Preview of Ballast Water Treatment System Market Status

Prikaz statusa sustava za obradu balastnih voda na tržištu

Nermin Hasanspahić
University of Dubrovnik
Maritime department
e-mail: nhasanspahic@gmail.com

Damir Zec
Faculty of Maritime Studies Rijeka
e-mail: zec@pfri.hr

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Summary

The International Convention for the Control and Management of Ships' Ballast Water and Sediments was adopted in February 2004 and it was ratified by a sufficient number of countries in September 2016. The most important part of the Convention is Regulation D-2. One way to meet D-2 is to retrofit Ballast Water Treatment Systems (BWTS) on existing ships and their fitting on newbuildings. The market consists of the following stakeholders: shipowners, equipment manufacturers, shipyards, recognized organizations, laboratories for testing the efficacy of the BWTS and coastal countries' administrations in charge for implementing Convention standards. In order to enable enough time to comply with the Convention, shipowners are granted maximum 5 year period, i.e. system retrofitting is connected to the first renewal of the International Oil Pollution Prevention certificate after September 2017. Some shipowners will postpone retrofitting for five years since they will renew IOPP certificates in advance, which is approved by many flag States and stated in their circular letters. More than 60 systems received flag State type approvals, but only few systems are approved by United States Maritime Administration (MARAD). That is one of the reasons why most of the shipowners are still waiting with planning and retrofitting, which leads to requests for more postponement. However, many manufacturers claim that they will be ready for increased demand for BWTS and will cope with and try to satisfy market demand by hiring additional work force, by expanding existing manufacturing facilities and maintain good cooperation with shipyards.

KEY WORDS
BWMC
ballast
IOPP certificate
shipowners,
BWTS
type approval

Sažetak

Međunarodna konvencija o nadzoru i upravljanju brodskim balastnim vodama i talozima donesena je u veljači 2004. godine, a dostatan broj država ju je ratificirao tek u rujnu 2016. godine. Najvažniji dio Konvencije je Standard D-2 koji zahtijeva ugradnju sustava za obradu balastnih voda na postojeće brodove i novogradnje. Tako je stvoreno tržište koje čine: brodari, proizvođači sustava za obradu balastnih voda, brodogradilišta, priznate organizacije, ustanove za ispitivanje učinkovitosti rada sustava i pomorske uprave obalnih država zadužene za primjenu standarda Konvencije. Kako bi se brodarima omogućilo dostatno vrijeme za primjenu standarda D-2, dan im je rok od pet godina, pa je ugradnja sustava vezana uz prvo obnavljanje Međunarodne svjedodžbe o sprječavanju onečišćenja mora uljima nakon rujna 2017. godine. Neki brodari će odgoditi ugradnju sustava za pet godina ranijim obnavljanjem svjedodžbe, što su mnoge države čiju zastavu brod vije, odobrile u svojim okružnicama. Više od 60 sustava za obradu balasta koji su trenutno na tržištu već je dobilo homologaciju od zemalja čiju zastavu brodovi viju, no mali broj sustava dobio je homologaciju od američke Pomorske uprave. Zato većina brodara još čeka s početkom planiranja i ugrađivanja sustava na postojeće brodove, što vodi do traženja daljnjih odgoda. Ipak, mnogi proizvođači tvrde da su spremni za pojačanu potražnju njihovih sustava na tržištu, te da će dodatnim zapošljavanjem radne snage, širenjem svojih pogona i dobrom suradnjom s brodogradilištima, pokušati zadovoljiti potrebe tržišta.

KLJUČNE RIJEČI
konvencija
balast
IOPP svjedodžba
brodari
sustavi za obradu balasta
homologacija

1. INTRODUCTION / *Uvod*

The transfer of harmful aquatic organisms and pathogens poses a threat not only to local eco-systems but also to local inhabitants [1]. This is caused by the increasing number of vessels and faster maritime traffic during the few last decades. The tendency to build larger vessels with larger ballast capacities implies larger amounts of discharged ballast water in coastal waters, which poses a global problem and economic loss for coastal states. [2, 3, 4]

IMO[1] adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWMC) in February 2004 [5]. The purpose of BWMC is to control the discharging and treatment of ballast water carried by vessels during voyages without cargo in order to reduce the transfer of harmful aquatic organisms and pathogens. The BWMC needed

1 IMO – International Maritime Organization

ratification by 30 IMO member countries which represent 35% of the world's merchant fleet. The condition of its adoption by 30 IMO member countries was fulfilled in September 2011. Finland ratified the BWMC in September 2016 and fulfilled the condition of its adoption by 35% of the world's merchant fleet. BWMC will come into effect in September 2017, one year after both conditions have been fulfilled.

