Methodology for designing and fabricating a novel SEABIN used in the marine industries

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ABSTRACT

One of the most significant issues facing our world right now is the extreme pollution of our seas and waterways. Every day, a large amount of rubbish and plastic waste is poured into our oceans. In actuality, the ocean receives fourteen billion pounds of trash annually, most of it plastic. One of the top three threats to the continuing health of the ocean is it (along with ocean acidification and ocean warming). Plastic is left floating in our seas because it does not decompose, unlike most natural materials. Unluckily, many marine species devour these floating microplastics. As a result of their inability to metabolise the plastics, this frequently results in mortality. As a result, the idea of Seabin is developed to deal with this problem. The Seabin uses a sucking mechanism to gather and filter rubbish at marinas, docks, and ports. It is simply a trash can that floats on water and collects litter. It is pushed by a motor that injects water into a vortex, collecting debris from the water and depositing it in a catch-bag within the bin before propelling the cleaned water back out into the ocean, with no harm to the local marine life. It employs a motor to draw electricity from the beach. Additionally, it features oil absorbent mats to remove petroleum-based lubricants and detergents from the surface water. Because they are less expensive to run, involve less labor, and are a more natural manner of cleaning, sea bins are preferable to alternative methods now in use. The goal of the Seabin project is to promote a healthy, sustainable way of living and to increase awareness of environmental health.

Keywords

Plastic, waste, Seabin, Marine.

1. INTRODUCTION

Water contamination is a serious issue that affects the entire planet and is brought on by several causes. It can seriously destabilise whole ecosystems and be very detrimental to our economy and health. Water is one of the most crucial components for maintaining life on earth. Sadly, it is also extremely susceptible to contamination. This is primarily because water is an all-purpose solvent that can dissolve a variety of compounds. Water now serves as a resource for all living things and helps to maintain the ecosystem; nevertheless, plastic trash is bad for animals, the environment, and people. Every year, there is a rise in the use of plastic, and this trend is predicted to continue. "Mismanaged plastic

garbage," or plastic debris that is not gathered and dealt with through recycling or burning but is instead discharged into the environment and not cleaned up, is the cause of most of the plastic rubbish that ends up in the ocean.

A new marine assessment found that annually, the oceans get more than 6 billion pounds of trash, mostly plastic. Over 5 trillion pieces of plastic are thought to be floating in the world's seas and rivers, not to mention 10,000 times more in the deep water. Nearly all bodies of water contain plastic waste, which may be seen dwelling on the bottom, suspended in the water column, and floating on the surface. It is transported by rivers to the ocean, where it floats with the currents for years before disintegrating into ever-tinier fragments. Oceans across the world are filled with accumulated plastic trash. It is regularly eaten by fish and birds, concentrating hazardous compounds in their tissues, and filling their stomachs to the point that they cannot digest the plastics, leading to starvation. Aquatic plastic waste may also make it difficult to navigate, hinder commercial and recreational fishing, put people's health and safety at risk, and hurt tourism. The most hazardous debris for vessel navigation is big debris, including old fishing nets and lines floating at the surface or close to it. Ships can crash with big items, breaking hulls, and damaging propellers, while lines and nets can tangle in motor intakes and wrap around blades.

Numerous efforts are being carried out by numerous nations globally to solve this issue. Interceptor, Mr. Trash Wheel, Floating Boom, Trash Skimmer Boat, etc. are a few of these projects. The Interceptor is the first. A self-sufficient, solar-powered contraption called Interceptor spans a river to gather plastic. The garbage is placed into bins and pushed up a conveyor belt; when the bins are full, a mechanism alerts the user so that a boat can arrive and collect the waste for recycling. Mr. Trash Wheel is the next one. Mr. Rubbish Wheel uses revolving prongs that dip in and out of the water to gather floating trash and then deposits it on a conveyor belt that carries it to a dumpster. The floating boom is the third item. In order to construct a barrier that may contain garbage, aquatic plants and algae, rubbish, and even marine life, floating booms are utilised. The trash skimmer boat is the fourth. A labour boat with a garbage skimmer gathers and discards trash out the front or bow. A storage conveyor fixed to the hull on a slide or track system that allows fore and aft mobility, about amidships and along the centre line. However, most of these initiatives rely on fuel and engine systems, which demand ongoing human labour. Coastal water has received less attention than open waterways or deep water, where these initiatives have mostly been deployed.

