# DESIGN AND DEVELOPMENT OF THE NOVEL SEABIN*

BY

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**ABSTRACT**

*Oceanic pollution is a major concern in today's world. The pollution majorly consists of chemicals and trash, most of which comes from land sources and is or blown into the ocean. This poses a great threat to the marine ecosystem. Marine trash is mainly composed of manufactured products, these manufactured products because of their slow decomposition rate turn into debris. Fish become tangled and injured in the debris, and some animals mistake items like plastic bags for food and eat them. In this paper, we explain the major concerns of ocean pollution and attempt to make our own model of the novel Seabin and demonstrate its purpose to decrease the problem of the former.*

**KEYWORDS**

An autonomous bot in the Seabin, POPs, Seabin model, Waste management, Working of a Seabin.

## I.INTRODUCTION

Humans have existed as the homo sapiens for several thousands of years [1]. During this century (a tiny fraction of one percent of their total tenure) have they begun to make any measurable impact on the oceans that cover most of the planet: since the industrial revolution as an instigator of chemical and physical changes that have modified rivers, estuaries and localized segments coastal water; and during the past four decades as serious predators and on ocean fish stocks [2]. There are major concerns in regard to oceanic pollution mostly that of relating to plastic. Understanding the simple synthesis, robustness and durability, industrial production of polyethylene terephthalate (PET) [3]. One of its major yet problematic properties is its chemical ability to remain hydrophobic which makes decomposition extremely difficult [4], [5]. Plastic fragments also leach contaminants and attract additional lipid soluble pollutants, such as persistent organic pollutants (POPs), aqueous metals, and endocrine disrupting chemicals.

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Debris are another cause of aquatic life endangerment. The threats to marine life are primarily mechanical due to ingestion of plastic debris and entanglement in packaging bands, synthetic ropes and lines, or drift nets. M.D. Robards examined the gut content of thousands of birds in two separate studies and found that the ingestion of plastics by seabirds had significantly increased during the 10–15 years interval

between studies. A study done in the North Pacific found plastic particles in the stomachs of 8 of the 11 seabird species caught as bycatch. Due to these various problems the need for avoiding and getting rid of plastic from the ocean is necessary, therefore the innovative discovery of the sea bin might help us to reduce or even eradicate this issue.

**II.PROPOSED MODEL OF THE SEABIN**

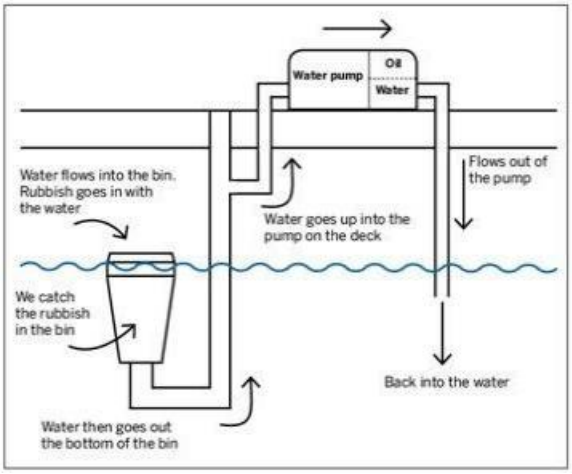


Fig. 1. Representation of the actual model of a Seabin (Source: Yachting World, “A marine vacuum cleaner to suck up plastic? Meet the Seabin Project”)

A Seabin focuses on a specific kind of water pollution. It sits on top of the water surface and collects all the rubbish in the catch bag present in the bin. This rubbish may include oils, fuels, woods, plastic, detergents, etc. The Seabin is connected to a dock that pumps and drains out water from the Seabin. (Fig. 1.) The inner mesh of the bin is then emptied regularly and disposed of responsibly.

U-Shaped Collector:

The U-shaped collector is the principal setting of the model. It acts as a basin and holds the main filter [6]. One end of the 20L bottle is confined to a small outlet. The main role of this collector is to collect all the waste once ducked in the water.

