To Study the Pollution Load Reduction Potential of Eichhornia Crassipus (Water Hyacinth) In the Kadodara Khadi, Surat

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Abstract--- The textile city of Surat contributes to a large amount of textile effluent being treated in the CETP's and treated water being release into the Tapi river via various khadi's and ultimately river Tapi empties it into Arabian sea. The study was conducted using Eicchornia crassipus as a potential bio remediating agent in treating the untreated effluent entering the PEPL CETP and treated effluent being released in to kadodara khadi; Surat. The plant was kept in effluent tanks of 0.02cu.m volume for 10 days. After the treatment it was observed that COD, TDS, TKN and PO4 reduced considerably. Thus proving Eichhornia to be a potential remediating agent; that could be used at the preliminary stage of effluent treatment process at the CETP. Thus reducing the effluent treatment costing and increasing the efficiency of cleanup with lesser amount of dosing chemicals in an environmental friendly manner.
Keywords: COD, Kadodara, textile, water hyacinth

I. INTRODUCTION

Phytoremediation takes advantages of the unique and selective up take capabilities of plant root system together with the translocation, bio accumulation and contaminant storage or degradation abilities of the entire plant body. (Ilya Raskin∗, Robert D Smith and David E Salt)
The environmental impact of the textile industries is associated with its high water consumption as well as by the colour, variety and amount of chemicals which are release in the wastewater. Wastewaters from dyeing and finishing operations in the textile industry are generally high in both colour and organic content. The wastewater from the textile industry is known to be strongly coloured, presence of large amount of suspended solids, broadly fluctuating pH, high temperature, besides high chemical oxygen demand.
Color is a visible pollutant and the presence of even very minute amount of coloring substance makes it undesirable due to its appearance. The effluents from dye manufacturing and consuming industries are highly colored coupled with high chemical and biochemical oxygen demands (COD and BOD) and suspended solids. Discharge of such effluents imparts color to receiving streams and affects its aesthetic value. The dyes are, generally, stable to light, oxidizing agents and heat, and their presence in wastewaters offers considerable resistance to their biodegradation, and thus upsetting aquatic life (Robinson et al., 2001; Aksu 2005)
Palsana Enviro Protection Limited (PEPL) is a company promoted by the members of Palsana Industrial Association. Majority of members are Textile Processing Units. The locations of the units are Vareli, Kadodara, Tati Thaiya and Jolva in Surat district in Gujarat. PEPL Common effluent treatment plant (CETP) is run by the contribution of all the members to treat the textile effluent

A. *Eichhornia crassipus (Water hyacinth)*

Water hyacinth (Eichhornia crassipus) is a free floating aquatic weed (refer Figure 1), which creates a serious problem of eutrophication and imposes harm to the aquatic life, causes potential nuisance in irrigation, power generation and in domestic water usages

Water hyacinth (Eichhornia crassipes Solms), due to its fast growth and large biogas production has potential to cleanup various wastewaters. Inorganic contaminants such as nitrate, ammonium and soluble phosphorus (Reddy *et al*., 1982; Reddy, 1983), heavy metals (Muramoto and Oki, 1983; Zhu *et al*., 1999) can be removed efficiently by water hyacinth through uptake and accumulation. Previously the roots of water hyacinth plants and their roots were used for phytoremediation of ethion and biosorption of reactive dyes (Huilong Xia, Xiangjuan Ma, 2005).
The water hyacinth has been shown to remove Nitrogen and Phosphates, as well as chemical oxygen demands. (Ilya Raskin∗, Robert D Smith and David E Salt) The results of several studies show plants such as the water hyacinth use appreciable amounts of the inorganic forms of nitrogen and phosphorus found in domestic sewage (Ilya Raskin∗, Robert D Smith and David E Salt)
This weed can be biotic resource due to its several properties which are useful in waste water treatment through Phytoremediation technology. In the present investigation, water hyacinth is used for the treatment of effluent coming to the PEPL CETP as well as treated effluent being discharged in to kadodara khadi.

