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Studies on Potential Use of Water Hyacinth, Pistia and Azolla for Municipal Waste Water Treatment

KEYWORDS: Phytoremidiation, Rhizofiltration, BOD, COD, Sewage.

A.A.Deshmukh
Department of Environmental Science, Dr. B.A.M. University, Aurangabad - 431004

N.N. Bandela
Department of Environmental Science, Dr. B.A.M. University, Aurangabad - 431004

J.R.Chavan
Department of Environmental Science, K.T.H.M. College, Gangapur road, Nasik-422002

P.M.Nalawade
Department of Environmental Science, K.T.H.M. College, Gangapur road, Nasik-422002

ABSTRACT *The effectiveness of sewage purification by aquatic plant such as Water Hyacinth (Echhornia crassipes), Pistia (Pistia stratiotes) and Azolla (Azolla filiculoides) was tested on laboratory scale. Laboratory experiments verified that the plants are capable of decreasing all tested indicators of water quality. The Echhornia sp. reduced the BOD from 465 to 152 mg/lit, COD from 368 to 201 mg/lit, Nitrogen from 190 to 73 mg/lit, Phosphate from 55 to 14 mg/lit, and Potassium from 110 to 49 mg/lit. The Pistia sp. survived for only 6 days under laboratory condition and reduced BOD from 465 to 318 mg/lit, COD from 368 to 284 mg/lit, Nitrogen from 190 to 125 mg/lit, Phosphate from 55 to 29 mg/lit and Potassium from 110 to 66 mg/lit.*

The Azolla sp. showed reduction in BOD from 465 to 155 mg/lit, COD from 368 to 210 mg/lit, Nitrogen from 190 to 83 mg/lit, Phosphate from 55 to 18 mg/lit and Potassium from 110 to 54 mg/lit. During the study it was found that Echhornia sp. was significantly more effective than Azolla sp. and Pistia sp. in municipal waste water treatment. The result shows that the use of such free floating macrophyte for treatment of urban sewage is a viable option

INTRODUCTION

Macrophytes play important role in balancing the aquatic ecosystem. For the first time they were recognized during 1960-1970's in water quality improvement. Aquatic macrophytes treatment systems for waste water are the need of developing countries because they are cheaper to construct and a little skill is required to operate. They improve the water quality by absorbing nutrients with their effective root system. Macrophytes not only retain nutrients by biomass uptake but also increase sedimentation. These are utilized for nutrient and metal removal from water in the form of Constructed wetland or retention ponds because of their fast growth rates, simple requirements and ability to accumulate biogenic elements and toxic substances.

Water hyacinth is a fast growing perennial aquatic macrophyte and has the great reproduction potential. The water hyacinth has successfully resisted of its eradication by chemical, biological, mechanical or hybrid means (Shufield,2009) . The water hyacinth requires only 13% of energy as compared to conventional sewage treatment plant for same quantity of sewage.

Pistia is a floating perennial commonly called water lettuce. These plants are known to accumulate large quantity of nutrient during a period of rapid growth. It has a potential to remove TDS by 70%, fecal coliform by 99%, BOD by 93%, COD by 59%, Nitrate by 70%, and total phosphorous by 33% (Zimmels 2006). Water lettuce growth decrease the EC of sewage due to salt removal from water by root adsorption and the water quality in pond was improved

Phytoremediation is a process of using plants to remove contaminants from the environment in an alternative approach to current remediation strategies. Phytoremediation is an efficient and economical method of contaminant removal without further damaging the environment (Asthana 1999). Once Rhizofiltration is filtration of water through a mass of roots to remove toxic substances or excess nutrients the remediation potential of these plants is used in terrestrial as well as aquatic systems. These plants absorb, concentrate and precipitate contaminants from polluted aqueous source with low contaminant concentration in their roots.

The present work was conducted to assess the effectiveness and potential of *Echhornia sp., Pistia sp., and Azolla sp.* for removing the nutrient load due to the detergents in the sewage sample using rhizofiltration process of phytoremediation technology.

