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# Efficiency of Activated Teak Leaves and Banana Trunk in the Removal of Synthetic Dye from Aqueous Solution

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## Abstract

This paper deals with two low cost, locally available renewable bio-absorbents Banana trunk and Teak leaves are used in the removal synthetic dye from aqueous solution. The effect of dye concentration, bio-absorbent particle size, quantity of bio-absorbent, effective absorbance and applicability of Langmuir and Freudrich isotherms were examined. One gram of teak leaves was found to be better bio-absorbent in removing the 80% of the dye from a synthetic effluent at a particle size of 2mm x 4 mm and 91% at 600 micron adsorption of dyes by teak leaves occurred at a faster rate in comparison to Banana trunk. Both isotherms were found to be applicable in the case of dye adsorption using Teak leaves.
**Keywords: Activated carbon, Teak Leaves, Banana Trunk, Chemical Activation, Adsorption Capacity**

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## I. Introduction

Since the dawn of civilization humans have been fascinated by color. In the primitive era humans explored the natural resources of dyes available in flora and fauna for the coloration of textile fiber, marking the beginning of colorful life style and what followed the next was the invention of the first synthetic dye Maure (Maureine) by Parkin (1856). This event created renaissance and is often associated with pioneering times of British Chemical Industry. As a consequence of all the developments, at present there are more than 1,00,000 dyes available commercially (of which azo dyes represent about 70% on weight basis) and over 1 million tons of dyes are produced per year, of which 50% are textile dyes. In India alone dyestuff industry produces around 60,000 metric tons of dyes, which is approximately 6.6% of total colorants used worldwide. The largest consumer of the dyes is textile industry accounting for two third of the total production of the dye [2]. . Industrialization is the back bone for the development of any country, but the pollution caused by these industries are matter of concern. Due to the prevailing demands, it has led to large scale production which in-turn ads to the effluents produced. These effluents are highly toxic and deleterious. Dyes are extensively used in many industries such as textiles, leather, paper, wool, printing and cosmetics [3]. . Methylene blue (MB) is used in some of the textile industries has adverse impact on the flora and fauna and aquatic ecosystems .therefore, it is essential to minimize the number of dyes to the lowest possible limit approved by the Environment and Health agencies [4]. The waste water comes from textile dying is difficult to treat satisfactorily because of high composition variability and high color intensity. It is essential that approximately 2% of dyes produced are discharged directly in aqueous effluents and 10% subsequently lost during the coloration process.

## II. Materials

The materials used in the present investigation are Teak leaves (Tectonagrandis) Banana trunk (Musa) (Adsorbents), Methylene blue dye, 0.1 N –$HNO_3$ (nitric acid), 98% $H_3PO_4$ (Orthophosphoric acid)) (Chemicals). The apparatus used are Hot air oven, Muffle furnace, Magnetic stirrer, Centrifuge and Photoelectric Colorimeter

## III. Methodology

The methodology followed in the present investigation has been given in the form of flow chart (Figure 1). The 5 ppm stock solution was prepared by using the de-ionized water and powder form of Methylene blue dye (MB). The quantity taken is 5mg of MB and mixed in the 1000ml of de-ionized water and it was placed on the magnetic stirrer to have homogenous mix and further used as stock solution.

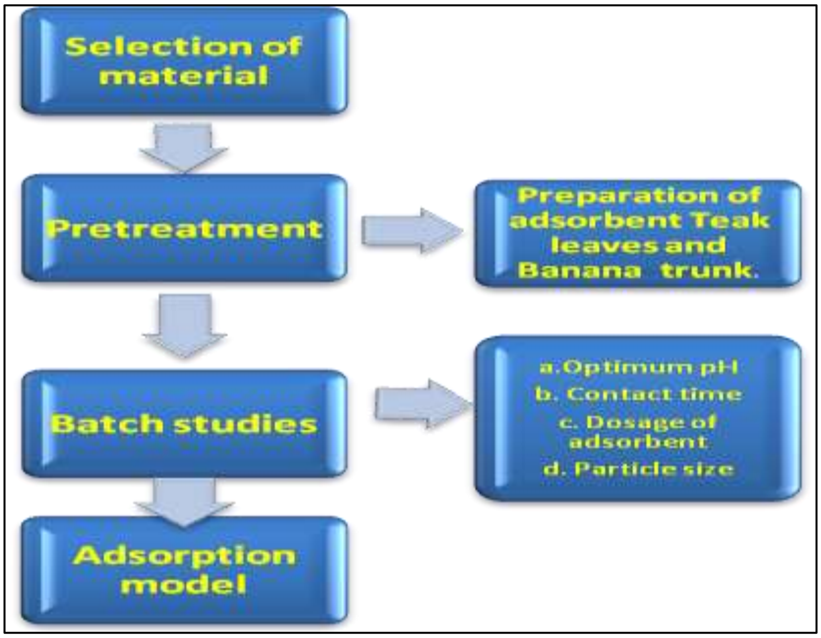


Fig. 1: Showing the Flow chart of the experiment conduction.

