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The Student Officer's Understanding of Ballast Water Treatment According to The Ballast Water Management (BMW) Convention

Abstract: The ballast water used as a ship's stabilizer when it is not loaded has a negative impact on health and the environment and even causes economic losses. One of them is caused by the pathogenic microbes in it. Therefore, the International Maritime Organization (IMO) enacted the Ballast Water Management (BWM) Convention to prevent the spread of pathogenic microbes that are very dangerous to health and the environment. The purpose of this study is to find out the extent of understanding of BWM Convention of the Deck and Engine Officer Class I and II in PIP Semarang. An analytical description and an overlap approach, including questionnaires, and in-depth interviews were applied to the research method. A total of 27 students from the deck and engine departments were included in the sample. According to the survey's findings, most participants don't fully comprehend the BWM contract. When being asked whether BWM was regulated, the correct answer was 0%. The right response when being asked whether Indonesia ratified the BWM was 0%. When being asked how the efficiency of BWM was 3.7% for the D-1 standard (ballast replacement) and 11.1% for the D-2 standard (ballast handling). However, 44.4% of respondents correctly identified the significance of treating ballast water, indicating that they are worried about the threat posed by this substance and that immediate action is required. The idea is to provide the student officers with knowledge via seminars, which could include training on maritime pollution or special ballast water training.

Keywords: ballast water, BWM convention, deck and engine officers, socialization

INTRODUCTION

The Republic of Indonesia (NKRI) as the maritime axis of the world has been known since the time of the Majapahit Kingdom. (Witjaksana, 2017). It is geographically located between several oceans, thus becoming the World Maritime Axis. Indonesia is a marine nation with 17,504 islands and the second-longest coastline in the world, measuring 95,161 km2, after Canada (Lasabud, 2013). 3/4 of its total area (5.9 million km2) is the sea. The sea brings many opportunities, such as potential for biological resources, mineral and energy resources, maritime transport and environmental services, industrial and maritime services, and artistic potential. The potential of such abundant natural resources must be preserved and maintained. Preventive action to minimize the entry of pollutants into Indonesian waters is a wise action and becomes necessary.

The transportation system for archipelagic regions such as Indonesia is more flexible using ships. Moreover, with a large carrying capacity, the use of ships is more profitable. Fugazza et al. (2017) and Erga et al. (2019) stated that the sea or ship

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transportation mode is the leading choice for export-import activities because it is cheaper and more reliable. Khee.A. 2005 in Elçiçek (2013) stated more than 90% of world trade commodities with high economic value are transported by ship.

Since the introduction of free trade in the ASEAN region in 2015, Indonesia's economic movement have been driven more by the increase in exports of manufactured goods. This will result in more ships entering and leaving the territory of Indonesia to transport export products. Mega tanker ships, bulk cargo ships come to the territory of Indonesia to pick up production goods. In an unloaded state, the ship will carry a large amount of ballast water, which is water that is loaded on ships that do not carry cargo to maintain the balance of the ship. So, the ship is safe during the voyage. The water will be discharged once the ship loads goods (Gollasch, 2018; Sayinli et al., 2021). Ballast water is also helpful in controlling the movement of ships while sailing or being hit by waves (Golash et al., 2018; Ardura et al., 2021). It is estimated that the ballast water transfers about 12 billion tons annually, equivalent to about 4 million Olympic-sized swimming pools (IMO, 2009) by the world shipping fleet and containing hundreds of species originating from coastal areas and having eutrophic water properties (Elçiçek, 2013). Even Naik et al. (2021) estimated that the global oceans carry more than 12 billion tons of ballast water. Xue et al. (2021) noted according to his paper, ballast water is used to introduce 3000-7000 new foreign species (microorganisms) into all of the world's oceans every single day, which are then eliminated in the new environment; this leads to invasion, alters the ecosystem's original flora and fauna, and brings about overall ecological changes. Ballast water can cause marine pollution, harming habitats and aquatic biota and adversely affecting health and economic activities (Witjaksono, 2017;Wang et al., 2020; Xue et al., 2021). Ship-based marine pollution reaches severe levels in marine and coastal environments. Pollution caused by sea transportation is around 20% of the total marine pollution, as stated by Güney C. B. (2008) in Elçiçek (2013).

