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DECOLORIZATION OF SYNTHETIC DYE (METHYL RED) WASTE WATER USING CONSTRUCTED WETLANDS HAVING UPFLOW AND DOWNFLOW LOADING FORMATE

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ABSTRACT

Decolorization of synthetic textile dye (methyl red) waste water using constructed wetlands is investigated as percentage reduction in O.D. values at 410 nm. Two types of loading format down flow and up flow were examined and compared in decolorization efficiency after mass loading of methyl red waste water. At the same time, performance of planted (phragmites wetlands) and up planted wetlands was also investigated. Constructed wetlands are found to be quite effective and competitive for decolorization. However, up flow format remained better after increase in RT. Planted wetlands dominated unplanted ones in colour removal.
Keywords: Decolorization; Methyl Red; Spectroscopy; Constructed Wetlands.

INTRODUCTION

Dyeing and printing of textile manufacturing has been development with human civilization. Today these industries are the backbone of economy in many developed as well as developing countries. In India, it contributes to about 25% of total export earning and providing employment to almost ¼ of the total labour force [1-2]. A considerable amount of waste water is generated having strong color, a large amount of suspended solids, a highly fluctuating p^H, salts, heavy metals, sulphides, chlorine, temperature and COD concentration[3]. The disposal of untreated textile wastewater is a serious threat to the environment. It accounts for 15-20% of total wastewater in the country[2]. The dyes are the most visible pollutant in the wastewater. About 3500 dyes are in practical use. Azo dyes contribute 84%, of which sulphonated azo dyes predominate. About 10-15% (128 tone/day globally) of the dyes are lost at various finishing steps of the printed cloths[4]. Besides dyes, the wastewater contains acids/alkalis, common salt (NaCl), heavy metals, sulphides, chlorine and mineral oils. As a result, the dye wastewaters are extremely toxic to both aquatic fauna and flora, crop plants, including human beings[5]. Traditionally, the dye effluents are treated by physical, chemical and biological methods[6-9]. It is accomplished by adsorption of dyes to clay mineral kaolinite, coals, bentonite[10], fly ash, red soil and bauxite[11-13]. CSBE (Carbonized spent bleaching earth) [14,] carbon based adsorption[15], cashew nut hurl carbon[16]. Using physical methods, the treatment of wastewater was poor[17], though fly ash removed 100% omega chrome ME[13] and 90% COD of textile mill effluents under ambient temperature and P^H conditions[18]. Recently artificial wetlands or constructed wetlands have emerged as a viable option to solve a wide range of water quality of water problems. These wetland systems become attractive alternatives particularly when they can become an integral part of the overall landscape plan. The deep interest in the wetland system can be attributed to their role in filtering particulate material thereby leading to a reduction of suspended solids, biochemical oxygen demand (BOD) and also the removal and storage of nutrients. However, there are ecological constraints in the use of naturally occurring wetlands for treating wastewater, since nutrient enrichment can change the composition of the biota and long-term impact of accumulation of nutrient (particularly phosphorous accumulation) and heavy metal contaminants is unclear. Hence, there is a need to create artificial wetlands for the purpose of wastewater treatment, which unlike conventional wastewater treatment systems are simply to construct, low in cost and require minimum operational energy. An assemblage of microbial communities in their rhizosphere assists in biodegradation of pollutants. Further, their low maintenance cost establishes and recommends constructed wetlands as an ideal choice for wastewater treatment. These wetlands may also provide indirect benefit such as green space, wild life habitats and recreational areas. The major demerit of these systems is requirement of relatively large land area for advanced treatment. Treatment of textile wastewater using constructed wetlands was also studied by earlier worker. The purpose of this study was to conduct experimental investigation to know better loading pattern in treatment of dye wastewater. As characteristics of wastewater varied greatly day to day on account of change in type of dyes. Optimization study of wetlands could not perform by earlier worker[5]. To overcome this problem a know dye methyl red was used to prepare dye wastewater.

EXPERIMENTAL

The plant species used for raising constructed wetlands was phragmita karka, as it was most tolerant to dye wastewater[15].Two types of wetlands having up flow and down flow, hydraulic format were raised. In up flow wetlands, wastewater was loaded through a central tube at the bottom of bucket (15 Lt.) and collected through on outlet fixed about 2” below top as a result water rises of during its loading whereas in case of down flow wetlands wastewater was loaded at the surface of gravel filled bucket and collected through an outlet fixed about 2” above the bucket as a result water flow down wards.

Preparation of synthetic methyl red waste water

The methyl red powder (make Merck) was first ground and dissolve4d in ethanol to make dye paste. This dye paste was then diluted in 5L tap water and filtered through five meshed nylon cloth (2 folds) to separate un-dissolved dye particles, which are again ground to completely dissolved in water. This synthetic wastewater was added in wetlands through mass loading where a known volume of inflow (methyl red wastewater) was loaded gradually within 2-3 minutes through a central tube in up flow wetlands and over wetland surface in down flow wetlands.

Spectroscopic analysis

After loading, treated water (out flow) was collected in flask to analyze its spectroscopic characteristics. The sample was first dried in parcelin cup for 24 hrs at 60 C and then dissolved in 25 ml methanol. This solution was centrifuged and supernatant was taken in 1 ml cuvette for observe UV-visible spectroscopy.

RESULTS AND DISCUSSION

The loading of methyl red in the down flow and up flow constructed wetlands were made at 1 and 2 days RT. Almost similar performance was observed at 1 day RT in both cases. However, down flow performed better in comparison to up flow, when RT was doubled. Down flow wetlands show no change in the performance at both RT (Table-1). This is

Table-1: Percent reduction in OD value of down flow and up flow wetland out flow at 410 nm

Wetlands format		**Retention Time(RT)**	
		1 day	**2 day RT**
Down flow	Planted	93.9 ± 1.2	92.86 ± 0.21
	Unplanted	92.2	86.7
Up flow	Planted	97.8 ± 0.1	54.3 ± 12.4
	Unplanted	97.3	52.4

Perhaps due to short circuiting during up flow loading. If performance as well as suitability of handing wetlands were taken in concentration, the up flow wetlands are better because water is continuously released. The mechanism of the Decolorization in the constructed wetlands is quite complex. As described earlier, the rhizosphere of planted wetlands and the solid matrix of unplanted were inoculated with two species of Bacillus and 15 fungal species from which two are reported. The degradation of methyl red is medicated by extra cellular enzyme released by the microbes in the rhizosphere. They degraded azo dye into simple compound and ultimately in carbon, amines and other colorless compound produced in due to catalyses and peroxides activity of azo reductase.

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