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Evaluation Of Potential Of Azolla And Duckweed In Municipal Waste Water Treatment

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Abstract: This project evaluates the potential of two aquatic plants, azolla and duckweed, for municipal wastewater treatment. The study was conducted in a laboratory-scale experiment, in which both plants were grown in wastewater collected from a local municipal treatment plant. The growth rate, nutrient removal efficiency, and the biomass production of both plants were evaluated. The results showed that both azolla and duckweed were able to remove a significant amount of nutrients, including nitrogen and phosphorus, from the wastewater, with high removal efficiency. Both plants also demonstrated rapid growth rates and high biomass production. However, azolla showed a slightly higher nutrient removal efficiency and biomass production than duckweed. Overall, these findings suggest that both azolla and duckweed have great potential for use in municipal wastewater treatment systems, particularly in areas with limited land and resources for traditional wastewater treatment methods.

Index Terms – Phytoremediation, duckweeds, azolla, municipal, *Spirodela polyrhiza*, traditional, *Lemna minor*, Biological treatment, Nutrient removal

I. INTRODUCTION

As the global population continues to grow, the demand for water is increasing rapidly, and the pressure on water resources is becoming more intense. This has led to an increase in the generation of wastewater, particularly in urban areas, where the majority of the population resides. Municipal wastewater treatment is therefore essential to protect public health and the environment. Traditional wastewater treatment systems, such as activated sludge processes, require a large amount of land and resources, making them expensive to implement in densely populated areas.

In recent years, there has been growing interest in the use of aquatic plants, such as azolla and duckweed, for wastewater treatment. These plants are known to have high nutrient removal efficiencies and can be grown in shallow ponds or tanks, requiring less land and resources than traditional systems. Azolla and duckweed are both fast-growing aquatic plants that can thrive in a wide range of environmental conditions. Azolla is a floating fern that has been used for centuries in Asia as a bio fertilizer for rice paddies.

Duckweed, on the other hand, is a small floating plant that has been used for animal feed and wastewater treatment in various parts of the world. Despite their potential, there is limited research on the use of azolla and duckweed for municipal wastewater treatment. This project aims to evaluate the potential of these two aquatic plants for nutrient removal and biomass production in wastewater treatment. The results of this study could contribute to the development of more sustainable and cost-effective wastewater treatment systems in urban areas.

In recent years, there has been growing concern about the negative impacts of traditional wastewater treatment systems on the environment, such as the release of greenhouse gases and the generation of sludge. This has led to an increased interest in alternative wastewater treatment technologies that are more sustainable and environmentally friendly. Aquatic plants have been identified as one such alternative technology that could provide a sustainable and cost-effective solution for wastewater treatment.

Azolla and duckweed, in particular, have shown promise due to their ability to rapidly grow and efficiently remove nutrients from wastewater. If azolla and duckweed are found to be effective at removing nutrients from wastewater and producing biomass, they could be used to supplement or even replace traditional wastewater treatment systems, reducing the cost and environmental impact of wastewater treatment while also providing a valuable source of biomass for energy production.

MATERIALS AND METHODS

2.1 Sample and material collection

The municipal wastewater was collected from primary settling tank of Sewage Treatment Plant. The azolla and duckweed collected from one of the private agricultural farm.

Figure 1 Azolla and duckweed collected from farm

Two plastic container of size 0.0426 sqm was taken and made a hole in its side of the container. Then a pvc tap is attached to it which makes easy discharge of water after the treatment.

Figure 2 Apparatus which is made for project

2.2 Methods for treatment

The wastewater is collected from primary settling tank and then reaches the azolla/ duckweed pond and after the treatment process the water is collected to sump or well.

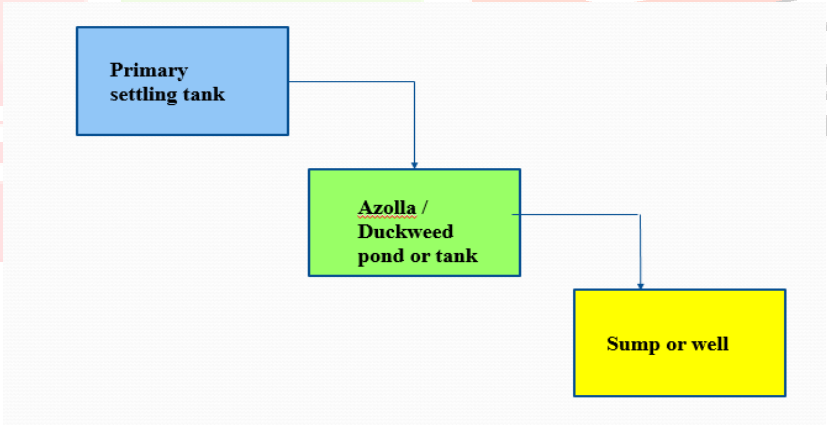

Figure 3 Methods or process

2.3 Growth process of azolla and duckweed

The growth process of azolla and duckweed from day 1 to day 12 studied here. On day 1 approximately 12 g of azolla and duckweed is taken and started the process. The growth increases from day to day. The azolla and duckweed plant implemented in wastewater carried apparatus and observed and noted the changes and the characteristics of the water.

