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Utilization of eucalyptus bark powder as low-cost adsorbent for the removal of methylene blue dyes from wastewater and comparison with activated charcoal

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Abstract
Dyes and pigments have been used in many industries for coloration purposes. There is a considerable need for the removal of colour from wastewater or effluents from dye industries. The use of low-cost and eco-friendly adsorbents had been investigated as an ideal alternative to the current expensive methods of removing dyes from wastewater. The aim of this study is to investigate the adsorption potential of Eucalyptus Bark Powder as a low cost adsorbent for Methylene Blue (MB) dye, and compare the result with Charcoal Powder (standard adsorbent).The adsorption was studied of different Methylene Blue (MB) dye concentration using batch technique.

Keywords: Eucalyptus Bark Powder, Methylene Blue, Adsorption

INTRODUCTION

Dyes and pigments are highly visible material. Thus even minor release into the environment may cause the appearance of colour, for example in open waters, which attracts the critical attention of public and local authorities. Dyes even in low concentrations affect the aquatic life and food web. The discharge of coloured wastes into streams not only affects the aesthetic nature but also interferes with transmission of sunlight into streams and therefore reduces photosynthetic activity. The removal of dyes from wastewater is of great concern, since some dyes and their degradation products maybe carcinogens and toxic and, consequently, their treatment cannot depend on biodegradation alone.[2]

Adsorption has been found to be superior to other techniques for water re-use in terms of initial cost, flexibility and simplicity of design, ease of operation and insensitivity to toxic pollutants.

Adsorption processes using activated carbons are widely used to remove pollutants from wastewaters. Due to high cost of commercial carbon the economically beneficial agro waste materials are effectively used for the removal of dyes from waste water.

In present work comparative study of Methylene Blue (dye) adsorption on Eucalyptus Bark Powder (adsorbent) and Activated Charcoal Powder in same condition is performed. The activated charcoal powder is purchased from market; and eucalyptus bark powder is prepared in laboratory for present work. The activated charcoal is costly adsorbent, but eucalyptus bark powder is easily available in India.

Methylene Blue (MB) is one of frequently used dyes. MB is a dark green powder or crystalline solid which can dissociates in aqueous solution. This dye is usually used for coloring paper, temporary hair colorant, dyeing cottons, silk and wools, and coating for paper stock, etc. [4]

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METHODOLOGY STEPS

Colour removal methods

The technologies for Colour removal can be divided into three categories: biological method, chemical method and physical method. All of them have advantages and drawbacks [5].

Adsorption (physical method) has been found to be superior to other techniques for water re-use in terms of initial cost, flexibility and simplicity of design, ease of operation and insensitivity to toxic pollutants. Adsorption also does not result in the formation of harmful substances. Due to its effectiveness and versatility, activated carbon is widely employed in water and wastewater treatment [2].

Dyes to be removed

Methylene Blue (MB) is a hetero cyclic aromatic chemical compound with the molecular formula $C_{16}H_{18}N_3SCl$.At room temperature it appears as a solid, odorless, dark green powder, which yields a blue solution when dissolved in water. The hydrated form has 3 molecules of water per molecule of methylene blue. It's IUPAC Name is 3, 7-bis (Dimethylamino)-phenothiazin-5-ium chloride. [8]

Methylene Blue (MB) is the most common among all other dyes of its category. Though methylene blue is not strongly hazardous, it can cause some harmful effects. Acute exposure to methylene blue can cause increased heart rate, vomiting, shock, Heinz body formation, cyanosis, jaundice, and tissue necrosis in humans. Therefore, the removal of such dye from effluents becomes environmentally important [2].

Adsorbent Used

1. Eucalyptus Bark Powder: - Eucalyptus bark is collected, washed and Sun dried afterthis it is grinded in domestic mixer grinder and washed with distilled water and dried in oven

at110°C for 30 minutes.

2. Charcoal Powder: - It is purchased from market manufactured by LOBA Chemie Laboratory reagents and fine chemicals [Grade: Charcoal Activated GR (Art.2691)].

Batch Adsorption

The adsorption experiments were carried out in a batch process with initial dye concentration 5,10 & 15 (mg/L) ,amount of adsorbent used is 2.5 & 5.0 (gm/L), particles which is used is passed with 1mm mesh (for making constant surface area for exposure) and time at which sample were taken for analysis was 5,10,15,20,25,30,35,40 (min.).Experiment was performed at room temperature (35 ± 2°C) on the month of May. From whole mixture approximately 5ml was taken out to separate the adsorbent and analyzed for dye content using UV-VIS-Spectrophotometer at 665 nm. This process was repeated for every sample withdrawn at different time intervals. The absorbance was recorded and concentration was noted from the standard curve "Absorbance-vs.-Concentration" The absorbance was recorded by using UV-VIS-Spectrophotometer at 665 nm. [7]

