never properly modelled in CAD.



Isometric model

Ballast Water Treatment System for the Frisiana

About us

“2021 and beyond. The best is yet to come!”

Moving forward means moving the needle on the way we do business.
It requires shifting gears and stepping-up.
Bold ambitions demand bold decisions.

We are ready.

How it started

Saltwater Engineering was-founded in 2007 by four naval engineers. With a small team and a hands-on approach we were able to deliver engineering solutions, fast. Our flexibility, speed and out-of-the-box thinking made us stand out. These traits gave us an edge over incumbents and allowed us to gain a foothold in various markets demanding naval engineering. Over time we have build strong relationships with clients providing us a steady stream of projects to realize organic growth.

Evolving

Over the years the company has grown; both in revenue and employee count.
To sustain year-over-year growth, management has focussed on building an organisation by investing in people, processes and technology.

These investments have paid off. The company has grown, the number of projects scaled up and a solid foundation has been put in place to enable further growth.

What sets us apart?

We pride ourselves in being transparent and reliable.
These are bold claims that we are staking every day. We communicate loud and clear, we manage expectations, we commit to promises made and we take ownership of a situation when needed.

Sander Broekmeulen - CEO

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