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Heavy Metal Protection for Plants Using Reusable Biopolymer Filters for Phytoremediation

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Introduction

In the near future, bioremediation using floating treatment wetlands/islands (FTW/I) will be used to clean over fertilized waters. The similar system might be used to treat heavy metal pollution. Heavy-metal-adsorbing filter sheets were made in a scalable manner in order to achieve this capability. In aqueous immersion baths, polyethyleneimine (PEI) and chitosan were combined to create polyamine-functionalized sheets, which were then examined for their ability to bind to heavy metals. The produced filter papers demonstrated significant heavy metal reduction in a filtration setting when compared to untreated cellulose [1].

One of the most important global problems is water contamination. The problem of river water contamination, particularly in Iran, is growing as a result of increased industrial and agricultural use. Some dam reservoirs, such as ZHAVE in the Iranian state of Kurdistan, have not been able to collect a sizable amount of water for the past ten years due to a huge number of sewer catchments. Water recycling and heavy metal contamination removal from runoffs are critical global issues that must be addressed. All kinds of contaminants are isolated and eliminated using a variety of techniques and criteria. This study focuses on the purification and elimination of toxins in water sources using the phytoremediation approach by adding a type of Vetiver grass in the case of floating treatment wetlands (FTW). The initial goal of this study is to look at a workable remedial remedy and improvement approach for the water quality of reservoirs and rivers using the expanding floating Vetiver islandmethod. The outcomes demonstrate a reduction in the following parameters, including COD by 97%, TN by 90%, phosphorus by 66%, TDS by 26%, and evapotranspiration by 40%. Therefore, we came to the conclusion that wastewater with varying neutrient concentrations, like that in the ZHAVE dam, could be controlled for the concentration of nutrients N and P, which allowed for the medium- and long-term inhibition and prevention of eutrophication of water resources due to a decrease in the rate of evaporation from reservoirs [2].

Description

The initial goal of this study is to look at a workable remedial remedy and improvement approach for the water quality of reservoirs and rivers using the expanding floating Vetiver islandmethod. The outcomes demonstrate a reduction in the following parameters, including COD by 97%, TN by 90%, phosphorus by 66%, TDS by 26%, and evapotranspiration by 40%. Therefore, we came to the conclusion that wastewater with varying neutrient concentrations, like that in the ZHAVE dam, could be controlled for the concentration of nutrients N and P, which allowed for the medium- and long-term inhibition and prevention of eutrophication of water resources due to a decrease in the rate of evaporation from reservoirs. A potential wastewater treatment technique for tropical developing nations is the floating treatment wetland (FTW), which requires access to land and high temperatures for biodegradation. These wetlands can handle a variety of wastewater types, including domestic, industrial, and aquaculture effluent. The prospect of utilising wastewater to irrigate agricultural regions has specifically been investigated through a number of practical investigations and various purification techniques. Plant-based water treatment techniques are efficient, affordable, and environmentally friendly. Choosing the proper plant is one of the most important aspects of using the phytoremediation process [3].

Ash and Truong claim that among all plants, Vetiver has the highest proportion of nitrogen and phosphorus elimination. In hydroponic environments, vetiver can remove 13,688 kg/ha of nitrogen annually, which is even six times better than potted settings and twelve times better than situations where it was grown in dry soil. In hydroponic conditions, it is also 6 times more effective than the other two media for removing nitrogen. Temperature, soil texture, soil moisture, and chemical characteristics including pH, salinity, and the concentration of heavy metals all affect plant growth. Nevertheless, this plant may thrive in challenging environmental conditions. Vetiver can survive a wide range of conditions however it is sensitive to a lack of light and cannot tolerate shadow. The plant returns to its original form and starts to develop and take root if the shade is removed, though. If the lack of light persists, the plant dries out and perishes. Vetiver develops fairly quickly. Its root system, which is branching and tangled and can penetrate several soil strata and weave them together, has a depth of 3 to 4 metres and a crown height of 1 to 2 metres. Wang conducted experiments on three varieties of vetiver plants with various genotypes and temperatures. According to the data, the Vetiver grows at the best rate between 25 and 35 degrees Celsius. According to research, at 25°C soil, the plant had the fastest root growth rate, at 4 cm per day. In other words, under ideal circumstances, the vetiver's root can grow to a length of 3 metres in just 75 days [4].

In the first container, there are 12 floating plants as well as diluted, nonaerated sewage. Twelve floating plants with diluted and aerated wastewater are contained in a second container, which also has an aeration pipe. The tube is positioned in a spiral five centimetres away from the bottom of the container. In order to thoroughly disturb the wastewater and carry out adsorption and treatment activities at a higher speed, holes in the surface of the pipe were drilled at intervals of 5 to 8 cm. twelve floating plants with concentrated wastewater and no aeration are contained in the third container. In order to have more strength and maintain its flotation on the water's surface while taking into account the weight of the plant, the floating surface was created of compressed ionolite with a 5 cm thickness and a 25 density. More than 99% of the water's surface was covered by an ionolithic plate that contained seedlings of the Vetiver plant with the same root and stem length [5].

Conclusion

The amount of water consumed in the samples of vetiver culture media is significant (total evaporation and transpiration). As a result of the increasing air pressure, the aerated container experiences the most evaporation. According to calculations, one square metre of free water surface evaporated about 48

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litres over the course of one week in September. The breakdown of phosphorus by microorganisms in treatment using plants is more than without plants, It should be emphasised that phosphorus can also be eliminated by chemical precipitation in addition to adsorption. We ultimately noticed a drop in total phosphorus in both containers over the course of a month during phosphorus-related tests. Anaerobic bacteria start to absorb and eliminate phosphorus in a container containing diluted, aerated wastewater, and the trend is a declining graph as shown in the image. Within 10 days, the phosphorus value can drop by up to 50%, and by the end of a month, the reduction has reached 66%. After a week in an anaerobic container, phosphorus values rise by 80% before falling, and at the end of a month, the total phosphorus rate is only 42%.

Acknowledgement

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Conflict of Interest

None.

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