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HORIZONTAL FLOW CONSTRUCTED WETLAND AND MACROPHYTES FOR WASTE WATER TREATMENT

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Abstract – *Water plays a major role in the life of living things. We can survive up to many days without food, but only few days without water. But the water is polluted by various ways and increase generation of waste water like domestic waste water polluted river water and industrial waste waters. So for future need treatment of waste water is must. The horizontal flow constructed wetland is an artificial wetland for waste water treatment. It uses natural functions only. And macrophytes are living plants which absorb maximum contaminants from waste water. This study aims to find the ability of constructed wetland with macrophytes Eichornia Crassipess and Nymphae for river water and dairy waste water treatment. And analyse water quality parameters. The BOD shows a higher removal in this treatment of waste water with Eichornia Crassipess.*

Key Words: **River water, Dairy waste water, Constructed wetland, Eichornia Crassipess, Nymphaea**

1. INTRODUCTION

Water is one of the important resources which are very important to the life of mankind. One cannot assume the life of living beings including both plants and animals without water. But as population increases, need for water also getting increased in random manner. When this necessity increased beyond the limits or when there is no other option than using the available water, people starts using either partially or fully treated water [2]. Avariety of pollution sources in river water or in the plants of aquatic ecosystem [4]. Concentrations of contaminants in dairy waste water are significantly higher than municipal effluent, and tend to vary throughout the year [1].

In this project, Constructed wetland using horizontal subsurface flow is studied. River water and dairy waste water are treated in constructed wetland planted with aquatic plants Eichornia Crassipess and Nymphaea. Waste waters contain a number of pollutants and contaminants including plant nutrients, Pathogenic microorganisms, heavy metals, organic pollutants and biodegradable organics. All of health and environmental problems and can have economic or financial impacts when improperly or untreated waste water is released in to the environment; nutrient contamination and microbial water quality issues are considered [3].

This study aims to treat the river water and dairy waste water with each macrophytes separately in horizontal flow constructed wetland and find the ability of wetland and macrophytes efficiency in waste water treatment.

1.1 Objectives of the Study

- To study the feasibility of a wetland for waste water treatment.
- To propose a constructed wetland design for treating and reusing waste water.
- To evaluate the pollutant removal efficiency in the proposed constructed wetland system.
- To evaluate the efficiency of macrophytes in the waste water treatment.
- To promote sustainable management of natural resources.

2. METHODOLOGY

The proposed methodology for finding the benefits while using macrophytes Eichornia Crassipess and Nymphaea in constructed wetland for the treatment of waste waters are;

2.1 Wetland Construction

Here we constructing horizontal flow constructed wetland with following operational parameters.

Table -1: Wetland Construction Details

Operational parameters	Characteristics
Type of wetland	Horizontal flow type
Filter media	Gravel, M-sand
Macrophytes	Eichornia Crassipess, Nymphaea
Bed dimension	0.7m*0.3m
Bed depth	0.45m
Sub surface area	0.21 m^2
Hydraulic retention time	2, 4, 6 days
Amount of water	40 litres

Place the constructed wetland basin with the size of 0.7m*0.3m in above the concrete block. Then provide an outlet connection between gravel and sand layer. The next step is to provide layers in the basin. First layer will be gravel of 20mm size at a height of 50mm and M-sand of size 10mm at a height of 100mm.

Fig -1: Construction of Wetland

2.2 Collection of Macrophytes

The macrophytes used in this study for the treatment of river water and dairy waste water are Eichornia Crassipess and Nymphaea. Both are available in nearby areas and the both macrophytes will be collected from kotooli wetland, Kozhikode. The macrophytes are collected carefully with roots.

2.3 Collection of Sample

The river water collected from Chaliyar River. The banks of the river are polluted by domestic activities. Collected the water sample from Feroke and stored this sample in a container at proper temperature. Dairy waste water is the waste water which is generated from dairy industry after processing milk in to various products. Sample should be collected from dairy industry, Kozhikode.

Fig -2: Chaliyar River

2.4 Setup of an Artificially Constructed Wetland

The wetland of capacity to hold 40 litres/day were designed and it is planted with the vegetation Eichornia Crassipess and Nymphaea separately. Proper outlet arrangement is done for the collection of effluent. Introduce the river water and dairy waste water to the wetland and treat. The figure 1 shows the artificial wetland with Eichornia Crassipess and Nymphaea.

