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HARMFUL AQUATIC ORGANISMS IN BALLAST WATER

Practicality and safety of ballast water exchange plus treatment (BWE+BWT)

Submitted by IMarEST

SUMMARY

Executive summary:	This document presents practicality and safety concerns related to practicing ballast water exchange plus treatment.
Strategic direction, if applicable:	1
Output:	Not applicable
Action to be taken:	Paragraph 19
Related documents:	BLG 15/5/7; BWM.2/Circ.62, BWM.2/Circ.69; MEPC 70/4/9; MEPC 71/4/21; MEPC 73/4/8, MEPC 73/INF.8; MEPC.288(71) and MEPC.306(73)

Introduction

1 Some ships have been performing ballast water exchange plus ballast water treatment (BWE+BWT). This practice, while not yet well defined, typically involves a combination of ballast water exchange (BWE) generally in accordance with regulation D-1 and ballast water treatment (BWT) generally in accordance with regulation D-2. In some cases, such as certain locations in the United States, this practice is required by regulations that seek to achieve more reliable and increased biological efficacy. In other cases, such as the Amazon River, this practice is performed as a contingency measure in case a treatment system is overwhelmed by local water conditions.

2 This document expands on the safety considerations previously raised by IMarEST related to BWE+BWT as a contingency measure (MEPC 73/4/8, paragraph 6). This document identifies jurisdictions that require this practice and the expected benefits. The practicality and safety of this practice are outlined. The utilization of this practice, as an additional measure and as a contingency within the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (herewith the Convention), is reviewed. Finally, the discussion suggests that these aspects require further study and review to better inform Parties that might require this practice and better prepare ship operators to practically and safely comply.

Jurisdictions requiring BWE+BWT, expected benefits, frequency of practice, and use as a contingency measure

3 The United States requires BWE+BWT as a management practice and Canada is considering similar measures. This review has not identified any other jurisdictions that are considering such measures.

.1 The United States requires ships entering the Great Lakes and Saint Lawrence Seaway System that are using a ballast water management system (BWMS) to also conduct BWE or saltwater flushing if they were operated outside of the United States Exclusive Economic Zone (EEZ) and have taken on ballast water with a salinity of less than 18 parts per thousand within the previous 30 days. (United States Vessel General Permit, 2013, Section 2.2.3.7).

.2 The United States recently enacted the Vessel Incidental Discharge Act of 2018 which expands the BWE+BWT requirement to all ships entering the Great Lakes and Saint Lawrence Seaway System, and in certain circumstances to the United States Pacific Region. This region includes any federal or state waters adjacent to the State of Alaska, California, Hawaii, Oregon or Washington; and the EEZ adjacent to each of these states.

.3 Transport Canada recently circulated a proposed approach that would require ships travelling to Canadian freshwater ports from outside its exclusive economic zone to continue performing BWE until 8 September 2024, in addition to compliance with the Convention. The proposed approach would "provide time for scientific research to determine if BWMS are performing well".

4 The expected benefits of BWE+BWT have been studied in several published papers. These benefits and papers include:

.1 A land-based study analysed the efficacy of treating natural fresh water by BWT alone as compared to performing a simulated BWE with 32 ppt synthetic ocean water, and then performing BWT. The study found that the BWE+BWT practice increased biological efficacy from 98.61% to 99.99% for ≥ 50 µm organisms, and from 91.69% to 99.38% for ≥ 10 to < 50 µm organisms (Briski et al. 2013).

.2 Another study performed three shipboard trials that analysed the effects of BWT alone as compared to BWE+BWT on freshwater ballast. The study found that BWE+BWT significantly reduced live plankton concentrations, and that the "BWE plus BWT tanks contained mainly marine taxa that primarily originated from the BWE area, and would likely not survive if discharged into freshwater ecosystems" (Briski et al. 2015).

.3 A technology assessment by California suggests that BWE+BWT could be more effective than BWT alone and avoid the discharge of polluted water sourced from other ports (California 2018).

5 BWE+BWT appears to be increasingly practised in some locations. An inquiry to California returned a preliminary analysis of data between July 2016 and 8 February 2019. "During the time period 105 voyages, by 74 unique vessels, discharged in CA ports AFTER using the exchange + onboard treatment management scenario." This included two such discharges in 2016, increasing to 27 in 2017, and then 68 in 2018.

