Utilization of Pistia Stratiotes for Textile Wastewater Nitrates and Phosphates Removal

Hina Kousar* , Pavithra M**,
*Assistant Professor, Department of P.G Studies and Research in Environmental Science, Kuvempu University, Jnana Sahyadri, Shankaraghatta-577 451, Karnataka, India
**Research Scholar, Department of P.G Studies and Research in Environmental Science. Kuvempu University, Jnana Sahyadri, Shankaraghatta-577 451, Karnataka, India.

Abstract

Textile industry effluent contains a variety of organic and inorganic pollutants. Effluents largely containing high concentration of dyestuffs, salts, acids, bases, surfactants, dispersants, humectants, oxidants and detergents render these waters asthetically unacceptable and unusable. Treatment of high volumes of wastewater becomes crucial because textile dyes are well known mutagens and carcinogens posing risks to various ecosystems, animals' health and agriculture. This situation has necessitated the development of effective and efficient wastewater treatment strategies without further stressing the environment and endangering other life forms. Phytoremediation catalyzed by green plants and their associated metabolic processes has emerged as a comparatively new approach and has proven to be one of the most effective environmental friendly strategies for removal and detoxification of contaminants. Several aquatic macrophytes have been found to effectively minimize the pollutant concentration in waste water. The present study was conducted to investigate the feasibility of Pistia stratiotes for treating textile wastewater in reducing the concentration of nitrates and phosphates. The result revealed that concentration of nitrates and phosphates reduced considerably upon phytotreatment.

Keywords: *Textile industry, effluents, phytoremediation, Pistia stratiotes, nitrates and phosphates.*

I. INTRODUCTION

Water is the most vital resource for all kinds of life, but it is being adversely affected both quantitatively and qualitatively. Today, most of the rivers receive millions of litre of sewage and industrial effluents containing varying characteristics from simple nutrients to highly toxic substances. The world's ever increasing population and progressive adoption of industry based lifestyle has inevitably led to an increased anthropogenic impact on the biosphere(Pavithra and Kousar, 2016). With the increased demand for textile products, the textile industry and its wastewaters have been increasing proportionally, making it one of the main sources of severe pollution problems worldwide. The textile industry is one of the most important and rapidly developing industrial sectors in India (Husain and Husain, 2012), accounting for about 20% of the total industrial production. It consumes large quantities of water and produces large volume of wastewater from different steps in the dyeing and finishing processes. Due to the danger of the entry of chemicals into wastewater, it must be treated before the final disposal. Many physical,chemical and biological methods have been developed for the treatment of wastewater. It is reported that biological methods are more interesting for wastewater treatment and one of the branches of biological method for wastewater treatment is phytoremediation (Roongtanakiat *et al*., 2007).

Phyto-remediation is the utilization of plant to remove and accumulate contaminants from environment. It includes the use of plants to mitigate, transfer, stabilize or degrade pollutants in soil, sediments and water. Recent studies on biomass of some selected plants, particularly macrophytes and rhizomes, provide leading clues on means of improving the quality of wastewater (Misbahuddin and Farduddin, 2002; Mohan *et al*., 2006; Dana, 2014; Alade and Ojoawo, 2009; Aremu *et al*., 2012).

Phosphorous is one of the major nutrients contributing to the increased eutrophication of lakes and natural waters. Its presence causes many water quality problems including increased purification costs, decreased recreational and conservation value of an impoundment, loss of livestock and the possible lethal effect of algal toxins on drinking water. (Metcalf and Eddy, 1991; Gray, 2005). Controlling phosphorous discharged from municipal and industrial wastewater treatment plants is a key factor in preventing eutrophication of surface waters. Usually, the removal of phosphorous from wastewater involves the incorporation of phosphate into total suspended solids and the subsequent removal from these solids. Phosphorous can be incorporated into either biological solids (e.g. micro organisms) or chemical precipitates.

