

Water Pollution Reduction: Waste Management Methods to Make Rivers Cleaner

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Abstract— The problem of water pollution is critical and to solve it we must go from minor to major issues starting with the rivers. To achieve this, begins by classifying the types of waste into three large groups: plastic, chemical and organic waste. Once the types of waste are understood, different options will be presented to clean the rivers. These options are: The River Cleaning System, River Oil, Port Skimmer and the Multi-Purpose Amphibious Dredger. Then a method will be chosen taking into account its pros and cons to finally modify it to achieve optimal performance in rivers.

Keywords: waste management, river pollution, cleaning methods, The River Cleaning System, River Oil, Port Skimmer, Multi-Purpose Amphibious Dredger

Resumen— El problema de la contaminación del agua es crítico y para solucionarlo debemos ir de menor a mayor comenzando por los ríos. Para conseguirlo, se empieza por clasificar los tipos de residuos en tres grandes grupos: residuos plásticos, químicos y orgánicos. Una vez que se entiendan los tipos de residuos, se presentarán diferentes opciones para limpiar los ríos. Estas opciones son: El Sistema de Limpieza de Ríos, River Oil, Port Skimmer y la Draga Anfibia Multipropósito. Luego se elegirá un método teniendo en cuenta sus pros y sus contras para finalmente modificarlo para lograr un desempeño óptimo en los ríos.

Palabras clave: gestión de residuos, contaminación de ríos, métodos de limpieza, The River Cleaning System, River Oil, Port Skimmer, Draga anfibia multipropósito.

I. INTRODUCTION

Currently, we are facing a very serious problem of water pollution. Marine and freshwater environments are being depleted by the waste that goes into the water and the water is becoming less and less clean, harming the people who live on this resource.

The oceans are the largest water resources on the planet and it is important both to control and reduce ocean waste. To achieve this goal, all the bodies of water that finally flow into the oceans must be cleaned. It is important to control the amount of waste that reaches rivers, as reducing river pollution is the first step in reducing ocean waste. This will

not only help marine species, but also the thousands of people who live from the resources provided by rivers.

All kinds of waste can be found in the river, but the most abundant is plastic waste, more specifically, plastic containers. Currently, due to this amount of waste rivers are being degraded and species are disappearing. This is so because many fish die as a consequence of plastic and other waste consumption, by mistaking it for food or by being intoxicated by it. If fish is thought of as a food resource, its quality is lower or even under threat of extinction.

This problematic issue has been specifically addressed in the Sustainable Development Goals framework, more specifically by means of Goal fourteen [1] “Life below water”. This goal calls for the conservation and the sustainable use of the oceans, seas and marine resources for sustainable development.

Given the need to study and delve into this issue, in this article, different methods of waste management will be presented with the aim of making rivers cleaner. To achieve this goal, this work is organized as follows. In the first place, it will seek to identify the kind of waste found in rivers. Once identified, different methods will be introduced and described to clean up such waste in the most effective way. Finally, the most efficient method will be chosen based on effectiveness and practicality

II. DIFFERENT TYPES OF WASTE

Before focusing on methods to clean rivers, it is necessary to understand the different types of waste that can be found in them. This waste is very varied, but can be divided into three large groups.

A. Plastic

Plastic is a synthetic material made from hydrocarbons. It is known that plastic is not only the kind of waste that is most found in rivers, but also it is the most harmful to life in water.

Unlike other waste, plastic takes between 100 and 1,000 years to degrade. Plastic remains floating on the surface of the water, but a large amount of it breaks into small pieces, generating microplastics [2]. These microplastics are the ones that are later ingested by marine and river species, thus reducing their quality of life.

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When animals ingest plastic, it can have several negative effects. These effects can include starvation (due to intestinal obstruction), a false sense of satiety, decreased physical fitness, behavioral changes, and impaired growth and reproduction [3]. Due to its long duration and the fact that it is massively produced, plastic waste represents a great danger for marine and freshwater ecosystems.

Another thorny issue related to plastic is the entanglement of animals in the plastic material. It is observed that a large number of vertebrates get fatally trapped in plastic debris, making it difficult for them to survive. The harm that plastic items cause to animals when they come in contact with or ingest them, including suffocation, entanglement, lacerations, infections and internal injuries, is very serious. These problems are very common, so much so that they can be seen with the naked eye in almost all large bodies of water, such as oceans, seas, or rivers.

B. Chemical Waste

Chemical waste is another very common type of pollution, both in the oceans and seas, as well as in rivers. Chemicals are very dangerous as they can contaminate both surface and groundwater sources [4].

The toxins in industrial wastewater cause acute poisoning, immune system suppression and reproductive failure. According to the World Health Organization, around 80% of diseases are waterborne.