Five years was estimated as enough time for shipowners to prepare for the implementation of Regulation D-2 by MEPC[2] [6]. It means that ballast water treatment systems (BWTS) will have to be installed on existing vessels during the first renewal of the IOPP[3] certificate after September 2017, i.e. first drydocking after BWMC comes into force.

BWTS type approvals are issued by recognized organizations on behalf of flag States after efficiency and efficacy of systems is tested in order to ensure compliance with IMO standards. Currently there are more than 60 BWTS type approved by flag States on the market [7].

The United States Maritime Administration (MARAD) has not ratified BWMC but they have implemented National Regulations in order to protect their territorial waters [8]. Their stringent and complex guidelines for testing BWMS efficacy and few approved independent laboratories for testing slowed down issuance of type approvals and increased testing cost which has had a negative effect on the BWTS market. Only three BWTS were type approved by MARAD by February 2017 [9, 10].

The challenges that arose are: differences between IMO and MARAD guidelines, a large number of ships in need of BWTS retrofitting, BWTS production capacities, repair shipyards capacities and resources of maritime administrations in charge of implementation of BWMC regulations.

An overview and explanation of the condition of the BWTS market from the point of view of the stakeholders is given in this paper.

2. STAKEHOLDERS / *Dionici*

The large BWTS market was created once BWMC was adopted. In 2015 the market's total value was estimated at 5.2 billion USD, and there are indications that it will increase up to 36 billion USD by 2020 [11]. The high value of the BWTS market looks promising for equipment manufacturers and shipyards, but it represents a considerable investment risk to shipowners.

Like every other market, the BWTS market also has its stakeholders including rule makers, equipment manufacturers and buyers. The stakeholders are:

- shipowners,
- BWTS manufacturers,
- shipyards,
- laboratories for testing efficacy of BWTS,
- recognized organizations,
- maritime administrations of coastal states.

In order to stop the transfer of harmful aquatic organisms and pathogens and to put BWMC into effect, all of the above mentioned groups have to be involved and actively participate.

2.1. Shipowners / *Brodari*

Shipowners are the largest group of stakeholders within the newly created BWTS market, and the world merchant fleet currently has about 60.000 ships in need of installing BWTS [12, 13, 14]. Table 1 shows the world merchant fleet in 2015 and age of ships in groups.

Table 1 World merchant fleet in 2015
Tablica 1. Svjetska trgovačka flota 2015.

Age of ships	0 – 4	5 – 14	15 – 24	>24
Number of ships	13.806	29.366	15.450	28.611

Source: [15]

The price of BWTS and installation costs pose the greatest challenge for shipowners. It is difficult to estimate the price of BWTS and installation costs, since it mainly depends on: ballast water capacity of a given ship, type and technology of BWTS, possibility of retrofitting on a given ship depending on the dimensions and power consumption of the BWTS, and labour costs of the retrofitting. Then, there is the difference in cost depending on whether the BWTS is installed during navigation or drydocking, since installation during navigation takes more time and is more expensive. However, the estimated price range of the BWTS is between 400.000 USD up to 1.500.000 USD [12].

Since large expenditures are at stake, shipowners are trying to prolong deadlines for installation of systems as long as possible. During the last, 70th MEPC meeting, one of the topics discussed was the suggestion that the window for retrofitting should be postponed for two more years, to accommodate:

1. The compliance with Regulation D-2 during the first IOPP certificate renewal after September 8th 2017, or
2. The compliance with Regulation D-2 during the first IOPP certificate renewal completed after September 8th 2017, but if the renewal is completed prior to September 8th 2019, then compliance is postponed until the next IOPP certificate renewal [16].

