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PHYTOREMEDIATION OF TEXTILE EFFLUENT BY *AZOLLA* HYBRID

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ABSTRACT

Phytoremediation is one of the biological wastewater treatment methods and it is based on the concept of using plant based systems and microbiological processes to eliminate contaminants from natural system naturally. The aquatic fern *Azolla*, a small-leaf floating plant that lives in symbiosis with a nitrogen fixing cyanobacteria (Anabaena), is an outstanding plant, thanks to its high biomass productivity along with its tremendous rate per unit area for nitrogen-fixation. This study involved a laboratory experiment on the use of *Azolla* hybrid in the phytoremediation of a textile waste water from Tirupur textile industry. The physiochemical characteristics of the waste water were determined before and after the treatment. The experiment lasted for four weeks and the rate of reduction was recorded. *Azolla* is gaining much importance. Various parameters like Biological oxygen demand (BOD), Chemical oxygen demand (COD), Nitrate, Sulphate and Phosphate were observed after the treatment. Other physiochemical parameters tested include Total Dissolved Solids (TDS), Total suspended Solids (TSS) and the pH. It is a cost effective method and the method is Eco friendly. The treated water can be used for irrigation purpose.

KEYWORDS

Azolla, Phytoremediation and Reduction of parameter.

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INTRODUCTION

Textile industries are major sources of this water pollution due to the nature of their operations which requires high volume of water that eventually results in high waste water generation. Phytoremediation is one of the biological wastewater treatment methods and it is based on the concept of using plant based systems and microbiological processes to eliminate contaminants from natural system naturally. Waste

water treatment is the process of treating waste water from different industries and making it suitable for discharging it in to the environment without any causative agents. Waste water treatment may be of three types- Physical, Chemical and biological. Using living organisms and plants for treatment of waste water is categorized as biological treatment process. Aquatic plants like *Azolla* have drawn more attention because of its rapid growth even in the polluted water and its capability to remove varieties of pollutants from domestic and industrial effluents. (Gjizen and Kondker, *et al*, 1997, Ugya *et al*, 2015b[1]).

The genus *Azolla* belongs to the single genus family *Azollaceae*. The aquatic fern *Azolla*, a small-leaf floating plant that lives in symbiosis with a nitrogen fixing cyanobacteria (Anabaena), is an outstanding plant, thanks to its high biomass productivity along with its tremendous rate per unit area for nitrogen-fixation. The present study investigates the potential growth of *Azolla* in textile effluent for removal of COD, phosphate and nitrate. *Azolla* is a good bioremediation and can be used for the treatment of waste water such as industrial effluents, sewage water etc. and it is eco-friendly and effective. The use of aquatic *Azolla* with hyper accumulating ability is known to be an environmentally friendly option to restore polluted aquatic resources. The present review highlights the phytoaccumulation potential of macrophytes with emphasis on utilization of *Azolla* as a promising candidate for phytoremediation. (Golzary A, Tavakoli O, Rezaei Y and Karbassi A R, *et al*, 2017[2]).

The quality of textile dyeing effluent by analyze the physico-chemical parameters such as colour, pH, total hardness, biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), turbidity, chlorides, sulphides, silica, calcium, iron, oil and grease of the effluent. (Lav Varma and Jyoti Sharma *et al*, 2010[3]).

MATERIAL AND METHODS

Site selection and preparations

The site for the project is selected in our college laboratory itself. The project must carry in four different trays. Each of trays must have the capacity to carry more than 20 litres. Trays are selected in the size of 345x245x80mm. The trays must be created in a place such that it should not have high temperature so the place for the project work is selected in a shadow place. The high temperature can causes damages to the *Azolla*. And also the high temperature can cause the easy vaporization of the textile effluent. *Azolla* is a type of algae and it must have a permissible limit of temperature for its growing. It cannot tolerate high level of temperature. When high temperature acts on it its leaf will be dying and it will make the water more polluted so the selected place should not have high temperature.