More living bacteria than plankton were discovered when Rivera et al. examined the organisms in ballast water tanks in 2012. There were 32% bacteria found, but plankton only 18% in the ballast water. Dobbs et al. (2013) investigated ballast water from ships in the waters of Singapore, Mexico, and Virginia, USA, which transmit Vibrio cholerae worldwide. Moreover, it was also found that Vibrio cholerae bacteria were resistant to one of the twelve antibiotics tested. Altug et al. (2012) surveyed the Sea of Marmara, Turkey in 2009–2010 for alien species arriving via ballast water from ships docked in Marmara Ereglise Port, Turkey. There were 27 of the at least 38 species of bacteria that were discovered in the investigation were pathogenic. El-Husna et al. (2017) investigated the effect of ship ballast water on environmental health by sampling the waters of Cilacap, Indonesia. The results showed a link between the microbes found in ballast water (Vibrio cholerae, Escherichia coli and Enterococcus intestinal) and the coastal environment. In addition, El-Husna et al. conducted a study in 2022 on ballast water from ships discharged at Port of Tanjung Emas Semarang, Indonesia and found nine types of pathogenic bacteria, including V. cholerae 0-15,000 CFU (colony-forming unit), E .. coli. 0 to 13,000 CFU and E. intestinalis 0 to 7,000 CFU, that exceeds the threshold given in Table 1 of the Standard Ballast Water Management (BWM) Convention D-2. (IMO, 2009).

Table 1. Performance Standard of D-2 BWM Convention

Microorganism category	Regulation D-2
Plankton, size > 50 μm	< 10 viable cells / m3
Plankton, size 10-50 μm	< 10 viable cells / mL
Toxicogenic Vibrio cholerae	< 1 Colony Forming Unit / 100 mL
Escherichia Coli	< 250 Colony Forming Unit / 100 mL
Intestinal Enterococci	< 100 Colony Forming Unit / 100 mL

The purpose of this study is to find out the extent of understanding of the BWM Convention of the Deck and Engine Officer Class I and II in PIP Semarang.

METHODS

This study applied a descriptive-analytical method and a cross-sectional approach. Questionnaires and in-depth interviews were used to obtain information. The study was carried out on 27 students (passed) of the I and II classes of the maritime and engineering curriculum, who already have experience in maritime work. The data collected by quaestionaires.

Table 2. List of questions from questionnaires 1: Publicity of Indonesia IMO BWM Congress

NO	QUESTION
1	Indonesia approved the BWM Convention's adoption by the IMO.
2	Indonesian government determined legislations and regulations as a derivative of the BWM Convention
3	It was decided for ships do not exchange ballast water
4	It is acceptable for ships to discharge ballast water that has not been treated
5	Ballast water treatment facilities are available at the port, regardless of the shippers agree or not to comply with the D-2 standard

Table 3. List of questions from questionnaires 2: The BWM convention is enforced

NO	QUESTION
1	When the BWM Convention was promulgated
2	When Indonesia ratified the BWM Convention
3	The quantity and date of legislation and regulations derived from the BWM Convention
4	What is known about the D-1 BWM Convention standard
5	What is known about the D-2 BWM Convention standard
6	How far the ballast water is discharge from the outermost land
7	How many meters the depth of ballast water discharge
8	How many kinds of ballast water treatment on the ship before being discharged
9	What chemical compounds are used for ballast water treatment
10	Whether it is important to remediate ballast water before discharge

RESULT AND DISCUSSION

According to the survey's findings, 27 participants (100%) strongly agreed that the IMO Indonesia BWM Convention should have been published. When being asked if they agree if the Indonesian government determined legislations and regulations based on the BWM Convention to protect Indonesian waters, 27 (100%) participants agreed. Regarding the question of it is decided that the ships do not exchange ballast water, it was agreed that ships do not exchange ballast water with the sanction, 2 (7.4%) participants answered that they do not agree, and 25 (92.6%) participants answered that they agree (Figure 1). Regarding the question of it is acceptable that ships that do not treat ballast water before disposal are penalized, 2 (7.4%) participants disagreed, and 25 (92.6%) participants agreed. Moreover, regarding the question of whether the shippers agree or not to meet the requirements of standard D-2 equipment for cleaning ballast water is in the port, 27 (100%) participants people agreed (Figure 1).