A final decision should be made during the 71st MEPC meeting, which was to be held in May 2017, but it was moved to July 2017. It can be expected that the first proposal will endure, and also shipowners whose ships have to renew IOPP certificates by the end of 2017 cannot wait until July 2017, since they have to start with BWTS installation preparations immediately. This is corroborated by estimates which show that the time needed for planning and selection of a BWTS, retrofitting and obtaining certificates takes about six months [17].

In addition to these large expenditures for BWTS retrofitting, shipowners whose ships are plying USA ports face an even greater challenge by investing large sums of money in a BWTS that MARAD may not accept. As it was already mentioned previously, only three BWTS are MARAD type approved [9, 10]. More MARAD type approved BWTS are needed on the market, but the type approval process is time consuming and complex. However, it is assumed that a few more systems will be MARAD type approved during 2017. In July 2016 MARAD issued a circular letter [18] that enables the postponement of installation of MARAD type approved systems for five years, if a vessel installs an AMS[4] type approved by another recognized organization [19]. Shipowners that want to use this opportunity have to act as soon as possible, since this circular letter was issued at a time when there were no MARAD type approved BWTS on the market.

[2] MEPC – Marine Environment Protection Committee
[3] IOPP – International Oil Pollution Prevention Certificate
[4] AMS – Alternate Management System is BWTS type approved by other recognized organization and approved as such by MARAD.

Another challenge that shipowners encounter is cost-effectiveness of retrofitting a BWTS on older vessels. Since BWTS installation is interconnected with IOPP certificate renewal after September 8th 2017, many shipowners postponed installation for five additional years. They have decided to renew their IOPP certificate in advance, i.e. de-harmonize it from the vessel's certificate system. This brings up the question of whether this will be allowed by flag States. By February 2017, maritime administrations of Antigua and Barbuda [20], Bahamas [21], Barbados [22], Cyprus [23], Gibraltar [24], India [25], Cayman Islands [26], Liberia [27], Luxembourg [28], Marshall Islands [29], Norway [30], Germany [31], Panama [32], St. Vincent and The Grenadines [33], allowed de-harmonization of the IOPP certificate in their circular letters.

How long shipowners operate individual vessels remains in question. The average vessel's operation period in practice is about 20 years [34, 35, 36]. The author's assumption is that most of the shipowners whose vessels will turn 15 years of age in 2017 and older (built before and during 2002) will try to de-harmonize the IOPP certificate in order to postpone BWTS installation for five more years [37], and after that time frame expires, based on experience to date, those vessels will most likely be scrapped. It will depend on the freight market, so if demand for vessels suddenly arises, installation of BWTS will become cost effective. Under the current market situation and low freight rates, a scrapping scenario is highly probable. Vessels built between 2003 and 2013 will most probably retrofit BWTS during scheduled drydocking. Most of the vessels built during and after 2014 already have BWTS installed, but if not, then it will be installed during scheduled drydocking. Assumed BWTS installation status can be seen in Table 2.

According to some indications, shipowners that find BWTS retrofitting unprofitable and are unable to get postponements or renew their IOPP certificate before September 2017, will most likely sell their vessels to scrapyards [38].

The author assumes that 45.000 vessels out of 60.000 will need BWTS installation during the Regulation D-2 implementation time frame (vessels less than 15 years of age) [15, 39], while 15.000 vessels or 25 % (15 years of age and older) [15] will de-harmonize their IOPP certificate. Estimated number of vessels in need of BWTS retrofitting per year is 9.000 (45.000 vessels divided by time period of five years), or 25 vessels per day. An estimated 2.000 newbuildings per year should be added to this figure [40]. Whether all shipowners will succeed in installing BWTS on their vessels during the Regulation D-2 implementation time frame, largely depends on the BWTS manufacturers and shipyards, as well as the shipowners themselves.

