ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

REMOVAL OF REACTIVE DYES FROM WASTEWATER OF TEXTILE INDUSTRIES BY USING ENVIRONMENTAL FRIENDLY ADSORBENTS

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Abstract: *This paper is aimed at developing a method to treat wastewater by using inexpensive adsorbents. Textile industries produce wastewater, otherwise known as effluent, as a bi-product of their production. The effluent contains several pollutants. Among the various stages of textile production, the operations in the dyeing plant, which include pre-treatments, dyeing, printing and finishing, produce the most pollution. The textile dyeing wastes contain unused or partially used organic compounds, and high level of different pollutants. They are often of strong color and may also be of high temperature. When disposed into water bodies or onto land these effluents will result in the deterioration of ecology and damage to aquatic life. Furthermore they may cause damage to fisheries and economic loss to fishermen and farmer, there may be impacts on human health which can be removed with the help of an effluent treatment plant (ETP). The "clean" water can then be safely discharged into the environment and ultimately save our environment from pollution. In this study, rice husk and cotton dust were used as an adsorbent. In this research work waste water was characterized with this useless adsorbents. The parameters which were tested in this study are DO, BOD, COD, TS, TDS and TSS. The results showed that the selected bio adsorbents have good potential for removal of reactive dyes from textile effluent.*

Key words: *Treatment, Environment, Effluent, DO, BOD.*

1. INTRODUCTION

Among all the manufacturing industries textile industry is cosidered one of the most complicated industries. Wastewater treatment is one of the major problems faced by textile manufacturers [2]. The presence of very small amounts of dyes in water (less than 1 ppm for some dyes) is highly visible and affects the aesthetic merit, water transparency and gas solubility in lakes, rivers and other water bodies. Dyes, however, are more difficult to treat because of their synthetic origin and mainly complex aromatic molecular structures [3]. The presence of dyeing effluent in a watercourse has a serious environmental impact. Dyeing effluent has high amount of color and other chemicals, which are very harmful for aquatic live [4].

Many studies have been undertaken to find low-cost sorbents, which include peat, bentonite, steel-plant slag, fly ash, maize cob, wood shavings and silica.[5] However, these low-cost sorbents generally have low uptake, which means that large amounts of sorbents are needed. Although good sorption capacities for dyes are found for such materials as cellulose, sugarcane bagasse, and coconut husk, successful regeneration has not been reported. Therefore, new, economical, easily available and highly effective sorbents still need to be found [6]. For my study I used two new and renewable biomaterials i.e micro dust and rice husk for wastewater treatment. The main purpose of this study was the removal of Color, TS, TDS, TSS and increase the DO of wastewater. From this experiment very good results were obtained in this regards.

2. EXPERIMENTAL METHODOLOGY

2.1 Materials and Reagents.

In addition to common laboratory glassware, apparatus and instruments used are UV-Vis spectrophotometer, portable multi-parameter, electronic balance, vacuum oven, magnetic stirrer, incubator and refrigerator.

2.2. Adsorbent preparation

After collecting grain size of rice husk were separated. Then dried husk was stirred in acetic acid solution at 60°C for 90 minutes. After that filtered husk was dried at 105 °C for 24 hours. [7]
Another biomaterial cotton dust was washed with distilled water for two times and then dust was stirred in water with sodium hydroxide, sodium silicate and hydrogen peroxide at 90°C for 90 minutes. Filtered dust was dried at 105°C for 24 hours.

2.3. Analytical Procedures:

Equal amount of biomaterials i.e cotton dust 1.5g, rice husk 1.5g and combined 1.5g (0.75g+0.75g) were added to the beaker. The adsorption experiments were carried out in beakers. Adsorption factors including the amount of adsorbents (1.5 g), initial sample concentration for waste water and dye solutions 100 mL and 10 mg/L respectively, contact time 120 minutes and pH 8 were evaluated. After the adjustment of pH to the desired value with 0.01 M HCL and 0.01 M NaOH solutions, the sample solution was stirred using a magnetic stirrer. The adsorption from the aqueous solution was studied. After the desired contact period for each batch experiment, the aqueous phases were separated from the materials, and the dye concentration of dye was measured using a UV-Vis Spectrophotometer.
Then optimization of different factors carried out like as adsorbents, pH and equilibrium time. The different amounts of adsorbents (1-4 g) were added to 100 mL dye solution in the bathes for 210 minutes for optimizing amount of adsorbent. Initial pH of solution was adjusted to 4, 5,6,7,8,9,11 and 12 using 0.01 M HCL and 0.01 M NaOH solutions at optimum condition adsorbent amount and dye solution concentration. To determine the equilibrium time for the maximum uptake of dye solution, the adsorption of two biomaterials were studied for the above optimized condition as a function of time(30,40,60,80,100,120,140,160,180,200 & 210 minutes).

