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Wastewater Treatment Using Lemna Minor

Chidambara Das, Geena Susan Abraham, Jerril Joseph Biju, Chris Merin Varghese

U G Students, Department of Civil Engineering, St Thomas College of Engineering and Technology Kozhuvallloor,
Chengannur, Kerala, India

Assistant Professor, Department of Civil Engineering, St Thomas College of Engineering and Technology
Kozhuvallloor, Chengannur, Kerala, India

ABSTRACT: Water body can be contaminated when it is exposed to high volume of wastewater and high concentration of contaminants. It is necessary to treat effluent before discharging into waterbody, also to treat the wastewater sustainably. Phytoremediation potential of Lemna minor was studied for a period of 14 days to investigate the removal of pollutants in surface water with a special reference to heavy metals lead and cadmium. Sample water was collected from Sasthamkotta lake. The characteristics of wastewater before phytoremediation was analyzed and noted as initial value. After that the sample was treated with Lemna minor for 14 days and the physico chemical characteristics were analyzed at 7th and 14th day. The study showed that treatment with Lemna minor provides good removal efficiency of pollutants. The main aim of this wastewater treatment is to produce an effluent that minimal additional controls are needed to manage any human health, agricultural and environmental risks. Lemna minor waste water treatment provides genuine solutions for these problems.

KEYWORDS: Phytoremediation, Lemna minor, Physico chemical parameters

I. INTRODUCTION

Water is an essential element of life. Providing clean and pure water is the base of development of a country. In today's world where the development, industrialization, colonization all lead to the vast majority of pollution, water is being affected drastically. There are so many pollutants present in wastewater that are harmful for human health and the environment. Common sources of waste water effluents are from industries, houseboats, domestic wastes, commercial wastes, medical wastes, mining, E wastes etc. Some of the wastes increase the presence of heavy metals in water. Cadmium, mercury, lead and arsenic which are in WHO's list of 10 substances of important public concern, are particularly susceptible to heavy metal poisoning. Heavy metals can bind to and disrupt the function of critical biological components. These heavy metals can be commonly found in mining, industrial wastes, automobile wastes, lead batteries, fertilizers, paints, and other products. Entrance of those heavy metals in the body of humans lead to different health problems such as cancer, kidney problems, nausea and high blood pressure in general. Health problems will bring for the healthy person as they are carcinogenic in small concentrations. Leachate from landfill through the water flow is gradually affecting the groundwater particularly that of Pb and Cd that is extremely high. Hazardous heavy metal pollution of waste water is one of the most important environmental problems throughout the world, to meet the increased more stringent environmental regulations a wide range of treatment technologies such as chemical precipitation, coagulation, flocculation, floatation, ion exchange and membrane filtration have been developed for heavy metal removal from wastewater. They require high cost and non eco friendly, as well as conventional method of disinfecting water are economically infeasible and also people reluctant to use chemicals as disinfectants. But treatment using Lemna minor and disinfection methods are cost effective and eco friendly for sustainable development and water can be used for domestic purposes like cleaning, flushing etc. The main objective of this treatment method is to determine the efficiency of Lemna minor to absorb heavy metals, and to convert the polluted lake water to domestic usable water.

II. RELATED WORK

Parthiban I, Porchelvan P, Ramasamy T and Shyamala gowri studied the coagulation, flocculation, sedimentation and cleansing methodology utilizing neem and tulsi seed as an Eco accommodating characteristic coagulant and disinfectant water. S Vanitha, NVN Nampoothiri, C Sivapragasam, Anitha Menon studied an experimental study on Lemna minor (duckweed) for improving pond water quality. From the experimental studies conducted it was understood that the Lemna minor plant can efficiently remove 75% phosphate from pond water. Akbarsha Manaf, Bhavana R M

,Haritha R, Sruthy A P and Suja S Nair cited the characteristics of lemna minor (duckweed) and its effect on wastewater treatment. They clearly state that treatment using lemna minor is cost effective and eco friendly

III. METHODOLOGY

3.1 Study area

Sasthamkotta region of Sasthamkotta lake in the Kollam district of kerala was selected for the study. Sasthamkotta lake is known as freshwater lake. This area is selected because this lake is a source of drinking water over more than 5 lakh people in kollam district. The water and environmental pollution has put the biggest fresh water lake in kerala at risk. According to wetland conservation and management rules the water bodies listed under Ramsar convention centre are not to be polluted, but in case of Sasthamkotta lake various Governmental, private bodies and people living closely to the lake have been polluting and encroaching the lake. Water sample was collected from a depth of 30cm from the surface in lake region and poured to the bottle without making bubbles.