Large input of nitrogen, to ground and surface waters may result in excessive growth of algae and other aquatic weeds. Moreover, a build-up of nitrate in drinking water supplies poses a health hazard to humans particularly infants, as well as livestock. Nitrates cause "Methemoglobinemia" or "Blue baby disease" among infants. Nitrate determination is essential to ascertain the state of decomposition of organic matters present in wastewater. It is used to assess the self-purification properties of water bodies and nutrient balance in surface water and soil. Nitrate is a highly mobile anion formed by microbial conversion of nitrite. Drinking water Standards have recommended a permissible nitrate value of 10 mg/l (Kotaiah and Swamy, 1994).

The present study was conducted to investigate the feasibility of *Pistia stratiotes* reducing for the concentration of nitrates and phosphates in textile wastewater. The plant commonly known as water lettuce has an extensive root system that aggressively accumulates contaminants and nutrients in its surrounding waters. This plant is currently employed in many parts of the world for heavy metal removal from wastewater and has shown promising results for the degradation of organic and inorganic wastes from contaminated water sources (Odjegba and Fasidi, 2004; Gupta *et al*., 2012).

II. MATERIALS AND METHODS

A. *Collection of Plants:*

Pistia stratiotes was collected from a natural pond near Shimoga. Same sized young and healthy plants were collected and acclimatized in laboratory conditions for three days. Later they were introduced into the effluent.

B. *Collection of Samples*

The sample for the analysis was collected from a textile industry near Shimoga. It was brought to the laboratory and analysed for various physico-chemical parameters including COD.

C. *Method*

Different concentrations (10% to 70%) of effluent were used for treatment, while the control was maintained separately. Plastic troughs of 10 litre capacity were filled with 7 litre of different concentration of effluent. The plants were allowed to grow in laboratory model ponds for 7 days, after which they were taken out and the plant treated effluent was analyzed for the efficiency of *Pistia stratiotes* in reducing Phosphate and Nitrate.

1) ***Phosphate*** *:-*

Phosphate (Total Phosphate as PO_4) was determined by Spectrophotometric method (IS:3025(p31)) before and after the treatment.

2) ***Nitrate*** *:-*

Nitrate (Nitrate Nitrogen as N) was determined by Spectrophotometric method (IS:3025(p34)) before and after the treatment.

III. RESULTS

The present study investigates the capability of Pistia stratiotes in reducing phosphate and nitrate concentration in textile wastewater. The result clearly indicates that Pistia stratiotes is extremely potent in reducing concentration of phosphate and nitrate as there was a significant reduction in their concentration. Concentration of total phosphates and nitrates of effluent after treatment with Pistia stratiotes is represented in Table 1 .The percentage of phosphate reduction is represented in Figure 1 and nitrate reduction in Figure 2.

Table 1: Concentration of Total Phosphates and Nitrates of Effluent After Treatment with Pistia Stratiotes.

Samples	Phosphate reduction	Nitrate reduction
10% concentration	4.55±1.732	13.6±4.525
20% concentration	6.1±2.192	22±5.656
30% concentration	8.25±2.793	33±7.778
40% concentration	10.2±3.111	41±9.192
50% concentration	12.4±3.676	54±11.313
60% concentration	15.66±4.426	72.2±14.0007
70% concentration	18.2±4.66690476	92±16.970

Figure 1: Different Concentration of Effluent and Percentage of Phosphate Reduction.

