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HARMFUL AQUATIC ORGANISMS IN BALLAST WATER

Challenges in complying with the BWM Convention requirements for existing ships operating in ports with challenging water quality (PCWQ)

Submitted by India, Japan, Liberia, ICS and INTERCARGO

SUMMARY

Executive summary:	This document aims to clarify issues related to challenging water quality and highlights the challenges that exist for ships in meeting the BWM Convention's requirements while operating in a port with challenging water quality.
Strategic direction, if applicable:	1
Output:	1.25
Action to be taken:	Paragraph 38
Related documents:	MEPC 78/WP.8, MEPC 78/4/1, MEPC 78/4/11, MEPC 78/INF.17; MEPC 79/4/13, MEPC 79/4/15 and MEPC 79/WP.6

Introduction and background

1 On 7 July 2017, resolution MEPC.290(71) established the experience-building phase (EBP) associated with the BWM Convention. The EBP consists of a data gathering stage, a data analysis stage and a Convention review stage. The EBP began with the entry into force of the Convention and ends with the entry into force of a package of priority amendments. The priority amendments are those that implement improvements to the Convention needed before the end of non-penalization measures specific to the EBP that are set out in resolution MEPC.290(71).

2 Aside from these non-penalization measures, the EBP does not alter the basic roles, responsibilities, obligations and recommendations under the Convention, its guidelines and relevant guidance. The Committee subsequently adopted BWM.2/Circ.67/Rev.1 containing a data gathering and analysis plan (DGAP) for the EBP. The circular set out specific arrangements for data gathering, as well as principles and organizational arrangements for analysing the data collected.

MEPC 78 key developments

3 With the submission of the data analysis report (MEPC 78/4/1) the data gathering and analysis stages of the EBP have been completed. The following is a summary of the key points (paragraphs 3.6.5 to 3.6.8 of the annex to document MEPC 78/4/1) in the report pertaining to challenging water quality:

.1 There may be operational difficulties during ballasting or deballasting in such challenging conditions. The problems have also been attributed to filter clogging or high differential pressure, low UV-I alarms and TRO alarms at the inlet and discharge. The report supported the notion that highly variable water quality conditions in ports around the world can present a challenge to the consistent and effective operation of BWMS for certain technologies;

.2 When a BWMS is designed, installed, operated and maintained properly, it is not solely dependent on water quality characteristics. It is possible that certain BWMS technologies can be fully functional under such conditions despite system design limitations/operational limitations;

.3 Recommendations based on the specific information provided for challenging water conditions could not be made at this time, as "challenging water" does not have a specific definition in the Convention beyond the type approval testing conditions described in the BWMS Code (resolution MEPC.300(72)); and

.4 BWMS retrofits may provide better reliability than BWMS installed during ship construction. There is no one-size-fits-all BWMS solution, and rigorous testing and certification of BWMS does not guarantee trouble-free operation. Additionally, proper installation and commissioning, crew training, maintenance, and operation are all essential to achieving compliance.

Other documents submitted to MEPC 78 pertaining to challenging water quality

4 Document MEPC 78/INF.17 provided updated information regarding ships experiencing problems with their ballast water management systems (BWMS) in ports with challenging water quality (PCWQ). The document mentioned that reduced ballasting rates have been occurring primarily in ports with heavy sedimentation, which has caused filter blockages and reduced UV transmittance. This has caused the BWMS to either fail or require bypassing to complete the ballasting process.

5 Document MEPC 78/4/11 describes the results of Japan's study on the annual amount of problems with BWMS aboard ships between 2018 and 2021, as well as how the number of problems per ship has decreased between 2020-2021 and 2018-2019. The reason for this seems to be that the systems have become more mature and stable, as well as crews having become more familiar with them. Document MEPC 78/4/11 concluded with key findings regarding the decrease in the frequency of problems encountered with BWMS.