MATERIALS AND METHODS

The area under investigation is Sewage Treatment Plant Tapovan, Nasik. The samples were collected from Inlet Chamber Sewage Treatment Plant. The aquatic macrophytes used for present study were ***Eichhornia Crassipes*** (water hyacinth plant, **Family**- Pontederiaceae), ***Pistia Stratiotes*** (water lettuce, **Family**- Araceae), ***Azolla Caroliniana*** (duck-weed fern, **Family**- Azollace). These aquatic plants were obtained from natural specimens grown in Godavari River. When the plants were used experimentally they were clean thoroughly with deionized, distilled water and kept in tap water for 24 hrs. at room temperature for acclimatization. Caution was taken during raising the plants to prevent damage to the delicate root system.

The 6 experimental setups were installed in the laboratory two of each plant for sewage treatment by using 18 tubs of 5 lit each, Sewage water freshly collected from sewage treatment plant. The above sets were kept for 10 days and sample analysis was performed after every 24 hrs. for the measurement of pH, EC, Turbidity, color, odor, temperature, DO, BOD, COD, total alkalinity, total acidity, TSS, Total hardness, Chlorides, Nitrate, phosphate, potassium. According to the procedures recommended by standard methods (R K Trivedi & P. K. Goel, 1994).

Result and Discussion

In the result of study it was found that the treated water is alkaline and not suitable for letting into river and inland water bodies. From the comparative study of result table 1, 2 and 3

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it was found that *Eichhornia sp.* is highly efficient in absorbing the nutrients in water till 10th day. After 10 days under lab conditions these plants start dying However, *Azolla sp.* has slow rate of absorption but under lab conditions it could last for many days however *Pistia sp.* has shown less amount of absorption of nutrient in sewage sample. The reason behind this is *Pistia sp.* doesn't have much amount of dense rooting network as compared to *Eichhornia sp.* and *Azolla sp.* More over it could not stay for longer time under lab conditions. In treated samples we observe that the value of BOD, COD, TSS are reduced to greater extent by various treatment processes but the macrophytes help to bring the level near standards prescribed by CPCB. The *Echhornia sp.* reduced the BOD from 465 to 152 mg/lit, COD from 368 to 201 mg/lit, Nitrogen from 190 to 73 mg/lit, Phosphate from 55 to 14 mg/lit, and Potassium from 110 to 49 mg/lit. The *Pistia sp.* survived for only 6 days under laboratory condition and reduced BOD from 465 to 318 mg/lit, COD from 368 to 284 mg/lit, Nitrogen from 190 to 125 mg/lit, Phosphate from 55 to 29 mg/lit and Potassium from 110 to 66 mg/lit.

The *Azolla sp.* showed reduction in BOD from 465 to 155 mg/lit, COD from 368 to 210 mg/lit, Nitrogen from 190 to 83 mg/lit, Phosphate from 55 to 18 mg/lit and Potassium from 110 to 54 mg/lit. The detergents of sodium salts and potassium salts as well as hardness can be reduced to a greater extent by *Echhornia sp.* as compared to *Pistia sp.* and *Azolla sp.* The considerable increase in the amount of Dissolved Oxygen was also noticed by all the three species of aquatic macrophytes.

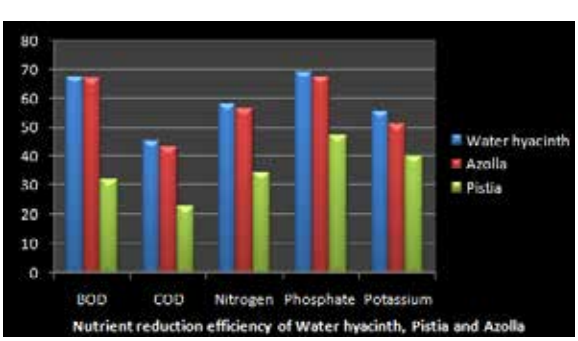
Table no.1 Influent parameter reading treated with water hyacinth (*Echhornia crassipes)*

