Drivers of change
Fact sheet series

VECTORS

New ballast water technologies

Vectors of change in European Marine Ecosystems and their Environmental and Socio-Economic Impacts

The VECTORS project seeks to develop integrated, multidisciplinary research-based understanding of changes taking place in our marine environment, the mechanisms for them and the ecological impacts expected from them. VECTORS will examine how these changes may affect the range of goods and services provided by the oceans, the ensuing socio-economic impacts and some of the measures that could be developed to reduce or adapt to these changes.

Regional seas vectors and drivers

This is a report which identifies and disseminates the current understanding of drivers, pressures and vectors of change that could be affecting the main areas of concern to VECTORS: outbreaks, invasives, changes in species distribution and productivity.

The full 220 page report, created through a desktop review exercise, is available to download from the VECTORS website, www.marine-vectors.eu. A series of twelve fact sheets, including this one, have been produced to summarise the key findings for each of the nine drivers studied and each of the three Regional Seas (Western Mediterranean, North Sea and Baltic Sea) that act as case studies for the VECTORS project.

Key points

- The International Convention for the Control and Management of Ships´ Ballast Water and Sediments (BWM Convention) was adopted in 2004 setting global standards to prevent transfers of harmful aquatic organisms and pathogens by vessels ballast water.
- The BWM Convention Regulation D-2 (D2 standard), Ballast Water Performance Standard, specifies the levels below which viable organisms may be present in ballast water before it is discharged.
- At present it is believed that the only way to achieve the discharge requirements of the D-2 standard is by using a ballast water treatment system (BWTS).

- BWTS have to undergo testing and certification processes according to the International Maritime Organization (IMO) requirements to obtain a type approval certificate, which proves BWTS compliance with IMO requirements.
- By July 2011 we identified 87 BWTS manufacturers. All BWTS use a combination of treatment technologies to achieve D-2 standard requirements, such as filtration, UV, (electro)chlorination, ozonation. 16 BWTS are already type approved by different administrations.
- More than 60,000 vessels may need to install such systems, which could prove very lucrative for BWTS manufacturers, however very challenging for BWTS production and shipyard installation capacities.
- This field represents opportunities and challenges for many EU manufacturers and administrations.

Overview

There are many different treatment technologies available, however only a combination of different treatment technologies have shown the capability to treat the ballast water to the level required by the D-2 standard. Our review (July 2011) identified 87 BWTS manufacturers. Most of the systems apply treatment at the uptake of ballast water, and 39 systems treat the ballast water both at uptake and discharge. In total 67 systems use pre-treatment technology (51 use filtration), others selected different methods or designed a BWTS with a combination of two or more pre-treatment steps. Most systems (60) make use of an active substance with the most frequently used technique being electrolysis/electrochlorination (25 systems).

The second most commonly used technology is UV radiation (24 systems). The treatment capacities of most systems range from 50 m^3/h to more than 10,000 m^3/h. Two vendors announced a capacity of 20,000 m^3/h and above. BWTS footprints occupy from less than 1 m^2 to 145 m^2 depending on their capacity and treatment technologies. Some BWTS operate with no electricity requirement, others may consume up to 200 kW per 1000 m^3/h.

All systems need to be type approved by a Flag state, according to the IMO G8 Guideline before being sold to a client. In addition, BWTS using Active Substances need to obtain Basic and Final Approval by IMO Marine Environmental Protection Committee and the relevant procedure is described in the IMO G9 Guideline. At present systems are at different stages of testing and approval, while 16 have completed the certification requirements and are type approved by different administrations.

The BWM Convention is likely to be in force by 2013, however BWTS production and shipyard capacities may cause a bottleneck in equipping the more than 60,000 vessels in time. EU manufacturers and administrations are actively involved in these processes.

