

Solid Waste Handling Techniques on Board Cargo Ships

Yan Zakri^{1*}, Andi Imran Anshari²

¹Akademi Maritim Pembangunan Jakarta, ²Politeknik Pertanian Negeri
Pangkajene Kepulauan

Corresponding Author: Yan Zakri yanzakri@gmail.com

ARTICLE INFO

Keywords: Solid Waste, Cargo Ship, Hydraulic Press Machine

Received : 4 October

Revised : 15 October

Accepted: 30 November

©2023 Zakri, Anshari: This is an open-access article distributed under the terms of the [Creative Commons Atribusi 4.0 Internasional](https://creativecommons.org/licenses/by/4.0/).



ABSTRACT

The objectives to be achieved in this study are to obtain an overview of the handling and characteristics of solid waste generated by cargo ships and reduce the volume of solid waste from cargo ships, while the benefits can be input for ship owners in managing waste on board. The method used is the experimental method by making a hydraulic press machine so as to reduce the volume of waste generated from cargo ships, in addition to using the interview method to the crew of the ship. The results of the solid waste survey generated on board the cargo ship originated from the deck, bridge, engine room, crew room, saloon, stern and kitchen. There are several types of solid waste including: Food scraps, Plastic, Paper, Iron, Textile/Fabric, Glass and others. The observation of the quantity of solid waste shows that the crew produces an average of 1.6 liters of waste per day per crew. While each room or section on board the cargo ship produces an average of 25 liters of solid waste per day per room. The crew's indifference to the handling of solid waste on board is 75%, so by trying to use a press, the volume of solid waste will be reduced. In addition, the press tool designed is also very easy to operate, high effectiveness, cheap and maintenance-free. The results showed that using a press can reduce the volume of solid waste by 50% to 75%

INTRODUCTION

Most of the territory of the Republic of Indonesia is in the form of sea waters which are very strategically located. In addition to being used as a means of local and international sea transportation, Indonesian sea waters also have very rich and important marine resources, including fisheries resources, coral reefs, seagrass beds, mangroves and in coastal areas can be utilized as attractive tourist objects. The sea also has an important meaning for the lives of living things such as humans, fish, plants and other marine biota. This shows that the marine sector has enormous potential to encourage development in the present and in the future.

The sea, which is one of the natural resources, is very necessary to be protected, it is intended that its utilization must be carried out wisely by taking into account the interests of present and future generations. In order for the sea to be sustainably useful with the desired level of quality, the activities of controlling marine pollution or destruction are very important (Djafar, 2018).

According to PP No. 19 of 1999, marine pollution is defined as the entry or inclusion of living things, substances, energy, and or other components into the marine environment by human activities so that the quality drops to a certain level which causes the marine environment to no longer comply with quality standards or functions.

Sea transportation is currently developing very rapidly. Ships as a means of sea transportation play an important role in launching safe and appropriate sea transportation. The types of commercial ships built today are more inclined towards specialization of the type of cargo transported such as cargo ships, tankers, bulk and others. When viewed from the point of view of the operation of the ship is generally distinguished between "Liner", namely ships that undergo a fixed route between two or more ports and "Tramp", namely ships serving non-permanent routes, usually ships operated in the form of "Charter". Diman Dali (2000), classifies ships according to the distance of their voyage, for example: Local shipping, archipelago shipping, special shipping, domestic & foreign, ocean shipping and people's shipping.

According to Khoirunnisa, R., (2018), shipping activities threaten pollution from harbors, oil spills, shipwreck disposal, garbage disposal from ships, and direct consequences from anchor throwing. According to the TKT (Coral Reefs at Risk) analysis of threats from marine pollution, based on the location of major shipping lanes and oil mining infrastructure. The results of the analysis showed that 7% of coral reefs in this area are threatened by pollution from the sea. Furthermore, it is said that solid waste can cause accidents to cargo ships entering the river channel route, where plastic waste; can cause jamming of the propeller leaf rotation which results in damage to the ship while wood waste or blocks will appear on the surface of the water which will be fatal to the ship if

it hits the garbage, and as a result the ship breaks or has a large leak and sinks. In almost all rivers in Indonesia, the handling of block waste has not been controlled, so ships made of fiberglass and wood are very vulnerable to this threat.