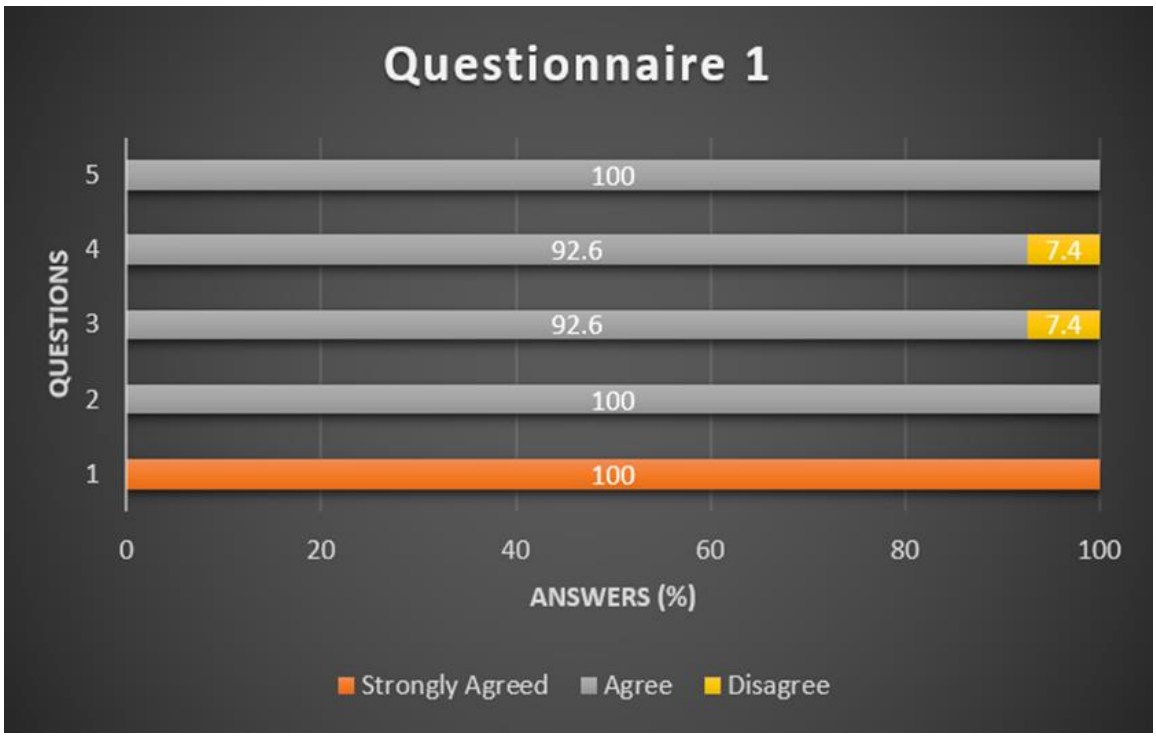

Figure 1. The result from the questionnaire 1: Publication of Indonesia IMO BWM Convention

Looking at the answers given by the respondents, they are quite optimistic that the student officers as seafarers understand the importance of marine regulations to protect the marine environment from the invasion of foreign microorganisms that pose a threat to the environment and health. Regarding the question about the validity of the BWM Convention, 0 respondents answered correctly, 17 respondents answered incorrectly, and 10 respondents answered that they did not know. When being asked the question of when Indonesia ratified the BWM Convention, 1 respondent answered correctly, 11 respondents provided erroneous information, while 15 respondents stated that they did not know. To the question about the number and year of derivative legislations and regulations of the BWM agreement, 1 respondent answered correctly, 19 respondents did not know, and 7 respondents answered incorrectly. As for the question of what is known about the D-1 BWM convention standard, 3 respondents answered correctly, 19 respondents answered that they did not know, and 5 respondents answered incorrectly.

The result towards the question of the standard knowledge of D-2 was that 4 respondents answered correctly, 3 respondents did not know, and 20 respondents answered incorrectly. Moreover, 4 respondents answered correctly, 6 respondents did not know, and 17 respondents answered incorrectly for the question of how far the ballast water is discharged from the outermost country. In response to the query of how many meters is the ballast water outflow depth, 6 respondents answered correctly, 7 respondents answered that they do not know, and 14 respondents answered incorrectly. When being asked on how much ballast water is cleaned in a ship before it is unloaded, 3 respondents answered correctly, 14 respondents did not know, and 10 respondents answered incorrectly. As for the question of which chemical compounds are used to treat ballast water, 4 respondents answered correctly, 11 respondents gave wrong answers and 12 respondents provided unsure responses. Moreover, when being asked if ballast water should be cleaned quickly before unloading, 12 respondents answered correctly, 11 respondents answered that they did not know, and 4 respondents answered incorrectly (Figure 2).

