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Research Paper

Reducing Environmental Pollution Due to the Use of Soap for Cleaning Ships by Using Innovation-Based Products Waste Lemons

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Abstract

Strict provisions in the MARPOL rules require every ship to neutralize any liquid that will be disposed of overboard in advance, forcing shipping business actors to provide an extra budget in order to comply with these regulations. The purpose of this paper is to examine the processing of lemon fruit waste to resolve the impact of ship cleaning soap waste, which is very dangerous because it contains chemicals that are deadly to life in the marine environment. With these environmentally friendly natural ingredients, it is hoped that it will create innovative products for ship care washing soap that are environmentally friendly and safe for life around the coast and the sea, which can be utilized by both ships owned by shipping companies and ships owned by coastal fishing communities. Around the harbor. The method used in this writing is descriptive qualitative, while the data collection method uses observation and literature study. Based on the data collection method, lime is one of the herbal plants that contains high citric acid, which can be used as a basic ingredient for making ship cleaning soap. It is this lemon that will be developed into an innovative product to anticipate seawater pollution waste, which results from ship washing.

Keywords: *Pollution; Product Innovation; Eco-friendly Soap; Lemon*

INTRODUCTION

Many facts indicate that the waste produced by soap is highly damaging to the environment. This is because soap is a byproduct of the petroleum refining process and is supplemented with various chemical additives such as surfactants (cleaning agents), alkyl benzene (ABS) which serves as a foaming agent, abrasives as scrubbing materials, organic compound decomposers, oxidants for whitening and breaking down organic compounds, enzymes for breaking down proteins, fats, or carbohydrates to soften materials, water-thinning solutions, anti-rust agents, and others. Based on previous research, ABS has been found to have adverse effects on the environment, as it is resistant to decomposition by microorganisms. As a result, the residual soap waste generated daily by the surrounding environment becomes hazardous waste that threatens the stability of the ecosystem. The soap waste the environment produces will find its way to drains, ponds, and eventually into the ocean.

Soap has a toxic effect in water, as it will break down the external mucus layer that protects fish from bacteria and parasites. Soap can also cause damage to their gills. Most fish will die when the soap concentration reaches 15 parts per million. Soap with low concentrations, around 5 ppm, can still kill fish eggs. Surfactants present in soap will reduce the reproductive capabilities of aquatic organisms. Soap also significantly contributes to the decline in water quality. Organic chemicals like pesticides and phenols, even at a concentration of just 2 ppm, can be absorbed by fish twice as much as other chemical compounds.

A real example of the negative effects of soap waste is Lake Toba. As we all know, water hyacinth grows uncontrollably along the shores of Lake Toba. This phenomenon is not only due to

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the residue of pellets scattered in the lake for fish farming but it is also suspected to result from leftover soap used by the Lake Toba community while washing in the water. Additionally, waste from restaurants, eateries, and hotels around Lake Toba, directly disposed of into the lake, contributes to this issue. Apart from damaging the beauty of Lake Toba as a prominent tourist destination in North Sumatra, the uncontrolled growth of water hyacinths will cover the water's surface, preventing sunlight from reaching the bottom. This leads to a drastic reduction in oxygen levels, degradation of aquatic life, and rapid nutrient enrichment. If left unchecked, fish will die due to lack of food, and it could even result in defects caused by genetic mutations.

The use of soap is indeed like a double-edged sword. On the one hand, it is highly necessary, but on the other hand, its waste has negative effects. Several countries worldwide have officially banned the use of ABS (Alkyl Benzene Sulfonate) in soap production and introduced a new chemical compound called Linear Alkyl Sulfonate (LAS), which is relatively more environmentally friendly. However, recent research by experts indicates that this compound also poses significant environmental drawbacks. According to data, it takes about 90 days for the environment to break down LAS, and only 50 percent of it can be decomposed. As environmentally conscious individuals, there are a few things we can do to mitigate the adverse effects of soap use. Before choosing a soap type, pay attention to the type of surfactant it contains. Opt for those with LAS or LABS (Linear Alkyl Benzene Sulfonate) rather than ABS, which is difficult to degrade.

