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RESEARCH ARTICLE

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Decolourisation of textile effluent by adsorption using carbonated rice husk

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ABSTRACT

Tirupur is an important trade centre of India which is famous for its knitted garment wears. It is situated near Coimbatore which is known as "The Manchester of South India". Tirupur accounts for 90% of India's cotton knitwear export. But the textile mills produce large amount of waste water effluents which results in environmental pollution. Waste water effluents contains synthetic dyes which cause a potential hazard to environment hence these dyes need to be removed from water. On a survey it was found that in Tirupur District the waste water effluents from all the textiles mills are collected in a common treatment unit. Biological Method is used for the treatment of effluent. This process releases out foul gases causing bad odour. Also most of the textile mill collects the treated effluent and reuse it for dyeing the garments. There by the owners are charged per litre of treated dye mixed effluent. The various dye removal process involves Chemical, Physical and Biological methods. Adsorption is a physical process which is carried out in this project. It is found to be very effective and cheap method among all the dye removal methods. Dyes from textile waste water effluents are effectively separated using adsorbents such as activated carbon. In the present study, rice husk is used for preparing activated carbon and observed that, it has the capacity of absorbing most of the dyes due to its porous nature and surface area.

Keywords: *Knitwear, Textile mill, Effluent.*

1. INTRODUCTION

The textile industry is one of the largest manufacturing industries. In every stage of textile industry various types of dyes are used to color their products. The dye containing wastewater is usually released directly into the nearby drains, rivers, stagnant, ponds or lagoons. Such wastewater disposal may cause damage to the quality of the receiving water bodies, the aquatic eco-system and the biodiver -sity of environment. The dyeing industry effluents contain high BOD value, COD value, suspended solids, toxic compounds and the color that is perceived by human eyes at very low concentration.

Moreover, dyes may adversely affect the aquatic life because of the presence of aromatic materials, metals and chlorides etc., The color removal was extensively studied using different methods such as coagulation, flocculation, ultra-filtration, nano-filtration, photo oxidation, activated carbon etc. The main objective of the present study includes,

- To find a feasible and economically viable bio-material, for treatment of textile effluent.
- To find out the adsorption capacity of rice husk.
- To determine the effect of pH, adsorbent rate, rate of degradation contact time and temperature on dye removal.

2. MATERIALS AND METHODS

- Rice Husk
- Ortho Phosphoric Acid
- Textile Effluent

3. RESULTS & DISCUSSION

The rice husk is washed with distilled water to remove the impurities and is dried in sunlight for 24hours. In that 10gms of dried husk is mixed with 5ml Phosphoric acid and placed in crucible and is kept inside the muffle furnace. The muffle furnace is set to a 450˚C. The rice husk is burned for about 10 minutes. Once the husk is completely burned it is taken out of the muffle furnace. Now the husk is called Carbonated Rice Husk (CRH) (Fig 1, 2).

Fig 1. RH mixed with H_3PO_4

Fig 2. Adsorbate at 450˚C in muffle furnace

Fig3. CRH

Fig 4. Powered Rice Husk Ash

The residual husk is washed with distilled water and heated to 100˚C in a hot air oven for 30 minutes in order to remove the moisture content. The carbonized husk is powdered and sieved in 300µ sieve. 500ml of dye water is taken in a glass jar. The powdered rice husk ash is added to the effluent water and mixed thoroughly by vibrating through Jar apparatus it for about 10 minutes. Initial amount of absorbance is noted and the solution is allowed to settle. For every 4 hours the amount of absorbance is noted using a spectrophotometer and it is continued for 24 hours (Fig 3, 4, 5, 6). The Spectrophotometer is set at a wavelength of 546nm. The values are tabulated and the graph is plotted with time in X-axis and absorbance in Y-axis.

Fig 5. RHA mixed With dye

Fig 6. Vibrating in a jar apparatus

3.1. INITIAL CHARACTERISTICS OF DYE

The Physicochemical characteristics of dyeing effluent is shown in Table 1.