2.2. BWTS manufacturers / *BWTS proizvođači*

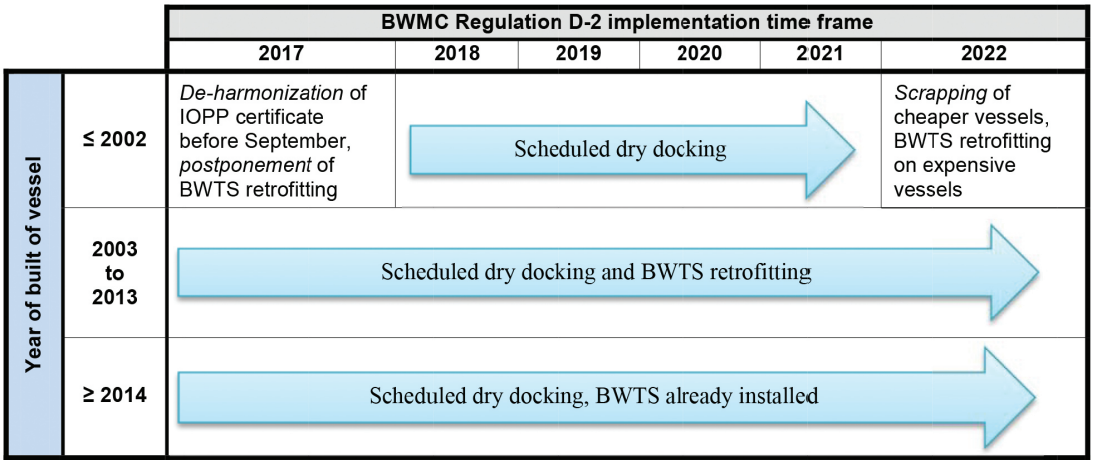
In order to get on the market, BWTS needs to be type approved. There are two type approval regimes: the IMO regime and the MARAD regime.

Within the IMO regime there are two groups of systems: systems that make use of active substances [41, 42] and systems that do not make use of active substances [43]. Testing of system efficacy and proper functioning under IMO guidelines is necessary for flag State type approval. Efficacy tests of systems that do not make use of active substances are performed under G8 guidelines, which include land based tests and ship-board tests [43]. If BWTS conforms to both of these tests, it is granted type approval by a recognized organization on behalf of a flag State.

Systems that make use of active substances have a somewhat different test process. Besides conforming to G8 guidelines, they also have to conform to G9 guidelines, i.e. they have to get Environmental Impact Type Approval (Final approval) before the issuance of flag State type approval [44].

Guidelines for establishing systems efficacy performed in USA are different than IMO guidelines. MARAD grants type approvals based on conformity tests performed in approved independent laboratories. Instead of tests that conform IMO G8 and G9 guidelines, approved independent laboratories perform tests in accordance with ETV[5] protocol [45]. The MARAD type approval process is time consuming and expensive, as can be seen on one BWTS manufacturer whose expences rose up to almost four million USD [46]. The greatest challenge for BWTS manufacturers is obtaining MARAD type approval.

Table 2 Assumed BWTS installation status
Tablica 2. Pretpostavljeni status BWTS instalacije



Source: [Author's own construction]

[5] ETV – Environmental Technology Verification is MARAD protocol containing guidelines for efficacy and conformity testing of BWTS for Type Approval granting.

As already mentioned in the paper, there are more than 60 BWTS type approved by the Recognized Organizations on behalf of flag States [7], and only three BWTS type approved by MARAD on the market [9, 10]. Since 2004, many changes regarding technical details and possibilities of systems were adopted. This considerably complicated development of BWTS manufacturers with changes in BWTS testing guidelines required to improve their products in order to remain on the market [47].

Will BWTS manufacturers manage to follow up market demands and produce already mentioned 11.000 systems per year during D-2 implementation period remains questionable [48, 49]. In order to succeed, expansion of existing production plants and hiring of extra workforce is needed. Many BWTS manufacturers affirmed that, and stated that they will be ready to meet market demand during the Regulation D-2 implementation phase [50]. Some manufacturers stated that they will be able to produce 1.000 BWTS per year [51]. If that would be the case, then it is highly probable that market demands will be met.

Number of BWTS suppliers that the market will sustain after the implementation time frame is very important. For the shipowners it is important, since expectations are that installed BWTS will last during the lifetime of the vessel, including regular maintenance by the manufacturer via approved workshops. When asked that question, most of the manufacturers have estimated that only about 15 of the largest will survive on the market [50].

