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HARMFUL AQUATIC ORGANISMS IN BALLAST WATER

Information on data gathered from commissioning testing of over 2,000 ballast water management systems

Submitted by Global TestNet

SUMMARY

Executive summary:	This submission presents information on experience gathered over years of performing independent commissioning testing of ballast water management systems (BWMS). Installed BWMS generally performs well (93-95% removal of organisms across all tests performed) and, while 11% of BWMS are found to fail at installation, the sources of failures can be corrected to ensure optimal performance. From these results, Global TestNet concludes that the failures are largely due to contamination from uncleaned tanks or non-treated ballast water present on board. Additionally, isokinetic sampling to obtain a representative sample of adequate size is found to be the cornerstone to compliance monitoring of the BWM Convention.
Strategic direction, if applicable:	1
Output:	1.24
Action to be taken:	Paragraph 18
Related documents:	MEPC 76/INF.56; MEPC 78/INF.11; MEPC 81/WP.9 and BWM.2/Circ.70/Rev.1

Background

1 Global TestNet members promote comparable and accurate test results on the performance evaluation of technologies and methodologies to control the risk of bio-invasions and harmful species introductions by shipping, through an open exchange of information, transparency in methodologies and advancing the science of testing.

2 BWM.2/Circ.70/Rev.1 recommends independent sampling and analysis tests to verify that newly installed BWMS can perform as expected and support the treatment of ballast water to ensure ships can discharge water in compliance with the D-2 performance standard of the Ballast Water Management Convention (the Convention).

3 In an effort to extract the most important learnings from such activities, six members of the Global TestNet have agreed to share anonymized information on test results and observations from commissioning work initiated in 2019. Some of these data have been previously shared with the Secretariat, through the World Maritime University, as part of the experience-building phase associated with the Convention, and a large number of additional data points support findings from this activity and link to previous information shared in document MEPC 78/INF.11 (Global TestNet).

Testing data from Global TestNet members

4 Tens of thousands of ships have been commissioned following the approval of BWM.2/Circ.70 (as revised) since 2019. Most tests have been carried out by providers approved by classification societies, estimated to be as many as 130 providers at peak time (2022). This number is likely to decrease over time due to the decreased demand as well as the costs associated with the approval process of many individual classification societies, which can be prohibitive.

5 As part of their commitment to better testing, Global TestNet members have compiled over 2,000 sets of results and information captured during testing. The increased activity between the periods 2019-2021 (704 tests reported to Global TestNet) and 2022-2023 (2052 tests reported to Global TestNet - 191% increase) are due to the enforcement of requirements for all ships installing a BWMS starting June 2022. Global TestNet members' observations are consistent across regions and testing approaches, and therefore should be considered representative of such activities, globally.

6 It is mandatory for all Global TestNet members to have a conflict-of-interest policy in place and remain independent from the shipyards installing the BWMS, the manufacturers of the BWMS and the engineering companies planning the installations. Global TestNet members rigorously documented these tests to keep track of failure rates, treatment technologies tested, reasons for failures (when found), as well as many other variables. The main statistics are presented in table 1.

Table 1: Overview of commissioning testing results for tests carried out and reported by the Global TestNet (six members)

Parameter	Data
Number of tests performed since entry into force (September 2017)	2052
Number of discharges failing to meet the Maximum Allowed Discharge Concentration at 0.1 mg/L Cl_2	66* (~7% failure rate for BWMS using active substances)
Number of tests using a combination of indicative and detailed analysis	423
Number of tests performed using indicative analysis only	1356
Number of tests performed using detailed analysis only	280
Number of tests showing compliance (any size class)	1822
% of tests failing compliance (any size class)	11%
% of failures due to ≥ 50 μm size class	91%
% of failures due to 10 μm ≤ x < 50 μm size class	9%
% of failures due to *E. coli*	4%
% of failures due to enterococci	3%
% of failures due to *V. cholerae*	0%

* Some members did not initially report TRO data from independent grab samples, because recognized organizations did not require this verification, initially. Therefore, the reported failure rate reported here should be considered an underestimate.

Main observations from commissioning testing

7 Members continued to observe the trend seen in 2017 regarding the type of treatment technology on ships (figure 1). That is, the proportion of installation of BWMS using active substances or not remained nearly even. Systems are expected to be chosen depending on the economics and environment that the ship will most commonly be operating considering also the system design limitations and the capacity of technology provider to offer technical support once the BWMS are installed and used (Gerhard et al. 2019 [Ocean & Coastal Management Vol. 181-104907]). Most members have not found any specific treatment approach to perform better than others at installation. The performance of the BWMS at installation reflects the performance of the individual BWMS (as evaluated during type approval testing) as well as the ship-specific design, planning and installation to ensure that none of those factors has compromised the performance of the BWMS.