The ocean, like other ecosystems, possesses the ability of homeostasis, which is the capacity to maintain balance. It is a water ecosystem with the carrying capacity to self-purify from any disturbances that enter its bodies of water. In reality, coastal waters serve as the ultimate receptacle or storage system for all types of waste generated by human activities (Dahuri, 2001). The sea receives substances carried by water from agricultural areas, household waste, garbage, ship discharges, offshore oil spills, and many other discarded materials (Darmono, 2001).

If the load imposed on the water bodies exceeds their carrying capacity, the water quality will decline. The aquatic environment no longer adheres to the set quality standards; it becomes polluted both physically, chemically, and microbiologically. This not only significantly affects the communities within it but also has a substantial impact on the people who utilize coastal waters. Based on research conducted by the Environmental Agency of Badung Regency in collaboration with PPLH Unud (2004), the condition of Kuta Beach's water, when viewed from its designated purposes, is already subpar. As water is intended for tourism and recreation, several physical, chemical, and microbiological parameters have exceeded the established thresholds, both during the rainy season and the dry season.

The International Maritime Organization, through MARPOL 73/78, has detailed regulations on how to reduce environmental damage caused by ship activities worldwide. As we are aware, one of the routine activities performed by ships is the maintenance of ship cleanliness, particularly in accommodation areas and decks, both inside and outside the accommodation spaces. Just like other modes of transportation, ships also need to be cleaned to remain clean and healthy. Generally, this activity is carried out while the ship is on water, using cleaning agents like soap made from chemicals readily available in the market. The use of chemical-based soaps, even in low concentrations, still has an impact on the environment.

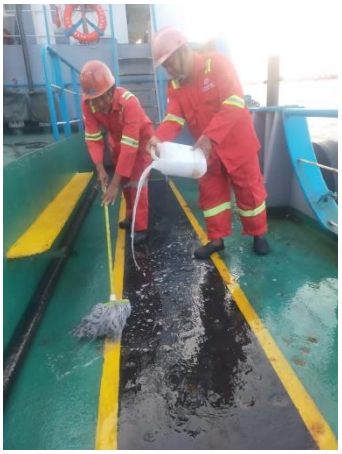

Figure 1. Ship maintenance and cleaning activity owned by PT Bahana Ocean Line
Source: Observation results on a ship owned by PT Bahana Ocean Line (2022)

The stringent provisions of MARPOL regulations that require every ship to neutralize any liquids before disposing of them into the sea have compelled maritime industry players to allocate extra budget to comply with these regulations. On the other hand, there are still many ships operating at sea that are not obliged to follow these rules as stipulated by MARPOL, such as tanker ships with Gross Tonnage (GT) below 500GT (Presidential Regulation No. 29/2012 Annex V MARPOL 73/78). Based on preliminary research, in Indonesia, only around 10% to 25% of ships truly adhere to MARPOL 73/78 regulations, while the rest do not properly follow these rules.

One of the herbal plants containing high levels of citric acid is citrus, particularly lemon. Several previous research findings have demonstrated that citric acid has the ability to dissolve fats. From these research results, it can be confirmed that one solution to address marine pollution caused by soap waste is to create innovative products using herbal ingredients. By using lemon juice, lemon peel, and lemon leaves as the main ingredients for soap production, utilizing discarded and unsuitable-for-consumption citrus fruits, it is hoped that this can help resolve the issue of marine pollution caused by ship cleaning soap waste. These discarded citrus fruits will be developed into an innovative product to anticipate marine pollution waste.