2.4. Determination of physical and chemical characteristics of wastewater:

At first Calibration curve were obtained by measuring the absorbance of standard dye solution of known five concentrations (5, 10, 15,20,20,25 mg/L). The amounts of dye onto the adsorbents were determined by measuring the absorbance of dye after batch experiment by UV-Vis Spectrophotometer. The sample were analyzed against a calibration curve prepare by standard solution of dye. Finally Different physical and chemical characteristics of wastewater like as Total

Solids, Total Dissolved Solids, Total Suspended Solids, Dissolved Oxygen, pH, Biological Oxygen Demand and Chemical Oxygen Demand were measured with help of respective method and machine.

3. RESULTS AND DISCUSSION

3.1. Calibration Curve For Novacron red dye:

Calibrations were obtained by determining the concentrations of Novacron Red dye solution by UV-vis Spectrophotometer at wavelength of 570 nm where maximum absorbance was observed. The Absorbance vs. Concentration of Novacron Red dye solution is presented in **Fig.1.** From this figure, it is seen that the absorbance vs. concentration curve is a straight line passing through the origin. The correlation coefficient (R^2) of the line is 0.9998.

3.2. Observation of effect of contact time:

The effects of contact time for the adsorption of novacron red was studied for a period of 210 min and the results are shown in the **Fig.2**. It showed that the dye removal was rapid at a certain time then the rate was decreased after saturation. In this experiment the cotton dust, rice husk and combined adsorbent showed highest absorptive capacity at 120 mins, 140 mins and 130 mins respectively. . So that, after a certain period of time, the adsorbent reached to its equilibrium condition and we find out the optimum contact time.

3.3. Observation of effect of pH variation:

Change of pH also affects the adsorptive process through dissociation of functional groups on the adsorbent surface active sites. Consequently, this leads to a shift in reaction kinetics and adsorption equilibrium. The effect of pH of Novacron red on the adsorbents was shown in the **Fig 3**.

3.4. Observation of effect of adsorbent dosage:

The effects of adsorbents dosage on the removal of novacron red were shown in **Fig.4**. Interactions were carried out between dye solutions and adsorbents by adding different amounts of adsorbents (2-25 g/L) to 100 mL of 10 mg/L of dye solution taken in a beaker for 120 mins, 140 mins and 130 mins for cotton dust, rice husk and combined respectively. Removal efficiency was calculated by measuring absorbance of dye solutions after adsorption.