2.3. Shipyards / *Brodogradilišta*

Shipyards are equally important stakeholders on the BWTS market. Since most of the retrofittings on existing vessels will be done in repair shipyards, this poses the question of whether their docks will have sufficient capacity for retrofitting systems on all vessels in the given time frame for the implementation of the D-2 standard [49]. It is assumed that most of the BWTS will be installed during scheduled dry dockings, i.e. renewals of IOPP certificates.

Dry docking including BWTS retrofitting of vessels of approximately ten years of age and with a ballast capacity of approximately 30.000 m^3 takes about one month [17, 52]. For vessels of that size and age, the usual dry docking time is between 12 to 15 days [53], meaning that the dry docking period is doubled. From September 2017 to September 2022, 9.000 vessels annually will need to install a BWTS.

According to the present situation, a particular shipyard in one dry dock can install a BWTS on one vessel with ballast capacity around 30.000 m^3 per month [17], which is not fast enough in order to install a BWTS on all existing vessels within a five-year time frame. However, the expectation that the time needed for installing a BWTS will be shortened is realistic. It is estimated that retrofitting time will be shortened to 8 to 15 days (dependant of ballast capacity of given vessel) [54, 55].

According to some literature data, there are 2.529 shipyards in the world [56], 784 of which are repair shipyards [57]. The industry assumes that 250 repair shipyards out of all will actively take part in the BWTS market [58]. If the number of 9.000 existing vessels is divided with the assumed number of 250 repair shipyards, that is 36 vessels per shipyard. This means that one repair shipyard should be able to complete dry dockings including BWTS installations on 36 vessels per year. Reducing the time needed for dry docking of vessels is possible with good planning of the BWTS installation process, efficient cooperation of all parties involved and hiring of additional work force.

2.4. Laboratories for testing BWTS / *Laboratoriji za testiranje BWTS*

The testing of efficacy and determining whether a certain BWTS conforms to standards set by IMO or MARAD is carried out in laboratories. Type approvals are later granted based on the results of these tests.

It is important to mention the difference in laboratory status and differences in methods used to verify BWTS efficacy between MARAD and IMO. MARAD adopted rules by which only independent laboratories approved by them can conduct testings. The method for measuring the efficacy of a system includes counting living organisms after treating the ballast water. Testings are conducted in accordance with the ETV protocol adopted by MARAD. Tests done in salt, brackish and fresh water, in water with low UV transparency and with high flow rates are just part of the testing conducted in independent laboratories. It should be pointed out that employees of BWTS manufacturers are not allowed to handle a system during testing, independent laboratory employees alone handle systems. Tests results are delivered to MARAD by an independent laboratory, and based on them type approval is granted (or not) [45].

IMO approved laboratories have a somewhat different role than laboratories approved by MARAD. The operator of the testing is the BWTS manufacturer and the laboratory for testing can be any competent lab. Testings are conducted in accordance with G8/G9 guidelines. The BWTS manufacturer or laboratory reports the results of testing to a recognized organization or flag State Administration [59].

From the above mentioned it can be concluded that the MARAD regime is more stringent. Its negative sides are time consuming testings and higher expenses.

2.5. Recognized organizations / *Priznate organizacije*

Recognized organizations have a double role on the market. DNV GL, Lloyd's Register and RINA, for example, are classification societies that are authorized by some flag States to carry out ship inspections, surveys and issue statutory certificates on their behalf, besides ship classification [60]. They grant type approvals to BWTSs on behalf of flag States and also issue certificates to vessels after BWTSs are installed. BWTS type approvals are granted based on the results of tests conducted in laboratories and in accordance with guidelines set by IMO.

It is important to stress that MARAD awards type approvals to BWTS conforming to US standards. Certificates are issued to vessels after successful installation of a BWTS and its commissioning. Whether recognized organizations will have enough resources to perform all given assignments and attend to all needed vessels in order to prevent a market standstill, remains questionable.

