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Sea Dump; Multi Function Waste Supply Tool Design to Reduce Belawan Sea Pollution

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Abstract

Belawan Sea are a very dense water area with industrial activities, shipping and human activities. Damage to marine ecosystems continues to increase as the amount of marine waste increases. It is estimated that around 80% of the waste in the sea comes from human activities on land and the remaining 20% comes from activities in the sea. The presence of plastic waste as solid waste is very dominant, with almost 60-80% of the total marine waste. Other marine waste which is a serious concern is oil and heavy metal waste originating from industrial activities. Belawan sea as an international standard port area are flanked by the mouth of the Belawan River and Deli River and receive domestic and non-domestic industrial waste from the river flow. Therefore, to overcome the problem of sea pollution, we designed Sea-Dump. This tool with the principle of desludging is multi-functional because it can carry out screening operations for solid waste such as plastic waste and absorb the liquid waste such as lead (Pb) and oil at once. Sea-Dump is applicable, effective and economical because it can be installed independently on fishing boats. Thus, the condition of the Belawan marine environment becomes conducive and beneficial for marine biota, fishermen, and surrounding communities.

Keywords: Belawan sea pollution; Sea-dump; Plastic waste; Heavy metals; Oil waste.

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1. Introduction

Marine pollution is one of the important issues that are being actively discussed in Indonesia. In North Sumatra Province, the coastal and marine areas that were damaged due to pollution are the Belawan Port. The destruction of the marine ecosystem continues to increase as the amount of marine waste increases in the form of liquid waste in the form of industrial waste and solid waste in the form of plastic, paper, glass and wood branches with an estimated amount of between 7,000 and 35,000 tons [1]. It is estimated that around 80% of the waste in the sea comes from human activities on land which are mobilized into the sea such as deforestation, industrial and agricultural waste disposal, domestic liquid waste, and solid waste. Meanwhile, the remaining 20% comes from activities in the sea such as transportation service activities, shipping, mining, oil and gas exploration and exploitation, and tourism [2]. The existence of plastic waste as solid waste is very dominant, with almost 60-80% of the total marine waste. According to the results of Jeena Jambeck's research in 2015, Indonesia was the second country in the world to produce the largest amount of plastic waste to the sea reaching 187.2 million tons [3]. Pollution of plastic waste will have a negative impact in the form of decreasing the quality and quantity of marine biota, especially fish catches by fishermen and deterioration in the quality of sea water. Another marine waste that is a serious concern is an oil spill. Oil pollution in the sea area is caused by tanker operations, scrappingships, fishing boat operations, oil leaks, and the use of oil waste from factory tools that are intentionally dumped into the sea [4]. According to IPIECA (2000) [5] that oil pollution will cause the penetration of sunlight to decline so that it does not support aerobic marine life and the physical closure of the surface of the water by oil layers so that plants and animals are no exception fish will be contaminated with the most severe impact is direct death [6]. The marine environment of Belawan Sea also receives a lot of waste in the form of lead heavy metal waste comes from industrial activities. The lead heavy metal waste comes from industries in the city of Medan and its surroundings which are dumped directly into water bodies in the form of tributaries which eventually empties into the waters of the Belawan sea. Belawan sea waters as an international standard port area are flanked by the mouth of the Belawan River and Deli River and receive domestic and non-domestic industrial waste from the river flow. In addition to originating from industrial waste disposal, heavy metal lead (Pb) is also caused by household activities of residential villages [7]. Heavy metal lead (Pb) contaminated in the waters of fish habitat can cause bioaccumulation in the body of the fish, entering the food chain, so that it can be dangerous when consumed by humans. Therefore, to overcome the problem of sea pollution, we designed *Sea-Dump*. This tool with the principle of desludging is multi-functional because it can carry out solid waste screening operations and the absorption of liquid waste at once. This tool is equipped with spoon / sondong nets which serves to filter plastic waste and other solid waste from water, as well as biosorbent of coconut fiber which serves to set aside water from oil and heavy metal Pb through the adsorption mechanism. *Sea-Dump* is applicable, effective, and economical because fishermen can reduce marine pollution independently through its installation on fishing boats. So that in the end it will increase the catch of fishermen in terms of quality and quantity. In addition, it will also improve the quality of marine environmental sanitation and settlements. Thus, the condition of the marine environment becomes conducive and beneficial for marine biota, fishermen, and surrounding communities.

2. Experimental

2.1. Sea Dump Design

Sea-Dump designed using the Solidworks application. The process of making Sea-Dump can be seen as the following scheme.

