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POLLUTANT ABATEMENT OF DYE INDUSTRY EFFLUENT USING AQUATIC MACROPHYTES

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ABSTRACT

The pollutant removal efficiency of *Eichhornia crassipes* Solms. & *Pistia stratiotes* L. from the dye industry effluent and the effect of dye industry effluent on the growth of *Eichhornia crassipes* Solms. & *Pistia stratiotes* L. were analysed. TDS, COD, BOD, DO, Total Hardness, Calcium, Magnesium, Nitrate, Chloride, Sulphate and Iron were highly reduced by *Eichhornia & Pistia* at 20 %. 40 % effluent concentrations. The number and length of roots and leaves were increased by 20 % effluent.

INTRODUCTION

Increasing pace of industrialization along with population explosion, urbanization and green revolution are reflected in vaiying degrees of the purity of water, soil and air. A majority of industries are water based and a considerable volume of waste water is discharged to the environment either untreated or inadequately treated leading to the problem of surface and ground water pollution. The capital costs and operating wastewater treatment systems are rising on one hand and on the other there is a pressing demand for the treatment of wastewater generated by increased residential and industrial development (Mehrotra & Aowal, 1982 and Reed, 1992). In recent years there has been an inceased interest in alternate and innovative technologies, which will prove low-cast, low-maintenance and energy efficient. In the present investigation dye industry effluent was treated with aquatic macrophytes such as *Eichhorina crassipes. Solms.* and *Pistia stratiotes L.*

MATERIAL AND METHOD

The raw dye industry effluent was collected from the equalisation tank of

Table - 1
Physico-chemical characteristics of dye industry raw effluent and its concentrations values (Mean + S.E. of 3 samples).

S.No.Characteristics 10080604020	Concentrations(%)
1.Total Dissolved Solids	6389 ±9.45656 ±4. 760 4630.3±4.140 4653.3 ±41 2613.314.1
2.Dissolved Oxygen	_2.5±0.24.610.14.610.14.9 + 0.1
3.Chemical Oxygen Demand	41 5. 7 ±1.4313.7 + 0.8235 + 2.295±0.776.5 + 1.3
4.Biochemical Oxygen Demand	150 ±7.1113.7±1.189±0.738 ±1.429±0.4
5.Total Hardness	1376.7+4.1115513.6991.713.1780 ±3.6565 ±3.6
6.Calcium	360 ±3.6352 + 1 .4316 + 1.4246.7 ±1.7174+1.4
7.Magnesium	1016.7 + 3.1803+4.3675.7+0.4533.3±5.139113.1
8Iron	0.59±0.10.4310.10.43 + 0.10.44 ±0.20.43 ±0.1
9.Nitrate	32 + 0.724±0.721 ±0.711.3±0.46.5±0.4
10.Chloride	2609.7±0.4 2233.3±4.1 2043.3 ±4.8 1535 ±3.6 930 ±3.6
11.Sulphate	308 + 1.4292 ±4. 8245 ±3.6177.7±0.9 136. 7 ±1.1

Central Effluent Treatment Plant (CETP), Manikkampalayam, Timpur, Coimbatore Dt. and was stored separately in the sterilized polythene carboys at 20° C.The pest free aquatic macrophytes *Eichhornia crassipes* Solms. (waterhyacinth) and *Pistia stratiotes* L. (waterlettuce) were collected from the natural fresh water river Bhavani and acclimatized in Hoaglands solution for 20 days. The plants of uniform size and biomass were selected to reduce the error. The effluent sample (raw-100 %) was diluted to 80%, 60%, 40%, and 20% with deionised tap water and taken in plastic tubs. Initially 100ml sample was withdrawn from each dilution and analysed for its physico-chemical characteristics like TDS, COD, BOD, DO, Total Hardness, Calcium, Magnesium, Nitrate, Chloride, Sulphate and Iron (APHA, 1995). The acclimatized macrophytes were placed separately in each dilution for 8 days. After the retention period 100ml of biotreated effluent was withdrawn from each dilution for the study of physico-chemical characters and the effect of effluent on plants was analysed

RESULTS AND DISCUSSION

The results of physico-chemical characteristics of raw and diluted dye industry effluent and biotreated effluents are presented in **Table 1 & 2**. As compared to control values, The maximum percent reduction of TDS, COD, BOD, DO, total hardness, calcium, magnesium, nitrate, chloride, sul-

Table - 2
Efficiency of *Eichhorina crassipes Solms and Pistia stratiotes* L. in treating raw effluent and its concentrations. Values (Mean ± S.E. of 3 samples).