6 The practice of BWE+BWT has been used as a contingency measure when BWMS are not able to be operated as intended because they are overwhelmed by ambient water conditions or equipment challenges. Some examples include:

.1 An inquiry to BWMS manufacturers returned various statements including, "owners that operate let's say in the Amazon River will have to bypass the filters to be able to ballast at all, due to the heavy load of sediments and dirt, filters of 40 micron will clog in matter of minutes". These operators then use the practice of BWE+BWT as a best practice contingency measure.

.2 An inquiry to classification societies returned various statements including: "Shipowners ballasting in the Mississippi River and at Nikiski, Alaska that could not operate the BWMS (one had a low salinity and filter clogging problem – the other was all about the filter clogging). The Captains of the Ports (COTPs) were very pleased with the detailed contingency measures – bypass the BWMS, leave port, conduct sequential BWE + BWT during re-ballasting."

.3 One example of international guidance on BWE+BWT comes from INTERTANKO: "In the event that a the BWMS has been repaired but there remains untreated (non-compliant) ballast water on board, the untreated ballast water may be treated en route by undertaking a ballast water exchange through the BWMS" (MEPC 73/INF.8, annex, page 10).

Exchange plus treatment description and practicality

7 Published best practices for performing BWE+BWT appear to be limited to the Republic of Korea documents MEPC 70/4/9 and MEPC 71/4/21. These documents offer guidance on the location of the BWE and BWT activities for contingency cases when the BWMS operating limits are exceeded.

8 The 2017 *Guidelines for Ballast Water Exchange* (G6) (resolution MEPC.288(71)) identifies three accepted methods for BWE: sequential, flow-through and dilution. The *Guidance on System Design Limitations* (BWM.2/Circ.69) identifies 11 treatment technologies. This suggests that there are many possible combinations of BWE+BWT. The combination sequence of BWE+BWT can significantly impact the expected benefits and practicality. For example:

.1 Should BWT be performed during initial in-port ballast water uptake?

.2 Should BWT be performed during the BWE, essentially flushing the ballast water tanks with treated ballast water?

.3 Should BWE+BWT only be performed in conjunction with sequential BWE, or are there cases where it works with flow-through or dilution?

.4 How does performing BWE+BWT as a planned treatment process differ from performance as a contingency measure?

9 The example of BWE+BWT with inline filtration and chlorination combined with flow-through exchange is presented below as an example of a challenging application. This example sequence includes: filtration and chlorination of the ballast water during in-port uptake, flow-through exchange during the voyage with ocean water that is filtered and chlorinated by the BWMS, discharge in-port with monitoring and neutralization.

.1 From a biological efficacy viewpoint, all water that enters the ballast water tanks during in-port uptake has at least an initial treatment and receives the benefit that a significant amount of any low salinity fresh water and associated organisms have been flushed out during flow-through exchange;

.2 From a regulatory compliance perspective, it is unclear if the overflowing treated ballast water would be able to meet the BWMS requirements such as hold time limitations and applicable required neutralization steps during flow-through exchange;

.3 From a treatment technology perspective, it is unclear if the system design limitations or type approval operating requirements can be met. Can the ship hold the water long enough to meet any hold time limitation? How can discharge monitoring take place if the discharge is overflowing on the ship's weather deck?

.4 From crew safety and environmental acceptability perspectives, high volumes of chlorinated ballast water flowing out of vents, unless fitted with overflow piping, and down the weather deck of a ship during flow-through exchange should be considered; and

.5 From an operational perspective, the planned voyage time may be insufficient to complete the BWE and then still have enough time to perform BWT and also meet any hold time requirements.

10 The example of BWE+BWT with inline filtration and ultraviolet irradiation (UV) combined with sequential exchange is presented below as an example of a practical application. This example sequence includes: filtration and UV disinfection of the ballast water during in-port uptake, sequential exchange with ocean water during the voyage including second UV dose during discharge and then filter and UV during the uptake, with the discharge in-port including a second UV dose.

.1 From a biological efficacy viewpoint, all water that enters the ballast water tanks during in-port uptake has at least an initial treatment and receives the benefit that a significant amount of any low salinity fresh water and associated organisms have been flushed out during sequential exchange;

.2 From a regulatory compliance perspective, as long as the voyage is long enough to allow any required treatment hold times, the discharge during the sequential exchange would be expected to at least meet the D-2 ballast water performance standards;

.3 From a treatment technology perspective, it appears possible to meet the system design limitations and type approval operating requirements if there is adequate voyage time and crew availability;

.4 From a safety perspective, the performance of the BWE itself has inherent risks. The performance of BWE and BWT together increases the complexity of the operation and would therefore further increase risks; and

.5 From an operational perspective, this practice will require approximately twice the interaction time from the ship crew as compared to BWE or BWT

alone. Further, the operations will take time and there might not be enough voyage time to complete BWE and then BWT.