3.1.1. TOTAL SOLIDS (TS):

Total solids are the measure of the suspended and dissolved solids in water. It is generally measured in mg/l. The total solids value is used to assess the reuse potential of waste water and to determine the most suitable type of treatment process.

$$\text{Total solids } (\bar{TS}) = \frac{(W_2 - W_1)}{20x10^6} \text{ mg/l}$$

3.1.2. TOTAL SUSPENDED SOILDS:

Total suspended are solids in water that can be trapped by a filter it includes a wide variety of materials such as silt, decaying plants and animal matter, industrial waste and sewages. High concentration of suspended solids can cause many problems for stream health and aquatic life. It can lower water quality by absorbing light.

3.1.3. TOTAL DISSOLVED SOILDS:

Total dissolved solids is a measure of the combine contents of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular suspended form. It can be measure in mg/l or in ppm (parts per million)

Total dissolved solids (TDS) = TS – TSS Levels of TDS in mg/l

- ➢ Less than 300 : Excellent
- ➢ 300-600 : Good
- ➢ 600-900 : Fair
- ➢ 900-1200 : Poor
- ➢ Above 1200 : Unacceptable

3.1.4. BIOCHEMICAL OXYGEN DEMAND (BOD):

Biochemical oxygen demand is the amount of dissolved oxygen need by aerobic biological organisms to breakdown organic material present in a given water sample at certain temperature over a specific time period. It is also called as biological oxygen demand. The BOD value is mostly expressed in mg/l.

Table 1. Physiochemical characteristics of dyeing effluent

Characteristics	Method of analysis	Textile effluent	IS tolerance limit IS-2490-1981
Color	Visual	Dark blue	NM
Turbidity	Visual	Turbid	NM
pH	Using Digital	6	5.5 – 9
Total Suspended	Filtration method	0	100
Total Dissolved Solids(mg/l)	Filtration method	27500	210
Chemical Oxygen	Open reflux titri	520	250
Biological oxygen Demand	Open reflux titri	110	30
Total	Filtration Method	27500	-
Phosphate	Turbid metric	555.8	-
Calcium	Flame photo metric	1	NM
Nitrate	By	775.7	45
Sodium	Flame photo metric	16	NM
Potassium	Flame photo metric	14	2

3.1.5 CHEMICAL OXYGEN DEMAND (COD):

Chemical oxygen demand test is commonly used to in directly measure the amount of organic compounds in water. It determines the amount of organic pollutants found in surface water or waste water it is expressed in mg/l.

3.1.6. DISSOLVED OXYGEN:

Dissolved Oxygen is the amount of gaseous oxygen dissolved in water. Oxygen enters the water by direct

3.1.7 OBSERVATION TIME:

Observation time indicates how long it takes for an amount of waste water to pass through a tank at a given flow. 5ml of Ortho Phosphoric Acid is mixed with 10gms of rice husk and mixed with 500ml of effluent (Table 2).

Table 2. Effect of Observation time

S.No	Amount of adsorbent (in gm)	Amount of acid (in ml)	Time in hrs	Absorbance in NTU
1	10	5	0	1.55± 0.532
2	10	5	4	0.474±0.154
3	10	5	8	0.457±0.070
4	10	5	12	0.420±0.021
5	10	5	16	0.313±0.050
6	10	5	20	0.258±0.847
7	10	5	24	0.255±0.654

3.1.8 ADSORBENT RATE AND ITS EFFECT:

Adsorbent is a substance that is usually porous in nature with high surface area that can adsorb substances onto its surface with the help of intermolecular forces. The dye mixed waste water was tested for different amounts of adsorbents keeping the contact time constant i.e. 24 hours. The uptake of dye for each sample was studied using spectrophotometer and the results were tabulated in Table 3. The graph was plotted for the observed values

Table 3. Removal Efficiency for various rate of adsorbent

S.No	Amount of adsorbent in gm	Amount of acid in ml	Absorbance in NTU after 24 hours
1	5	2.5	0.312±0.941
2	10	5	0.255±0.645
3	15	7.5	0.167±0.341
4	20	10	0.124±0.050
5	25	12.5	0.129±0.328

3.1.9. pH

pH is the measure of hydrogen ion concentration of a solution. Solutions with higher concentration of hydrogen ion have low pH and solutions with low concentration have high pH. Pure water should have pH of 7. Solution with pH below 7 is termed as acidic and solution with pH above 7 is termed as basic.