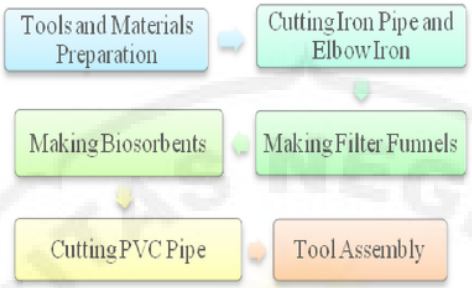

Figure 1: Scheme of Sea-Dump Preparation

1) Preparation of Tools and Materials. The tools used in making *Sea-Dump* are grinding, hand drill, welding machine, pliers, cutter knife, ring lock and fitting, screwdriver, and drill. Whereas the materials used in making *Sea-Dump* are pump engine, intake hose, 60-liter capacity drum, diton paint, elbow iron, PVC pipe, elbo elbow, elbo T, socket, elbo cap, iron plate, grinding eye, emery and welding wire.

2) Cutting Pipe Iron and Elbow Iron. Cutting iron pipes and angled iron is settled to make the frame from the filter funnel.

3) Making Filter Funnels. Making filter funnels is done by welding each part of the funnel that has been cut in the cutting section of the iron to then be painted using spray paint on the iron.

4) Preparation of Biosorbent. Biosorbent which is mounted on the*Sea-Dump* drum is made of coconut fiber. The procedure for making biosorbents was carried out according to the procedure in the research of I Wayan Sudiarta (2011) [8].

5) PVC Pipe Cutting. PVC pipe cutting is done by cutting the pipe with a grinding wheel. Pipes are cut according to the specified size.

6) Tool Assembly. Assembly of tools is carried out by uniting previously made parts such as filter funnels, PVC pipes, pumping machines, biosorbent, and drums. The part is joined together to form a*Sea-Dump* tool.

After build the Sea Dump tool, to trials this tool design in Belawan Sea, it attached to Boat as seen in Figure 2.

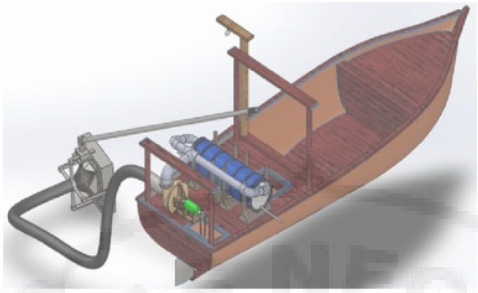

Figure 2: *Sea-Dump* attached in Boat

2.2. Mechanism of Work Tools

The working mechanism of the tool can be seen as shown below.

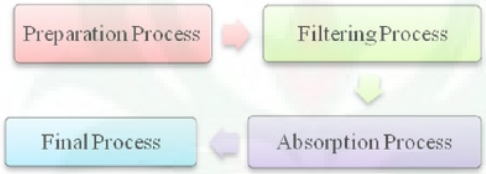

Figure 3: Mechanism of Sea Dump Operation

1) Preparation Process. Preparation process is carried out to check each component of the equipment starting from the pump, hose, filter funnel, biosorbent,storage drum, and filter control lever whether it can function properly as expected.

2) Filtering Process. This process begins with turning on the pump engine. When the pump works, the water will automatically be sucked into the filter funnel and then enter the hose. Solid waste/ rough waste such as plastic waste will be filtered in a filter funnel. If the rough waste in the filter funnel is full, it can be collected in a container. While the water sucked in by the pump, it will be pushed out by the pump blades until it enters the storage drum. In the reservoir drum the absorption process will be carried out.

3) Absorption Process. Absorption Processis the process of absorbing liquid waste contained in water, namely lead (Pb) and oil. This process occurs in the drum of the container. In the drum an absorbent cloth has been installed containing biosorbent coconut husk which functions to remove water from the liquid waste through the adsorption mechanism. After that, the water that has passed through the biosorbent will flow into the pipe and be wasted into the waters with conditions that have been free or reduced from the content of lead (Pb) and oil in seawater.

4) Final Process. Final process occurs when the water has been filtered, then the water will automatically come out to the surface with conditions that is free from the content of marine waste both solid waste and liquid waste. Solid waste in the form of rough waste such as plastic waste and other garbage that has been collected can be transported to land and saved to a waste bank so that it can be recycled and managed again so that it has economic value.