The selected site is first cleaned to place the trays. After that four trays having same size are selected. This is because of the cost analysis. Also we stated in the introduction that we are looking forward to a cost effective method. Hence we selected the trays by avoiding the other kind of tank preparations. As we considering the naturally growing plants for the test, it is necessary provide all the growing facilities. As we selected the *Azolla* algae for the test procedure, it is necessary to find out its growing temperature and other needs.

COLLECTION OF MATERIALS

Collection of materials includes the collection of normal tap water, textile effluent and the collection of *Azolla*.

Sample collection

The normal tap water was collected from our college campus itself.

The textile industry effluent was collected from the tirupur textile industry before it reached the effluent collection tank. The textile industry effluent was dark blue with pungent odour.

The *Azolla* were collected from The Tamil Nadu Agricultural University (TNAU), Coimbatore.

The water is collected in wide level because the test should carry in each four trays. One tray should at least contains 5 litres. 150gram of *Azolla* is collected and it is placed in a tray having tap water collected from the college. This is for the primary growth of *Azolla* and to use in other trays. Red soil is mainly used for the growth of *Azolla.* In the trays we should

add some phosphorus and cow dung for the better growth of the *Azolla*. *Azolla* have the ability to capture the water phosphorus for its growth and also the cow dung will help for its fast growing. It is a good nutrient for the growth of *Azolla*. As it having a deep root, it is able to catch all the nutrients from its surrounding water level.

PHYTOREMEDIATION

The trays should be separated into two sets with two trays for each sets. One set should be used as a control containing tap water. Other set should be used as a sample containing textile effluent. Each trays should be filled with 1/4th of the soil. Five litres of tap water should be filled in first two trays. Other two trays should be filled with five litres of textile effluent. Cow dung and super phosphate should be added in limited amount for the better yield of *Azolla.* Neem cake can be used to act as fungicide. The contents should be mixed to form as slurry. Then weigh the *Azolla* into 150g for each trays. Make the *Azolla* to float above the slurry.

The growth of the *Azolla* algae is observed in the day 15 and day 30. The rate of growth of the *Azolla* in the first 15 days is faster than the other 15 days. The continuous observation and the weight measurement of the *Azolla* are noted. It absorbs the nutrients from the water in a high rate and grown. After certain limit its growth rate began to reduce. That we observed from the weight calculation. The reason for this type of reduction in growth is the insufficient nutrients in the water medium.

Azolla completely absorbed all the nutrients that are added to the water such as the phosphorus and the cow dung. Also the water medium is pure, hence the availability of the nutrients in the medium for the growth of *Azolla* comparatively less. This study helps us to find out the availability of nutrients for the growth of *Azolla*.

EFFLUENT ANALYSIS BEFORE AND AFTER TREATMENT OF PLANTS

Laboratory tests were performed in order to examine the efficiency of using *Azolla* to treat the textile effluent. All physico- chemical analyses for pH, COD, BOD, Nitrate, TSS, TDS, DO, Alkalinity, Acidity, Turbidity, Hardness, Sulphate, chlorides were performed to standard Methods. The plant growth rate and yield were monitored after the experiment in each trays.

RESULTS

The water sample in the trays is periodically taken for water testing to identify the reduction in the water parameters. The test taken on both initial and 30th day. The biomass concentration of *Azolla* was measured during the interval of 15 days. The full growth of the *Azolla* is completed in 30 days.

Biomass concentration

S.No	Time period (days)	Total biomass (control)	Total biomass (sample)
1	Day 1	150g	150g
2	Day 15	320g	360g
3	Day 30	530g	620g