3.1 Material used

Lemna minor (Duckweed): They are small floating aquatic plants found worldwide and often seen growing in thick, blanket-like mats on still or slow moving, nutrient-rich fresh or brackish waters. Duckweed species are adapted to a wide variety of geographic and climatic zones. Duckweeds grow at water temperatures between 6 and 33°C. A duckweed leaf is flat and ovoid. Many species have adventitious roots which function as a stability organ and which tend to lengthen as mineral nutrients in water are exhausted. For this study a sufficient amount of lemna minor was collected and farmed.



Fig.3.1 Lemna Minor

3.2 Procedure adopted:

Collected water sample was initially analyzed for parameters such as pH, Dissolved oxygen, Chlorides, BOD and COD. Concentration of lead and cadmium on the water sample was also analyzed using Atomic Absorption Spectroscopy.

Plastic tubs of round shape of 8 liter capacity were used for the experimental setup. Plastic tubs were properly washed and dried with tissue. All the tubs were filled with the waste water. Lemna minor (duckweed) was collected from our nearby aquarium and washed with distilled water to avoid any contamination. Duckweed was applied over the water sample (8 liter each). Amount of duckweed is based on the water surface area. Samples were taken after 7 and 14 days separately and analyzed for pH, BOD, Dissolved oxygen, Chlorides, COD, concentration of lead and cadmium.



IV. EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Characteristics of water sample collected

The water sample was analyzed for pH, Chlorides, COD, BOD, Lead and Cadmium before treatment and the observed result were tabulated in Table 4.1

Table.4.1 Water sample parameters before treatment

Sl.No	Parameters	Observed value
1	pH	6.72
2	Chlorides	438mg/l
3	Dissolved Oxygen	2 mg/l
4	BOD	6.9 mg/l
5	COD	20.12 mg/l
6	Lead	0.483 mg/l
7	Cadmium	0.04 mg/l

4.2 Analysis of water sample after duckweed treatment

Water parameters were assessed after 7 and 14 days of treatment. The level of pollution of water was found out by determining DO (Dissolved Oxygen), BOD (Biological Oxygen Demand) , COD (Chemical Oxygen Demand) and amount of Heavy metals like Lead & Cadmium .The observed values of different parameters after duckweed treatment is given below.

Table 4.2 Water sample parameters after treatment

Sl.No	Parameters	Obtained value after 7 days	Obtained value after 14 days
1	pH	7.03	7.21
2	Chlorides	261 mg/l	183mg/l
3	Dissolved oxygen	5mg/l	7.1mg/l
4	BOD	5.7mg/l	4.7mg/l
5	COD	14.01mg/l	7.92mg/l
6	Lead	0.275mg/l	0.009mg/l
7	Cadmium	0.03mg/l	0.002mg/l