To check the compatibility with Beer-Lambert's law the results are tabulated in Table 1.and a graph has also been plotted (Figure 2). The test parameters considered for the investigation of Tectona Grandis (Teak leaves) and Banana trunk are particle size, effective dosage, contact time and optimum pH. The results for each parameter have been tabulated in Table 2.

Table – 1
Showing the OD value of different concentrations of the 5ppm stock solution.

| *Effluent Soln (ml)* | *Distilled water (ml)* | *Optical density* | *Concentration in mg/ml* |
|---|---|---|---|
| *0* | *10* | *0.00* | *0* |
| *2* | *8* | *0.05* | *0.005* |
| *4* | *6* | *0.15* | *0.010* |
| *6* | *4* | *0.21* | *0.015* |
| *8* | *2* | *0.26* | *0.020* |
| *10* | *0* | *0.34* | *0.025* |

Table – 2
Particle size for Tectona Grandis

| *Sl.No* | *Adsorbent* | *Initial OD* | *Final OD* | *Efficiency %* |
|---|---|---|---|---|
| *1* | *Coarse >425 micron* | *0.34* | *0.02* | *94.12* |
| *2* | *Fine <425 micron* | *0.34* | *0.01* | *97.06* |

For the particle size parameter the quantity stock solution taken is 100ml and it remains constant for the test runs [1]..

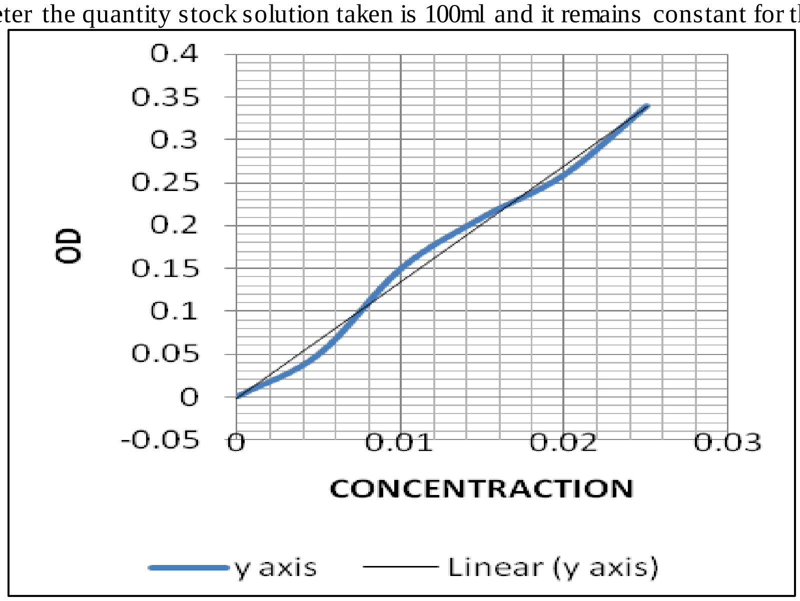


Fig. 2: Graph showing OD v/s Conc. The linearity of the graph showing that it obeys Beer-Lambert law.

## IV. RESULTS AND DISCUSSION

In the present investigation the quantity of Methylene Blue (MB) taken is 5mg and it is mixed in the 1000ml of de-ionized water and it was placed on the magnetic stirrer to have homogenous mix and further used as a stock solution. The test parameters considered in the present investigation of Tectona Grandis and Banana Trunk are Particle size, Effective Dosage, Contact time and Optimum pH. The details of the tests carried out for the Tectona Grandis have been tabulated in Tables 2, 3, 4, and 5. Since efficiency of fine adsorbent is more thus it is selected as efficient particle size. The dosage of 1mg/ml is adopted as effective dosage. The contact time of 30 min is adopted as efficient contact time. The efficient adsorption is in alkaline range. The details of the tests carried out for the banana trunk have been tabulated in Tables 6,7,8 and 9. Since the efficiency of the fine adsorbent is more thus it is selected as an efficient particle size. The dosage of the 0.5mg/ml is adopted as an effective dosage. The contact time of 30 min is adopted as efficient contact time. The efficient adsorption is in alkaline range.