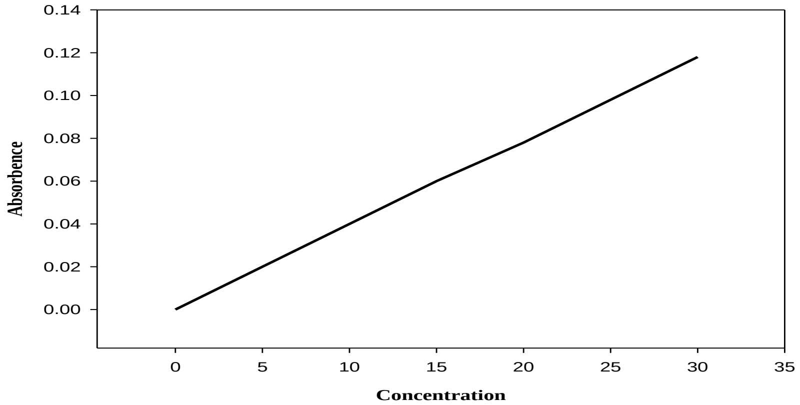

Fig. 1*: Calibration Curve of Novacron red dye*

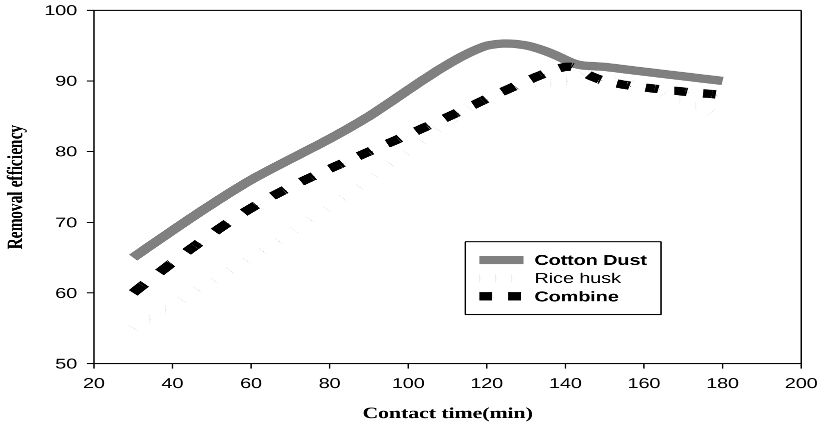

***Fig. 2**: Observation of effect of contact time*

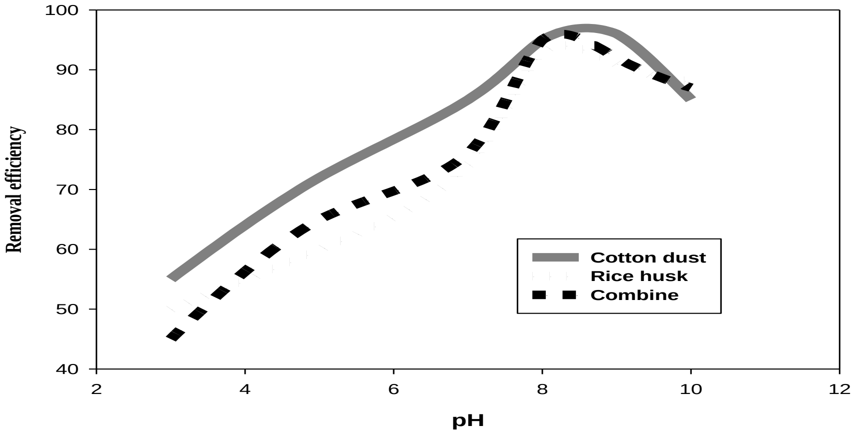

***Fig. 3**: Observation of effect of pH variation*

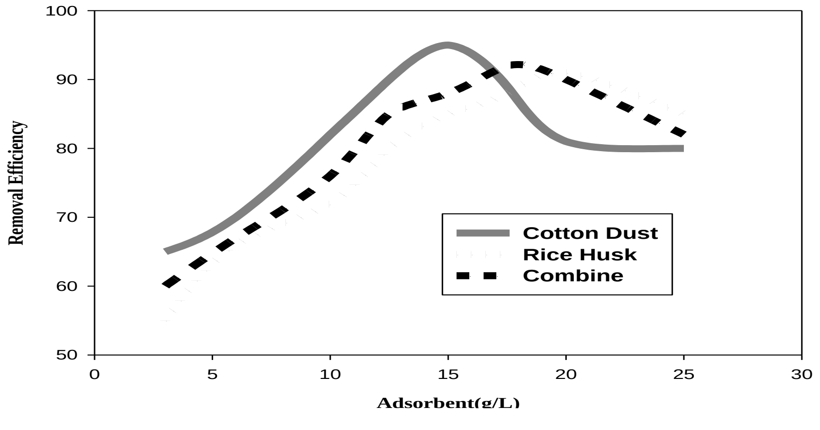

***Fig. 4**: Observation of effect of adsorbent dosage*

3.5. Physical and chemical characteristics of the textile waste water

Table1: *Physical and chemical characteristics of the textile waste water*

Parameters	Before Treatment	After Treatment With Cotton Dust	After Treatment With rice husk	After Treatment With combined
pH	11	8	7	7.5
DO(mg/L)	6.8	7.2	7	7.4
BOD(mg/L)	98	44	48	47
COD(mg/L)	992	315.5	389	330
TS(mg/L)	3444	2155	2214	2190
TDS(mg/L)	3224	2014	2090	2050
TSS(mg/L)	220	141	124	116

It is seen from visual and machine observation that after treating with the adsorbents, deep colored non-transparent wastewater became colorless and transparent indicating that both the adsorbents studied in this work are capable to remove reactive dyes from wastewater generated from textile industries.

5. CONCLUSIONS

Two new biomaterials namely cotton dust and rice husk were found to be very effective in removing reactive dyes from wastewater. Initially although one reactive dye, Novacron red was used, it is found that these adsorbents are able to remove all three reactive (Novacron red, Novacron yellow and Novacron blue) dyes present in collected wastewater sample.

Adsorptions on both biomaterials are found to be affected by pH of dye solution, contact time and adsorbent/dye ratio. Both the adsorbents are found able to decrease pH, COD materials, and BOD materials, TS, TDS and TSS significantly. They are also found to increase DO level in wastewater.

Comparable adsorptive ability of dyes from wastewater was found by cotton dust and rice husk regarding removal efficiency, however, regarding adsorbent/dye ratio and contact time, cotton dust seems to be a better adsorbent compared to rice husk. Rice hulls are economically cheap and so regeneration is not necessary [8]. The factors which favors the selection of cotton dust and rice husk are its low cost, widespread presence and organic composition which shows strong affinity for some selected dyes.

As Sorption is an effective process for decolorization of textile dyes so this is one of the effective techniques for color removal. Although cotton dust was the most effective sorbent due to the high surface area, another low cost sorbent rice hust could also be used for color removal.

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