Recognized organizations have to send their surveyors on vessels during scheduled dry dockings during which BWTSs are installed [60]. Since vessels dry dockings are twice as long than usual due to BWTS retrofitting, the surveyor's job is made more difficult since they can survey only one vessel per month, instead of the usual two. The industry estimates that

dry docking time will be reduced to about 8 to 15 days [54, 55], which will significantly reduce the burden on the recognized organization surveyors. However, it will certainly be necessary to additionally educate existing surveyors, hire additional work force and carefully plan jobs in order to avoid possible expensive standstills.

2.6. Maritime administrations of coastal states / *Pomorska administracija u obalnim državama*

Coastal states' maritime administrations are responsible for the implementation of BWMC standards on vessels.

MEPC adopted guidelines for Port State Control inspection under BWMC. Guidelines contain explanations of four-stage inspection and actions by the PSC officer in case of apparent violation of Convention standards [61].

Inability to control compliance of all vessels with BWMC can cause inspection failures. For example, the port of Singapore annually receives more than 70.000 commercial vessels, that come to more than 190 vessels per day with average turnaround time between six and eight hours, which leads to the conclusion that it is impossible to control all vessels [48].

Random inspections of documentation that is required by the Convention [62, 63], visual inspections of the condition of a BWTS, the condition of the vessel and control of crew training in system operation can easily identify irregularities which can be ground cause for more detailed inspections. In that case ballast water samples will be taken [64] and analysed to ascertain any non-compliance. Random inspections can be performed rather quickly and do not require additional finances [48].

3. CONTINGENCY MEASURES / *Mjere u iznenadnim slučajevima*

De-ballasting is a crucial action for cargo loading operations [65]. Contingency measures have to be adopted in order to avoid costly delays of vessels and enable undisturbed cargo loading, for example when there is a BWTS breakdown.

One of the contingency measures is discharging ballast into shore tanks or barges [66], that may be provided by maritime administrations of coastal states [67]. It was already announced that some Dutch ports may be prepared for contingency situations and for vessels without a BWTS since they will use barges with an installed BWTS. Also, there is an option to install BWTS on trucks that would also enable the treatment of ballast water during de-ballasting. It is expected that these systems will be tested in the Netherlands during 2017 [68].

In order to be able to perform de-ballasting into these barges, vessels will have to install standardized shore connections on their ballast pipelines [69]. Oil tankers have an advantage since they can perform de-ballasting via the cargo pipeline, what is already standard practice on Flotta Oil Terminal, Orkney Island [70].

4. CONCLUSION / *Zaključak*

The overview of the current situation on the BWMS market and an assessment of the development in future years are given in this paper.

BWMC will enter into force in September 2017, 13 years after adoption. IMO should act more resolutely during the next 71st MEPC meeting and confirm the already set time frame for the implementation of BWMC standards.

Most of the shipowners are still monitoring the development of the situation, and they have not started with preparations for the installation of BWTSs, although the given five-year time frame is approaching. MARAD is contributing to the confusion with time consuming type approval process that additionally discourages shipowners and stimulates them to wait for a clearer situation on the market.

Some of them will renew IOPP certificates before September 2017 and postpone BWTS installation for five years. After that time frame expires, the most probable situation development would be the scrapping of cheaper bulk carriers and oil tankers older than 20 years. Most of the costly vessels, like LNG tankers and cruise vessels, will most probably install BWTS regardless their age.

The assumption is that due to the shortage of BWTSs on the market, and insufficient number of repair shipyards capacities, all shipowners will not be able to install BWTSs on existing vessels within the Regulation D-2 implementation time frame. However, BWTS manufacturers claim that they will be ready for the increased demand of BWTSs in the upcoming years, which is questionable.

Shipyards expect reductions in time needed for dry docking and BWTS installation, resulting in a significant progress on the market. If that would be the case, shipowner's costs would be reduced.

The biggest challenge is expected to be in the control of the implementation of BWMC standards. The inspection of vessel's compliance with BWMC standards is a difficult task that maritime administrations of coastal states need to carry out. But, it is expected that Port State Control Officers will succeed in that task, by performing random inspections, as they have always done.

Finally, it is important to stress that it is very difficult to predict the accurate development of the BWTS market situation, as confirmed by previous attempts of forecasting development of this market.

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