6 The DGAP report (MEPC 78/4/1) does not provide specific recommendations for challenging water quality conditions, in addition to the many mixed viewpoints provided by other documents at MEPC 78. MEPC 78 established the Correspondence Group on Review of the BWM Convention with the terms of reference set out in paragraph 4.33 of document MEPC 78/17, including to submit a report to MEPC 80. Although the data gathering and analysis stage has been completed, it is still considered appropriate that any further information and data be submitted to the Committee during the Convention review stage of the EBP.

MEPC 79 key developments

7 During MEPC 79, the Ballast Water Review Group (BWRG) considered a number of submissions related to ship operations at PCWQ. The BWRG was instructed to review the proposals and the information within documents MEPC 79/4/12 and MEPC 79/4/13, as well as the relevant comments made in document 79/4/15, and advise the Committee accordingly. Prior to considering concrete proposals, the Group prioritized discussing how to address the issue at a fundamental level and created a list of elements which should be considered in the development of any future guidance for ships encountering challenging uptake water. The list is contained in annex 4 of document MEPC 79/WP.6 (discussions were based on document MEPC 79/4/13).

8 A summary of the key points from the BWRG report can be found below:

.1 since BWMS may continue to improve, it was noted (paragraph 43 of document MEPC 79/WP.6) that the issue of challenging water quality did not pose a long-term threat, but it affects only earlier generation BWMS. Concerns were raised that the guidance or other solutions proposed to address this issue should not inadvertently incentivize the installation of less robust BWMS assuming that BWMS bypassing would be broadly allowed;

.2 the need for an improved BWMS type approval process was noted;

.3 the BWRG report acknowledges that there must be clear evidence before choosing options such as ballast water exchange + ballast water treatment (BWE+BWT) and BWMS bypassing;

.4 there is a need to determine why the BWMS operate repeatedly in challenging water conditions beyond their capabilities;

.5 how to optimize BWMS maintenance, operation, crew training and familiarization;

.6 identifying triggering conditions for BWMS bypass, defining criteria and taking pre-emptive actions are some aspects that merit further consideration;

.7 it was suggested that flow rates should be viewed in terms other than percentages (for example, in the context of safe ship operations or BWMS limitations) and alternative parameters, such as BWMS rated capacities, could be used instead of pump flow rates;

.8 there were concerns regarding the proposals to use reception facilities or port-based treatment facilities to provide D-2 compliant water;

.9 a significant amount of energy may be expended during ballast water exchange, so consideration needs to be given to the relationship with ship energy efficiency and GHG emissions; and

.10 compliance issues with respect to BWMS bypassing were discussed, including the steps to be taken before resorting to BWMS bypassing, and the planning process after BWMS bypassing.

9 In conclusion, the Group recommended (paragraph 59 of document MEPC 79/WP.6) that the Committee should invite interested Member States and international organizations to submit concrete proposals for guidance for ships encountering challenging uptake water, taking into consideration the core elements in annex 4 of document MEPC 79/WP.6.

10 The co-sponsors would like to point out that the existing ships are not able to complete the ballasting process to D-2 standards using their BWMS in certain discharge ports with high sediments. This submission takes a holistic view on the issue of challenging water quality (CWQ), taking into account all the contributory factors, their potential impact and contributing to a deeper understanding of key elements listed by the BWRG in annex 4 of its report to MEPC 79 (MEPC 79/WP.6).

Discussion

11 Based on the feedback from shipowners and operators, the co-sponsors discovered that the pre-treatment filter clogging issue has long been misunderstood in conjunction with BWMS failure issues. The co-sponsors believe that ships with compliant BWMS will not be able to perform ballast operations through the BWMS in certain ports with high sediment levels until a solution is found to the issue of pre-treatment filters. As such, it is expected that these existing ships will continue to seek alternate methods for complying with Convention requirements in ports with high sediment levels, which cause the pre-treatment filters to clog rapidly.