11 The performance of the combination of BWE+BWT will require more energy consumption as compared to BWT or BWE alone. In the first example above, inline filtration and chlorination with flow-through exchange, the total pumping and treatment system fuel consumption would increase nearly four times. In the second example above, inline filtration and UV with sequential exchange, the fuel consumption would increase nearly two times.

12 For new design ships that are only expecting to perform BWT, they might not be designed with adequate structural strength or stability considerations to also perform BWE. Crews on ships that are only expecting to perform BWT might not be trained to also perform BWE.

Safety considerations

13 BWE, when practised in accordance with regulation D-1, introduces safety considerations which are well documented in the 2017 *Guidelines for Ballast Water Exchange* (G6) (resolution MEPC.288(71)). However, this guideline does not address considerations specific to BWE+BWT. Such considerations include:

.1 New safety and environmental acceptability considerations may be required when exchange is conducted in combination with treatment, such as crew exposure to active substances from the overflowing ballast water through a weather deck vent during a flow-through exchange;

.2 Most new-build ships have BWMS installed and consideration should be given to designing the ability to perform BWE as a contingency measure. BWE may impact ship structure, loading plans and piping arrangements; and

.3 Crews that operate ships might be trained to perform BWE as a contingency measure, and on performing BWE in combination with BWT.

14 BWE continues to be associated with some marine casualties (Australia Transport Safety Board, 2019). However, there is little information on how often such casualties are occurring.

Applicability of exchange plus treatment under the Convention

15 The Convention, when drafted, may not have considered BWE+BWT as an option. This section considers the additional measures under regulation C-1 and how a Party might take into account safety measures and practicality considerations.

16 A preliminary review of applicability of BWE+BWT under the Convention is outlined below. However, various experts have offered differing interpretations suggesting that further review is needed:

.1 Regulation B-3 provides the time frame for compliance with regulation D-1 and regulation D-2 but does not address the concept of complying with both;

.2 A Party, under regulation C-1, may require "measures in addition to those in Section B are necessary to prevent, reduce or eliminate the transfer of harmful aquatic organisms and pathogens". Requiring BWE, in addition to the Section B requirements, appears to be aligned with regulation C-1;

3 A Party requiring BWE as an additional measure under regulation C-1 would effectively be requiring BWE+BWT for ships that are required to manage their ballast water under regulation D-2 (ballast water performance standard); and

.4 The practice of BWE+BWT as a contingency measure is not clearly covered under the Convention.

17 The applicability of the exceptions, exemptions and practical guidance within the Convention to a BWE measure adopted under regulation C-1 may merit additional discussion:

.1 The exceptions in regulation A-3 appear to include measures adopted by a Party pursuant to Section C;

.2 The exemptions that a Party might grant under regulation A-4 appear to include requirements under regulation C-1;

.3 Regulation B-4 offers practical guidance such as not requiring deviations or delays to intended voyages in order to perform BWE. It is not clear if this guidance would apply to BWE required under C-1; and

.4 Regulation C-1 makes clear that the safety of a ship comes first stating in paragraph 5: "Any additional measures adopted by a Party or Parties shall not compromise the safety and security of the ship."

Discussion

18 BWE+BWT appears to offer increased protection to the marine environment especially for freshwater receiving environments. It is also currently in use as a contingency measure. However, the practicality and safety of this combined practice may require further consideration. Further, the regulatory framework is not clear. It is recommended that the below listed aspects be studied further.

.1 The cited literature suggests that BWE+BWT offers increased environmental protection by increasing the reliability and biological efficacy of the overall process. However, type approval testing of BWMS (BWT) already require significant reductions in viable organisms. Further analysis might better quantify the relative benefits of BWE+BWT as an added measure.

.2 Performing BWE+BWT as an additional measure may increase fuel consumption by as much as four times as compared to BWT alone. The resulting impact on a vessel’s Ship Energy Efficiency Management Plan (SEEMP) should be considered.

.3 Guidance on the practicality and safety of BWE+BWT either as an additional measure or as a contingency measure is very limited. Further study and published recommendations could address the aspects discussed in this document and provide safe operating procedures to ship crews.

.4 Once a ship is required to conduct management under regulation D-2, it appears that it is no longer allowed to discharge ballast water on the high seas unless that ballast water meets the D-2 standard. It is suggested that this requirement be reviewed in view of BWE+BWT for both the additional measure case and the contingency measure case.

Action requested of the Committee

19 The Committee is invited to note the information contained in this document.

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