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ASSESSMENT OF WASTE HANDLING PRACTICES ON SHIPS OPERATING IN THE COASTAL REGION OF EAST NUSA TENGGARA

Penilaian Praktik Penanganan Limbah Pada Kapal Yang Beroperasi di Wilayah Pesisir Nusa Tenggara Timur

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ABSTRACT

Marine environmental pollution due to shipping activities is a strategic issue in coastal area management. To address this, the Indonesian Government issued Regulation of the Minister of Transportation Number 29 of 2014 as a guideline for preventing pollution from ships. This study aims to evaluate ship waste management practices in the coastal area of East Nusa Tenggara, especially on passenger ships that operate regularly, and to assess the implementation of these regulations. The methods used include direct observation, interviews with ship crews, and literature studies on national regulations and international conventions such as MARPOL 73/78. The results of the study indicate that ships have implemented waste management according to standards, both for solid waste (organic and inorganic) from the deck area and liquid waste (oil and sludge) from the engine room. The management stages include collection, storage, unloading, and transportation to facilities on land. The ship also has a pollution prevention certificate as stipulated in Article 57 of Regulation of the Minister of Transportation 29 of 2014. This implementation shows compliance with regulations and increased awareness of ship crews towards preserving the marine environment. These findings can be a reference for ship waste management practices that support sustainable maritime development.

Keywords: Ship waste management, marpol 73/78, sustainable maritime development, marine pollution, maritime regulation

ABSTRAK

Pencemaran lingkungan laut akibat aktivitas pelayaran merupakan isu strategis dalam pengelolaan wilayah pesisir. Untuk mengatasi hal tersebut, Pemerintah Indonesia menerbitkan Peraturan Menteri Perhubungan Nomor 29 Tahun 2014 sebagai pedoman pencegahan pencemaran dari kapal. Penelitian ini bertujuan untuk mengevaluasi praktik pengelolaan limbah kapal di wilayah pesisir Nusa Tenggara Timur, khususnya pada kapal penumpang yang beroperasi secara reguler, serta menilai implementasi peraturan tersebut. Metode yang

digunakan meliputi observasi langsung, wawancara dengan awak kapal, serta studi literatur terhadap regulasi nasional dan konvensi internasional seperti MARPOL 73/78. Hasil penelitian menunjukkan bahwa kapal telah melaksanakan pengelolaan limbah sesuai standar, baik untuk limbah padat (organik dan anorganik) dari area geladak maupun limbah cair (oli dan sludge) dari ruang mesin. Tahapan pengelolaan meliputi pengumpulan, penyimpanan, pembongkaran, dan pengangkutan ke fasilitas di darat. Kapal juga telah memiliki sertifikat pencegahan polusi sebagaimana diatur dalam Pasal 57 pada Peraturan Menteri Perhubungan 29 Tahun 2014. Implementasi ini menunjukkan kepatuhan terhadap regulasi dan meningkatnya kesadaran kru kapal terhadap pelestarian lingkungan laut. Temuan ini dapat menjadi referensi praktik pengelolaan limbah kapal yang mendukung pembangunan maritim berkelanjutan.

Kata kunci: Manajemen limbah kapal, marpol 73/78, pembangunan maritim berkelanjutan, pencemaran laut, regulasi maritim

INTRODUCTION

Indonesia is an archipelagic country with most of its territory consisting of sea, making it very strategic both geographically and economically (Nugraha & Desnanjaya, 2024). The Indonesian sea not only acts as a local and international transportation route, but also contains abundant marine resources, such as fisheries, coral reefs, seagrass beds, and mangrove forests. In addition, coastal areas also have high ecological and economic value, both as a source of livelihood for the community and as a marine tourism destination (Dwicaksana *et al*., 2021; Nugraha *et al*., 2022, 2023).

The marine and coastal sectors have great potential in driving sustainable national development (Anwar, 2018; Prita *et al*., 2021; Sukamto, 2017). However, this potential is threatened by various environmental problems, one of which is marine pollution due to human activities, including from the marine transportation sector (Abbas *et al*., 2022; Abdi, 2022; Aryanti & Isman, 2023; Chrismawati, 2023). The increasing intensity of shipping, especially passenger ships and inter-island logistics, has a direct impact on the increasing volume of waste dumped into the sea, both intentionally and unintentionally (Hermawan *et al*., 2017; Kamal *et al*., 2022; Kosior & Crescenzi, 2020; Kuncowati, 2019; Lambonan, 2020).