12 The co-sponsors agree with the conclusion contained in document MEPC 78/4/11 that BWMS have improved as the number of problems per ship has decreased over time. This is because BWMS are a relatively new technology and there have been fewer problems per ship recently due to the lessons learned over the years. In addition, the co-sponsors also agree with the statement contained in document MEPC 78/INF.17 that ships in ports with heavy sediments are required to bypass BWMS to complete ballasting. This document refers specifically to the pre-treatment filter issue that ships with compliant BWMS encounter in certain ports with high sediment levels, and this issue cannot be solved by improving the BWMS. There is a need to keep these two issues separate.

13 Also, high sediment levels in ballast uptake water can cause other treatment method-specific BWMS equipment problems related to UV transmittance and TRO concentration levels. A specific treatment method problem such as UV transmissivity is also a bit more complicated to explain. However, even a basic understanding of the concept can help when it comes to creating a framework for making decisions.

14 Among the elements that can influence UV transmissivity are sediments and naturally dissolved metals within river bed rocks. The most suitable example for this is at Lake Superior, where river flows in that region deliver water with high dissolved iron concentrations which reduce UV transmissivity. Even though the water is clear and has a low suspended solids concentration, and may have some colouration or none at all, the dissolved iron still alters the UV light wavelength that renders organisms non-viable. Similar problems occur in the St. Lawrence River as well.

15 It will be beyond the scope of this document to explain all the existing treatment method-specific BWMS limitations. However, the co-sponsors emphasize that alternative measures are necessary to achieve the D-2 standard so existing ships can also operate in areas where their BWMS are ineffective. The following paragraphs seek to clarify selected key concepts that can be helpful in identifying and resolving any potential issues related to challenging water quality and thus paving the way for future guidance on this matter.

Determination of challenging water quality conditions

16 There is a common misconception that ships only have difficulties ballasting in shallow waters. There are operational best practices that can be utilized to mitigate the ballasting problems that ships encounter in shallow waters, such as the use of a high sea chest filter. In a port with challenging water quality, ships have the same problem regardless of under keel clearance (UKC). It is fairly easy for the crew to identify silt or sand content in water based on the colour of the water. The muddier and murkier the colour, the higher the amount of silt or sand present. When there is more sand/silt in the water, the pre-treatment filter clogs more quickly. During breeding or blooming seasons, aquatic organisms can also clog filters, which is an exception to the colour rule.

17 Challenging water quality is a very broad term, and it is important to clarify some fundamental concepts regarding its determination. The co-sponsors' research identified two ports, Detroit and Toledo (United States), separated by only a few nautical miles that illustrate practical criteria for determining challenging water quality conditions. Toledo is located on the Maumee River, while Detroit is located on the St. Clair River, which is not a river but a runoff stream from one lake to another.

Figure 1: An example of an easy way to identify ports with high sediment levels

18 Based on the colour of the water, it is evident that the water of the River Maumee contains a high level of sediments. This is also supported by years of science monitoring[1]. Under most circumstances, a ship with the same UKC in both ports will have ballasting problems in Toledo rather than Detroit. As a result of seasonal and tidal changes, Toledo will have better days and worse days. However, Detroit will never experience problems with ballasting, since it is not a port with high sediment level.

[1] For the Maumee River, see:
Status and trends in suspended-sediment discharges, soil erosion, and conservation tillage in the Maumee River basin: Ohio, Michigan, and Indiana. Water-Resources Investigations Report 2000–4091
Prepared in cooperation with the U.S. Army Corps of Engineers and the U.S. Department of Agriculture, Natural Resources Conservation Service. https://doi.org/10.3133/wri004091

Thirty-year Trends in Suspended Sediment in Seven Lake Erie Tributaries, September 2008, Journal of Environmental Quality 37(5):1894-908 https://www.researchgate.net/publication/23158510_Thirty-Year_Trends_in_Suspended_Sediment_in_Seven_Lake_Erie_Tributaries

19 A further example of challenging water quality being related to location is the River Weser in Germany, also evident from science monitoring[2]. Several ships encountered difficulties during ballasting in river ports, such as Brake and Bremen. It was necessary for the crew to bypass the BWMS in order to complete the ballasting process. Several other river ports have also been identified as having challenging water quality, and live satellite images confirm the colour of the water to be murky/muddy and therefore likely to pose difficulties for ships undertaking ballast operations.