Fig – 3: Wetland planted with Nymphaea on the wetland

Fig – 4: Wetland planted with Eichornia Crassipess

2.5 Experimental Setup

The raw water samples will be collected and treated with both macrophytes . Before the treatment test the parameters pH, turbidity, conductivity, TDS, BOD, COD, nitrate and chloride. The water samples after testing should be treated in hydraulic retention time of 2, 4 and 6 days. First of all by using Eichornia both waste waters are treated. Then by using Nymphaea the river water and dairy waste water is treated. After the treatment tested the same parameters. Also removal efficiency was calculated as the percentage removal for each parameter.

3. RESULTS AND DISCUSSION

This section deals with the results and discussion showing promising results of treatment of river water and dairy waste water using Eichornia Crassipess and Nymphaea.

Table – 1: Initial characteristics of two waste waters

Parameters	Values obtained	
	River Water	Dairy waste water
pH	7.38	6.85
Turbidity	10.3 NTU	280 NTU
Conductivity	286 µs/cm	1961 µs/cm
TDS	208 µs/cm	691 µs/cm

Nitrate	14 mg/l	159 mg/l
Chloride	60 mg/l	834 mg/l
COD	72 mg/l	3230 mg/l
BOD	42 mg/l	1770 mg/l

3.1 Treatment of River water

The river water was treated in wetland with both Eichornia Crassipess and Nymphaea in 2, 4 and 6 days. The results are given in the table given below.

Table – 2: Characteristics of River water after treatment with Eichornia Crassipess

Prameters	Values obtained (days)		
	2	4	6
pH	7.12	7.10	7.03
Turbidity (NTU)	5.9	3.6	1.5
Conductivity (µs/cm)	252	198	147
TDS (µs/cm)	151	128	95
Nitrate (mg/l)	3.88	2.26	2.08
Chloride (mg/l)	43	33	19
COD (mg/l)	51	30	11
BOD (mg/l)	16.3	9.8	2.2

All parameters show considerable reduction. The best result was after 6 days. The better removal takes place in the BOD removal. And also turbidity and COD of the river water is removed from the river water.

Table – 3: Characteristics of River water after treatment with Nymphaea

Parameters	Values obtained (days)		
	2	4	6
pH	7.28	6.93	6.79
Turbidity (NTU)	7.2	4.3	2.3
Conductivity (µs/cm)	272	213	147
TDS (µs/cm)	178	139	96
Nitrate (mg/l)	4.53	2.66	2.47
Chloride (mg/l)	60	46	28
COD (mg/l)	54	36	14
BOD (mg/l)	28.5	11.2	3.8

Here also all parameters show considerable reduction. The better removal occurs after 6 days. In this treatment after 6th day BOD, COD and turbidity and nitrate is removed more.

3.2 Treatment of Dairy waste water

The dairy waste water was treated in wetland with both Eichornia Crassipess and Nymphaea in 2, 4 and 6 days. The results are given in the table given below.

Table – 4: Characteristics of dairy waste water after treatment with Eichornia crassipess

Parameters	Values obtained (days)		
	2	4	6
pH	6.77	6.63	6.49
Turbidity (NTU)	100	80	45
Conductivity (µs/cm)	1147	1040	642
TDS (µs/cm)	942	728	442
Nitrate (mg/l)	53	41	20
Chloride (mg/l)	638	392	245
COD (mg/l)	1873	1356	987
BOD (mg/l)	567	376	239

All parameters show considerable reduction. The best result was after 6 days. After treatment the parameters like turbidity, nitrate, chloride and BOD of the dairy waste water is decreased.

The dairy waste water then treated with Nymphaea on the wetland after 2, 4 and 6 days and tested. The values are given in the table 5.

Table – 5: Characteristics of dairy waste water after treatment with Nympheae

Parameters	Values obtained (days)		
	2	4	6
pH	6.89	6.73	6.70
Turbidity (NTU)	130	110	50
Conductivity (µs/cm)	1610	1332	922
TDS (µs/cm)	1127	912	633
Nitrate (mg/l)	68	53	35
Chloride (mg/l)	821	511	339
COD (mg/l)	2311	1628	1352
BOD (mg/l)	722	446	370

Here also all parameters show considerable reduction. The better removal occurs after 6 days.

From these It was clear that Eichornia Crassipess was remove the contaminants efficiently from the waste waters. And also the better removal occurs after 6th day.