In the case of chemical residues, in addition to seriously affecting the species that live in the rivers, they permanently affect the waters in which they are found, turning them into non-potable waters, considerably affecting the people and animals that drink from the river. Chemical residues mix with the water, making it much more difficult to remove them from the rivers.

C. Organic Waste

Finally, one of the less harmful but equally important waste will be discussed: organic waste. Although it is believed that this waste is less harmful since it has a fast decomposition, measures must be taken.

Organic pollutants are very varied, including organic herbicides, organic pesticides and plant and animal tissues. Leachate is defined as any contaminated liquid that is generated from water percolating through a solid waste disposal site, accumulating contaminants, and moving into subsurface areas. A second source of leachate arises from the high moisture content of certain wastes. If leachate enters a river, it can be extremely polluting.

Despite being the least harmful contaminants, organics are still waste that must be treated. The minimum residual levels of organic contaminants present in the water can have harmful effects on environmental health [5]. The elimination of this waste from the river is of great importance to achieve cleaner water but if organic waste is stored or used correctly, it should not cause water pollution.

III. METHODS TO CLEAN RIVERS

Once the different kinds of waste are known and understood, it is necessary to investigate the different ways of cleaning the rivers. To this end, several methods were selected.

A. The River Cleaning System

This system was created by River Cleaning Company and is made up of a series of floating devices, shown in [6, Fig 1], which allow plastic waste to be intercepted. As [5, Fig 2] illustrates, the garbage is collected by these small devices [6]. The most important aspect is the rotary movement, since these machines use this type of movement to capture the debris that floats in the water. Rotational motion is also known as circular motion. The speed at which the devices rotate will be determined by an angular velocity that will be generated by the flow of water that passes through the devices.

This system is very useful to clean the surface of the river but it does not manage to clean deeper parts of it, this is a problem because if the waste does not float, the collectors will not catch the garbage.

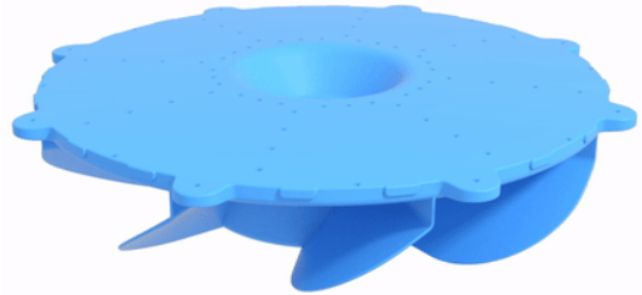


Fig. [1] The floating rotating device [6]

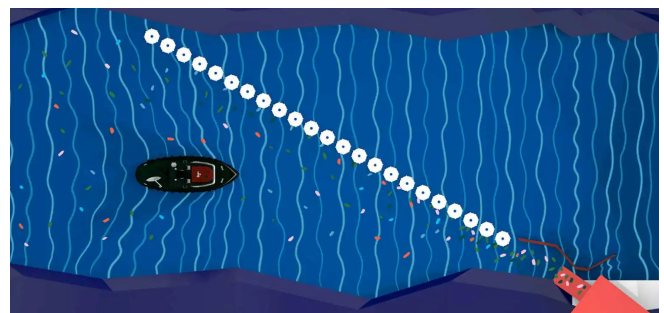


Fig. [2] Placement of the devices [6]

B. River Oil

River Oil is another system developed by River Cleaning Company as an improved version of the River Cleaning System. River Oil is a system designed to stop contamination by oils and other polluting liquids. A filter is added to the device developed for the river cleaning system that serves to retain polluting liquids such as oil [6]. This new device can be seen in [6, Fig 3].

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This option is a great improvement over the original system, but it has a higher implementation cost and maintains the defect of the original system. The garbage can pass under the devices if it is heavy enough to submerge in the water because the devices are on the surface of the water.

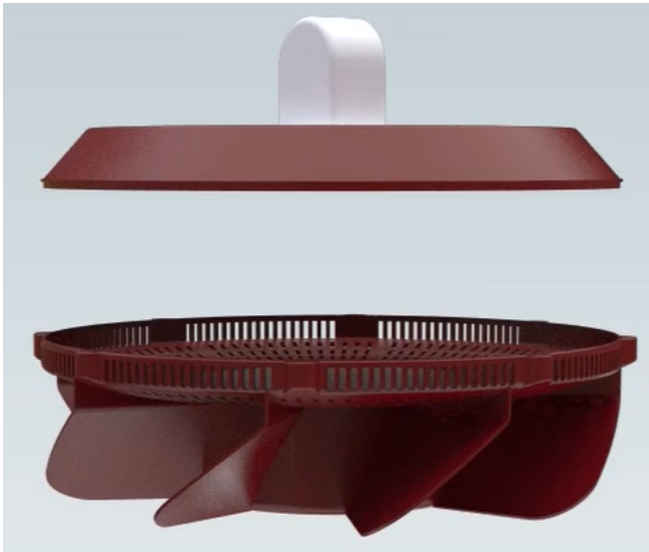


Fig [3]. The device with a filter [6]

