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Domestic Waste Management of Passenger Ships at the Soekarno-Hatta Port of Makassar

Jony Sumbung[1], M.Yamin Jinca[*)2], Shirly Wunas[3], Esther Sanda Manapa[4]
[1]*Master Degree of Transportation, Postgraduate School of Hasanuddin University*
[2,3,4]*Lecturer, at Masters in Transportation at the Postgraduate School of Hasanuddin University*
**) Corresponding Author*

Abstract: *Domestic waste of passenger ships is waste generated by passengers on the ship during shipping. This study uses SWOT analysis to find out how the domestic waste management strategy of passenger ships that rely on Makassar's Soekarno-Hatta Port. The results showed that the garbage produced by passenger ships can be recycled such as plastic, paper, and cans/iron. Ship waste treatment infrastructure in Makassar's Soekarno-Hatta Port still needs to be developed and adjusted to the International Maritime Organization (IMO) rules. The waste management strategy on the ship should be managed with a separator container system between organic and non-organic waste, at the Makassar port, it should be managed with the principle of 3 R (Reuse, Reduce and Recycle).*

Keywords: *Passenger, Waste, Ship Visits, Pollution.*

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I. Introduction

Makassar City is a metropolitan city, an area of 176 km², with a population of 1.41 million people, a population density of 7,764 people / km², and a center of service and industrial activity in Eastern Indonesia, and has a port with a very dense movement of people and goods. Makassar's Soekarno-Hatta Port is the gateway to Eastern Indonesia and is the largest port in Indonesia after Tanjung Priok in Jakarta and Tanjung Perak in Surabaya. Passenger traffic activity at this port is quite high; the growth rate of passenger fluctuation is around 8.77% / to 11.19% / year [1].

Makassar's Soekarno-Hatta Port is managed by Indonesia Port Company IV (IPC-IV), as an inter-island and beach transportation infrastructure as well as a means of supporting trade and business. So important and the war, the manager is trying to always maintain environmental quality, marine pollution, cleanliness of the port area, air quality, and waste management [2,3]. One of them is waste originating from ships which usually consist of residual dirty oil, organic and non-organic waste, and human waste. Waste that is not managed properly will have a negative impact on the environment [4,5,6], especially in the marine pollution and Port area. Seeing the potential growth of passengers and ship visits at the Soekarno-Hatta Port of Makassar is increasing every year so that it impacts on waste products on board. For this reason, the management infrastructure for waste is important to be managed well, and this is also a mandate from the International Maritime Organization [7,8,9].

The study was classified as descriptive-quantitative, identifying passenger growth and ship visits and waste production on the ship, alternative waste handling strategies using SWOT analysis [10], the research sample was the waste product from the passenger ship waste of Indonesian National Shipping Company (INSC) who visited Soekarno-Hatta Port.

II. Discussion

Waste Characteristics of Passenger Ship

Based on the record of garbage discharges, the waste characteristics of Passenger Ship is generally composed of plastic, paper, glass, glass, wood, organic, tin/iron, and other waste [11], as in Figure 1.

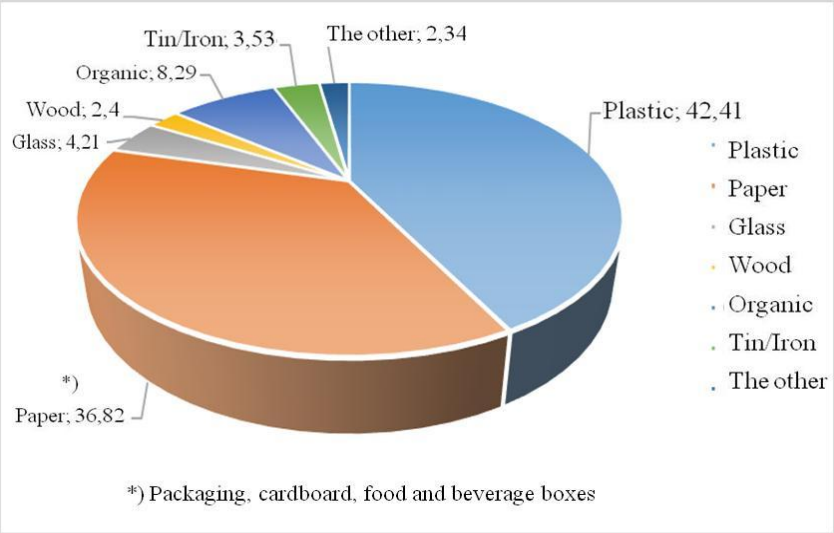

Figure 1. Waste Characteristics of Passenger Ship

The percentage of waste can mostly be recycled around 83% namely the category of plastic waste 42%, paper 37%, and cans/iron 4%. The domestic waste production of passenger ships is directly proportional to the number of passengers going up/down and the frequency of passenger ship arrivals at the Makassar's Soekarno-Hatta Port (see Figure 2).