3.3 Removal Efficiency of treated River water

Table 6 shows the removal efficiency of river water after treatment with Eichornia Crassipess.

Table -6: Removal efficiency of treated River water

Parameters	Removal Efficiency (%)		
	2	4	6
Turbidity	42.71	65.04	85.43
Conductivity	11.88	30.76	48.60
TDS	27.40	38.46	54.32
Nitrate	72.28	83.85	85.14
Chloride	36.76	51.47	72.05
COD	29.16	58.33	84.72
BOD	61.19	76.66	94.76

The table shows the removal efficiency of the Eichornia river water. In the river water macrophytes are efficient. From this it is clear that Eichornia Crassipess is good for the treatment of waste water. And the better removal was taken place for BOD, COD, Nitrate, and turbidity. And these all parameters are above 50% after 6 days treatment.

3.3 Removal Efficiency of treated Dairy waste water

Table 7 shows the removal efficiency of dairy waste water after treatment with Eichornia Crassipess.

Table -7: Removal efficiency of treated dairy waste water

Parameters	Removal Efficiency (%)		
	2	4	6
Turbidity	64.28	71.42	83.92
Conductivity	41.50	46.96	67.26
TDS	-36.32	-5.35	36.03
Nitrate	66.66	74.21	87.42
Chloride	23.50	52.99	70.6
COD	42	58	69.44
BOD	67.9	78.7	86.4

From the table, the Eichornia was purify dairy waste water by removing the contaminants like turbidity, Nitrate, chloride, COD and BOD efficiently.

After that draw removal efficiency graph of all parameters of the river water and dairy waste water with Eichornia and Nymphaea.