Net Fabric:

Net Fabric is required to filtrate the water and collect the waste. In the proposed model, a mosquito net was used as net fabric. When submerged in water, the mosquito net stays for a

longer period of time, making minimum space for any impurities to pass through it. A mosquito net can also collect any oil or fuel content from the water. Hence, it is proved to be strong and recyclable and possesses no harm.

The property of the net includes, high tensile strength, low extensibility and thermal conductivity (when submerged in water), and ensures better durability. It can also hold the strong current of water. Therefore, a mosquito net is very suitable for using it as a filter. Additionally, due to its insulating properties, a person who cleans the net after removing it from the bin will not be affected by any skin diseases or skin irritation. These properties are similar to that of a jute bag [6].

Rubber Tube:

A rubber tube was used to make the mouth of the Seabin model. This makes the bin fixed at the level of the water surface. The level of the mouth also aligns with the level of the surface of the water. It then adjusts itself and the water comes to the collector in an appropriate manner without damaging the mosquito net.

Suction Set:

A suction set was created to pump and drain out the water from the bin, leaving behind the debris in the net. One end of a pipe was connected to a motor of 0.5 hp (horse power), the other end was connected to the mouth (tapering end) of the U-Shaped Collector [6].

The purified water can be lifted up to a height of 10 meters and recycled back out into the water body.

**III.OUR VERSION OF THE MODEL**

The design of the Seabin was first created by Andrew Turton and Pete Ceglinski. Their design gained an increased amount of interest due to its simplicity yet efficiency in its ability to collect trash. Many models so far have been tried out and designed. Here we speak about the effectiveness of our model.

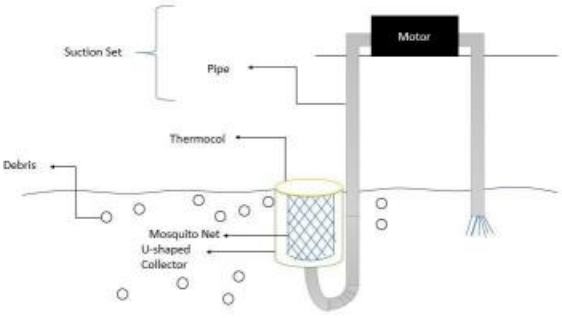


Fig. 2. Diagrammatic representation of the proposed model

So firstly, we have taken a 20L bottle which will be used as a basin. This was then cut from the top and a mosquito net was fitted from the top. The bottle was then cut from either of its sides to create balance so it doesn't topple over when placed in a water body. Rubber tube was then fitted around the rim of the bottle for it to be more efficient when floating. A nozzle was then incorporated into one of the holes, through which a pipe passes. The pipe was then connected to a motor of 0.5 horsepower which would create a suction effect. Our Seabin model is made from everyday household items which demonstrates that anyone with the urge to conserve the ocean can create this prototype.

Working:

When the Seabin is placed in a contaminated water body it almost acts like a flooding trash can, through the suction power that is being supplied by the power source of 0.5 hp. The sea bin which is surrounded by the contaminated water is pulled into the sea bin through said suction effect and debris or trash are then collected into the filtering net which filters the smaller debris.

The purpose of the rubber tube as demonstrated before is to stabilize the amount of water flowing into the bin. Since we want the sea bin to float at the same level of

the water and maintain a state of buoyancy. The force applied is made equal to the water buoyancy force.

