Removal of Textile Dye by using *Eichhornia spp.* and *Pistia spp.* by Aquatic Macrophytes Treatment Systems (AMTS) – An Eco Friendly Technique

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Abstract: ***Dyes are extensively used in various branches of the textile industry, leather industries, paper production, food technology and agriculture research. The dye effluents of these industries produces pollution when they are discharged in natural resources like underground stream, rivers, ponds and lakes which are the drinking water sources without any treatment. This causes serious problems of health in whole population. Textile dye effluent contains substantial pollution load which increases the change of physicochemical parameters. So pre-treatment is needed prior to discharge of these effluents. In the present study, an attempt is made to compare the efficiency of aquatic macrophytes like Eichhornia crassipes and Pistia stratiotes to treat the dye effluents. Water was initially analyzed for physicochemical parameters i.e. pH, TS, DO, COD and dye concentration. After 07 days, of phytoremediation same physical and chemical parameters will be measured.There was statistical significant decrease in COD of dye effluents with different interval of days. In general, all the effluent samples collected were devoid of DO. There was increase in the DO after treatment as indicated by reduction of COD in the effluents. The results indicate that the water hyacinth is very efficient in reducing the pollution loads in dye effluents. At the present time AMTS, a phytoremediation is still a nascent technology that seeks to exploit the metabolic capabilities and growth habits of aquatic macrophytes: delivering a cheap, soft and safe biological treatment that is applicable to specific contaminated sites and wastewaters is a relatively recent focus. In such a context, there is still a significant need to pursue both fundamental and applied research to provide low-cost, low-impact, visually benign an eco friendly technique. AMTS includes its tolerance to dye and dye absorption along with good root development, low maintenance and ready availability in contaminated regions.Colour reduction of effluent water was prominent Eichhornia crassipes proves to be an effective aquatic plant in reducing the pollution load of the effluent waters.***

Keywords: COD, Macrophytes, Phytoremediation, AMTS

1. Introduction

Many industries such as textile (Gupta *et al.,* 1992), paper (Ivanov *et al.,* 1996), plastic, Leather tanning (Tunay *et al.,* 1999) uses dyes extensively in different operations (Gercel *et al.,* 2008). These dyestuff industries discharge variety of pollutants in different processes (Mall *et al.,* 2006). Dyes exhibit considerable structural diversity and thus become difficult to treat them by a single process. It is a fact that due their visibility, dyes are recognized easily even at the levels as less as 1 ppm. Toxicity of dyes to fauna and flora is well documented (Karaca *et al.,* 2008). Colour of textile effluents escalates environmental problem mainly because of its non-biodegradable characteristics (Southern, 1995).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 (Aksu, 2005). 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).

Recently the term phytoremediation has been substituted by the term phytotechnology to indicate all applications in which plants are used to manage and control pollutants, even without removing or destroying it (ITRC, 2001). This technology has greater potential to remediate contaminants from soil and water over conventional and costly methods. Several physical and chemical methods have been suggested for the treatment of dye-contaminated wastewater but are not widely used because of the high cost and secondary pollution that can be generated by excessive use of chemicals.Several conventional methods are already being used to clean up the environment from these kinds of contaminants, which include chemical precipitation, lime coagulation, ion exchange, reverse osmosis solvent extraction, aeration, chemical oxidation, electrolysis, ultra filtration, and chlorination. But most of them are costly and far away from their optimum performance (Bieby *et al.,* 2011). The chemical technologies generate large volumetric sludge and increase the costs (Rakhshaee *et al.,* 2011). Chemical and thermal methods are both technically difficult and expensive. All of these methods can also degrade the valuable component (Bieby *et al.,* 2011).

In the present study, an attempt is made to compare the efficiency of aquatic macrophytes like *Eichhornia crassipes* and *Pistia stratiotes* to treat the dye effluents. Water was initially analyzed for physicochemical parameters i.e. pH, TS, DO, COD and dye concentration. After 07 days, of phytoremediation same physical and chemical parameters will be measured. There was statistical significant decrease in COD of dye effluents with different interval of days.Therefore, in the present research programme, a removal of dye by using different aquatic macrophytes by phytoremediation technique is proposed. The study will help in the search of a Aquatic Macrophytes Treatment Systems (AMTS) model to take the advantage of Macrophytes as environmental cleanup agents.The technology of phytoremediation is cost effective and ecologically friendly in which plant utilizes its natural abilities to restore environment.