The habit of sailors who often consider the sea as a giant garbage pool that disposes of garbage arbitrarily so that the marine environment is very vulnerable to polluting substances (special environmental sensitive). This research will develop a press tool to reduce the occurrence of water pollution caused by garbage discharged from ships that can be used as a reference in developing systems and procedures for overcoming it.

LITERATUR REVIEW

Waste and its Management

Waste management can be defined as a discipline related to the control or management of waste generation or generation, collection, storage, transportation, transfer, disposal, and management of waste in such a way that it can be in accordance with the values or principles in public environmental health, economics, aesthetics, conservation, and considerations of other general environmental factors.

Waste management has a scope that covers all aspects and is involved in all elements of community life. The various aspects referred to are all planning, administrative, financial, legal and functions used to solve waste problems.

In the work environment related to ships there are separate regulations in handling waste, broadly speaking a waste management or handling plan is a complete guide consisting of written procedures for processing, collecting, storing, disposing of waste generated from activities on board in accordance with the regulations given in Annex V of MARPOL explaining that all ships carrying 15 or more people and measuring more than 400 GT must carry a Garbage Record Book and Garbage Management Plan.

Marine Pollution

Marine pollution is the entry or introduction of energy, living things or other components indirectly or directly into the marine environment area by human life activities so as to reduce the quality of marine environmental quality that has previously been determined. There is also pollution in the marine environment including:

- 1) Pollution originating from activities at sea
- 2) Pollution originating from land activities, and
- 3) Pollution comes from air activities.

Mochtar Kusumaatmadja (1978: 177) said that marine pollution is a change in the marine environment area caused by the entry of energy materials into the sea by humans either directly or indirectly which has a negative impact

on the environment so that it causes losses to biodiversity, human health, disturbances in the sea including fisheries, deteriorating water quality. Marine pollution has a considerable impact on the surrounding environment, especially if the surrounding area is a settlement where people usually make a living in the marine environment as fishermen or sailors (Hasjim Djalal. 1978). Marine pollution includes discharges from the rest of the activities on the ship, oil spills, oil drilling, waste waste from the community.

Preventing pollution in the sea is done by prohibiting activities or actions that can cause pollution in the sea, requiring managing solid waste and liquid waste. Obliging activities or businesses for prevention and mitigation if they occur, in marine destruction and pollution are required to carry out marine environmental recovery activities, pay compensation, bear all costs of mitigation (Takdir Rahmadi. 2015).

METHODOLOGY

The type of research used is non-experimental and quantitative descriptive, which aims to describe systematically, carefully and accurately about the conditions, circumstances, potential and problems that occur in the cargo ship domestic waste management system. The activities carried out in this study are to identify the growth of cargo ship visits and the amount of waste. Various data obtained are analyzed so that they can produce a proposal or alternative in dealing with the problems faced. The research design carried out is a survey method to the research location, with the aim of obtaining more accurate data and information.

This research was conducted in September 2018 on board the KM Cargo Ship. Asterix No. 8 with the main port in Tanjung Priok, Jakarta and the destination port in Pekanbaru, Riau.

The tool used in this research is a waste press, where the tool specifications can be seen in the tool design. The use of this press tool is to see the crew's concern in preventing pollution. While the material used is solid waste on board the cargo ship.

The tools needed in making this press tool are as follows:

- Hydraulic pump with a compressive power of 2 tons.
- Iron plate.
- Asphalt drum
- Packaging or plastic bags.
- Power Supply.