Fig.1: Water hyacinth

II. EXPERIMENTAL

To test the COD, TDS, pH, TKN, $S0_4$ & $P0_4$ from the water of kadodara khadi after 10 days of Eichhornia treatment

A. Methodology

1. Sampling: Grab sampling of water from the equalisation tank of PEPL CETP and kadodara khadi was conducted. About 20 litres of sample was filled up in tubs that were previously cleaned with non-ionic detergent, rinsed twice with tap water, later soaked in 10% HNO3 for 24 hrs. And finally rinsed with distilled water prior to use. Temperature of effluent was 41 degree Celsius

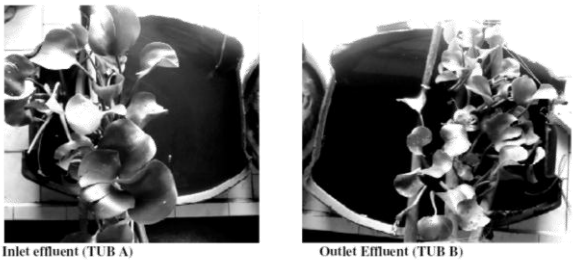


Fig. 2: Photographs of the plants in the inlet effluent tub (A) and outlet effluent tub (B) at day.

2. Tub dimensions (Volume): 20inches x12inches x6.5inches=0.02cu.m
   Surface area: 20 inches x 12 inches =0.15sq.m
3. Plant used: Eichhornia crassipus (water hyacinth). The plants were supported using scrap cable wires for floating in the tub. About 250gms of plants was used.
4. Duration: 10 days (17.09.13 to 26.09.13)
5. Experimental design: There were 2 plastic tubs taken. One contained the effluent water entering the PEPL CETP (inlet effluent –TUB A) and other treated effluent (outlet effluent – TUB B) being discharged into the khadi. Refer the Figure 2. Daily analysis of water samples for the parameters: pH, COD, TDS, TKN, and SO_4 and PO_4 was conducted.

B. Analysis Procedure:

Grab samples were collected in the tank and the Physico-chemical effluent had been carried out with the following methodology

The following parameters were tested in the laboratory using standard procedures as given below.

1. PH: pH meter was used. Method: IS 3025 (Part -11) – 1983 (Reaffirmed 2002) / APHA -22nd Edition (Part – 4000, Section : 4500-H+)
2. COD: Open reflux method [IS 3025 (Part -58) – 2006 / APHA -22nd Edition (Part – 5000, Section : 5220)]
3. TDS: Gravimetric [IS 3025 (Part -16) – 1984 (Reaffirmed 2002) / APHA -22nd Edition (Part – 2000, Section :2540 C)
4. TKN: Kjeldahl method [500-Norg B, C (APHA et al. 1998)]
5. SO_4: Titration method [IS 3025 (Part -24) – 1986 (Reaffirmed 2003) / APHA -22nd Edition (Part – 4000, Section : 4500-SO42-)]
6. PO_4: Titration method [the SnCl2 method 4500-P D (APHA, 1998)]

Daily analyses of samples from the respective tanks were recorded as under.

The plants were kept at in tubs (A, B) near the window of the research lab to allow sufficient light and natural conditions for the plant to survive.

Fig.3: Plant shows flowering in the tub B after 10 days of the experiment

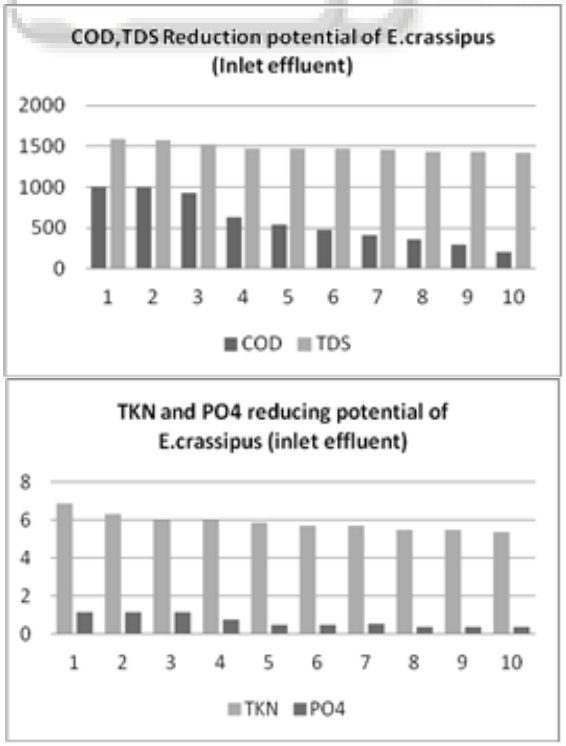
The below are given tabular representations of the results recorded.