The Indonesian government through Government Regulation No. 19 of 1999 has defined marine pollution as the entry of living things, substances, energy, and/or other components into the marine environment by human activities that cause a decrease in the quality of the sea to exceed quality standards or disrupt its function. One source of pollution that requires special attention is solid waste or ship waste which can include domestic waste, plastic, food waste, and other hazardous materials (Alam & Ermin, 2019; Putut *et al*., 2021; Rappe & Nardilla, 2019; Sarjono *et al*., 2022; Sukirno *et al*., 2023).

Internationally, the MARPOL Convention 73/78 Annex V regulates the prohibition of dumping certain waste into the sea and requires every ship to manage waste according to established standards (Bagaskara *et al*., 2022). However, ship waste management practices in various waters of Indonesia, including in the coastal areas of East Nusa Tenggara, still face various obstacles, such as minimal management facilities, lack of supervision, and low awareness and knowledge of ship crews regarding waste management in accordance with regulations (Gerhanae & Permanawati, 2016; Jun *et al*., 2020; Yulianto & Wahyudi Santoso, 2022).

The coastal areas of East Nusa Tenggara have quite high shipping activities, especially as connecting routes between islands that serve the needs of community mobility and distribution of goods. This activity produces a lot of waste, both from ship operations and from passengers. If not handled properly, waste can damage the sea, damage coastal ecosystems,

and threaten the health of coastal communities that depend on marine resources (Ryan *et al*., 2019; Tekman *et al*., 2022; Unger & Harrison, 2016).

Based on these conditions, it is necessary to evaluate ship waste management practices in the coastal areas of East Nusa Tenggara. This evaluation aims to determine the extent to which ship waste management has been implemented in accordance with national and international regulations, as well as to identify challenges and opportunities for improvement. The results of this study are expected to contribute to formulating more effective ship waste management policies and strategies, in order to maintain the sustainability of the marine environment.

METHODS

This research was conducted for approximately four months, namely from March to June 2022, with the object of research being a passenger ship, namely XYZ Ship which operates routinely on the Kupang-Rote route and docks at Tenau Port, Kupang, East Nusa Tenggara. This ship serves crossings every day, except in bad weather conditions or when undergoing maintenance. The approach used in this study is a qualitative descriptive approach, which aims to describe the actual conditions in the field related to ship waste management and provide interpretations based on relevant literature to produce solutions and recommendations.

Data collection was carried out through three main methods, namely direct observation, interviews, and literature studies. Observations were carried out directly on the ship to see and record waste management activities by the crew, starting from the collection process, submission, storage, to waste disposal. The emphasis of observations was directed at the types of waste produced, the waste facilities and infrastructure available, and the extent to which these management procedures were in accordance with applicable standards. In addition, semi-structured interviews were conducted with several important personnel on the ship, such as the chief engineer and other crew. The purpose of this interview was to obtain in-depth information regarding waste management practices on ships, the challenges faced in their implementation, and the level of understanding of the crew regarding national and international regulations, especially those contained in Annex V MARPOL 1973/1978.

Furthermore, a literature study was conducted by reviewing various literature sources such as books, scientific journals, government regulations, and other technical documents relevant to the topic of ship waste management. This study provides a theoretical basis and comparative reference for the field data collected. The data obtained from the third method was then analyzed descriptively qualitatively. The analysis was carried out by organizing the data, identifying the main themes, and comparing the findings with the references that had been reviewed. The aim was to describe the real conditions of waste management on ships and identify gaps that may occur between practices in the field and applicable provisions.

As a final stage, the data editing and verification process was carried out to ensure the accuracy and consistency of the information obtained. The data that had been collected was re-examined thoroughly, both observation notes and interview transcripts. In addition, the data was also certified with supporting documents on the ship, such as waste management records (if available), and compared with applicable standard procedures. This process aims to strengthen the validity of the data and draw conclusions that can be scientifically justified.