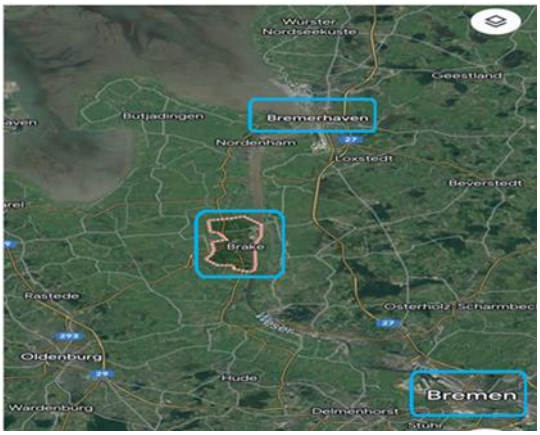

Figure 2: Further example of identifying and distinguishing ports with high sediment levels

Triggers for bypassing the BWMS

20 As an important step, the BWRG report suggests (paragraph 47 of document MEPC 79/WP.6) identifying trigger conditions that result in BWMS bypasses in ports with challenging water quality. There is a direct relationship between ballasting rates and cargo discharge rates, as both must be co-ordinated together. To prevent the ship from becoming unstable, shore-side operations must be slowed or completely stopped when the ship is unable to take ballast water at a sufficient rate. Cargo discharge rates have to be slowed or completely stopped in ports with challenging water quality when the BWMS cannot cope with cargo discharge rates, resulting in extended unloading times and higher costs.

21 The inability of ballasting flow rate to meet cargo discharge rate and the potential for increased cargo discharge time and costs are the major triggers for bypassing BWMS. Another trigger for BWMS bypass in CWQ is the automatic shut-down of the system if critical parameters are unable to meet the Convention requirements. In ports where water quality is challenging, inorganic particles may escape the pre-treatment filter and adversely impact the maintenance of critical parameters. Further continuous operation may result in BWMS components being damaged.

The significance and problems associated with pre-treatment filters

22 It is common for BWMS to have a pre-treatment stage filter that traps particles in excess of 50 microns (approximately). In ports such as Toledo, Brake and Bremen, the pre-treatment filter rapidly becomes clogged with suspended solids (mostly silt/sand and

[2] For the River Weser, see:
On Different Time Scales of Suspended Matter Dynamics in the Weser Estuary
October 2001, Estuaries and Coasts, 24(5):688-698
https://www.researchgate.net/publication/226982130_On_Different_Time_Scales_of_Suspended_Matter Dynamics_in_the_Weser_Estuary

aquatic organisms). In these circumstances, most of the filtration systems will switch repeatedly into a self-cleaning backwash mode and the flow rate of ballast water into the tanks is then reduced, and, when particles remain stuck in the filter despite backwashing, the flow may be completely stopped by an automatic shutdown caused by a high differential pressure alarm.

23 Manually cleaning the filter is then the only option to restore the system, which takes about 6 to 10 hours (depending on the size of the filter) and also requires substantial manpower. However, due to the challenging water quality, the filter is likely to clog again within minutes of using the system. Since type approved BWMS are unable to treat challenging water conditions, the ship's crew will evaluate the available options. These include reducing the rate, stopping cargo discharge or bypassing the BWMS. Unfortunately, reducing the rate or stopping cargo discharge is not a practical solution. In addition to the increased costs associated with reducing the rate or stopping cargo discharge, these options may lead to other issues like increased GHG emissions and port congestion. So the crew may have no choice but to take the BWMS bypass option.