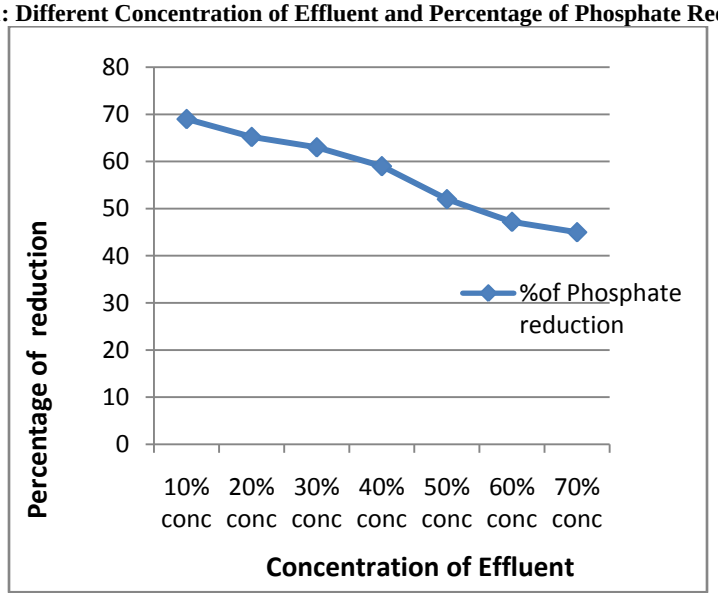
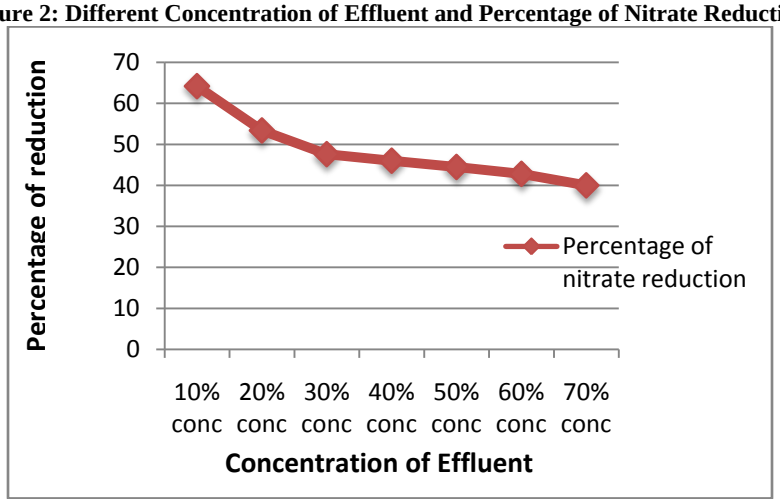


Figure 2: Different Concentration of Effluent and Percentage of Nitrate Reduction.



IV. DISCUSSION

Results indicated that phytoremediation was effective in reducing N and P concentration in textile water. The finding was consistent with other studies on phytoremediation, whereby hydrophytes were found to absorb and accumulate superfluous nutrients like N and P (Xu *et al.*, 1999). These findings indicate that phytoremediation could promote the removal of N and P from the textile mill effluent. The released nutrients are absorbed by plants, and the contaminants in water will gradually be diminished. The study has shown that *Pistia stratiotes* could remove a large amount of nutrients from textile wastewater and purify it by means of remobilization, assimilation and metabolizing (cf. Li *et al*., 2000).

V. CONCLUSION

The feasibility of *P. stratiotes* to treat textile effluent was investigated and it was found to be efficient in reducing the concentration of Phosphate and Nitrate within 7 days of treatment. Hence, *P. stratiotes* could be used for treating textile mill effluent.

REFERENCES

[1] Alade G.A and Ojoawo, S.O. 2009. Purification of domestic sewage by water hyacinth (Eichhornia crassipes). Int. J. Environ. Technol. & Management. **10 (3&4)**:286-294.

[2] APHA. 2005. Standard Methods for the Examination of Water and Wastewater, APHA, AWWA and WEF, 21st Edition.

[3] Aremu, A.S., Ojoawo, S.O and Alade, G.A. 2012. Water hyacinth (Eichhornia crassipes) culture in sewage: Nutrient removal and potential applications of bye-products. Transnational J. Sc. & Tech. **2 (7):**104-111.

[4] Dana, A.M. 2014. Phytoremediation as an Alternative Method to Remove Lead and Cadmium from Wastewater Using Some Aquatic Plants. European Int. Jour. of Sc. and Tech., **3 (4)**: 4.