This research utilized various tools and materials to support data collection, processing, and analysis, as described in the Tools and Materials subsection. These tools included documentation equipment such as a digital camera or smartphone to record field conditions, stationery and notebooks to record observations and interviews, and a voice recorder to ensure the accuracy of data obtained from informants. A laptop or computer was used to process data, compile interview transcripts, and compile the final report. Observation forms or sheets served as a guide for data recording in the field. Data storage devices such as flash drives or external

hard drives served to secure the documentation, while personal protective equipment (PPE) was used to ensure the safety of researchers while on board and in port.

The research materials consisted of primary data obtained through direct observation and interviews with ship crews, as well as secondary data covering international regulations such as Annex V of MARPOL 1973/1978, government regulations, standard operating procedures for waste management, and internal ship documents such as garbage record books and waste facility lists. Scientific literature in the form of books, journals, articles, and technical publications also served as important sources to strengthen the theoretical foundation and provide comparisons to field findings. With the support of these tools and materials, research can be carried out systematically and the results have validity that can be scientifically accounted for.

RESULTS

Waste Management on Ship

Waste management on board XYZ ship is carried out in various strategic areas. In the bridge area (ship's bridge), the main waste comes from crew consumption such as plastic snacks and plastic cups. This waste is collected in the trash bins that have been provided. In the passenger area, there are five classes, each equipped with a closed trash bin to prevent odor. The types of waste produced include food wrappers, leftover food, paper, beverage cans, and plastic bottles. The amount and type of waste in the passenger area is influenced by the number and density of passengers and the class in their place. Management is carried out with an initial summary to facilitate the next process.

Waste Management in the Engine Room

The ship's engine room is one of the areas that produces the most complex types of ship waste compared to other parts. This is due to the operational activities of the engine that produce liquid waste and solid waste, both from the combustion process, lubrication, and engine cooling (Table 1).

Table 1. Waste Management on Board Ships

Source	Type of Waste	Description	Handling Measures
Bridge	Food and beverage waste	Inorganic	Recycling, separate storage
Passenger area	Organic and inorganic waste	Food scraps, plastic packaging	Recycling, collection in segregated bags
Engine room	Used oil, diesel, sludge, oil filters	Hazardous liquid and solid waste (B3)	Filtration, sealed storage, delivery to onshore facilities
Engine room	Sludge (oil-water residue)	Waste from centrifugal separation	Filtered, packaged, sent to treatment facility
Engine room	Sea water and oil filters	Solid waste	Collected and stored in hazardous waste (B3) containers

One of the main sources of liquid waste comes from the stuffing box, which is a component on the piston rod that functions to prevent lubricating oil from rising into the cooling room. In practice, the stuffing box can leak, so that lubricating oil drips into the rinse room. This leak, if not handled properly, has the potential to pollute the environment and reduce the volume of oil in the main system. To overcome this, the crew collects the leaking oil in a container (such as a bucket), then filters it using an oil filtering machine. The filtered oil is not

immediately disposed of, but is stored in a closed container to be taken ashore for further handling according to applicable procedures.

Another source of waste in the engine room comes from the Alfa Laval system, which is a separator between oil and air using the centrifugal principle. This process produces sedimentation of sludge, which still contains residual oil and must be handled specially. The resulting sludge is collected in a container, then filtered using rags to separate the remaining oil before being repackaged in a closed container. This waste is then sent to a waste treatment facility on land for further processing.

In addition to liquid waste, the engine room also produces various types of solid waste, such as used oil filters, sea air filters, and dirty rags contaminated with hazardous materials. All of this solid waste is categorized as B3 waste (Hazardous and Toxic Materials), so it must not be discharged directly into the sea. The waste is collected in a dry and closed ship container, then stored until it docks at the port and can be handed over to a certified waste management party.

To maintain the cleanliness of the ship and prevent marine pollution, waste management is carried out in a structured manner in each area. Each type of classification is classified based on its source and character, then handled with the appropriate method. Waste management on board refers to national and international regulations, including Annex V MARPOL 73/78, which regulates the discharge of waste into the sea and its management. All ship crews are required to classify waste classifications, appropriate disposal sites, and their respective responsibilities in an effort to maintain marine cleanliness. The implementation of good waste management procedures is not only part of legal compliance, but also a form of responsibility for the sustainability of the marine environment. Table 1 and Figure 1 are details of ship waste management.