S No.	Charactristics	Concentration (%)				
		100	80	60	40	20
1.	Total Dissolved Solids	# 6343.7±4.1	5613.3±3.1	3515.7 + 1.1	2146±0.7	1628.3±3.1
		*6347 + 4.1	5616.7 + 5.7	3616. 7±5. 7	2260 + 5.6	1660 ±3.4
2.	Dissolved Oxygen	# 2.5 + 0.1	2.5±0.1	4.7±0.1	4.8±0.16	5.1 ±0.01
		*2.3±0.1	2.2±0.1	4.6 + 0.1	4.7 + 0.1	5 + 0.1
3.	Chemical Oxygen Demand	# 401.7 + 5.5	314 + 1.4	235+ 1.4	82.4 + 0.5	64.5±0.2
		*405±1.1	320 ±1.1	222.6 ±1.2	84±0.1	74.3±1.1
4.	Biochemical Oxygen Demand	# 143±1.4	112±1.2	82.3 + 0.1	32.4±0.1	25.4±0.2
		*141±1.1	117±1.3	83.8 + 1.2	34.7±1.1	27.7±0.9
5.	Total Hardness	# 1365 ±3.6	1150±3.6	940±7.1	665 ±3.6	481.713.1
		*1365 ±3.4	1159 + 2.5	950 ±4. 5	675 ±1.9	482.111.8
6.	Calcium	# 365 ±3.6	350 ±3.6	290±3.6	241.7 + 3.1	165.7±1.1
		*367.3±1.1	360 ±0.9	293 + 0.8	243.3±0.1	162.7 + 0.1
7.	Magnesium	# 1000.7±3.1	800±7.1	650 + 6.1	423.3 + 5.5	316 + 2.1
		*998 + 1.1	799 + 1.5	656.7 + 2.9	431.7 + 1.9	320 ±1.7
8.	Iron	# 0.59±0.2	0.38±0.1	0.28±0.1	0.29 + 0.1	0.29±0.1
		*0.54±0.01	0.37±0.01	0.27±0.01	0.27 + 0.02	0.21 ±0.02
9.	Nitrate	# 30+1.4	20 ±1.4	19 + 0.7	5.6±0.7	2.5 + 0.7
		*31 + 1.1	24 ±0.9	20 + 0.8	6 + 0.1	5±0.02
10.	Chloride	# 2585 + 3.6	2210 + 3.6	1885 + 3.6	1488±1.9	845 ±3.6
		*2603 + 5.1	2210±4.1	1890±3.1	1470 + 1.2	861.7±0.9
11.	Sulphate	# 305±3.6	277.7 ±1.1	210 + 0.7	165 + 1.4	116.7±1.1
		*302.7 + 1.1	288 + 0.01	220.7 + 0.2	171.3±0.1	120 ±0.2

#Eichhornia crassipes, *Pistia stratiotes.

Table - 3

Effect of raw effluent on the root system of *Eichhornia crassipes and Pistia stratiotes* values (Mean ± S.E. of 3 samples)