RESEARCH METHOD

In this writing, the method employed is qualitative research with a descriptive approach. The qualitative method is often referred to as a naturalistic method because its activities are carried out in a natural setting (Sugiyono, 2013). Qualitative research is defined as a method of social science research that collects and analyzes data in the form of words and human actions, and researchers do not attempt to count or quantify the qualitative data obtained, thus not analyzing numerical values (Afrizal, 2016). According to Nana Syaodih Sukmadinata (2011), qualitative descriptive research aims to describe and depict existing phenomena, whether natural or human-engineered, paying more attention to characteristics, qualities, and the interrelationships between activities. Furthermore, descriptive research does not involve treatment, manipulation, or alteration of the variables under investigation; it merely portrays a condition as it is. The only intervention applied is the research itself, conducted through observation, interviews, and documentation. Based on the explanations provided by several experts above, it can be concluded that qualitative descriptive research is a series of activities to obtain data in their natural state without being influenced by specific conditions, with an emphasis on meaning. Here, the author employs a qualitative descriptive research method because this writing explores the phenomenon of marine pollution caused by ship-cleaning soap waste, which has negative impacts on the coastal community

environment.

The data collection techniques employed in this writing are as follows:

1. Observation

According to Djunaidi Ghony and Fauzan Almanshur (2012), the observation method is a data collection technique that requires the researcher to go into the field and observe aspects related to space, place, individuals, activities, objects, time, events, purposes, and feelings. The technique used in this writing is participatory observation, which involves directly observing the conditions of coastal communities near the port environment affected by soap waste pollution resulting from ship cleaning activities.

2. Documentation

According to Hamidi (2004), the documentation method involves information derived from important records, whether from institutions, organizations, or individuals. The documentation in this research involves the researcher taking photographs to strengthen the research findings. Documentation can take the form of written records, images, or monumental works created by an individual (Sugiyono, 2013). In this writing, the documentation method consists of capturing images of ship cleaning activities using chemically based harmful soap that can contaminate the surrounding environment.

Figure 2. Documentation of ship maintenance and cleaning owned by PT Bahana Ocean Line
Source: Documentation of a ship owned by PT Bahana Ocean Line (2022)

3. Literature Review

A literature review is a series of activities related to the method of collecting bibliographic data, reading and note-taking, as well as managing research materials. According to Danial and Warsiah (2009), a literature review is research conducted by gathering a number of books and magazines related to the research problem and objectives. This technique is performed with the aim of uncovering various relevant theories related to the issues being faced or investigated, serving as reference material in discussing the research findings.

Another definition of a literature review is seeking theoretical references relevant to the identified case or problem. In general, a literature review is a way to address issues by exploring written sources that have been previously created. In other words, "literature review" is also very familiar with the term "literature study." In any research, a researcher must undoubtedly possess a broad understanding of the object under investigation. If not, it can be assured that there is a significant likelihood of the research failing. In this writing, the literature review draws from journals and previous research studies on soap waste contaminating marine organisms.

FINDINGS AND DISCUSSION

International Maritime Organization (IMO)

The International Convention for the Prevention of Pollution from Ships, known as MARPOL (Marine Pollution), is IMO's (International Maritime Organization) primary convention on preventing marine environmental pollution caused by ships. It comprises various regulations aimed at preventing and minimizing pollution originating from ships, whether accidental or due to routine ship operations (Presidential Regulation No. 29/2012 Annex V MARPOL 73/78). The term "Ship" in MARPOL 73/78 is defined as: "Ship means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air cushion vehicles, submarines, floating craft, and fixed or floating platforms." Thus, the definition of "Ship" in MARPOL is very broad, encompassing all types of structures operating in the sea, whether floating, hovering, or fixed to the seabed.

The MARPOL structure consists of six technical annexes (Annex I – VI), namely:

Annex I: Prevention of Pollution by Oil. Effective from 2 October 1983; Annex II: Prevention of Pollution by Noxious Liquid Substances in Bulk. Effective from 2 October 1983; Annex III: Prevention of Pollution by Harmful Substances in Packaged Form. Effective from 1 July 1992; Annex IV: Prevention of Pollution by Sewage from Ships. Effective from 27 September 2003; Annex V: Prevention of Pollution by Garbage from Ships. Effective from 31 December 1988; Annex VI: Prevention of Air Pollution from Ships' Emissions. Effective from 19 May 2005.