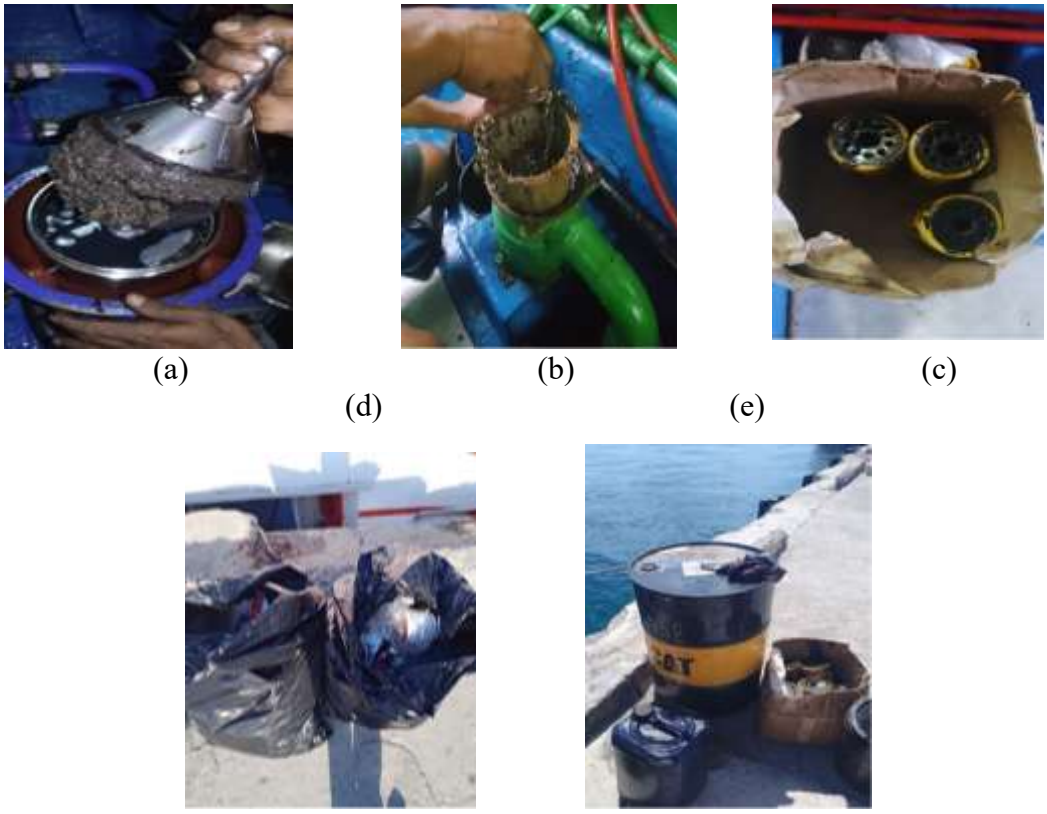

Figure 1. Waste Management On XYZ Ship
a. waste from alfa laval; b. waste from sea chest; c. main engine oil filter;
d. waste from passenger cabin; e. waste from engine room

DISCUSSION

Ship Description and Operations

The XYZ ship is a fiberglass passenger ship with a size of 163 GT (Figure 2). The selection of fiberglass material aims to increase resistance to corrosion and prevent air leakage through gaps in the hull structure. This ship serves the Kupang-Rote crossing route routinely every day, except when there are bad weather conditions, shipping bans from related authorities, or when the ship is undergoing maintenance (docking). Based on the construction from bow to stern, this ship has a number of important rooms such as the wheelhouse (steering bridge), cargo room, engine room, and passenger room which are divided into several classes, namely Executive, VIP, and Class A to D. Each room is equipped with air conditioning facilities and there is a canteen room at the front of the Executive C room.

Figure 2. *Passenger XYZ Ship*

Crew Awareness of Waste Management

The crew's concern for waste management is shown from their routine and discipline in transporting waste from the ship to the shelter provided at the port. This management is not just a technical activity, but includes aspects of planning, administration, finance, law, and operations that are integrated as a whole. All shipboard waste management activities are carried out in accordance with the Shipboard Garbage Management Plan (SGMP), a mandatory guidance document prepared based on the provisions of Annex V of the MARPOL 73/78 Convention on the prevention of pollution by shipboard waste.