C. Harbor Skimmer

The Harbor Skimmer is a water vehicle that has two pumps and a stainless steel filter used to attract plastic and floating debris. Inside, the water moves very slowly and does not harm any fish that might swim in it [7]. This machine is just over 22 feet long and features retractable arms that give the boat a wingspan of almost 13 feet. The retractable arms funnel plastic and other debris under the front of the skimmer where it is picked up by a conveyor belt that sends the debris down the track into a large sack. The conveyor belt consists of a continuous band that is dragged by friction by the action of a cylindrical drum, called a driving drum, which is driven, in most cases, by an electric motor, although other sources of energy can be used. In this case, solar energy is used. In [7, Fig 4] there is a harbor skimmer working.

This method has a drawback: there must be workers on the coast who are in charge of emptying and keeping the machine in good condition. However, since this system creates jobs it is not entirely negative.



Fig[4]. The harbor skimmer from 4ocean [7]

D. The Multi-Purpose Amphibious Dredger

The Multi-Purpose Amphibious Dredger is an effective machine that can be used in rivers that have only a few millimeters of water as it is shown in [8, Fig5]. This machine seeks to remove debris and obstructions from the river through a large claw that deposits the collected debris on the shoreline. This machine is very useful to prevent river flow obstruction due to blockages of debris [8]. Large-scale shallow water dredging requires large-scale dredging capacity and the traditional big dredgers with limited mobility are poorly suited for inland waters. When using the Multi-Purpose Amphibious Dredger, special care must be taken with the supports of the machine since if it is placed on soft ground, such as mud, it could get stuck.

The problem with this machine is its maneuverability: since it is quite large and it is used in rivers with few millimeters of water, it must be handled carefully so that it does not get stuck.



Fig[5]. The Multi-Purpose Amphibious Dredger working [8]

IV. FINAL CHOICE OF METHOD

In this section, the method considered most suitable for cleaning the rivers will be chosen: the "River Oil" method. This method is the most complete and it not only cleans the garbage in the water, but also cleans the liquid waste.

To implement this method and obtain the best results on a single trawl, some improvements can be made to the system. First, a net can be placed below the devices that reaches down to the bottom of the river. In this way, the garbage that does not float in the river and is below the surface can be collected. The use of bottom gillnets is recommended, which will be anchored to the seabed with weights and raised with buoys attached to the devices, creating netting walls that can be up to 15 km long and 15 m high. This net must have spaces of 20x20 square centimeters to allow the passage of the fish and thus avoid affecting the species that live in these rivers.

It is recommended to use nylon, polyethylene and polypropylene nets. These are the most used because they do not generate waste in a short period of time. In addition, they are easy to get with the specifications mentioned above because they are in common use.

A device cleaning and maintenance team should also be added to avoid serious breakdowns. This team must ensure that the devices work properly, checking that they do not stop or break. They must carry out preventive maintenance, which must be carried out every three months. This maintenance will consist of opening the devices to clean the filters and checking the fins to make sure they are not damaged and changing the nets approximately every two years to avoid severe wear. This team should also remove the nets daily to ensure that no fish are trapped in the nets. If there are fish in the net, they must release them. This team must also collect the garbage that is on the network. The team must take care of the garbage that is filtered by this cleaning system, taking it to a collection area. In this way, you will prevent garbage from accumulating on the river bank.

Finally, the flow of the river will have to be taken into account since the devices used are plastic and if there is a very large flow they will suffer great wear in a short time. Once the river flow has been defined, it must be calculated how often the devices must be changed.

Using these methods and applying the specified improvements, a great improvement will be achieved in the rivers, extracting a large amount of waste and thus achieving cleaner rivers through a simple and effective method.

V. CONCLUSION

In conclusion, it can be said that, despite the amount of various residues in rivers, they can be cleaned with a simple but effective method such as River Oil, as long as it is optimized. In this work, the final method was chosen as the one that can be used in any river, even so, the use of the final method must be modified depending on the properties of the river in which it is going to be used (flow, width, geographical location, etc).

The chosen method will help to achieve the objective of cleaning the rivers and in this way will also contribute to cleaning the seas and oceans.

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