3.1.10 EFFECT OF pH

pH is is an important factor in controlling the removal of dye from the effluent. The pH of the textile effluent was found to be 6 i.e. the dye was in acidic state and it was observed that when the pH changes to more acidic, decolourisation was found to be inefficient.

3.1.11 DEGRADATION OF RICE HUSK

Degradation of rice husk is a process by which it gets contaminated by dye from the textile effluent. When degradation reaches its maximum limit, the efficiency of dye removal is said to be maximum. On degradation rice husk loses its further ability of absorbing dye.

3.1.12. SCREENING FOR DYE DEGRADATION CAPACITY OF RICE HUSK

Isolated rice husk were assessed for their dye degradation capacity.100 ppm of stock solution was prepared. From the stock solution, various concentrations namely 1 ppm, 2 ppm, 3 ppm, 5 ppm, 10 ppm, 15 ppm, 25 ppm and 50 ppm of dye solutions were prepared. The absorbance was measured, and the standard graph was plotted. The slope of the calibration line was determined (Fig 7) by using the formula given below.

C_f = Absorbance / Slope of calibration plot

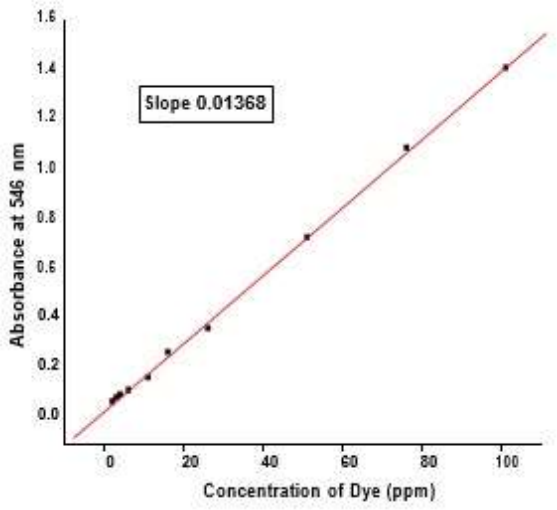

Fig 7. Concentration of dye vs Absorbance

3.1.13 EFFICIENCY OF ISOLATED RICE HUSK ON DYE DEGRADATION:

Different volumes of rice husk were kept under observation at 37ºC for a period of 4 to 24 hours. The degrading capacities of the rice husk were determined by withdrawing the samples at 4, 8, 12, 16, 20 and 24 hrs from the time of inoculation. The samples were read spectrophotometrically at 546nm and the percentage of degradation efficiency was determined.

The percentage of dye degradation was then calculated as follows:

$$\%\text{Degradation} = (C_i - C_f) \times 100$$

where,

C_i is the initial concentration of the dye (NTU)

C_f is the final concentration of the dye (NTU)

Table 4. Percentage Degradation of RH

S. No	Initial concentration (Ci) in NTU	Final concentration (Cf) in NTU	% of degradation (Cf-Ci)*100)/Ci)
1	0.01368	1.55	75.52
2	0.01368	0.585	80.25
3	0.01368	0.494	81.22
4	0.01368	0.385	82.85
5	0.01368	0.304	83.65
6	0.01368	0.256	84.88
7	0.01368	0.105	86.66

From Table 4 it was found that, the percentage degradation of dye is 86.66 % and later on RH loses its ability to adsorb dyes.

4. CONCLUSION

For treating 500ml of textile effluent, 15gms of rice husk is found to be appropriate. More than 15gms of rice husk cause turbidity. Degradation efficiency of rice husk was found to be 86.66%.The present study suggests that the treated textile effluent can be reused in textile mills for dyeing, processing and finishing purpose. It can also be used for irrigation by the farmers on the basis of the fact that the effluents may serve as a potential source of fertilizer.

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