Formula Used

1. Adsorption density "q_t "was computed by the following equation:[2]

$q_t = \{(C_o - C_t)V\}/M$

2. Removal Efficiency is calculated by the following equation: [6]

$\% R = \{(C_o - C_t) / C_o\} \times 100$

Where, C_o = Initial dye concentration (mg/L)
C_t = Final dye concentration (mg/L)
V = Volume of the solution (L)
M = Mass of the dry adsorbent used (gm)
q_t = Adsorption density at any time t (mg MB/gm adsorbent)

OBSERVATION AND CALCULATION

The observations were taken for initial dye concentration 5, 10 & 15 mg Methylene Blue (MB) per liter of distilled water and amount of adsorbent used were 2.5gm & 5.0gm. The calculation has been done for effect of concentration of dye, effect of amount of adsorbent and effect of contact time

The concentration was noted and absorbance was recorded from the standard curve "Absorbance-vs.-Concentration". [figure:1]

Table1. Concentration vs. Absorbance.

Concentration	2.5	5.0	10	15	20	40
Absorbance	0.4	1.1	2.1	2.9	2.93	2.97

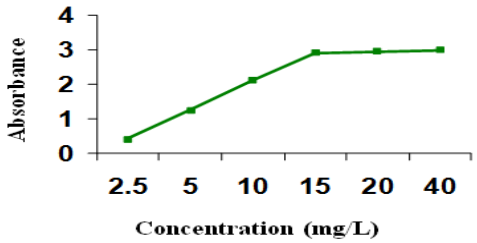

Fig 1. Concentration vs. Absorbance.

RESULT AND DISCUSSION

1. Percentage removal is increases (up to 91.4 %) as the dye concentration increases for Eucalyptus Bark Powder when 2.5 gm adsorbent is used. figure-2.

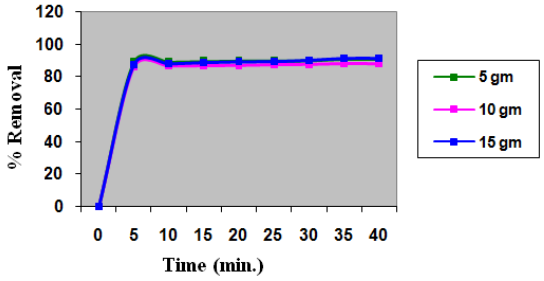

Fig 2. Effect of initial dye concentration on % Removal for adsorbent Eucalyptus Bark Powder (2.5 gm/L).

2. Percentage removal is increases (up to 94.3 %) as the dye concentration increases for Eucalyptus Bark Powder when 5 gm adsorbent is used.figure-3.

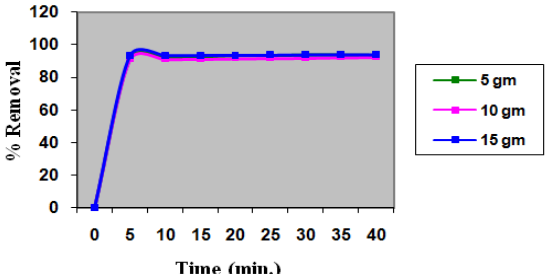

Fig 3. Effect of initial dye concentration on % Removal for adsorbent Eucalyptus Bark Powder (5 gm/L).

3. Percentage removal is increases (up to 99 %) as the dye concentration increases for Charcoal Powder when 2.5 gm adsorbent is used.figure-4.

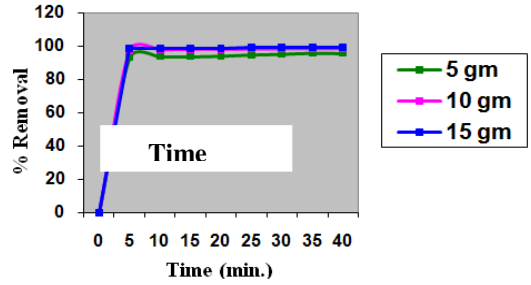

Fig 4. Effect of initial dye concentration on % Removal for adsorbent Charcoal

Powder (2.5 gm/L).

4. Percentage removal is increases (up to 98.6 %) as the dye concentration increases for Charcoal Powder when 5 gm adsorbent is used. figure-5.

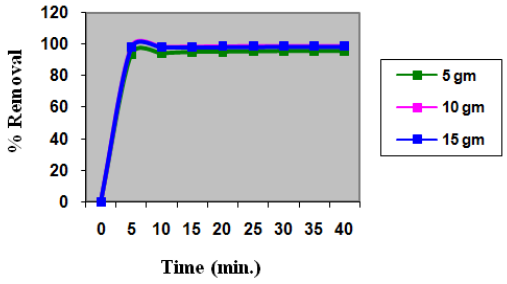

Fig 5. Effect of initial dye concentration on % Removal for adsorbent Charcoal Powder (5 gm/L).

5. For 2.5 gm adsorbent the percentage removal is decreases as Charcoal Powder >Eucalyptus Bark Powder > Tea Dust Waste (i.e. 99% > 91.4% > 89%). figure-6.