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SEVENTH FRAMEWORK PROGRAMME

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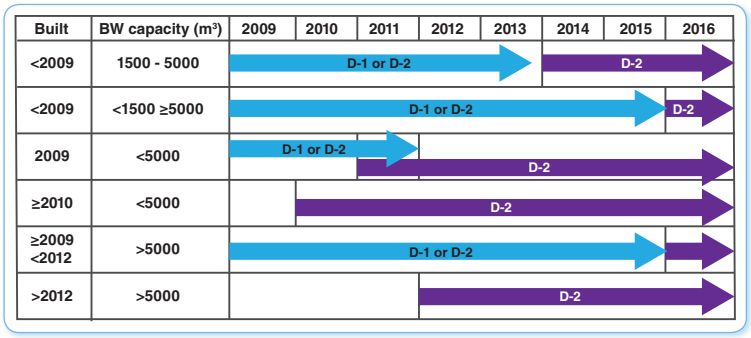
Requirements for BWTS

Ballast water management was addressed by the International Convention on the Management of Ships' Ballast Water and Sediments, London, 2004 (BWM Convention; IMO, 2004). The BWM Convention introduces two different regimes with a sequential implementation:

- Ballast Water Exchange Standard (Regulation D-1) requiring ships to exchange a minimum of 95% ballast water volume;
- Ballast Water Performance Standard (Regulation D-2) which requires that ballast water discharged has the number of viable organisms below specified limits.

At present it is believed that the only way to achieve the discharge requirements of the D-2 standard is with the installation of a BWTS. The installation of BWTS triggers additional costs, and is not yet required as the BWM Convention is not yet in force.

The BWM Convention will enter into force 12 months after the date on which at least 30 States with combined merchant fleets of not less than 35% of the gross tonnage of the worlds' merchant shipping have signed it without reservation. 33 States constituting 26.5% of the gross tonnage of the world merchant fleet had ratified the convention by 31 January 2012. The entry into force of the BWM Convention is an important driving force for ballast water treatment technology developments worldwide (David *et al.*, 2008). As a result, it is expected that the development and implementation of these systems will now proceed at a greatly accelerated rate. The phasing in of the D-2 standard was agreed by the IMO according to ballast water capacity and ships' age.



Phase in of the D-1 and D-2 standard of the BWM Convention

Treatment technologies used in BWTS

Manufacturers have developed different BWTS combining several technologies. The technologies are applied at different stages of the ballasting process, i.e., at the uptake of ballast water, during holding the ballast water in tanks during navigation, and/or at discharge. Most of the systems apply treatment at the uptake, 39 BWTS treat the ballast water at uptake and discharge. Some systems (may) have residual active substances above the allowable levels in the ballast water at discharge, therefore some of these manufacturers have included also a neutralisation process. Among the 87 manufacturers identified, 67 use some pre-treatment technology; 51 use filtration, others use different methods or combination of these as pre-treatment.

Most systems (60) use some kind of active substance. The most frequently used technique for treatment seems to be electrolysis/electrochlorination (25 systems), used as a stand-alone treatment method by 20 systems, or in combination with other techniques. In second place is UV (24 systems); and 16 of these systems use UV as the only treatment process, while 8 systems use UV in combination with other techniques (i.e. TiO_2, ultrasound, ozonation, electrolysis, plasma). In total 20 BWTS use two or more treatment techniques as the main treatment method, while 64 rely on one treatment technique.

BWTS testing, production, and compliance monitoring challenges

BWTS need to be type approved by a Flag state before being installed on vessels. Systems that use Active Substances by the definition in the BWM Convention have to undergo a more thorough certification process and manufacturers need to obtain Basic and Final Approval by IMO MEPC to prove the environmental acceptability of treated ballast water. BWTS are tested in land-based test facilities and on vessels to show that the D-2 standard is met. Land-based test facilities are located in Denmark, India (facility planned), Japan, Korea, Netherlands, Norway, Singapore, South Africa and the USA. After testing the system gets eventually type approved by a Flag state. The approval process may take 18 months or longer. At present most systems are in different stages of testing and approval, while 16 are already type approved by different administrations.

The number of vessels to which regulation D-2 will apply from 2009 to 2020 will total more than 60,000, with the highest annual number in 2017. The number of vessels required to install BWTS is expected to rapidly increase in 2015 and drop sharply in 2020, because the vessels constructed before 2009 shall install BWTS between 2015 and 2019. The phase-in time for the vessels to meet the D-2 standard may be relaxed, which would result in a longer high demand for BWTS installation.

Even when BWTS are operated by vessels, compliance with the BWM Convention remains a challenge. Gollasch and David are involved in testing mainly onboard vessels, and also provide expert support to the European Maritime Safety Agency and IMO regarding testing and compliance monitoring (Gollasch *et al.*, 2010; IMO 2010).

References

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Further information

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