3. Results and Discussion

The process of testing the *Sea-Dump* tool was carried out in the waters of the Belawan Sea. *Sea-Dump is* able to work for 4 hours a day which is two hours of operation in the morning and 2 hours of operation in the afternoon. Due to the size of the *Sea-Dump* have a total weight is 50 kg with an average maximum weight of fishing vessels is 2000 kg, *Sea-Dump* is applicable because it can be installed on almost all fishing vessels. Based on the results of testing, *Sea-Dump* can operate as expected multifunctional properties, the tool is able to perform water filtration functions from coarse rubbish and the function of adsorption of lead metal (Pb) and oil contained in water at once. The following is the data from the trial results of the tool on the crude waste filtering function.

Table 1: Sea Dump Test Results on Rough Waste Filtering Function

No.	Specifications	Achievement
1.	Discharge water in the drum	60 L/ 3 minutes
2.	Discharge of water produced after the absorption process	4,5 L/ 3 minutes
3.	Lots of garbage filtered	800 gr/ 3 minutes
4.	Speed of water flow	16 L/minute

Sea- Dump is designed using two PVC pipe branches. The first pipe branch is to drain the filtered water back to the sea and the second pipe branch is to drain water without the filter process to return to the sea. Based on the data in Table 1 is the water discharge generated after the absorption process with a drum capacity of 60 liters is 4.5 liters which full drum estimation for 3 minutes. It induce a lot of water can be filtered for 1 hour is 90 liters. If it operates for 1 hour it is estimated that the capacity of water that can be filtered in the water of Belawan sea is as much as 90 liters. For the capacity of coarse trash that can be transported once to work with the length, width and height of the filter funnel 35 cm, 45 cm, and 40 cm which is 800 gr. With estimated filter funnels it can be full for 3 minutes. So that if it is operated for 1 hour it is estimated that the capacity of trash that can be filtered around the waters of the Belawan sea is 16 kg.

In addition beside to filter crude waste, Sea-Dump also functions to absorb lead metal (Pb) and oil contained in water using coconut husk biosorbent. Data from the trial results of the tool on the function of water absorption

from lead (Pb) and oil can be seen in the following table.

Table 2: Pb(II) and Oil content Analysis of Belawan Sea water before and after treatment

No.	Content	Before	After
1.	Pb(II)	24,13 ppm	7,04 ppm
2.	Oil	0,05 gr/L	NA

Seawater sampling was carried out in the PLTU area as a *center of area* Belawan sea. According to the Decree of the Ministry of Environment No. 51 of 2004 that the value of the quality standard for metal Pb (II) in water is 0.05 mg / L or equivalent to 0.05 ppm. Based on the results of the test of lead metal content (Pb) for seawater samples that the content of lead metal (Pb) in water before filtered water using a very high tool exceeds the threshold of 24,13 ppm. However, the content of lead metal (Pb) in water after filtered using a tool has decreased which is 7.04 ppm. This shows that the use of *Sea-Dump* can reduce three times the lead metal content (Pb) before the water is filtered using a tool. According to the Decree of the Ministry of Environment No. 51 of 2004 that the value of seawater quality standards for port waters in the oil parameter is 5 mg / L equivalent to 0.005 gr / L. Based on the test results of the oil content of seawater samples (table 2) that the oil content in the water before the water is filtered using a tool that exceeds the threshold of 0.05 gr / L. However, the oil content in water after being filtered using a tool shows the *Not Applicable* result because the seawater sample has been homogenized so that no significant changes occur. Thus, the results of the testing tool prove that Sea *Dump* can work effectively in absorbing lead (Pb) and oil contained in seawater in the waters of Belawan.

4. Conclusion

Sea-Dump is a multi-functional marine waste suction device because it can filter solid waste and absorb liquid waste at once. In solid waste screening operations, the capacity of coarse waste can be filtered in one work for one hour, which is 16 kg. Whereas the operation of liquid waste absorption using biosorbent coconut husk can reduce oil and lead metal (Pb) from 24.125 ppm to 7.038 ppm so that it can produce water with lower lead (Pb) and oil content. Thus, *Sea-Dump* is applicable in dealing with solid waste, especially plastic waste because it can be installed on almost all fishing vessels, it is effective in absorbing lead (Pb) and oil because it can reduce three times of the content of liquid waste before using the tool, and is economical because the basic ingredients of the tool do not require expensive costs including coconut fiber biosorbent components that are easily available because they come from natural waste with abundant availability.

Acknowledgements

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