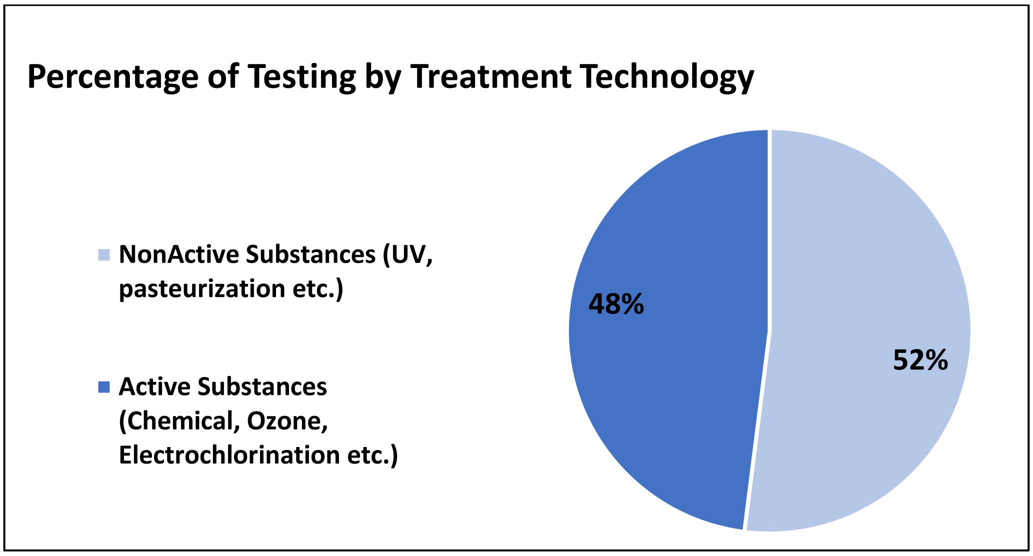

Figure 1: Percentage of commissioning tests of ballast water management systems (BWMS) that had been type approved in accordance with Guidelines (G8) / BWMS Code (not using active substances) or Guidelines (G8) / BWMS Code and Procedure (G9) (using active substances)

8 Members also documented the concentration of organisms in the inlet water (before treatment) and in the discharge (after treatment), as this was a requirement in the early days of commissioning, and a few clients still request such testing (figure 2). On average, members observed over 93% reduction of living organisms in both the ≥50 µm and the ≥10 to <50 µm size classes. These results prove that, when BWMS are properly installed, they consistently achieve a high efficacy in removing organisms, although, notably, this efficacy may not have been sufficient to meet the D-2 discharge standard. It is not possible to compare the reduction of organisms with that of type approval because type approval testing has specific requirements for the minimum concentration of organisms in inlet water. During commissioning testing and regular compliance monitoring, it is highly recommended that inlet water contains a high concentration of organisms (as similar to type approval testing as possible) to ensure that the testing can detect malfunctions of the BWMS at installation or point out to maintenance issues during regular monitoring. This recommendation is echoed in recent guidance from IACS (IACS 180 – Recommendation for conducting testing of BWMS) on commissioning testing.

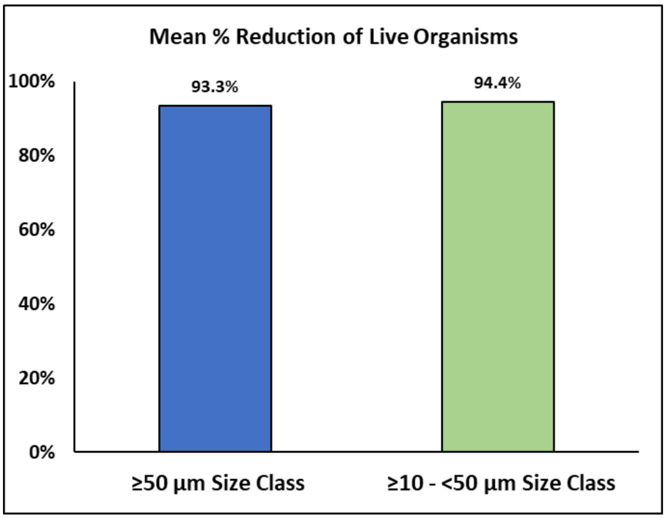

Figure 2: Mean percent reduction of both size classes during discharge (n=96)

9 Some Global TestNet members have reported occasions where more organisms were found in discharged water than in the inlet water (as measured by the concentration of adenosine triphosphate, ATP, a macromolecule found in all living cells) (Drillet et al. 2023 [Marine Pollution Bulletin 191 (2023) 114911]). This result suggests that ballast water tanks were contaminated, valves were improperly closed or both (see later).