2. Methods

2.1 Preparation of Dye solutions: Dye stock dye solutions of both the dyes were prepared by dissolving 100 mg of dye in 100 ml sterile distilled water to get 1000ppm dye solution. A suitable aliquot of the sample solution containing dye was transferred into a 100 ml volumetric flask and the solution was made up to the mark with double distilled water. The absorbance was measured at the respective lambda max (490 nm) against a blank.

2.2 Aquatic macrophytes

2.2.1 *Eichhornia crassipes* (*Water hyacinth)*

Water hyacinth is a fast growing perennial aquatic macrophytes is a member of Pontederiaceae family.

2.2.2 *Pistia stratiotes (Water lettuce)*

Family- Araceae. Plant samples are collected from the Amdhara village near chikhli, Navsari (Gujarat) and wash with double distill water.

2.3 Experimental methodology

- Dye effluent was taken in tubs of 3 litre capacity in triplicates. Nearly equal weight of *Eichhornia crassipes* (100 g fresh weight) will be transferred to tubs containing royal blue dye effluent (100ppm) which will be labelled as experimental plants A and another tubs containing HD blue dye and these were labelled as experimental plants B. Equal weights of *Eichhornia crassipes* were transferred into another set of tubs containing natural water and these were labelled as control C.
- Same sets were prepare in triplicates for experimental plant *Pistia stratiotes* royal blue dye labelled as experimental plants D and HD blue dye these were labeled as experimental plants E**.** equal weight for this plant was also taken (100 gm) as positive control and labelled as control F. Before transferring plants into tubs, initial physical and chemical parameters i.e. pH, TS, DO, COD and dye concentration were analyzed. After 07 days, the analysis of treated water was taken for same parameter.

3. Result and Discussion

The feasibility of *Eichhornia crassipes* and *Pistia stratiotes* to treat the dye effluents was carried out for 07 days. The results are presented in Tables 1 to 10 and also results for each parameter determined are presented in Graph. The results indicate that the water hyacinth is very efficient in reducing the pollution loads in dye effluents.

The maximum color reduction was observed at 07 days after the introduction of the Aquatic Macrophytes Treatments Systems (AMTS) into the 100 ppm Royal blue dye and HD blue dye solutions. It accounts for royal blue dye phytoremediation of *Pistia stratiotes* Vs *Eichhornia crassipes* P value = 0.8360, Water Vs *Pistia stratiotes* P value = 0.03089 and Water Vs *Eichhornia crassipes* P value = 0.0284. Also the HD blue dye phytoremediation of *Pistia stratiotes* Vs *Eichhornia crassipes* P value = 0.0445, Water Vs *Pistia stratiotes* P value = 0.0040 and Water Vs *Eichhornia crassipes* P value = 0.0101 respectively (Tables 7 and 8). Similarly Vasanthy *et al***.**, (2006) has checked the treatability of aqueous Majanta HB solutions (5, 10, 15, 20 and 25 ppm) using *Eichhornia crassipes*.

COD reduction of dyes by Aquatic Macrophytes Treatments Systems (AMTS) of *Pistia stratiotes* Vs *Eichhornia crassipes* P value = 0.0090, Water Vs *Pistia stratiotes* P value = 0.0191 and Water Vs *Eichhornia crassipes* P value = 0.0354 of royal blue dye. Also the phytoremediation of HD blue dye *Pistia stratiotes* Vs *Eichhornia crassipes* P value = 0.3467, Water Vs *Pistia stratiotes* P value = 0.0268and Water Vs *Eichhornia crassipes* P value = 0.0446 respectively shown in graph. In general, all the effluent samples collected were devoid of dissolved oxygen (DO). There was increase in the DO after treatment as indicated by reduction of COD in the effluents. According to Reddy (1981), the presence of plants in wastewater can deplete dissolved CO_2 during the period of high photosynthetic activity. This photo-synthetic activity increases the dissolved oxygen of water, thus creating aerobic conditions in wastewater which favor the aerobic bacterial activity to reduce the BOD and COD. The presence of aquatic macrophytes in water body alters the physiochemical environment of the water body (Reddy, 1983).