Table – 3
Dosage for Tectona Grandis.

| *Sl no* | *Dosage (mg/ml)* | *Initial OD* | *Final OD* | *Efficiency (%)* |
|---|---|---|---|---|
| 1 | 0.005 | 0.34 | 0.24 | 29.41 |
| 2 | 0.10 | 0.34 | 0.20 | 41.18 |
| 3 | 0.20 | 0.34 | 0.14 | 58.82 |
| 4 | 0.25 | 0.34 | 0.12 | 64.70 |
| 5 | 0.50 | 0.34 | 0.05 | 85.29 |
| 6 | 0.75 | 0.34 | 0.04 | 88.24 |
| 7 | 1.0 | 0.34 | 0.01 | 97.1 |
| 8 | 0.50 | 0.34 | 0.01 | 97.06 |
| 9 | 2.0 | 0.34 | 0.01 | 97.06 |
| 10 | 3.0 | 0.34 | 0.00 | 100 |

Table – 4
Contact time for Tectona Grandis.

| *Sl no* | *Contact time in min* | *Initial OD* | *Final OD* | *Efficiency (%)* |
|---|---|---|---|---|
| 1 | 5 | 0.34 | 0.07 | 79.41 |
| 2 | 10 | 0.34 | 0.05 | 85.3 |
| 3 | 20 | 0.34 | 0.03 | 91.18 |
| 4 | 30 | 0.34 | 0.01 | 97.1 |
| 5 | 40 | 0.34 | 0.01 | 97.1 |
| 6 | 50 | 0.34 | 0.00 | 100 |

Table – 5
Optimum pH. for Tectona Grandis.

| *Sl no* | *Effluent pH* | *Initial OD* | *Final OD* | *Efficiency (%)* |
|---|---|---|---|---|
| 1 | Acidic(2.48) | 0.34 | 0.03 | 91.18 |
| 2 | Normal(8.24) | 0.34 | 0.01 | 97.1 |
| 3 | Alkaline (11.11) | 0.34 | 0.00 | 100 |

Table – 6
Particle Size for Banana Trunk

| *Sl.no* | *Adsorbent* | *Initial OD* | *Final OD* | *Efficiency (%)* |
|---|---|---|---|---|
| 1 | Coarse >425 micron | 0.32 | 0.02 | 93.75 |
| 2 | Fine <425 micron | 0.32 | 0.01 | 96.88 |

Table – 7
Dosage for Banana Trunk

| *Sl no* | *Dosage (mg/ml)* | *Initial OD* | *Final OD* | *Efficiency (%)* |
|---|---|---|---|---|
| 1 | 0.05 | 0.32 | 0.21 | 34.38 |
| 2 | 0.10 | 0.32 | 0.16 | 50.00 |
| 3 | 0.20 | 0.32 | 0.12 | 62.50 |
| 4 | 0.25 | 0.32 | 0.03 | 90.63 |
| 5 | 0.50 | 0.32 | 0.01 | 96.88 |
| 6 | 0.75 | 0.32 | 0.01 | 96.88 |

Table – 8
Contact Time for Banana Trunk

| *Sl no* | *Contact time in min* | *Initial OD* | *Final OD* | *Efficiency (%)* |
|---|---|---|---|---|
| 1 | 5 | 0.32 | 0.07 | 78.13 |
| 2 | 10 | 0.32 | 0.06 | 81.25 |
| 3 | 20 | 0.32 | 0.02 | 93.75 |
| 4 | 30 | 0.32 | 0.01 | 96.88 |
| 5 | 40 | 0.32 | 0.01 | 96.88 |

Table – 9
Optimum pH for Banana Trunk

| *Sl no* | *Effluent pH* | *Initial OD* | *Final OD* | *Efficiency in %* |
|---|---|---|---|---|
| *1* | *Acidic(2.48)* | *0.32* | *0.01* | *96.88* |
| *2* | *Normal(8.24)* | *0.32* | *0.01* | *96.88* |
| *3* | *Alkaline (11.11)* | *0.32* | *0.00* | *100* |

The test parameters considered in the present investigation of Tectona Grandis and Banana Trunk are Particle size, Effective Dosage, Contact time and Optimum pH. The details of the tests carried out for the Tectona Grandis have been tabulated in Table 2, 3, 4, and 5. Since efficiency of fine adsorbent is more thus it is selected as efficient particle size. The dosage of 1mg/ml is adopted as effective dosage. The contact time of 30 min is adopted as efficient contact time. The efficient adsorption is in alkaline range. The details of the tests carried out for the banana trunk have been tabulated in Table 6,7,8 and 9. Since the efficiency of the fine adsorbent is more thus it is selected as an efficient particle size. The dosage of the 0.5mg/ml is adopted as an effective dosage. The contact time of 30 min is adopted as efficient contact time. The efficient adsorption is in alkaline range

## V. CONCLUSIONS

From the above results it can be concluded that the efficiency of banana trunk adsorbent (Musa) is comparatively higher than that of the Teak leaves (Tectona grandis). This is based on the test parameter no: 2 ie; test for effective dosage. The quantity of the adsorbent required in case of Tectona grandis is 100mg and to that of Musa is 50mg for the same volume of the effluent sample (100ml). It is seen that only half the quantity of musa adsorbent is required for the same volume of effluent dye degradation. Thus, Banana trunk adsorbent (musa) is much more efficient than teak leaf (Tectona grandis).

## ACKNOWLEDGEMENT

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