10 The global dataset clearly reveals that failures mostly occur with the size class of organisms in the ≥50 µm size fraction. Therefore, this size class must be evaluated in compliance monitoring and enforcement as well as the future, regular testing regime agreed to at MEPC 81 (MEPC 81/WP.9). Two members reported that, when a discharge failed to meet the limit of the ≥10 µm to <50 µm size class, it was always accompanied by a failure to meet the discharge standard for the ≥50 µm size class.

11 Since 2019, Global TestNet has advocated for using detailed analysis for commissioning and compliance monitoring because the most complex part of the testing is collecting a representative sample isokinetically during discharge.

12 The volume of the sample collected must allow for the production of statistically relevant results. This volume was defined as a minimum of 3 m^3 during the revision of the Guidelines (G8) and the preparation of the BWMS Code. It is 1 m^3 in BWM.2/Circ.70/Rev.1 and should be considered a strict minimum. Larger volumes should be encouraged when possible. However, not all BWMS are installed with a sampling facility (sampling probe) permitting optimal sampling (Drake et al. 2021; Marine Pollution Bulletin 167 (2021) 112280). The ongoing revision of the Guidelines (G2) and the publishing of the ISO Standards 11711-1:2019 (Ballast water discharge sample port) and 11711-2:2022 (Ballast water sample collection and handling) will likely support improvement of installations and ease sampling in the future.

13 Results from this study have been produced using either indicative analysis or detailed analysis, sometimes in combination, to carry out the tests as approved by classification societies working on behalf of Administrations. One member noted that detailed analysis carried out after failures of indicative analysis often proved that the discharge was compliant; in such cases the results of the detailed analysis prevailed.

14 Global TestNet members have shared their testing approach as part of the Global TestNet intercomparison chart available on the website (https://www.globaltestnet.org/Discussions). Based on years of sharing information, it is

expected that all Global TestNet members are able to perform sampling in accordance with the published standard ISO 11711-2:2022, which may be used to perform testing under the general accreditation for laboratories (ISO 17025).

15 Members were asked to provide the most likely source of failure during the discharge based on their observations (table 2). From this evaluation, the most common source of non-compliance was the contamination of treated water from dirty ballast water tanks and mixing of waters with unmanaged ballast water on board, which sometimes occur during testing, for example when an uncleaned tank is used for the test. The second highest reason for non-compliance was contamination of treated water with untreated water. This typically occurs when valves are left open or piping carrying untreated water is not properly flushed. The third-ranked source of failure was human error. A working BWMS will fail if the crew do not have sufficient training and thus cannot operate the BWMS properly. Some examples include not adhering to proper hold times after treatment, or not maintaining the systems to the vendor specifications (e.g. cleaning lamp sleeves, not calibrating the sensors, etc.).

Table 2: Most common sources of non-compliance during discharge according to five members

	Top ranked sources of failure
1	Contamination inherent to presence of organisms in tanks (no cleaning of tanks at commissioning and regrowth)
2	Contamination from mixing treated water with untreated water
3	BWMS not used in accordance with manufacturer instructions (including a lack of sufficient crew training)

16 Finally, the members were surveyed regarding the importance and frequency of compliance testing (table 3). For all questions, the responses were unanimous. Following additional discussions, there was hearty agreement that routine compliance checks are required to evaluate the ongoing efficacy of BWMS installed on ships. Members were concerned that conducting a single commissioning test would not be indicative of future performance (and convey environmental protection), as BWMS can fail for numerous reasons throughout the life of a ship. Without routine compliance testing of the treated discharge, it is impossible to know if a system is working properly. A false assumption can lead to the proliferation of harmful aquatic organisms and pathogens.

Table 3: Response to questions from five members regarding routine compliance testing

TESTING REQUIREMENTS	
Do you think it is important to do regular tests of the discharge against the D-2 standard on all ships?	YES (unanimous)
From your expertise in biological testing how often should regular compliance tests be done to ensure success of the Convention?	Every year (4), every 2 years (1)
Do you think high TRO discharge is a risk for the environment?	YES (unanimous)
Do you think TRO discharge should be regularly tested?	YES (unanimous)

17 The members of the Global TestNet note that the information from compliance monitoring occurring after installation reveals that some non-compliance still occurs at relatively high rates as presented by recent submissions to the Organization (e.g. MEPC 76/INF.56 (Australia)). Global TestNet members are discussing potential sources of failures and will continue sharing new information with the Committee as may be available.

Action requested of the Committee

18 The Committee is invited to take note of the information in this document.

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