Parameters	Date										% Reduction
	17.09.13	18.09.13	19.09.13	20.09.13	21.09.13	22.09.13	23.09.13	24.09.13	25.09.13	26.09.13	
pH	6.8	6.9	6.9	6.9	6.9	6.10	6.9	6.9	6.11	7.4	NA
COD (mg/l)	1006	997.2	929.3	629.5	540	483	407.1	368	298.2	210.8	79.05
TDS (mg/l)	1584	1577	1520	1480	1477	1470	1465	1440	1433	1427	9.91
TKN	6.9	6.3	5.98	6.01	5.87	5.71	5.7	5.5	5.5	5.4	21.74
SO_4 (mg/l)	61.42	416	380.7	363.3	362	370	369	358.3	359.8	455.1	NA
PO_4 (mg/l)	1.17	1.17	1.17	0.78	0.456	0.5	0.51	0.37	0.38	0.39	66.67

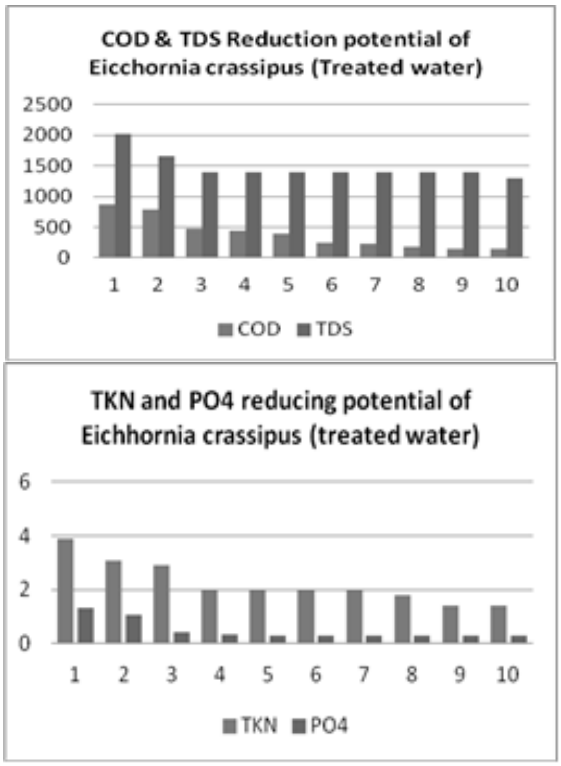
Table 1: Inlet effluent from the equalisation tank of CETP

Parameters	Date										% Reduction
	17.09.13	18.09.13	19.09.13	20.09.13	21.09.13	22.09.13	23.09.13	24.09.13	25.09.13	26.09.13	
pH	7.1	7.1	7.1	7.1	7.2	7.2	7.2	7.3	7.5	7.5	NA
COD (mg/l)	878	786	470.1	435	398	250	224	187	140	139.12	84.154897 5
TDS (mg/l)	2016	1656	1390	1390	1390	1390	1390	1390	1390	1300	35.515873
TKN	3.9	3.1	2.9	2	2	2	2	1.8	1.4	1.4	64.102564 1
SO4 (mg/l)	50.84	178	271.4	302	312	345	350	352	352	352.9	NA
PO4 (mg/l)	1.33	1.09	0.408	0.35	0.3	0.3	0.3	0.3	0.29	0.288	78.345864 7

Table 2: Treated effluent being discharged into the kadodara khadi



Graph 1: COD ,TDS (Graph 1A) and TKN,PO4 (Graph 1B) reduction potential of Eichhornia. crassipus.