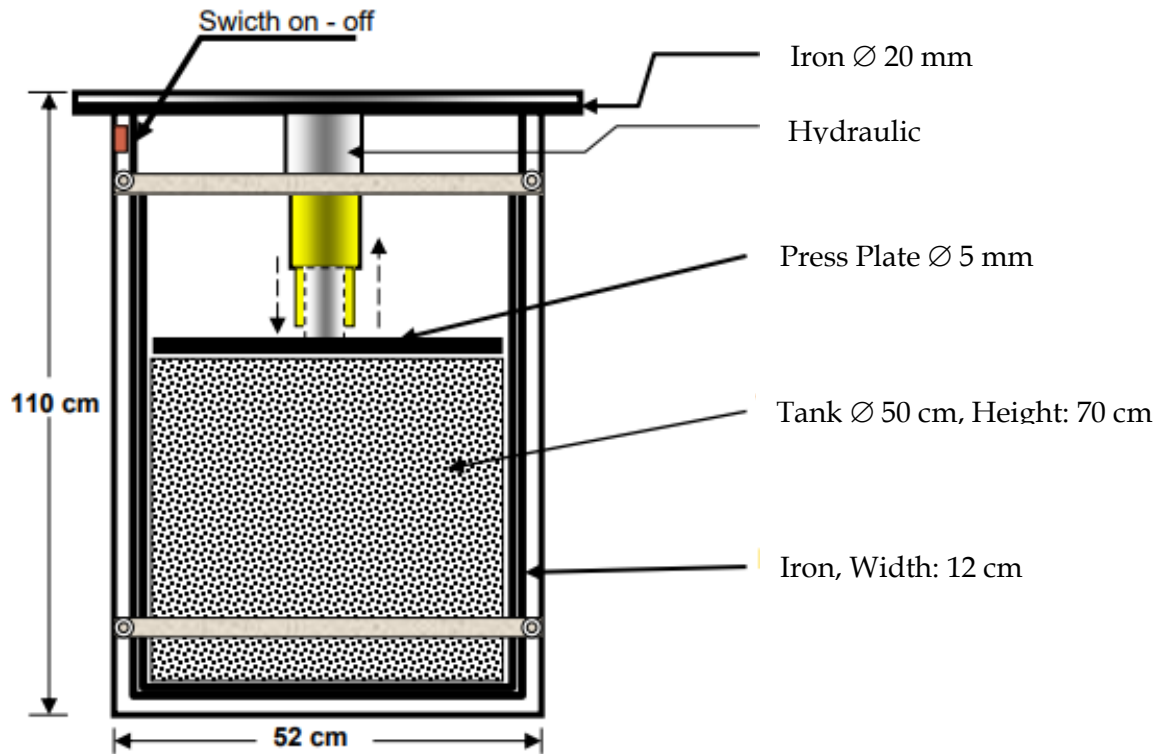


Figure 1. Hydraulic Press Tool Design

The data required for this research was collected using several methods, namely:

- a. Literature Study Being the first step taken to obtain a theoretical basis regarding cargo ships in general, solid waste handling and others through various references, the internet, journals and articles related to the object of research and secondary data needed as supporting data for research.
- b. Interview and survey method Is an effort to collect data related to the object of research by interviewing competent parties (crew members) and surveys using a questionnaire or questionnaire method so that the crew's concern for pollution prevention is known.
- c. Observation Method An effort to collect data by making direct observations of the internal and external conditions of the ship as the object of research.

RESULTS AND DISCUSSION

The shipping flow of KM. Asterix 8 is around Jakarta waters to Riau, namely in the area 060 05' 30 "S - 1060 53' 07 "E and 00 32' 26 "N - 1010 26' 35 "E, the base port is Tanjung Priok, Jakarta. The ship used for this research is a cargo ship.

The number of respondents set as many as 15 people according to the position of the crew working on the cargo ship. The research sample can be seen in Table 1.

Table 1. Research Respondents

NO.	SAMPLE
1	Captain
2	Chief I
3	Chief II
4	Chief III
5	Chief Engineer
6	Machinist I
7	Machinist II
8	Machinist III
9	Bossman
10	Helmsman 1
11	Helmsman 2
12	Oiler 1
13	Oiler 2
14	Chief Cook
15	Mess Boy

Source: Kapai Asterix Crew Sample Data No. 8

A.1. Sources of Solid Waste

Solid waste generated on board most commonly comes from the galley, deck, bridge, engine room, crew room, stern and saloon (Table 2).

A.2 Solid Waste Handling Facilities

The availability of garbage bins is very important on board, this is related to the habits of ship crews who tend to throw garbage directly into the sea. In connection with this, the availability of garbage bins on board is not maximally available, while the availability of garbage bins at the port is already available.

A.3 Characteristics and Volume of Solid Waste

The types of solid waste or garbage found on the ship are food waste (31%), and paper (25%), followed by plastic waste (10), textiles / fabrics (9%), iron (8%), and glass (4%), and others, such as cans, cigarette ash, wood, rubber (13%). The waste collected on the ship will then be disposed of in the garbage containers available at the port when the ship is docked. the volume of waste

disposed of at the port, 13% is above 50 liters, 20% is less than 50 liters, and 67% is less than 30 liters.