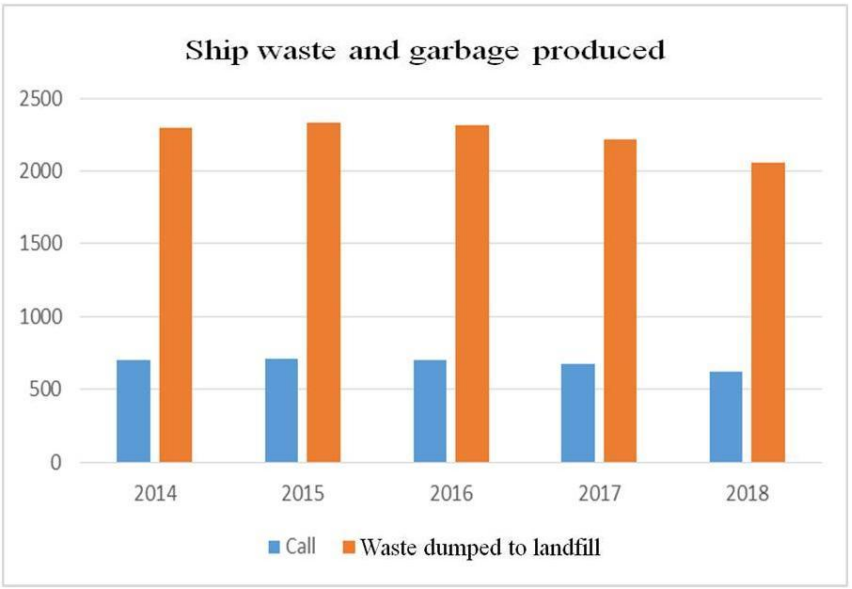

Figure 2. Ship call and production of waste

Between 2014 and 2018, the number of INSC Passenger Ships visiting the Soekarno-Hatta Port has increased, although in 2018 it has decreased slightly, as well as the amount of domestic waste generated has also increased.

Table 1. The Emergence of INSC Passenger Ship Domestic Waste

No.	Date and time	Ship Visits (name)	Waste Amount (bag)	Number of Garbage Cars (trucks)	Total Weight (kg)	Volume (m^3)
1	Monday, 19-11-2019	KM. Umsini	16	1	240	9,6
		KM. Ceremai	25	2	375	15
2	Tuesday, 20-11-2019	KM. Awu	25	2	375	15
		KM. Bukit Siguntang	25	2	375	15
		KM. Gunung Dempo	25	2	375	15
3	Wednesday, 21-11-2019	KM. Ngapulu	25	2	375	15
		KM. Doro Londa	25	1	375	15

4	Thursday, 21-11-2019	KM.Awu	16	1	240	9,6
		KM. Binaiya	15	1	225	9
		KM. Willis	20	1	360	10,8
5	Friday, 21-11-2019	KM. Lambelu	25	2	375	15
		KM. Dobon Solo	25	2	375	15
6	Saturday, 21-11-2019	KM. Gunung Dempo	25	2	375	15
		KM. Umsini	25	2	375	15
7	Sunday, 21-11-2019	KM. Doro Londa	20	2	400	15
		KM. Ceremai	20	1	400	12
		KM. Bukit Siguntang	25	2	625	15
	Average per day		55	4	892	31

Source: Survey Results, 2019

Observations November 19-25, 2019, on the INSC passenger ship visiting the Soekarno-Hatta Port showed that the process of handling waste from the ship was transported using trash trucks. On average 2 (two) trips per day, the volume of transportation in 1 (one) trip ranges from 10 to 15 m3 or about 16-25 bags. The average passenger ship waste production per day is 55 bags, transported by 4 trucks, weighing around 900 kg, with volumes ranging from 31 m3 with a specific gravity ranging from 30 kg/m3, as shown in Table 1.

Passenger Ship Waste Management

Domestic waste management is carried out by organic and contracted personnel, playing a direct role in the management of INSC passenger ship waste at the Soekarno Hatta Port with a total of 21 people. The organizational structure in the division as in Table 2.

Table 2. Organizations and Manpower Managers

No.	Division	Organic (person)	Contract (person)
1.	Head of Division	1	
2.	Supervisor	8	
3.	The truck driver and crew		4
6.	Temporary Storage		2
8.	Transport		3
9.	Supervision		3
Total		**9**	**12**

Field operational staff, consisting of truck drivers and truck crews, is tasked with transferring the domestic waste from the ship into the truck car. Every 1 (one) truck fleet is manned by 1 driver and 2 loading/unloading workers to service the entire Soekarno-Hatta port area of Makassar.

INSC waste management facilities consist of 2 (two) units of the truck fleet, the process of moving waste from the ship to the dump truck is still done manually without using a crane and requires to peruse time around 30 minutes.

The crew immediately threw the garbage from the ship to the garbage transport truck leaning near the ship so that the waste that did not fit into the truck finally scattered around it, and this is not according to the ideal Waste Management System [12].

Figure 3. Transfer of waste from the ship to trucks

Waste Management in Soekarno Hatta Port does not yet have an installation to process the waste generated by passenger ships or the port itself.