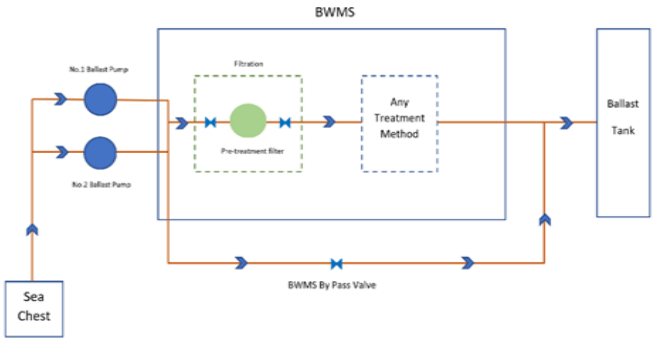

Figure 3: A line diagram illustrating where the pre-treatment filter is located

24 As pre-treatment filters are an integral part of the BWMS, they cannot be bypassed separately. The option of increasing the micron size of the filters will cause sediments to enter the system, which will result in a BWMS malfunction that triggers a shutdown of the whole system. In addition, the presence of more sediments in the tank is in violation of the Convention and may result with organisms in sediments multiplying within the tanks during the voyage and eventually resulting in a failure to comply with the D-2 standard at the next loading port.

25 Various types of manual pre-treatment filters are available. However, regardless of their type, filters are designed to capture particles greater than the specified limits for which they are designed. Therefore, in ports with high sediment levels, a working pre-treatment filter will result in sediment clogging the filter within minutes in ports with high sediment levels. This in turn makes it impossible to carry out ballast operations through the BWMS in these ports.

26 Due to the fact that pre-treatment filters are a part of most treatment methods, these BWMS with a pre-treatment filter are not capable of treating water with high sediment levels. In addition to affecting older BWMS generations, this issue also impacts newer versions since most newer versions also require a pre-treatment filter. There is therefore a gap between the technology available to treat challenging water quality in ports and the ability to meet the Convention's requirements.

Implications for existing ships

27 According to paragraph 12 of document MEPC 78/4/1, 93.6% of all known BWMS utilize either UV irradiation or electrochlorination treatment methods and the use of pre-treatment filters is an integral part of both of the treatment methods. Consequently, it is safe to conclude that most existing ships have pre-treatment filters as part of their BWMS. When these existing ships visit river ports with high sediment levels, they are not able to perform ballast operations using their BWMS and instead seek alternative methods for compliance with the Convention requirements.

28 BWMS are still an emerging technology that is continuing to improve as the industry learns from experience. However, it is important to point out that little progress has been made in the pre-treatment filter area since its inception. Options such as filterless BWMS technology are still in their infancy, and only time will tell if they will meet the D-2 standard requirements consistently. A filterless system, for instance, raises the question of whether sediments accumulate in ballast tanks and cause organisms to multiply in an undesired manner.

29 It is also questionable whether suggestions such as developing, selecting, and using a robust BWMS (paragraph 16 of document MEPC 79/4/15) would have a significant impact at this stage, since most ships have already installed a type approved BWMS to meet the Convention requirements. Similarly, improvements to type approval standards will improve the performance of the newer versions of the BWMS, but because most existing ships have already been fitted with type approved BWMS, these newer versions will have a limited impact. Therefore, it is recommended to take existing ships into account when finalizing the priority amendment package. Type approved BWMS fitted on existing ships should not need to be replaced or continuously upgraded and these existing ships should be provided with alternative options to meet the D-2 standard requirements.

30 There are a significant number of river ports where existing ships will have difficulty complying with the Convention requirements without alternative methods of compliance. As part of the experience-building phase when non-penalization measures are in force, ships are required to request dispensations from their flag State and often from the port State where they are located. It is possible for both flag States and port States to play a significant role in collecting and sharing data, enabling a more accurate evaluation of ports with challenging water quality.