Table No.1: Analysis of physico-chemical parameters

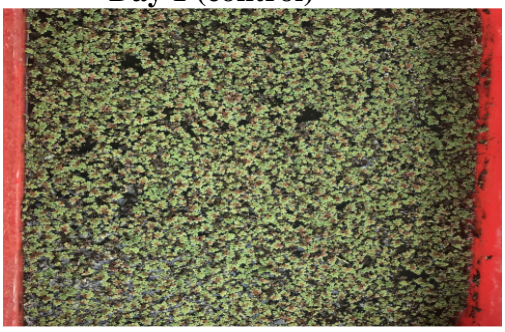
S.No	Parameters	Before treatment with *Azolla*	After treatment with *Azolla*	% Reduction
1	BOD (control)	0.48mg/L	0.24mg/L	50% reduction
2	BOD (sample)	24mg/L	20mg/L	16% reduction
3	COD (control)	0.08mg/L	0.048mg/L	40% reduction
4	COD (sample)	0.24mg/L	0.19mg/L	20% reduction

Table No.2: Physio-chemical parameters

S.No	Parameters	Control	Sample	Water for irrigation (IS: 2296)	Comments
1	pH	7.6	7.4	5.5 – 9	Within the limit
2	EC (mS/cm)	2.79	2.53	2.25mS/cm	Over the limit
3	TDS (mg/L)	1289	1128	2100 mg/l	Within the limit
4	Sulphate	265	215	1000mg/l	Within the limit
5	Chlorides	418	365	600mg/l	Within the limit
6	Nitrate	4.1	3.8	-	-
7	T. Hardness	670	595	-	-
8	TSS (mg/L)	176	184	200mg/l	Within the limit
9	Fluorides	0.43	0	-	-
10	Turbidity	46	6	-	-
11	Acidity (mg/L)	10	6	-	-
12	Alkalinity (mg/L)	14	10	-	-

Day 1 (control)

Day 30 (control)



Day 1 (sample)

Day 30 (sample)