The Seabin Project was thus developed to address these problems. The Australian firm Seabin Pty Ltd., established in 2015, invented the Seabin with the aim of creating a localised solution to marine litter in urban maritime regions. Clean up efforts are typically made at harbours and marinas for two reasons: marina patrons dislike floating trash for aesthetic reasons, and immovable trash that obstructs a vessel's cooling water intake might cause significant financial harm. More than 860 Seabins have reportedly been deployed across the world and have collected approximately 3,250,000 kg of trash. A "garbage skimmer" called the Seabin was developed for quiet, protected locations like marinas, ports, and yacht clubs. The system is made to capture organic material that has been polluted as well as floating trash in the micro to macro range. The Seabin is made to continually draw in water using a submersible pump that is filtered via a 2 mm by 5 mm triangular mesh bag, displaces 25 L per hour. Once the water has been cleaned, it is pumped back into the vicinity while the trash is left in the catch bag.

This work was focused on evaluating the performance of a Seabin and developing a technique to create a unique typical Seabin that can be utilised in many lakes and rivers due to their growing use and lack of formal assessment.

2. LITERATUR REVIEW

By raising awareness among the public, business, and government, Winton et al. [1] identified the common MP items in freshwater of Europe, notably plastic, that might possibly be minimized. Their research focused on the reported MP fluctuation in freshwater and marine atmospheres. The distribution of atmospheric microplastic (MP) abundance across the ocean was provided by Wang et al. [2] based on a survey carried out in the Pearl River, South China Sea, and East Indian Ocean. They discovered that the major source of marine microplastic (MP) travels across a long-range distance into the atmosphere, more than a thousand kilometres. Winton et al. [3] highlighted the prevalent MP items in freshwater of Europe, particularly plastic, that may perhaps be minimised by increasing awareness among the general public, business, and government. Their

research focuses on the reported MP variation in freshwater and marine atmospheres. The potential effects of macro- and MP-waste on marine biodiversity and human life were researched by Gallo et al. [4]. They recommended rigorous plans of action to control unnecessary plastic packaging, a ban on single-use plastic bags, an intensification of the collection rate of plastic waste, and deposit-refund policies for plastic beverage bottles that have a high rate of success in many nations. They also suggested analytical methods on the production and consumption of plastics and waste management. On 2018, Krishnakumar et al. [5] conducted study in the beach sediments of the Andaman and Nicobar Islands and discovered white debris of irregularly shaped polyethylene and polypropylene. Tourists, shipping, and incorrect processing of solid wastes deposited in the maritime environment all contributed to most of the plastic trash that ended up on the island's beaches and threatened the marine life there.

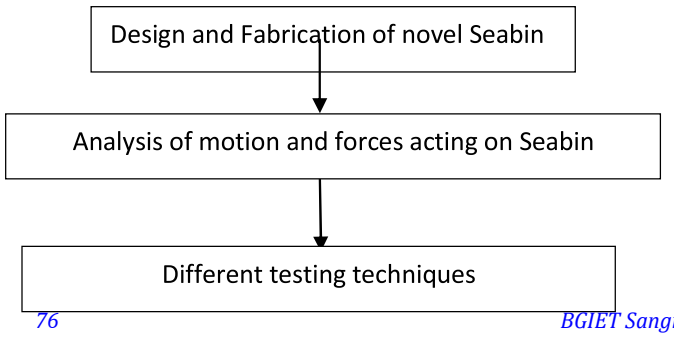
On Yongxing Island in the South China Sea, Zhu et al. [5]. The investigation of the prevalence of plastic debris on 1 seabird species and 2 shorebird species discovered 56 pieces of plastic debris in 4 of 9 birds, ranging in size from 0.67 to 8.64 mm. Most of the MP products (92.9 %) were under 5 mm in size and were made mostly of polypropylene-polyethylene copolymer (83.9 %). Blue made up 91.1% of the gathered MP debris's primary hue, whereas thread made up 89.2% and sheets made up 8.9%. This study concluded that sea birds could confuse plastic waste for food. In order to account for wind-driven vertical mixing, Sonam et al. [6] used an oceanographic model to examine the effects of marine pollution and estimated at least 5.25 trillion particles weighing 268,940 tonnes. They observed a significant loss of microplastics from the ocean's surface compared to expected rates of discontinuity, which suggests active processes that remove plastic particles measuring 4.75 mm or smaller from the water's surface. By creating corn straw fiber by traditional impregnation, Xu et al. [7] created an easy, quick, and inexpensive technique to clean oily wastewater. Chemical coupling agents allowed them to boost absorption efficiency and capacity, which offers considerable promise for treating oily water. In order to separate oil from liquid mixtures, Tan et al. [8] presented a unique environmentally friendly maize straw material with preferred super hydrophobicity and superoleophobicity. It was discovered that the modified maize straw had better chemical resistance and environmental endurance, enabling it to both selectively absorb oils and totally reject water. The specially crafted maize straw offers a greener option for cleaning up oil spills and resolving the environmental issue of disposing of agricultural waste. The many characteristics in the advancement of the floating modular photovoltaic system were given by Jian Dai et al. [9]. They created a system that consists of several uniform floating modules made of high-density polyethylene that may be used as either pathways for maintenance or floating solar panels. Additionally, they discussed the projected floating photovoltaic system's testbed launch in depth and evaluated the system's ability to generate power.