[5] Fox,L,J., Struik, P,C., Appleton,B,L., & Rule,J,H. 2015.Nitrogen Phytoremediation by Water Hyacinth (Eichhornia crassipes (Mart.) Solms). Aquatic Procedia, **4**: 349 – 356

[6] Garcia, J., Aguirre, P., Barragan, J., Mujeriego, R., Matamoros, V., Bayona, J.M. 2005. Effect of key design parameters on the efficiency of horizontal subsurface flow constructed wetlands. Ecol. Eng. **25**:405-418

[7] Gupta, P., Roy, S., Mahindrakar, A.B., 2012. Treatment of water using water hyacinth, water lettuce and vetiver grass-A review. Resour. Environ. **2:**202-215.

[8] Husain, J. and Husain, I. 2012. Groundwater pollution by discharge of dyeing and printing industrial waste water in Bandi river, Rajasthan, India, Int. J.Environment and Bioenergy, **2(2)**:100-119

[9] Kotaiah, B and Swamy, K.N. 1994. Environmental Engineering Laboratory Manual, Charotar Publishing House, Gujarat, India, 25 – 26.

[10] Li, X. M., Yang, Z. Y., Jian, S. G., Huang, Z. X., & Liang, J. G. (2000). Effects of effective microorganisms (simplified as EM) on control of algae bloom in eutrophic water. Journal of Transaction of Zhongshan University, **39(3):** 81–85

[11] Metcalf and Eddy, Inc., 1991. In: Tchobanoglous, G., Burton, F.L (revisors), Wastewater Engineering: Treatment, Disposal and Reuse, third edition. McGraw-Hill Publishing, NY, USA.

[12] Misbahuddin, M., Farduddin, A. 2002. Water hyacinth removes arsenic from arsenic-contaminated drinking water, Arch. Environ. Health, **57 (6):**516-518.

[13] Mohan, D., Pittman Jr., C.U., Steele, P.H. 2006. Pyrolysis of wood/biomass for bio-oil; a critical review, Energy Fuels, **20 (3):**848-849.

[14] Odjegba**,** V**,**J**.**, Fasidi**,** I**,**O**.,** 2004. Accumulation of trace elements by Pistia stratiotes: implications for phytoremediation. Ecotoxicology**. 13(7):**637-46.

[15] Ojoawoa,O,S., Udayh=kumar, G., and Naik, P. 2015.Phytoremediation of Phosphorus and nitrogen with Canna x generalis Reeds in Domestic Wastewater through NMAMIT Constructed Wetland. ICWRCOE 2015. Aquatic Procedia, **4**:349 – 356

[16] Pavithra, M and Hina Kousar. 2016. Characterization of certain Physico-chemical parameters of Textile Waste Water. International Journal of Environmental Sciences. **5(1):**39-41

[17] Rezania,S. , Ponraj,M., Talaiekhozani,A., Mohamad,S,E., Mohd Fadhil Md Din , Shazwin Mat Taib, Farzaneh Sabbagh , Fadzlin Md Sairan, 2015. Perspectives of phytoremediation using water hyacinth for removal of heavy metals, organic and inorganic pollutants in wastewater. Journal of Environmental Management **163**: 125-133

[18] Roongtanakiat, N., Tangruangkiat, S., Meesat, R., 2007. Utilization of vetiver grass (Vetiveria zizanioides) for removal of heavy metals from industrial waste waters. Sci. Asia, **33**:397-403.

[19] Wu Xiang·Yang Xiao-E·Zed Rengel. 2009. Phytoremediation facilitates removal of nitrogen and phosphorus from eutrophicated water and release from sediment. Environ Monit Assess **157**:277–285

[20] Xu, H., Chen, H. Z., Xiong, Q. Q., & Wang, B. Z. 1999. Research on the purification efficiency and mechanism of macrohydrophyte pools. Journal of Transaction of Herbin Architecture University, **32(4)**: 69–73