The optimum growth of azolla/duckweed needs 12 days and after 12 th day it starts to decay and then the values started to rise. The factors like pH, BOD, COD, nitrate and phosphate is selected since the municipal wastewater contain that elements in more amount.

Figure 4 Growth process of azolla and duckweed in apparatus from day 1 to day 12

2.4 Characteristics of sample

The municipal wastewater sample was analyzed for pH, total dissolved solids (TDS), nitrate, phosphate, BOD, COD, and chloride. The various analytical methods used for analyzing the physicochemical parameters such as BOD, COD, pH etc. For the COD analysis the instrument used is the reflux apparatus and the method is reflux method. For the BOD analysis the BOD incubator is used as the instrument and the method is Winkler's method. For pH and TDS analysis the water quality analyzer is used as an instrument and the method is electrometric method. For the nitrate analysis the spectrophotometer instrument is used and the method is UV. For the phosphate analysis the UV visible spectrometer is the instrument used and the method is ascorbic acid method and for chloride the method used is argentometric method.

2.5 After use of azolla and duckweed

The zolla and duckweed after the treatment it can be used either for cattle feed in which it is a good for cattle's or either it can be used for bio fuel production. It can also be used as fertilizer or compost.

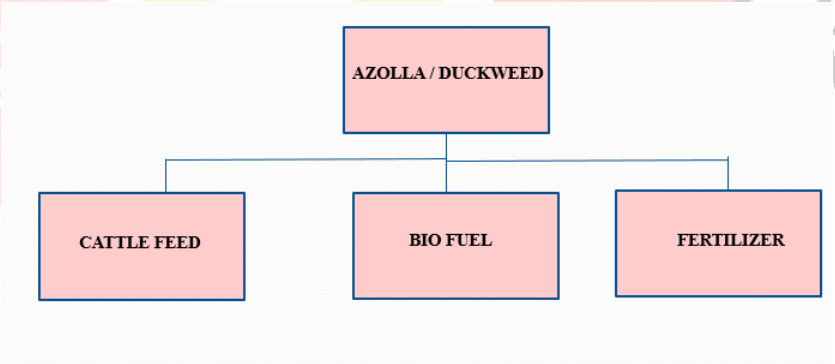

Figure 5 After use of azolla and duckweed

II. RESULTS AND DISCUSSIONS

The results for azolla and duckweed at day 12 is represented. At day 12 it reached the maximum removal efficiency under certain conditions and at day 15 test results give a higher value which indicates the decay of azolla and duckweed started. Hence, the day 12 is taken as optimum growth period for this experiment.

Table 1 Results of azolla implemented wastewater at day 12 (under certain conditions)

No:	Parameter	Initial value (mg/l)	Final value (mg/l)	Standard (Inland surface water)	Standard (Land for irrigation)
1	pH	7	6.2	6.5 – 9.0	6.5 – 9.0
2	Nitrate	34.45	8.82	10	-
3	Phosphate	29.10	4.18	5	-
4	BOD	780	26	30	100
5	COD	1280	200	250	-

Table 2 Results of duckweed implemented wastewater at day 12 (under certain conditions)

No:	Parameter	Initial value (mg/l)	Final value (mg/l)	Standard (Inland surface water)	Standard (Land for irrigation)
1	pH	7	6.3	6.5 – 9.0	6.5 – 9.0
2	Nitrate	34.45	9.1	10	-
3	Phosphate	29.10	4.3	5	-
4	BOD	780	28	30	100
5	COD	1280	230	250	-

It is observed that azolla performed a little bit higher than duckweed and the optimum growth is taken as 12 days for complete growth and after that starts to decay under the certain conditions.

III. CONCLUSIONS

The municipal wastewater if discharged to water bodies without the proper treatment will result in eutrophication. The use of azolla and duckweed for municipal wastewater treatment offers a promising solution to address the challenges of wastewater management. These two aquatic plants have been shown to effectively remove pollutants such as nitrogen, phosphorus, BOD, COD etc. from municipal wastewater, while also producing a valuable biomass that can be used as a source of renewable energy or as a fertilizer.

The use of azolla and duckweed in municipal wastewater treatment is not only cost-effective but also environmentally friendly, as it reduces the need for chemical treatment methods and minimizes the discharge of pollutants into the environment. Additionally, these plants have the potential to improve the overall water quality of the receiving water bodies. From the experimental results it is clearly proved that azolla have a little higher efficiency as compared to that of duckweed but only a slight variation is in between

the azolla and the duckweed.

The 12 th day results showed the higher removal efficiency and after 12 th day the azolla and duckweed started to degrade and hence the water started to pollute again. So, the optimum time period is 12 days. The results obtained so far are promising and suggest that this approach can be a viable alternative to conventional wastewater treatment methods.

Therefore, the use of azolla and duckweed should be considered as a potential solution for sustainable wastewater management in municipalities.

IV. ACKNOWLEDGMENT

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