3. METHODOLOGY

The main aim of the Seabin project is to collect detritus from the ocean and seawater. The idea is very similar to the existing Seabin project but some changes have been done to improve the efficiency and performance of the Seabin project. The methodology of designing a typical Seabin is as follows

3.1 Design and fabrication of typical seabin

The figure 1 depicts the front, top and side view of the typical Seabin. The Seabin comprises of L-shaped vertical post, debris collector, water pump, panels, and fibers. Debris collector is a cylindrical collector with a varying cross-sectional area holding the main filter that collects detritus from the ocean and seawater. Because of the decrease in the cross-sectional area, it creates varying pressure which is used to suck water with more power. It contains a catch bag that holds the detritus. Further, Seabin is also capable of separating oil from water with the help of an oil absorbent pad that is made from CORN STRAW FIBERS(CSF).



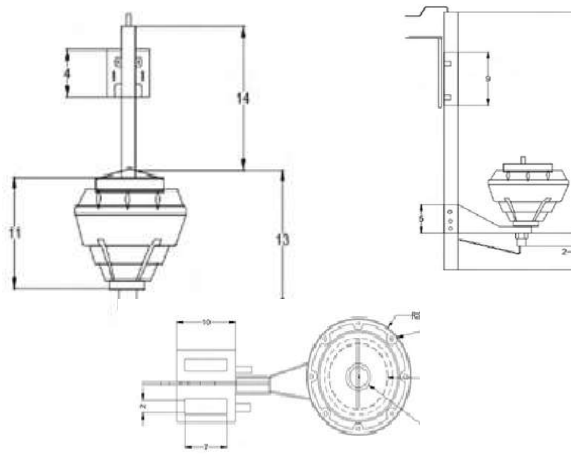


Fig. 1. Front view, side view, and top view of typical Seabin.

3.2 Analysis of motion and forces acting on Seabin

In the existing Seabin, there is only translational motion which is used for the collecting the trash. Owing to this translational motion only axial force is applied over the surface. However, as an alternative rotation motion is applied along with the translational motion owing to which generates a centripetal force along with the axial force as shown in the Figure 2, that aids in collecting more detritus from the water.

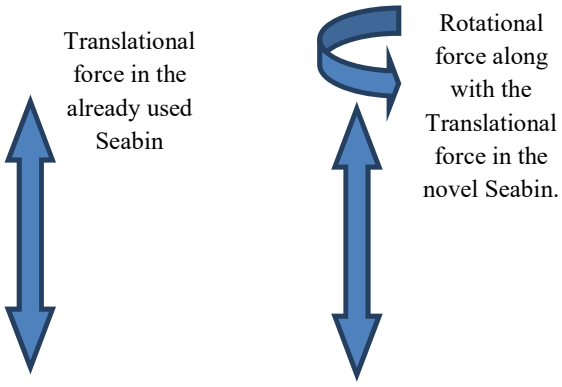


Fig. 2. Difference in motion for already used Seabin and suggested novel Seabin.

3.3 Different testing techniques

Water quality determines the 'suitability' of water for specific purposes. It will reveal information about the waterway's health. The changes in the quality of the water can be seen by testing it over time. Water is a valuable natural resource that requires constant quality monitoring to ensure its safe use. Traditionally, water quality detection has been done manually, with water samples being collected and transported to laboratories for analysis. Because these methods do not provide real-time data, we propose a system that can continuously sense the water quality parameter and send the data to the monitoring station in real time using wireless technology. It monitors the contents of the bins as well as water temperatures, pH levels, and other parameters. The system's wireless sensor node is intended to monitor the pH of water, which is one of the primary parameters influencing water quality. A signal conditioning module, a processing module, a wireless communication module, and a power module are the main components of the proposed sensor node design. After signal conditioning and processing, the pH value will be wirelessly transmitted to the base station via Zigbee communication.

4. CONCLUSIONS

The Seabin aims of creating a localised solution to marine litter in urban maritime regions. Clean up efforts are typically made at harbours and marinas for two reasons: marina patrons dislike floating trash for aesthetic reasons. The novel developed Seabin provides the rotational motion along with the translation motion which can be effective for collecting more detritus from the water. Hence, enhancing the quality of water which can be beneficial for marine industries and water wild life.

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