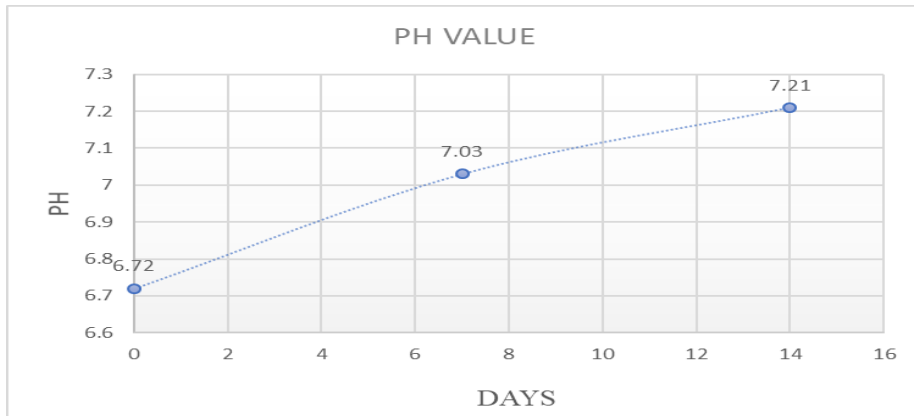


Fig 4.1 Analysis of pH

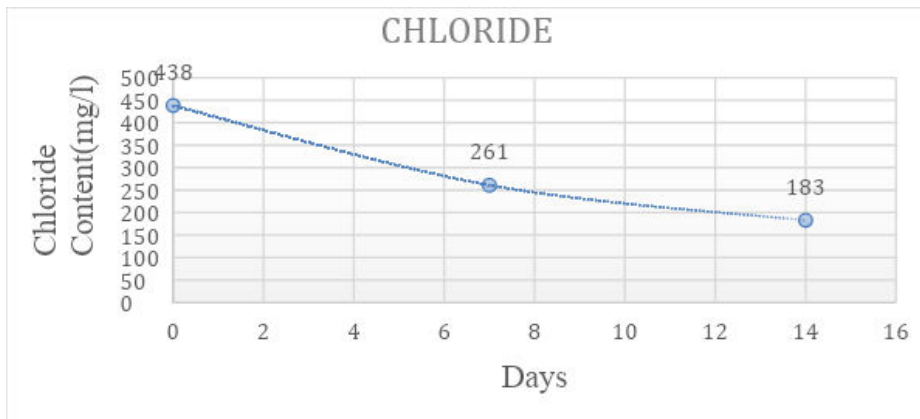


Fig 4.2 Analysis of Chlorides

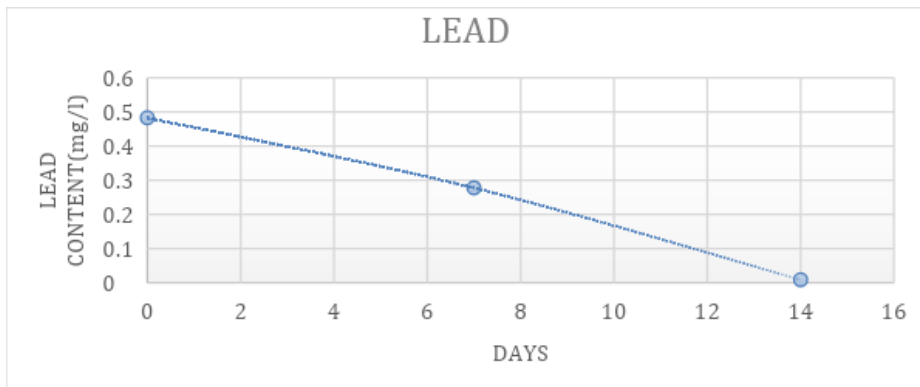


Fig 4.3 Analysis of Lead Concentration

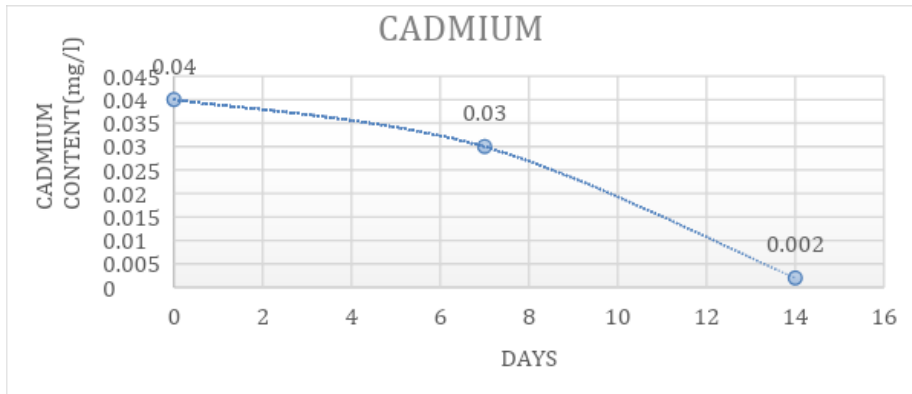


Fig 4.4 Analysis of Cadmium Concentration

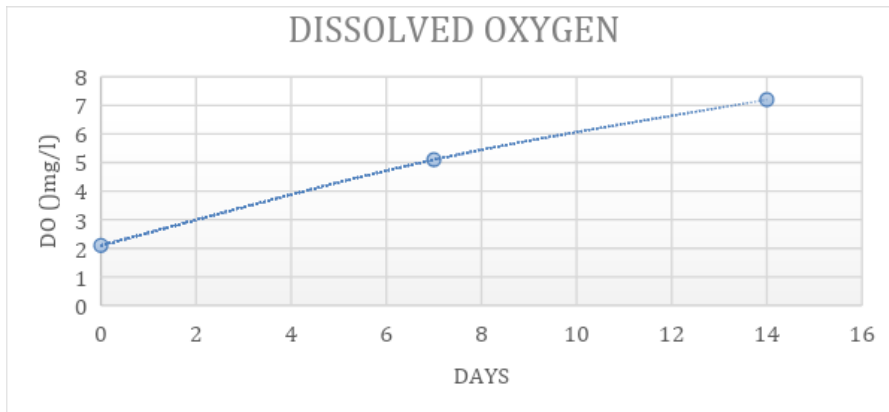


Fig 4.5 Analysis of Dissolved Oxygen

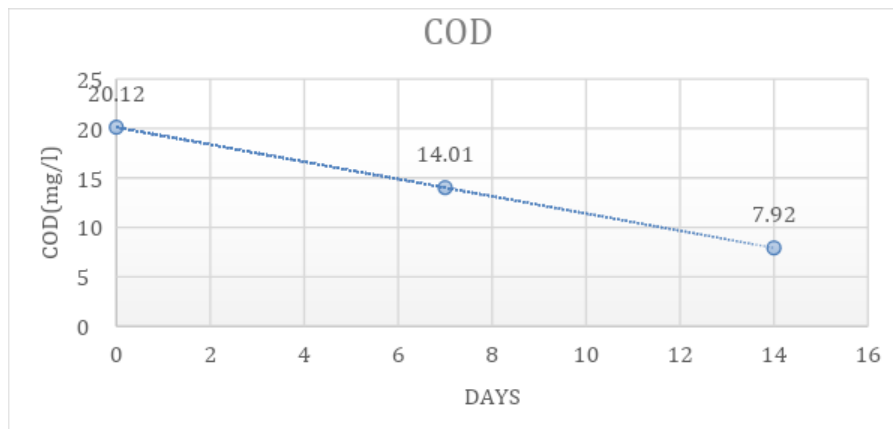


Fig 4.6 Analysis of Chemical Oxygen Demand

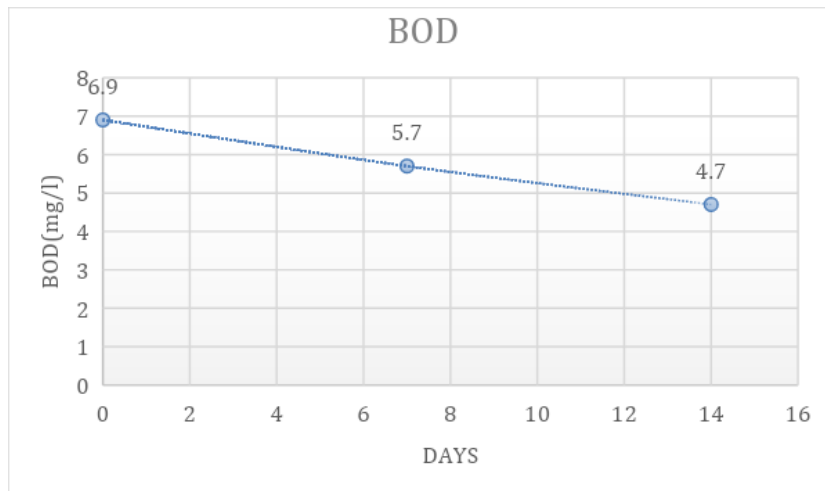


Fig 4.7 Analysis of Biological Oxygen Demand

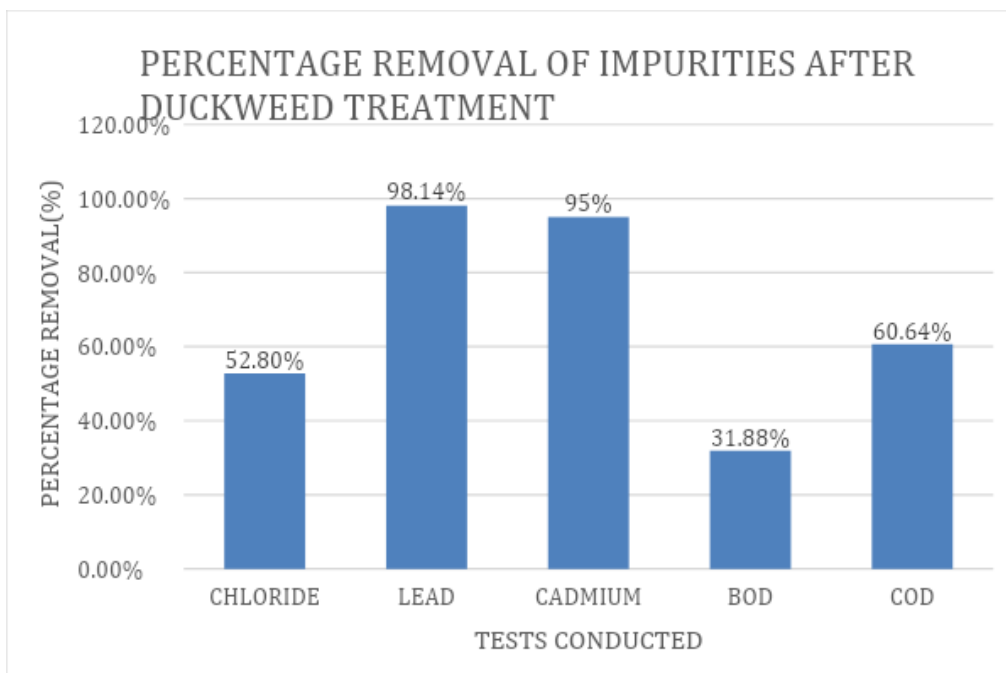


Fig 4.8 Percentage Removal of Impurities after duckweed Treatment