A.4 Crew Knowledge and Concern for Solid Waste Handling Regulations

The ship's crew's habit of handling garbage on board, generally throwing it overboard, the rest is collected in the trash cans available on the ship. As for what is thrown overboard, most of it is certain garbage. Based on this, waste handling still needs attention. This condition is exacerbated by the lack of socialization of specific regulations related to the handling of waste on board, in addition, the crew's understanding of international regulations regarding marine pollution due to garbage is not fully understood.

Government regulations related to pollution are regulated in :

- Law No. 21 of 1992 concerning Shipping.
- Government Regulation No.20 of 1990 concerning Water Pollution Control.
- Presidential Decree No. 46 of 1986 on the Ratification of the International Convention of Pollution from Ship.
- Decree of the Minister of Transportation No. KM-215/A1-506/Phb-87 of 1987 concerning the Procurement of Waste Containment Facilities from Ships.

Law No. 21 of 1992 concerning Shipping explicitly states the responsibility of shipping companies for pollution originating from ships they operate (attachment 2). In Chapter VII articles 65 to 68 regarding the prevention and control of pollution by ships, it is stated as follows:

1. Vessels are prohibited from discharging waste or other goods if they do not meet the specified requirements. This means that the discharge of waste or other materials into the sea coming from ships must meet the requirements of national regulations and international regulations that have been ratified by the government.
2. Ships are required to be equipped with pollution prevention equipment and are part of the ship's seaworthiness requirements. A ship is said to be seaworthy if it meets regulations that can ensure the safety of the ship, the goods loaded, the people on board and the environment.

With the increasingly strict regulations regarding environmental pollution, the criteria for seaworthiness of ships today are ships:

- Built and maintained in accordance with class and statutory regulations.
- Operated by certified and competent crew members in accordance with the Revised STCW Convention 95.
- Operated by an ISM Code certified shipping company.

3. Using GMDSS (Global Maritime Distress Safety System) communication tools.
4. Compulsory certificate of pollution insurance.
5. Every skipper or master of a vessel and/or his crew shall prevent pollution of the environment from spilling over from his vessel. If pollution occurs, the skipper must be responsible for overcoming the pollution. Therefore, every ship of a certain size is required to have an emergency management plan approved by the Government.

Table 2. Sources of Solid Waste on Cargo Ships

Type Rubbish	Sources						
	Deck	Bridge	Engine Room	Saloon	Crew Cabin	Galley	Stern
Remainder Food	√			√	√	√	√
Plastic		√			√	√	
Wood	√						√
Rubber			√				√
Csn		√	√	√	√	√	
Bottle/ Glass	√		√	√	√	√	√
Paper		√		√	√		
Textiles/ Cloth			√				
Cardboard			√			√	
Cigarette ash				√	√		√
Dust	√						
Rust	√						
Others	√	√				√	

Source: Cargo Ship

The average solid waste produced by the crew is 1.6 liters per day. While each room or section on the cargo ship produces an average of 25 liters of solid waste per day. So if in a cruise for 10 days the volume of solid waste generated by the ship is 1.99 ms The large volume of waste generated, so in this study using a garbage press with the aim of reducing the volume of waste.

In order for the results of the solid waste press to be maximized, when using a press tool, plastic waste such as plastic bottles, styrofoam should be separated separately.

Waste waste separation activities before being put into the press are carried out by the mess boy, where the activities are as follows:

- a. every manganese on the cargo carrier is placed a trash can and separates the waste according to its type such as plastic, paper, glass and others.

- b. The garbage that has been separated is each put into a separate trash can as well.
- c. Mess boy picks up the garbage from its place and brings it to the back of the ship. This can be done in the morning or at night.
- d. The garbage is then pressed into plastic bags.
- e. The results of the garbage press are collected at the stern of the ship as a temporary disposal site.

The average solid waste produced by each crew is 1.6 liters per day. While each room or section on the cargo ship produces an average of 25 liters of solid waste per day.

Based on this, the amount or volume of solid waste in 1 trip (10 days) is as follows:

- a. $1.6 \text{ liters} \times 15 \text{ crew} \times 10 \text{ days (1 trip)} = 240 \text{ liters per trip.}$
- b. $25 \text{ liters} \times 7 \text{ rooms} \times 10 \text{ days (1trip)} = 1750 \text{ liters per room per trip.}$

Based on the above calculations, the volume of solid waste per trip is 1990 liters or 1.99 ma.