S. No.	Concen-trations (%)	No. of roots				Length of roots (Cm)			
		Initial	III Day	V Day	VIII Day	Initial	III day	V Day	VII Day
1.	Control	# 69 ± 0.7	73 ± 1.9	75 +0.7	75.07	16 ± 0.7	16 ± 0.7	16.4 ± 0.2	16.4 ± 0.2
		* 25 ± 1.1	30± 0.7	34+ 0.7	35.07	13± 0.7	13 ± 0.7	14.3 ±0.1	0
2.	100	# 55.06	55±1.1	0	0	15.3 ±0.7	15.3 ± 0.7	0	0
		* 20±0.7	20±0.7	0	0	11.3 ± 1.1	11.3	0	0
3.	80	#31±1.4	31± 1.4	0	0	16 ±0.7	16±0.7	0	0
		* 22± 0.7	22±0.7	0	0	11.9 ±0.1	11.9 ± 0.1	0	0
4.	60	# 50±1.4	50±1.4	0	0	15±0.7	15±0.7	0	0
		* 19 ±0.7	19±0.7	0	0	12±0.7	12±0.7	0	0
5.	40	39±1.9	39±1.9	39±1.9	0	15±0.7	15±0.7	15±0.7	0
		# 25 ± 0.7	25±0.7	0	0	11.3 ±1.1	11.3 ±1.1	0	0
6.	20	# 58±1.8	60± 0.7	62±0.7	62 ±0.7	15.3 ±0.1	15.3 ±0.1	16 ±0.7	16±0.7
		* 22± 0.7	25±0.7	15± 0.7	15±0.1	13±0.1	13±0.1	10±0.7	0

Eichhorina crassipes, * *Pistia stratiotes*

phate and iron was recorded in lowest concentrations after the retention period. The pattern of increase in percent reduction of above parameters was observed with increase in the dilution of effluent concentration from 100% to 20%. The DO was found to be nil at 100% effluent, however the dilution improved it particularly at 20% concentration. *Eichhornia* treated effluent revealed higher DO values then the Pistia treatment. TDS, COD and BOD the reduced to the maximum extent by *Eichhornia* than *Pistia* as reported by Trivedy and Gudekar (1985). Calcium, magnesium, nitrate, chloride, sulphate and iron were also found to be reduced by *Eichhornia* and *Pistia* at different concentrations of effluent. Out of these two macrophytes *Eichhonia* proved to be more efficient in removing the pollutants. The lower concentration (20%) favoured growth of plants. Hbth the plants did not survive at higer concentrations. The diluted effluentSare an excellent media for plant growth and gains in number and length of roots and leaves both in *Eichhornia* and *Pistia* **(Table - 3 &4).**

From the above findings it may be concluded that in order to minimize the pollution effects of industrial *effluents* Eichhornia* and *Pistia* plants can be grown in waste water and effluent logged areas.

Table - 4

Effect of raw effluent on the leaves of *Eichhorina crassipes and Pistia stratiotes*. Values (Mean ± S.E. of 3 samples)

S. No.	Concen-trations (%)	No. of roots				Length of roots (Cm)			
		Initial	III Day	V Day	VIII Day	Initial	III day	V Day	VII Day
1.	Control	# 11 ± 0.7	12± 0.7	12±0.7	13±0.7	12±0.7	13±0.7	13.8 ±0.7	14±0.7
		* 7 ±0.7	10±0.7	10 ±0.7	7±0.7	4±0.7	4±0.7	5±0.7	5±0.7
2.	100	# 10±0.7	8± 0.7	0	0	14±0.7	13.5 ±0.1	0	0
		* 7 ±0.7	7±0.7	0	0	2.5 ±0.7	2.5 ±0.7	0	0
3.	80	# 13±0.7	8 ±0.7	0	0	14±0.7	13±0.7	0	0
		* 6 ± 0.7	6±0.7	0	0	2.9 ± 0.1	29±0.1	0	0
4.	60	# 9 ±0.7	7+0.7	0	0	15±0.7	15±0.7	0	0
		* 7 ± 0.7	7±0.7	0	0	3±0.7	3±0.7	0	0
5.	40	# 10±0.7	8±0.7	0	0	15±0.7	15±0.7	0	0
		* 9 ± 0.7	9 ±0.7	8 ± 0.7	0	4± 0.7	4± 0.7	4± 0.7	15±0.7
6	20	# 9± 0.7	12± 0.7	14±0.7	15±0.7	13.5 ±0.7	14±0.7	15±0.7	15±0.7
		* 6± 0.7	7±0.7	7±0.7	7±0.7	4± 0.7	5 ± 0.7	5± 0.7	5±0.7

Eichhorina crassipes, *Pistia stratiotes*

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