V. CONCLUSION

The water pollution of the Sasthamkotta lake is due the effluents from domestic and industrial sewage into the lake. As a result, the water is highly polluted, so this water is not fit for domestic needs. The poor quality of the water can cause adverse environmental problems. Common Duckweed (lemna minor) can be used to lower the amount of heavy metals like Lead and Cadmium. It has the property to reduce levels of COD (Chemical Oxygen Demand), BOD (Biological Oxygen Demand), Chloride content and to improve DO level (Dissolved Oxygen). From the results of study it was found that the Duckweeds have the ability to decrease the levels of Chloride by 52.795% , Lead by 98.136% , Cadmium by 95% , COD level by 60.636% ,BOD level 31.884% and increase of DO by 70.83% . This shows the phytoremediation potential of duckweed.

Table 5.1 Comparison of permissible limits and obtained values

Parameters	Permissible Limits	Obtained value
pH	6.5-7.5	7.21
Chlorides	250 mg/l	183 mg/l
Dissolved Oxygen	4-8 mg/l	7.2 mg/l
BOD	1-2ppm (very good),3-5ppm (medium clean),6-9ppm(organic matter),above 10ppm (very polluted)	4.7 mg/l
COD	10 ppm	7.92 mg/l
Lead	0.015 mg(0.010 mg or less safe)	0.009mg/l
Cadmium	0.005 mg	0.002mg/l

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