4. Conclusion

At the present time, Aquatic Macrophytes Treatments Systems (AMTS), a phytoremediation is still a nascent technology that seeks to exploit the metabolic capabilities and growth habits of aquatic macrophytes: delivering a cheap, soft and safe biological treatment that is applicable to specific contaminated sites and wastewaters is a relatively recent focus. In such a context, there is still a significant need to pursue both fundamental and applied research to provide low-cost, low-impact, visually benign an eco friendly technique. As per the study the promising attributes of Aquatic Macrophytes Treatments Systems (AMTS) includes its tolerance to dye and dye absorption along with good root development, low maintenance and ready availability in contaminated regions. These characteristics prove the suitability of macrophytes in dyeing industry effluent treatment. However further experiment could be done to optimize the conditions for the treatment of the direct effluents and caution must be always taken as these Hydrophytes can easily contaminate the aquatic ecosystem. Colour reduction of effluent water was prominent *Eichhornia crassipes* proves to be an effective aquatic plant in reducing the pollution load of the effluent waters.

5. Abbreviations

pH: Potential of H^+ ion concentration, **TS:** Total solids, **DO:** Dissolved Oxygen, **COD:** Chemical Oxygen Demand, **AMTS:** Aquatic Macrophytes Treatment Systems, **BOD :** Biological Oxygen Demand, **ppm :** Parts Per Million.

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Figures

Figure A: *Eichhornia crassipes* in Dye effluent and Tap water (Reference) before the treatment

Figure B: *Pistia stratiotes* in Dye effluent and Tap water (Reference) before the treatment

Figure C: *Pistia stratiotes* in Dye effluent and Tap water after the treatment

Figure D: *Eichhornia crassipes* in Dye effluent and Tap water after the treatment