Graph 2: COD, TDS (Graph 2A) and TKN, PO4 (Graph 2B) reduction potential of Eichhornia crassipus

III. RESULTS AND DISCUSSION

- The pollution load gets reduced faster in the treated effluent tub B , thereby concluding that the plants survive better at low pollution load concentrations and are able to degrade the organic matter faster.
- COD redution of about 81% on an average shows promising results .
- Some of the leaves turned yellow due to chlorosis.
- PO_4 reduction was prominent in both the cases .
- The effluent color at the end of 10 days reduced drastically showing the ability of the plant to reduce the color of the effluent by its degradation ability. .
- Graph 1 shows that the TDS removing efficiency of the plant is not so prominent as compared to the COD,TKN and PO_4 removal efficiency
- Graph 2 shows that at the end of three days COD & PO_4 reduced considerably.
- Fugure 3 shows flowering at the 8^{th} day of the experiment, indicating the survival ability of the plant

IV. CONCLUSIONS

After 10 days of treatment with Eichhornia crassipus the following average reduction in pollution load in the effluent was observed as below:

- COD = 81.6% average
- TDS = 22.7% average
- TKN = 42.9% average
- PO4 =72.5% average
- Colour reduction of effluent water was prominent Eicchornia crassipus proves to be an effective aquatic plant in reducing the pollution load of the effluent waters.

V. RECOMMENDATION

Phytoremediation by the use of water hyacinth is recommended as polishing treatment for the textile process effluent. Using appropriate engineering design a moving type bed could be designed that could float the plants on the equalization tank for a certain time period and can be removed after the treatment period and again reused for next cycle of treatment.

VI. REFERENCES

[1] Tolu Olufunmilayo Ajayi1& Atoke Olaide Ogunbayo, Department Of Chemical Engineering, University Of Lagos, Akoka, Yaba, Lagos State, Niger, Achieving Environmental Sustainability In Wastewater Treatment By Phytoremediation With Water Hyacinth (Eichhornia Crassipes)

[2] Mahmood, Q., P. Zheng, E. Islam, Y. Hayat, M. J. Hassan, G. Jilani, R. C. Jin. 2005. Lab Scale Studies On Water Hyacinth (Eichhornia Crassipes Marts Solms) For Bio Treatment Of Textile Wastewater. Caspian J. Env. Sci. 3(2): Pp. 83-88.

[3] Vasanthy Muthunarayanan, Santhiya. M, Swabna. V, Ge etha. A,
Phytodegradation of Textile Dyes by WATER HYACIN TH (EICHHORNIA CRASSIPES) FROM Aqueous Dye Solutions,

[4] Ilya Raskin∗, Robert D Smith And David E Salt, Phytoremediation Of Metals: Using Plants To Remove Pollutants From The Environment

[5] Phytoremediation Of Zinc, Cadmium, Copper And Chrome From Industrial Wastewater By Eichhornia Crassipes.

[6] Treatment Of Sewage Through Phytotechnological Studies With Constructed Wetland Using Eichhornia Crassipes

[7] Himanshu Patel* And R.T. Vashi, Treatment Of Textile Wastewater By Adsorption And Coagulation

[8] Rouf Ahmad Shah, D.M. Kumawat, Nihal Singh And Khursheeed Ahmad Wani, Water Hyacinth (Eichhornia Crassipes) As A Remediation Tool For Dye-Effluent Pollution

[9] Sharma H.K., Dogra P., Sharma N. and Sharma S. ,Comparative Study on Phytoremediation of Synthetic and Industrial Effluent

[10] Robinson et al., 2001; Aksu 2005 Remediation of dyes in textile effluent: a critical review on current treatment technologies with a proposed alternative, Bioresour. Technol. 77 (2001) 247–255.

[11] Reddy *et al*., 1982; Reddy, 1983"Effect of nitrogen source on productivity and nutrient uptake of water hyacinth (*Eichhornia crassipes*)". Journal of Economic Botany. No.37: Page 236 - 246.

[12] Muramoto and Oki, 1983; Zhu *et al*., 1999"Removal of some heavy metals from polluted water by water hyacinth (Eichhornia crassipes)". Bulletin of Environmental Contamination and Toxicology, 30, pp 170177

[13] Huilong Xia, Xiangjuan Ma, 2005."Phytoremediation of Ethion by Water Hyacinth (Eichhornia Crassipes) from Water". Journal of Phytoremediation. Volume 6: Page 137 – 148

BOOK REFERRED:

[1] Standard Method for Examination of Water and Waste Water (21st Edition). APHA, AWWA, Washington DC