Fw = Fb Fw = mog Fb = w gV

Fb = Fbouyuancy Fw = Fweight

w = Water density g = Gravity

mo = Mass of object

V = Volume of body fully submerged

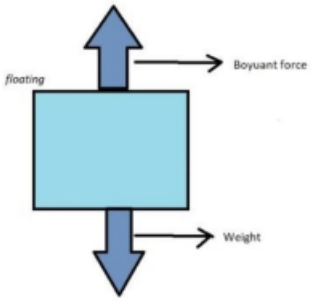


Fig. 3. Free-Body Diagram of The Seabin

IV.WEIGHT ANALYSIS AND CALCULATION OF THE BUOYANCY FORCE AND VOLUME OF THE SEABIN

Note1: For calculating the mass of the materials (items) used in the Seabin, the weight of the materials was divided by 10 (since, gravity = 9.8 m/s2) and the result was divided by 1000 kg, as the weight was calculated in grams (g) initially.

Note2: All measurements were taken approximately.

| No. | Item | Material | Mass (kg) |
|---|---|---|---|
| **1.** | U-Shaped Collector | Plastic | 1.000 |
| **2.** | Net Fabric | Nylon | 0.090 |
| **3.** | Rubber Tube | Natural latex, synthetic rubber | 0.042 |
| **4.** | Pipe | Copper, PVC, ABS | 3.000 |
| **TOTAL** | | | **4.132** |

Table 1. Mass Analysis

Since the Seabin consists of many parts, it is vital to determine the weight of every part of the Seabin. But due to limitations, only major parts of the Seabin were taken into consideration for the calculation of the buoyancy force.

This is to get an idea of the minimum upward force that the water will exert on the Seabin for it to float.

Calculation of the buoyancy force:

Given: mo (Total Mass of the Seabin) = 4.132 kg

g (Gravity) = 9.8 ms-2

To find: Volume of the body fully submerged.

Fw = mog

Fw = (4.132) (9.8)

Therefore, Fw = 40.49 N

Now since, Fw = Fb Fb = 40.49 N

Therefore, the minimum upward force required for the Seabin to float is 40.49 N.

Now,

Fb = w gV

(where, w = water density

= 997 kg/m3)

40.49 = (997) (9.8) V

Therefore, V = 0.0041 m3.

Therefore, the total volume of the Seabin is 0.0041 m3.

**V.IMPLEMENTATION OF AN AUTONOMOUS BOT IN THE SEABIN**

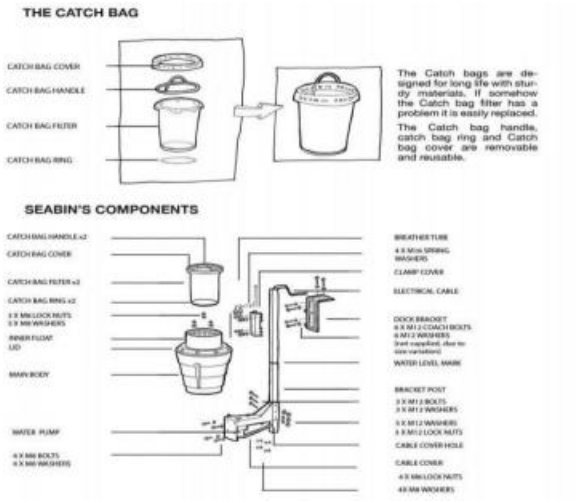


Fig. 4. Diagrammatic Representation of the actual design of the Seabin

(Source: Tech Insider, “This Australian invention by two surfers automatically sucks rubbish from the Seabin”)

Fig. 4 shows the diagrammatic representation of the actual Seabin model. Due to limitations and cost barriers, a mini model of the Seabin was created in the similar manner.

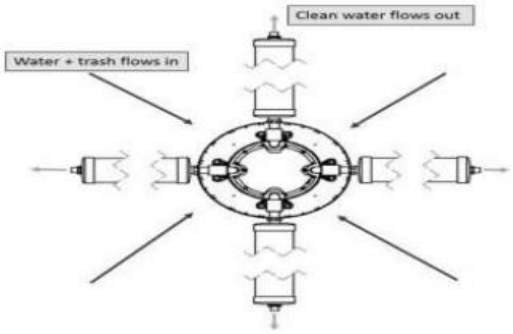


Fig. 5. Water Orientation of the Seabin

(Source: IOP Publishing, “Development of River Trash Collector System”, 2020) [7].