Sr. No.	Parameter	CPCB Standards	Inlet reading	Echhornia crassipes					Pistia					Azolla				
				Day2	Day4	Day6	Day8	Day10	Day2	Day4	Day6	Day8	Day10	Day2	Day4	Day6	Day8	Day10
1.	pH	6.5-8	8.9	8.7	8.5	8.5	8.4	8.2	8.7	8.7	8.7	-	-	8.8	8.6	8.6	8.5	8.5
2.	EC	<1dS/m	1.9	1.5	1.2	1	0.9	0.9	1.6	1.4	1.2	-	-	1.5	1.2	1.1	1.0	0.9
3.	Turbidity	20	50	46	43	36	33	32	47	44	43	-	-	45	42	34	32	29
4.	Acidity	50	100	64	51	40	30	30	64	55	55	-	-	66	42	38	33	32
5.	Alkalinity	50	560	408	252	180	132	129	467	294	280	-	-	461	259	178	138	124
6.	Hardness	100	620	509	373	265	237	236	551	541	420	-	-	510	370	270	217	213
7.	Chloride	30	160	118	84	80	75	70	125	98	89	-	-	120	93	80	74	70
8.	DO	10	0.3	2.4	6.7	7.8	8.3	8.5	1.9	4.6	5.4	-	-	1.8	4.1	6.6	7.2	7.5
9.	BOD	100	465	368	280	213	164	152	378	343	318	-	-	308	273	219	160	155
10.	COD	100	368	318	251	225	213	201	320	294	284	-	-	328	294	250	215	210
11.	TSS	100	700	550	360	300	250	200	590	490	459	-	-	570	380	320	270	220
12.	Nitrogen	20	190	152	120	92	79	73	159	130	125	-	-	165	133	108	87	83
13.	Phosphate	6	55	36	28	21	16	14	39	31	29	-	-	37	29	23	20	18
14.	Sulphide	0.5	15	9.7	6.3	5.1	2.3	1.6	9.3	7.8	6.9	-	-	11.7	7.3	4.9	2.4	1.9
15.	Sodium	20	135	96	68	54	51	48	121	95	85	-	-	122	81	64	61	58
16.	Potassium	30	110	89	71	58	53	49	84	75	66	-	-	98	71	62	57	54

Note: all the parameters are expressed in unit mg/liter except pH, EC (dS/m) and Turbidity (NTU)

Table No.2 Efficiency of each plant in reduction of Important parameter expressed in Percentage

Sr. No.	Parameter	*Echhornia sp.*	Azolla sp.	Pistia sp.
1.	BOD	67.31	66.66	31.61
2.	COD	45.38	42.93	22.82
3.	Nitrogen	57.89	56.31	34.21
4.	Phosphate	69.09	67.27	47.27
5.	Potassium	55.45	50.90	40.00



From the comparative study of the three macrophytes *Ech-*

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hornia sp. was found more efficient in treatment of municipal waste water with maximum efficiency in phosphate reduction (69.09%), and second highest in BOD reduction(67.31%). The Efficiency of *Echhornia sp*. and *Azolla sp*. is nearly equal to each other. The *pistia sp*. also showed considerably good efficiency in removing the organic load of sewage water.

Conclusion

The finding of this study revealed that treatment of sewage using water hyacinth (*Echhornia crassipes*), pistia *(Pistia stratiotes*) and azolla (*Azolla filiculoides*) does not involve any elaborate mechanism nor does it require the setting up of the complex unit. Hence it is effective and recommended for use especially in developing countries. The treated water compares favorably with untreated water which means that it could be discharge to the environment without adverse effect on environment quality and health. Hence a low cost, environment friendly and appropriate treatment system has been achieved.Finally, we can conclude that Eichhornia and Azolla are good plants to control load of nutrients from sewage & it helps to solve the problem of **Eutrophication** and phytoremediation is an ecofriendly process of sewage treatment and highly effective if used with other treatment processes.

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