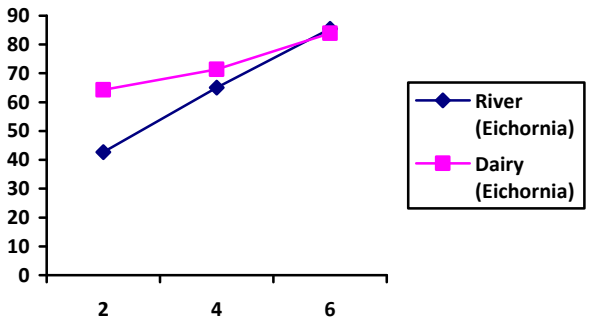

Chart -1: Removal efficiency of turbidity after treatment with Eichornia

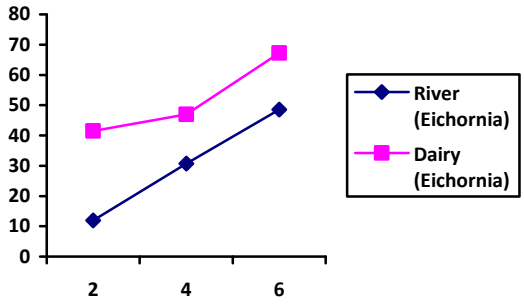

Chart -2: Removal efficiency of Conductivity after treatment with Eichornia

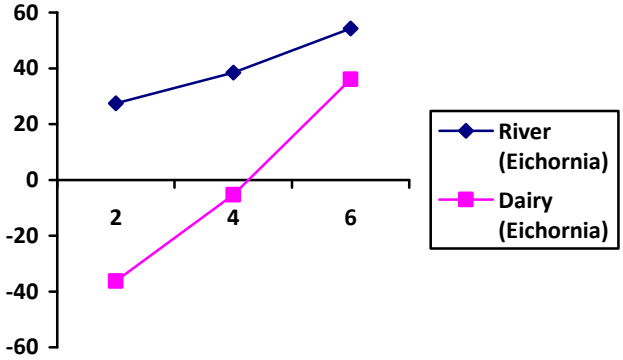

Chart -3: Removal Efficiency of TDS after treatment with Eichornia

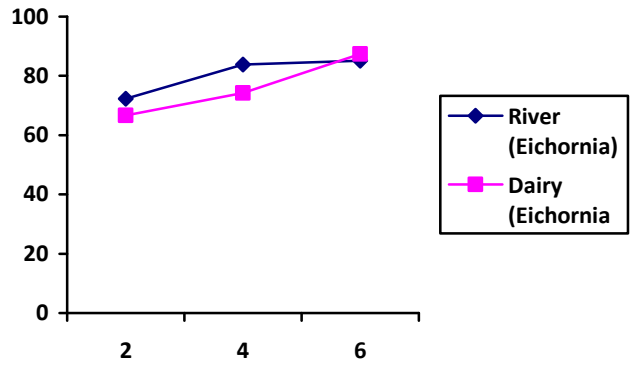

Chart -4: Removal efficiency of Nitrate after treatment with Eichornia

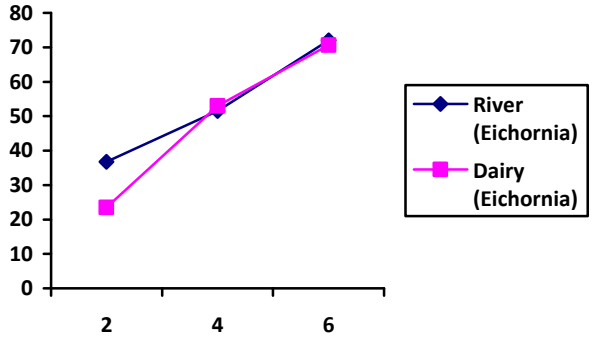

Chart -5: Removal efficiency of Chloride after treatment with Eichornia

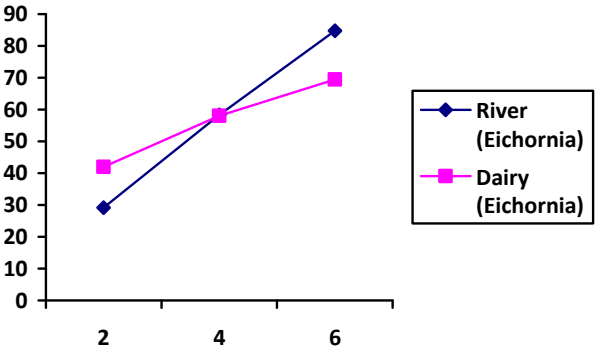

Chart -6: Removal efficiency of COD after treatment with Eichornia

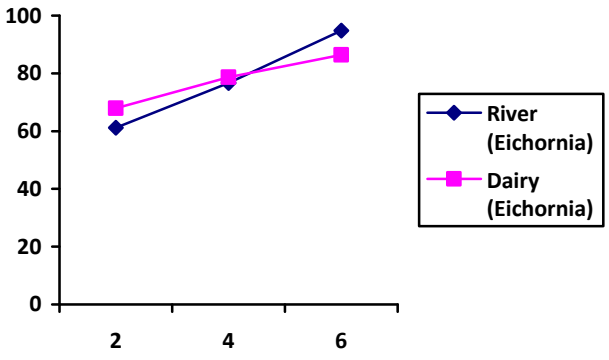

Chart -7: Removal efficiency of BOD after treatment with Eichornia

The above charts show the removal efficiency of Eichornia in the river water and dairy waste water. From the resultsit is observed that the maximum removal efficiency taken place for BOD by Eichornia crassipess. Percentage removal is increases with increase in hydraulic retention time. Here retention times are 5, 4 and 6 days. So maximum removal is occurring after 6 days. After treatment, it was reduced all parameters above 50% except TDS in the case of dairy waste water.

In the case of river water treated with Eichornia Crassipess higher removal takes place in the case of BOD. Removal of BOD is about 94.76% after 6th day. The less removal is takes place in the conductivity. The removal is only 48.60% after 6th day. The percentage of removal in conductivity is not more than 50%. And in the case of dairy waste water treated with Eichornia Crassipess better removal is takes place in the case of BOD. Percentage of removal is about 86.4%. But in the case of TDS there is no removal of contaminants is takes place. In the 2nd and 4th day the total dissolved solids are higher than that of the initial values. But in the 6th day it was removed a small percentage.

4. CONCLUSIONS

This study involved treatment of two types of waste water such as river water and dairy waste water using macrophytes Eichornia crassipess and Nymphaea. As a result it was inferred that the removal of pH, turbidity, conductivity, TDS, chloride, nitrate, COS and BOD efficiently by both macrophytes. From the above investigation the following conclusion can be drawn.

By comparing the results of both macrophytes, it is observed that the removal efficiency of Eichornia crassipess is found to be higher than that of Nymphaea. The optimum day for removal of contaminants is 6 days. Eichornia can be used to purify both waste waters as well as hazardous waste water. When it comes to higher pollution, it seems to be less effective. It promotes sustainable management of natural

resources. Use of natural resources in wetland can be reduced to an extent for large scale construction of treatment plants.

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