The SGMP establishes procedures for the collection, separation of ships, storage, and transfer of waste from and to the receiving facility on land (Port Reception Facility). The SGMP also includes the appointment of personnel responsible for waste management, as well as recording waste disposal and transportation activities in the Waste Record Book, which must be checked by maritime or port authorities.

Each ship's crew has specific responsibilities according to their duties and functions, both in terms of operations and efforts to ensure the availability of applicable regulations. The crew is strictly prohibited from dumping waste into the sea, especially waste that is included in the prohibited category (prohibited waste) such as plastic, used oil, toxic materials, and medical waste. On the other hand, all waste generated during the voyage must be handled safely, stored in a closed and separate place according to its type, then taken to the port for further processing by an agency or waste management company that has an official permit.

The consistency of the ship's crew in carrying out this procedure shows a work culture that cares about the environment and an awareness of the importance of protecting the marine ecosystem from pollution. This is also proof that the implementation of the waste management system on board is not only administrative, but also an important part of the ethical and professional responsibilities of the ship's crew in supporting sustainable marine development.

Implementation of Marine Pollution Regulations

The implementation of regulations related to the prevention of marine environmental pollution in Indonesia is carried out through the Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 29 of 2014 concerning the Prevention of Maritime Environmental Pollution. This regulation serves as a guideline for ships operating in Indonesian waters to prevent, control, and handle marine pollution originating from shipping activities. Ships that have met these provisions will receive an official certificate as a form of recognition of compliance with national and international standards in maritime environmental protection.

One of the ships that has implemented these regulations is the XYZ passenger ship which operates routinely in the waters of East Nusa Tenggara. This ship has received various certificates from authorized agencies indicating the ship's provisions regarding pollution prevention provisions, including pollution by oil, waste, and air. Based on the results of the government's assessment, the ship was deemed to have met the criteria in Article 57 of the Regulation of the Minister of Transportation Number 29 of 2014, which states that the ship is far from the potential for excessive air contamination, oil contamination, and other waste contamination. This evaluation shows that the waste and pollution management system has been running effectively on board the ship.

In general, the provisions in this regulation cover several important principles. First, pollution from ships is defined as damage or degradation of environmental quality caused by the spill or release of materials such as oil, toxic liquids, hazardous cargo in containers, waste, garbage, and exhaust air from ships, either intentionally or unintentionally. Second, prevention of ship pollution is the obligation of the ship's captain and/or crew through various technical and administrative efforts, such as management of oil spills, hazardous liquid chemicals, domestic waste, and gas discharges from ship engines. Third, there are provisions regarding operational pollution control, namely actions that must be taken quickly, precisely, integrated, and coordinated to control, reduce, and clean up oil spills or other hazardous materials so as not to cause harm to the community and not damage the marine environment. Fourth, special steps are also regulated in preventing oil contamination due to ship accidents, such as spill containment, oil suction from fuel tanks, transportation of remaining cargo that pollutes the sea, and assisting the ship's frame if its presence interferes with shipping lanes. These implementing regulations are also in line with the MARPOL 73/78 International Convention, especially Annex I on prevention of contamination by oil, and Annex V on waste management from ships. In practice, the ship in question has implemented a Shipboard Waste Management Plan (SGMP), limited waste according to its type, stored waste in closed containers, and transported it to waste receiving facilities at the port. Emergency response procedures have also been carried out for the crew to ensure readiness to deal with a pollutant spill situation quickly and in a coordinated manner.

With the implementation of appropriate regulations, this ship demonstrates a high commitment to preserving the marine environment and shipping safety. Compliance with the Regulation of the Minister of Transportation of the Republic of Indonesia Number 29 of 2014 is not only a form of legal responsibility, but also part of an effort to encourage sustainable and environmentally friendly maritime development. This is a real example that good environmental management in the shipping sector can be implemented in real terms and have a positive impact on marine ecosystems and coastal communities.

CONCLUSION

Passenger ships operating in the waters of East Nusa Tenggara have complied with the Minister of Transportation Regulation Number 29 of 2014 and the MARPOL 73/78 International Convention, specifically Annexes I and V, in waste management and marine pollution prevention. Waste management is carried out according to procedures from collection

to delivery to shore, equipped with official certificates, implementation of the Shipboard Garbage Management Plan (SGMP), crew training, and recording in the Garbage Record Book. These efforts reflect a commitment to environmental responsibility, shipping safety, and sustainable maritime development.

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