Port treatment facilities as an option in PCWQ

31 The Ballast Water Review Group has considered submissions such as MEPC 79/4/13 proposing mandatory use of port reception facilities for ships visiting PCWQ. However, there may be limitations to options such as port-based treatment facilities for providing D-2-compliant water. Port-based treatment facilities are not regulated by the IMO, so it is unclear how a ship operator can be certain that their legal obligation to meet the D-2 standard has been met, when a port treatment facility is not legally required to comply.

32 Currently, existing ships do not have provisions for receiving treated water from shore-based treatment facilities. Structural changes would be needed for most ships before they can utilize port treatment facilities for the uptake of ballast water from ashore. As such, while various concepts for such port-based treatment facilities have been proposed (berth-based in fixed location or more flexible barge-based systems), in practice they are very rare.

33 Ballasting flow rates not matching cargo discharge rates, pre-treatment filter problems, and safety of the entire operation are all concerns that already exist. But, when using ballast water obtained from a port treatment facility, balancing the ballast flow and cargo discharge can be more difficult as operations now involve a third party, instead of being under direct control of the ship's master. For managing financial risk, it is also necessary to assign clear responsibilities, such as who is responsible for failure of compliance with the D-2 standard at the next loading port, the port authority supplying the D-2 standard water or the ship owner. Additionally, costs could increase if there is a delay at the berth due to the port not being able to supply treated water at the required rate.

34 As a result, there are new challenges in establishing a mechanism of accountability that clearly identifies who is responsible for such costs and delays, including assigning clear responsibilities to stakeholders and establishing clear protocols and measures to resolve delays and disruptions. With so many variables involved, it is difficult to determine if port treatment facilities supplying D-2 standard water to ships are a better option. This is due to the difficulty of assessing the costs and benefits associated with the two options, as well as the complexity of establishing a system of governance that will ensure compliance with the agreed-upon protocols and measures.

Other practical aspects

35 The Ballast Water Review Group has considered document MEPC 79/4/13 that recommends multiple rounds of ballast water treatment. However, it is highly energy intensive to perform ballast and deballast operations, and proposals to treat the water in the ballast tanks twice or more to attain the D-2 standard are not feasible on a short voyage and will result in an increase in greenhouse gas emissions which will adversely affect the ship's Carbon Intensity Indicator (CII) rating.

36 The Ballast Water Management Convention requires that ships renewing their IOPP Certificates after 2019 must meet the D-2 standard requirements. Taking into consideration the points elaborated in the above paragraphs 11 to 35, it should be evident that, in a port with challenging water quality, type approved BWMS may not be capable of treating water to the D-2 standard, leaving the ship's crew in a dilemma as to what should be done in order to comply with legal requirements. The viable options available for ship crews to address these situations are very limited and currently only include the option of ballast water exchange + ballast water treatment (BWE+BWT).

Proposal

37 The co-sponsors request the Committee to take note of the information in paragraphs 11 to 36 and consider this information in developing provisions for ships encountering challenging uptake water. The Committee is invited to specifically consider agreeing to the following proposals for further work on this topic:

.1 consider including the issue of type approved BWMS unable to treat water of challenging quality in certain ports in the list of issues table that is being developed for inclusion in the package of priority amendments as per resolution MEPC.290(71);

.2 recognize that the pre-treatment filter will clog rapidly in ports with high sediment levels, making it impossible to complete ballast operations through the type approved BWMS. Note that options such as widening the filter mesh size or filterless BWMS should be carefully evaluated because they can cause problems such as re-growth from sediments in the tank;

.3 recognize that existing ships with BWMS may not be able to meet the Convention requirements even after EBP ends. Existing ships fitted with type approved BWMS should not be required to undergo structural and system modifications to address PCWQ issues and should be allowed alternative operational measures for meeting the ballast water management requirements of the Convention when encountering these situations; and

.4 recognize that other treatment method-specific BWMS limitations also prevent existing ships from meeting the D-2 standard, and that guidance is needed to allow existing ships to trade globally.

Action requested of the Committee

38 The Committee is invited to review the discussions and proposals presented in this document and take action as appropriate.