Concept of half vacuum water suction [7], is applied to collect the trash, since the level of the water and the Seabin is equal. Oils and fuels from the water are also flown down with the trash and are trapped by the net fabric present inside the bin. The collected water is then filtered and the clean water is allowed to flow back into the river, fig. 5. Similarly, the concept of half vacuum water suction was used and applied in our version of the Seabin.

To add up, an autonomous bot was proposed to be implemented in the Seabin. According to [8], waste is still collected and segregated manually in many countries like India, Oman and Philippines. People who are employed to manually pick and segregate the trash are vulnerable to skin infections, allergic disorders, respiratory and gastrointestinal problems [8]. This bot collects and separates the trash into its appropriate recycling bin.

If implemented, this bot can be controlled by Bluetooth communication technologies. ATMega16 can be used as a master robot controller, while ATMega8 can be used as a sensor to sense the position of the garbage and communicate serially with the master controller for necessary trash collecting operation [8].

These sensors can be implemented as bots in the Seabins to segregate the trash according to their recycling bins. But these bots were not implemented in our version of the model due to the barriers. Hence, we put forward to implement it in the actual model of the Seabin.

Research shows, several improvements can be done in the actual model of the Seabin. For the main body of the Seabin, materials like fiber can be used instead of plastic as it is stronger and harder [7]. Moreover, the water pumps which are generally used in a Seabin might be replaced with a stronger suction pump, since the regular water pump may not be able to work continuously and properly [7].

**VI.PRACTICAL MODEL OFOUR VERSION OF THE SEABN**

In the following part of this paper, we also created a simulation model of the Seabin using the Commercial Computer-Aided Design (CAD) and Drafting Software application, 'AutoCAD' by using simple techniques. It was put forth to demonstrate its structure as it is unsophisticated and quite effortless to make. Using this software, simple components such as the bin and net were combined together to make something almost ground breaking in the discovery of science and engineering.

This software helped us to create a three-dimensional model of our version of the Seabin and allowed us put forward an idea of how the Seabin works.

**CONCLUSION**

To conclude, the fight for conserving the oceans, rivers, and all the other water bodies is still going on. And this is due to turning a blind eye to it every year.

About 70% of the debris are discarded into the ocean's ecosystem, 15% floats, and 15% lands on our beaches. Over 99% of plastic is made from the chemicals sourced from fossil fuels. Eight million tons of waste

– most of it plastic - is added to the oceans each year. This leads to global warming.

Liter can be easily mistaken as food by the marine animals. This accounts for a major threat to the marine life causing health complications or even death. According to two researchers, Blaunch and Perry, marine debris ingestion was reported to occur with least 462 individual cetaceans belonging to 48 species. There has been an increase in the number of debris ingestion incidences every year.

Marine debris can also lead to a decline in tourist traffic and can cause a considerable amount of increase in cleaning costs. Floating marine debris endanger the maritime traffic. In other words, small items in the debris can block propellers. Moreover, litters trapped by fishing nets are becoming a huge problem for fishermen.

Our solution to reduce the amount of debris in the water bodies is to create more Seabins that will help clean the water bodies. Till now there are a total of 860 Seabins created to reduce the waste disposed off in the water bodies. According to the researches, total amount of waste captured till now is 1,915,346 kg. Considering huge water bodies and the amount of debris in the water, this number is not large. In other words, we need to bring an awareness of the Seabins. And hence, we proposed to create a mini model of the Seabin to show how it works. The Seabin focuses on one specific kind of water-location. It can collect any type of pollution including detergents, plastics, wood, fuel, etc.

Additionally, as discussed earlier, an auto sensor that senses and segregates the trash collected in the Seabin can also be added to the Seabin. This will help prevent skin infections, allergic disorders and other disorders or diseases like them among the people who are employed to clean and segregate the waste from the trash bag manually.

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