CONCLUSION

In general, the handling of garbage or solid waste on board cargo ships is still poor, and needs to be improved immediately. The following are some important findings in this study:

1. The crew's concern for the prevention of pollution in the waters is 25%. The sources and types of solid waste generated on cargo ships come from, among others: the deck of the ship which produces waste from loading and unloading such as: wood, ropes, cargo waste and dust. When the ship sails, crew activities produce thinner, rust and ship paint splashes. Food waste, packaging materials (plastic, cans, etc.), bottles (glass and plastic), tableware, paper, cardboard sourced from the kitchen. Operational waste from the engine room, including: oily rags/pads, engine maintenance remains, broken parts, packaging materials (paper, plastic, metal, bottles, oil), rags, dust, rust, paint and others.
2. Characteristics of solid waste on cargo ships consisting of, among others: food waste, plastic, paper, iron, textiles / fabric, bottles / glass and others. The average crew produces an average of 1.6 liters of waste per day, while the solid waste produced by each room or section on the cargo ship produces an average of 25 liters of solid waste per day. By using a press the volume of solid waste can be reduced by 50% to 75%.
3. By using a press on the ship can prevent pollution in the waters because it is not discharged directly into the sea but after the press is collected at the stern

of the ship as a TPS and after the ship is docked it is disposed of in a waste storage near the port.

REFERENCES

- Apriadi. (1989). *Menghindari, Mengolah dan menyingkirkan Sampah*. Jakarta: Abdi Tandur.
- Djafar, C. D. R. (2018). *Studi Sanitasi Kapal Penyebrangan Kapal Motor Penumpang Ferry Tuna Tomini di Pelabuhan Gorontalo*. Skripsi, 1(811413077).
- Djalal, Hasjim. (1978). *Perjuangan Indonesia di Bidang Hukum Laut*. Bandung: Bina Cipta.
- Hadi, Sutrisno. (2013). *Metodologi Research, Metode Penelitian Kuantitatif, Kualitatif dan R & D*. Bandung: CV. Alfabeta.
- Irwan, I., & Habibi, M. (2018). *Kondisi Sanitasi Kapal Tugboat di Wilayah Kerja Kantor Kesehatan Pelabuhan Kelas II Balikpapan*.
- International Convention. (1973/1978). *MARPOL (Marine Pollution)*. International: IMO.
- Khoirunnisa, R., Ashari, M. L., & Setiani, V. (2018, December). *Pengukuran Timbulan, Densitas, Komposisi dan Kadar Air Limbah Padat Non B3 di PPNS*. In *Conference Proceeding on Waste Treatment Technology (Vol. 1, No. 1, pp. 71-76)*.
- Kusumaatmadja, Mochtar. (1978) *Bunga Rampai Hukum Laut*. Bandung: Bina Cipta.
- Lampiran v peraturan 5 "Peraturan Tentang Pencegahan Pencemaran Yang Diakibatkan Oleh Sampah Dari Kapal" (MARPOL 1973/1978)
- Narimawati, Umi. (2008). *Metodologi penelitian kualitatif dan kuantitatif, teori dan aplikasi*. Bandung: Agung Media.
- PP No. 19. 1999. *Pengendalian Pencemaran dan kerusakan Laut*. Jakarta
- Prasetyo, T. (2012). *Analisis Kualitas Air Laut Akibat Kegiatan Perbaikan Kapal di Daerah Pesisir, Studi Kasus Kawasan Industri Shipyard (Galangan Kapal) Kelurahan Tanjung Uncang, Kecamatan Batu Aji, Kota Batam, Provinsi Kepulauan Riau (Doctoral dissertation, UPN" Veteran" Yogyakarta)*.
- Rahmadi, Takdir. (2015). *Hukum Lingkungan di Indonesia*. Jakarta: PT Rajagrafindo Persada.
- Sari, R. W. (2016). *Evaluasi Sanitasi Kapal Penumpang yang Telah Tersertifikasi di Dermaga Jamrud Utara, Pelabuhan Tanjung Perak Surabaya (Doctoral Dissertation, Universitas Airlangga)*.
- Sugiyono. (2013). *Metodelogi Penelitian Kuantitatif, Kualitatif Dan R&D*. Bandung: Alfabeta.
- Terry, George R. (2011). *Principles of Management*. Jakarta: Sukarna