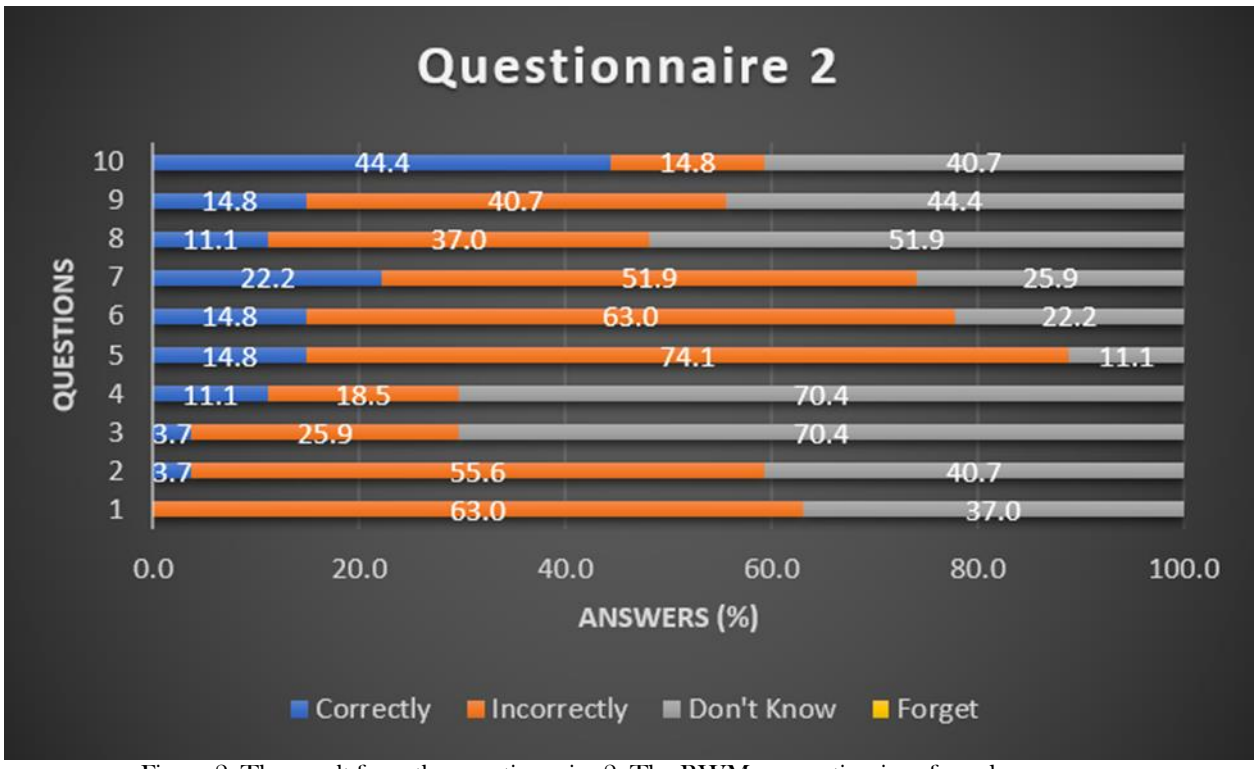

Figure 2. The result from the questionnaire 2: The BWM convention is enforced

Result and sailing experience affect the level of expertise. When sailing in international waters, the student officers usually have ballast management experience on board. It is because many countries have implemented provisions of the BWM Convention that require ships to meet the D-1 and D-2 standards. When being asked about the urgency of handling ballast water before unloading, 12 respondents answered correctly, meaning that authorized seafarers were concerned about handling ballast water before disposal to prevent environmental pollution. More socialization and education regarding ballast water and the dangers of managing are needed. Besides understanding the BWM agreement is necessary as well. This may take place in conferences, workshops, or the arrangement of instructional resources on marine pollution.

CONCLUSION

The survey results showed that the majority the BWM contract is incorrectly understood by some of the respondents. However, 44.4% respondents correctly responded to the query regarding the significance of ballast water treatment, which means that the respondents concerned about the danger of ballast water that needs urgent action. The proposal is to disseminate information to the student officers through seminars, including marine pollution courses or in the form of specialized ballast water training.

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