Annex I and II are mandatory because they are technical regulations inseparable from the original MARPOL 73/78 document when it was first adopted. The other annexes (III-VI) are voluntary, with different entry-into-force dates based on the level of support from member states. However, as of 31 December 2005, the MARPOL convention had been ratified by 136 countries, representing 98% of the world's total ship tonnage.

MARPOL does not just regulate what kind of waste can be disposed of into the oceans but also addresses toxic and harmful substances pollution, hazardous substances in packaging, ship waste, and air pollution from ships. This includes waste resulting from soap (detergent). When a ship undergoes maintenance and cleaning, how is it carried out, and what are the impacts? If it pollutes the marine environment, how does it affect the rights of the community around the port? (Fikri Muhammad, 2021).

Waste Hazards

In daily life, household waste has become a common occurrence, especially in densely populated residential areas. Although it might seem trivial, the impact of this waste can be substantial on various aspects of life, ranging from environmental degradation to health disturbances due to diseases caused by residual waste contaminating water sources. Among the household wastes commonly found is soap waste. This type of waste easily pollutes water because it contains compounds that are difficult to degrade, such as Alkyl Benzene Sulfonates (ABS), commonly found in stain-removing soaps.

The danger of this waste is also felt by aquatic ecosystems. On the other hand, experts mention that compounds in soap waste can dissolve the mucus layer on fish and damage their gills. With the loss of this layer, fish's ability to protect themselves from bacteria and parasites diminishes. Consequently, fish living in contaminated waters are not safe for human consumption (Fikri Muhammad, 2021). According to Raras Utami (2020), the hazards of soap waste include:

1. **Causing various chronic diseases**; reports from Toxic Links state that the phosphate content found in soap waste can trigger skin irritation. If left untreated, the accumulation of phosphate on the skin can lead to cancer.
2. **Causing water eutrophication**: another significant danger of waste is water eutrophication,

the uncontrolled growth of water hyacinths and algae on the water's surface caused by the compounds in soap waste. Both of these plants hinder the circulation of sunlight and oxygen, which aquatic life relies on. Left unchecked, the aquatic ecosystem's balance can be disrupted, resulting in the death or extinction of many aquatic organisms.

3. **Non-environmentally friendly plastic packaging**; soap waste is not the only threat to the environment. The plastic wrapping of soap can also be hazardous and a threat to life. Most plastics used cannot decompose in water or soil for up to 40 years, making proper separation and disposal of plastic waste essential to prevent this.

4. **Causing significant economic losses**; besides the significant environmental impacts, waste hazards can also affect economic activities. For instance, soap pollution in the sea affects the cleanliness of the seawater, disturbing beach tourism, which could lead to its closure. This is just one example. Imagine if the agricultural and fishing sectors are impacted, affecting the income of the communities around the water tourism area.
5. **Creating a sustainable water crisis**; soap waste contains harmful compounds for the environment. If left untreated, more water sources will be contaminated with soap waste, resulting in a scarcity of clean water for the community.

After understanding the environmental hazards of soap waste, particularly in marine environments, an innovative product is developed: environmentally friendly soap made from waste citrus fruit (inedible citrus). The natural components of citrus fruit that can dissolve fat will be highly beneficial for cleaning ships without polluting the marine environment. In other words, innovative products are created from waste to anticipate waste.

CONCLUSIONS

To anticipate marine water pollution, it is advisable to choose a soap that is entirely phosphate-free or has a very low phosphate content. Laundry waste with low phosphate content should be used for watering plants, as phosphate is beneficial for soil and plants but unsuitable for water bodies. Some soaps rely on excessive foaming as a selling point; in this case, it's better to choose a soap with minimal foaming to reduce the water needed for rinsing.

Opt for local products. Apart from promoting love for domestic products and supporting the economy, using local products will minimize the carbon footprint generated by transportation. Lastly, the innovative herbal soap made from citrus lemon as a base material is greatly expected to minimize marine water pollution caused by chemical-based soaps that can contaminate the sea.

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