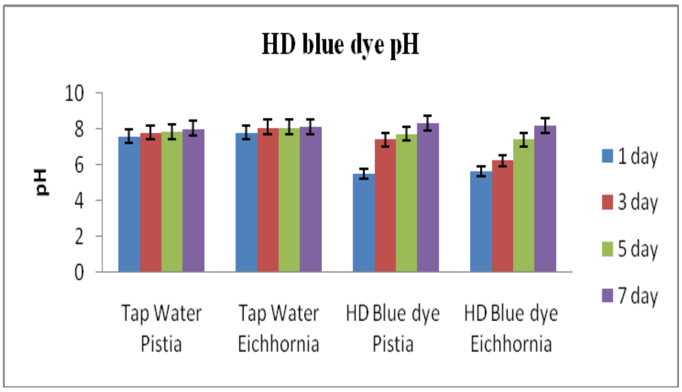

Figure 2: *pH of HD blue dye Phytoremediation.*

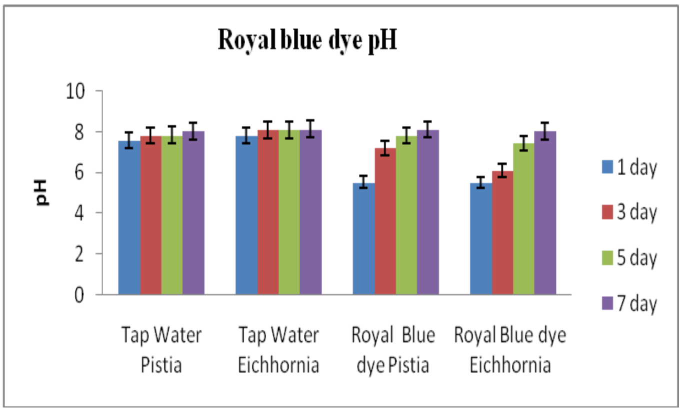

Figure 3: *pH of Royal blue dye Phytoremediation.*

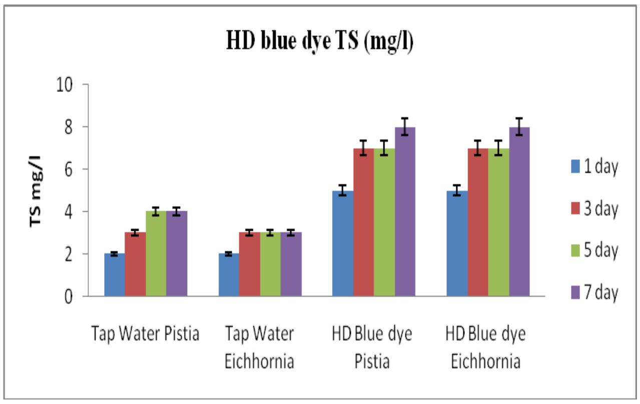

Figure 4: *TS of HD blue dye Phytoremediation.*

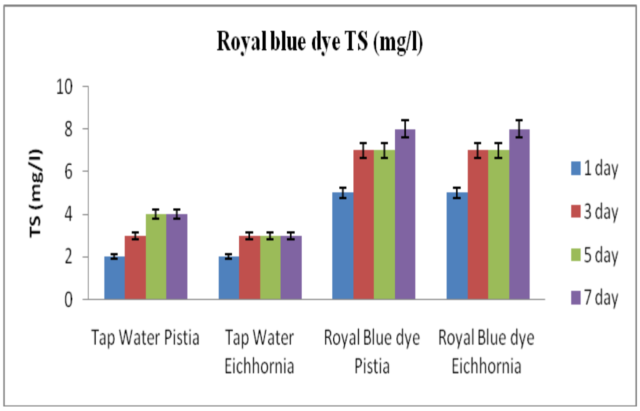

Figure 5: *TS of Royal blue dye Phytoremediation.*

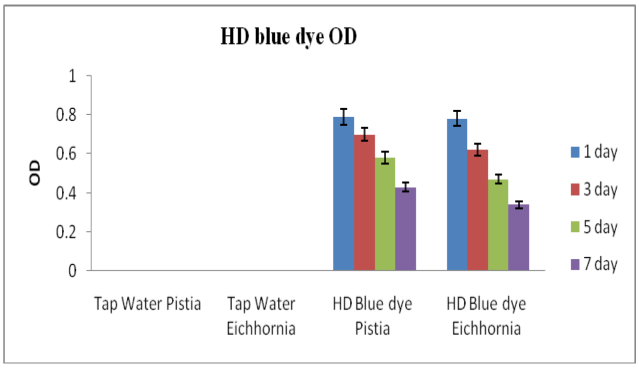

Figure 6: *OD of HD blue dye Phytoremediation.*

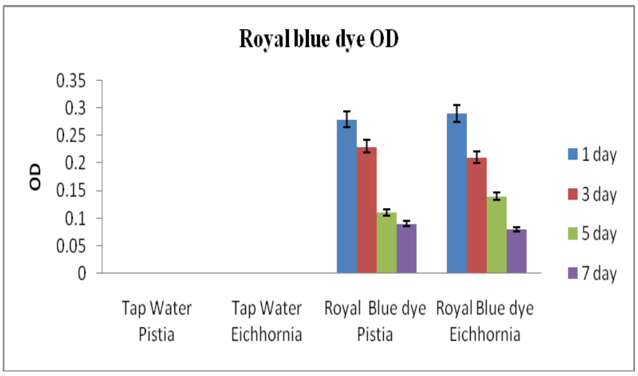

Figure 7: *OD of Royal blue dye Phytoremediation.*

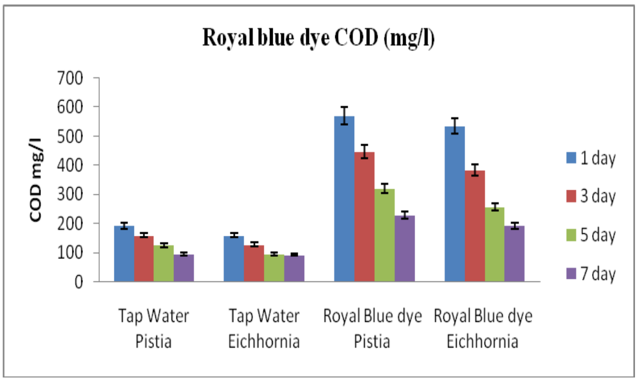

Figure 8: *COD of Royal blue dye Phytoremediation.*

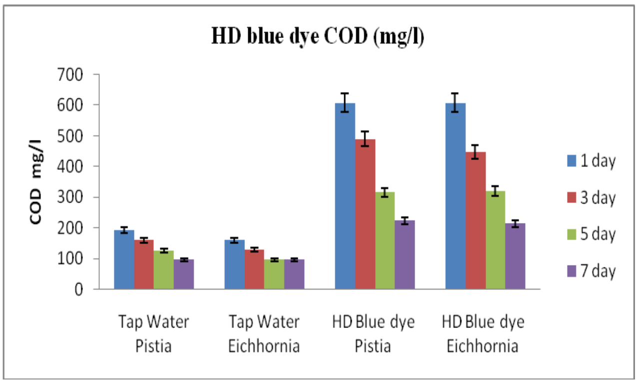

Figure 9: *COD of HD blue dye Phytoremediation.*

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