GRAPHICAL REPRESENTATION

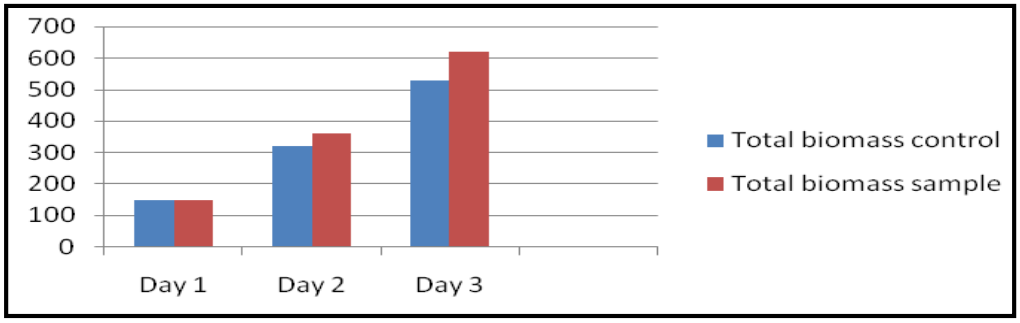


Figure No.1: Biomass concentration

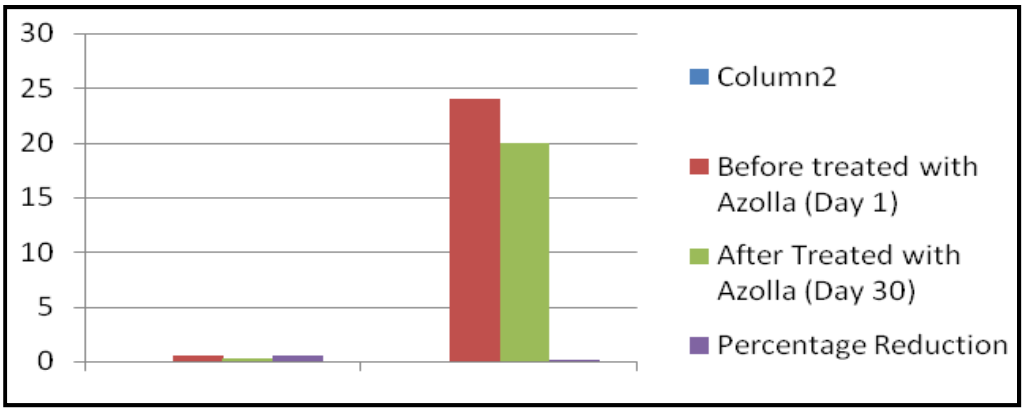
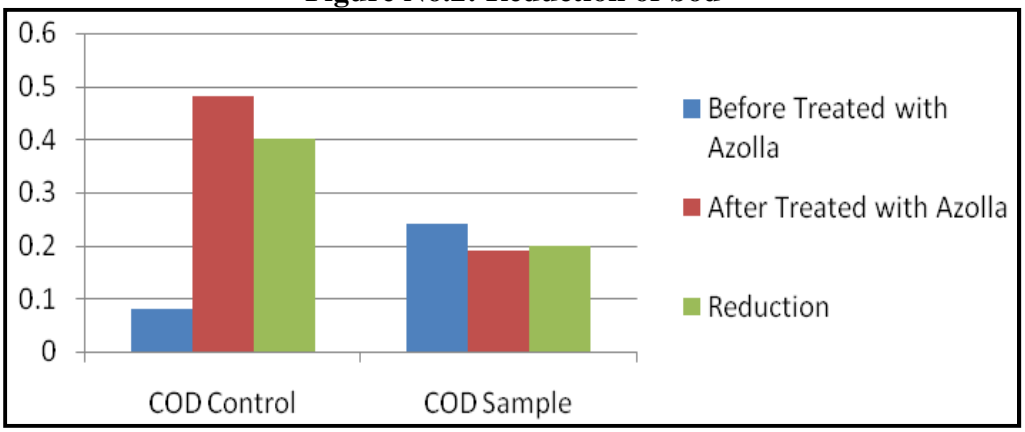
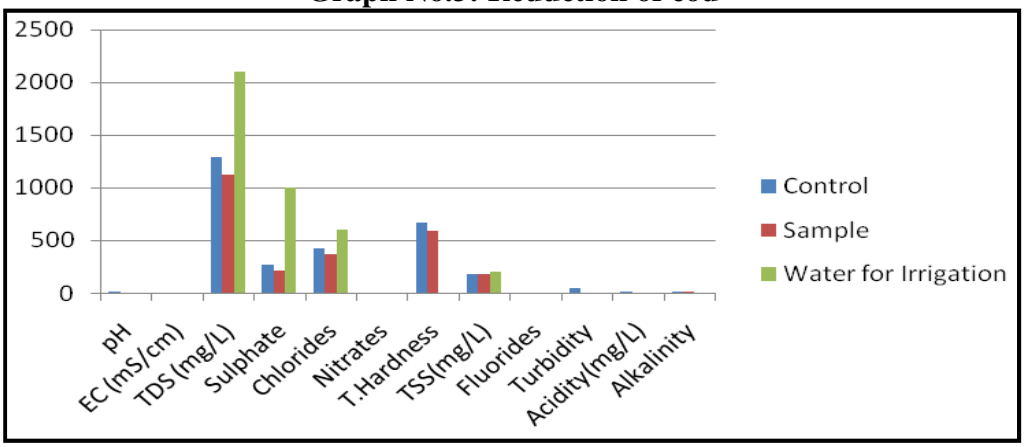


Figure No.2: Reduction of bod



Graph No.3: Reduction of cod



Graph No.4: Physio-chemical parameters reduction

CONCLUSION

From the above observation it can be concluded that the naturally growing aquatic fern *Azolla* is a good method for waste water treatment. *Azolla* has the ability to reduce all the impurities in the water by consuming it for their growth. The growth of *Azolla* has also been increased in textile effluent. The wastewater treatment processes employing *Azolla* are advantageous over chemical methods, as they are eco-friendly and effective. As a result it is identified that naturally growing aquatic plants like *Azolla* are a good method for phytoremediation of textile effluent and it is a cost effective method. It can be easily carried out and the water can be purified at a good rate.

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CONFLICT OF INTEREST

We declare that we have no Conflict of interest.

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