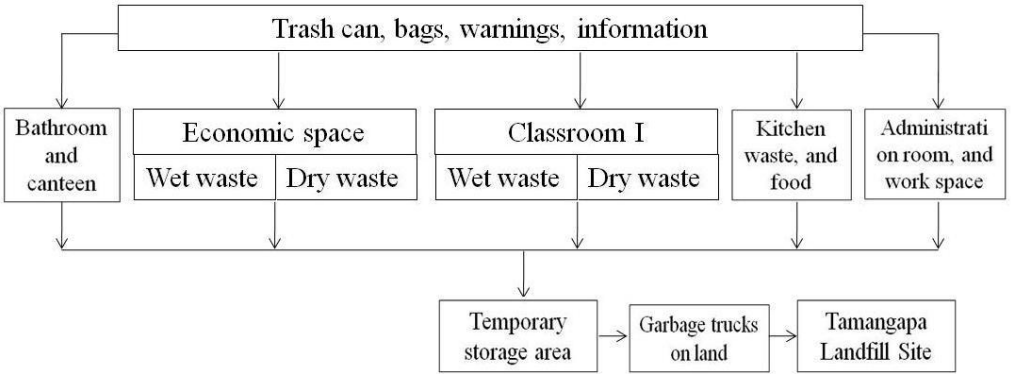

Figure 4. Waste Handling System

Figure 5. Garbage collection containers on ship

In the process of transporting waste from the port to the landfill, it often causes problems that are scattered waste on the road because the transportation process is not covered using a cloth cover/tarpaulin.

The distance that must be taken is quite far, which is around 15.6 km or equivalent to the travel time of 1 hour if traffic conditions are normal. Although theoretically the capacity of the garbage transport fleet is sufficient, namely one fleet capable of transporting garbage with a volume of 11.2 m3, but sometimes for reasons of efficiency the process of transporting waste is only done by 1 (one) garbage fleet truck to transport 12

m3 of waste generated by KM. Ceremai. So that the process of supervision in transporting waste from ships to landfill also needs to be tightened.

Strategy for Passenger Ship Waste Floating

The direction and strategy for developing a waste management system sourced from passenger ships is carried out with the following SWOT analysis matrix:

Table 4. Matrix of SWOT Analysis

Internal factor / **External factor**	**Strengths**	**Weaknesses**
	Crew and Cooperative Passengers throw garbage in its place. The waste from ships to the landfill site is carried out by ISNC.	Waste is not separated (organic and inorganic). Waste transfer from the ship to the garbage truck is done manually.
Opportunities Commitment to maintaining port cleanliness. Enough Human Resources are available.	**Strategic (SO)** Improve supervision and discipline, cooperation and coordination with land management. The garbage record book is needed to improve the crew's expertise in improving waste management.	**Strategic (WO)** Regulations for the control of garbage and waste on ships. Effectiveness and efficiency of resources with garbage disposal technology from the ship to the garbage truck to make it more.
Threats There are no waste treatment facilities available at the port. Awareness of passengers disposing of waste according to SOP is still low.	**Strategic (ST)** The handling of ship waste must according to IMO, and provision of supporting tools for the process of transporting from the ship to the truck to the process and final waste disposal. The use of a garbage record book for control management can optimize the process of handling waste.	**Strategic (WT)** The pilot project for recycling waste is directly managed at the port. Improve education of ship passengers in disposing of garbage by increasing posters and information boards about the garbage management plan.

Source: Results of analysis, 2019

Based on the identification and some SWOT criteria, and according to the conditions in the field, it can be explained that;

a. The strategy that needs to be done is the WO strategy, maximizing available resources by utilizing the technology of moving waste from ships to garbage trucks. For example, the use of mobile cranes to make time efficient and energy efficient so that the waste removal process can be done quickly. Besides, a pilot project for garbage processing facilities originating from ships can be needed that can be directly processed at the port without having to be disposed of at the landfill site in Tamangapa. This can reduce the burden of waste at the landfill site and the volume of solid traffic from the port to the Antang landfill site. Educate passengers by extending posters and information boards on procedures for disposing of trash on the ship to increase passenger awareness in terms of protection and pollution of the marine environment by the Marine Pollution criteria.

a. ST strategy, which is to maximize crew supervision and discipline, cooperation, and establish coordination with land management parties. Conducting routine training and the availability of garbage record books will improve the crew's expertise to facilitate the implementation of solid waste management on board.

III. Conclusion And Recommendation

Domestic waste products of passenger ships that visit the Soekarno-Hatta Port range are 31m^3/day. Specific gravity is around 30 kg/m^3 classified as light and hollow waste, prioritizing plastic waste, and paper around 81%. Port companies and port authorities have not yet managed ship waste, managed by shipping company INSC. The Temporary Disposal Sites on ships are available in the form of bags transported from the ship by truck to the landfill site in Antang-Makassar. Need to manage the waste infrastructure managed by the Makassar Soekarno-Hatta port, given its war as an international port. The construction and development of the ship's domestic waste infrastructure processing should refer to IMO regulations.

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