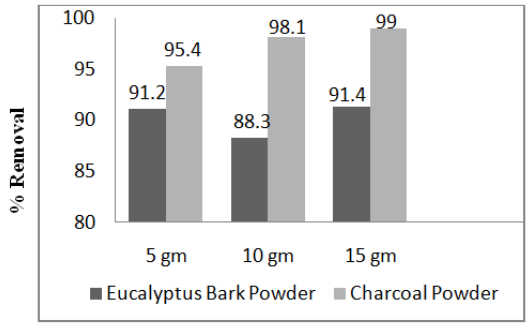

Fig 6. Comparison of Effect of initial dye concentration on % Removal for 2.5 gm adsorbent at 40 minutes.

6. For 5 gm adsorbent the percentage removal is decreases as Charcoal Powder > Eucalyptus Bark Powder > Tea Dust Waste (i.e. 98.6% > 94.3% > 88.7%). figure-7.

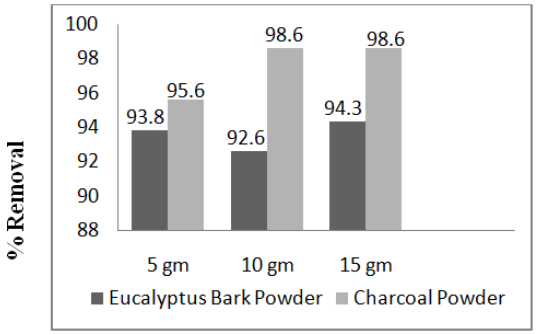

Fig 7. Comparison of Effect of initial dye concentration on % Removal for 5 gm adsorbent at 40 minutes.

CONCLUSION

The Eucalyptus Bark Powder could be used effectively for the removal of Methylene Blue (MB) dye from dye solutions. The amount of Methylene Blue (MB) adsorbed per unit mass of Eucalyptus Bark Powder was found to increase with increase in contact time and adsorbent dosage.

The maximum percentage removal of Methylene Blue (MB) in this study achieved is 99.0%,and 94.3% respectively for Charcoal Powder, and Eucalyptus Bark Powder. Therefore, the present study shows that the Eucalyptus Bark Powder can be effectively used as adsorbent for the colour removal from wastewaters. Since Eucalyptus Bark Powder is cheap and the availability is not restricted, regeneration is not necessary and is incinerated.

Future Scope of the Work

Present studies were focused on the colour removal of Methylene Blue (MB) dye at various dye concentration, contact time and amount of adsorbent. Some other parameters like temperature and pH are also recommended. The Eucalyptus Bark Powder is cheaper than Charcoal Powder but it is not compared with other adsorbents which are found suitable by other researchers.

This study was performed using synthetic dye solution at laboratory conditions. The results obtained may vary if applied to real samples. The real samples are in fact complicated because textile industries use a mixture of various types of dyes for different applications. Thus, a separate study focusing on the real wastewater is needed.

REFERENCES

[1]Ahsan Habib, Zahidul hasan, A.S.M. Shajedur Rahman and A.M. Shafiqul Alam, 2006. “Tuberose Sticks as an Adsorbent in the Removal of Methylene Blue from Aqueous Solution,” Pak.J.Anal. &Envir.Chem. 7 (2):112-115.

[2]Md. Tamez Uddin, Md. Rukanuzzaman, Md. Maksudur Rahman Khan & Md. Akhtarul Islam, 2009. “Jackfruit (Artocarpusheterophyllus) leaf powder: An effective adsorbent for removal of Methylene Blue from aqueous solutions,” Indian Journal of Chemical Technology.16:142-149.

[3]M.Sarioglu and U.A.Atay, 2006. “Removal of Methylene Blue by using Biosolid,” Global Nest Journal, 8 (2):113-120.

[4]Devarly Prahas, Yoga Kartika, Nani Indraswati, and Suryadi Ismadji, 2008. “The Use of Activated Carbon Prepared from Jackfruit (Artocarpus heterophyllus) Peel Waste for Methylene Blue Removal,” Journal Of Environmental Protection Science. 2: 1 – 10.

[5]Olugbenga Solomon Bello, Oladipo Mary Adelaide, Misbaudeen Abdul Hammed, Olalekan Abdul Muiz Popoola Macadonian, 2010. “Kinetic and equilibrium studies of Methylene blue removal from aqueous solution by adsorption on treated sawdust.”, Journal of Chemistry & Chemical Engineering.29 (1): 77-85.

[6]A.Rasheed Khan, Hajira Tahir, Fahim Uddin, Uzma Hameed, 2005. “Adsorption of Methylene Blue from aqueous Solution on the Surface of Wool Fiber & Cotton Fiber,” Journal of Applied Sciences & Environmental Management, 9 (2): 29-35.

[7]Rasika C.Torane,Kavita S.Mundhe, Ashish A. Bhave,.Gayatri S. Kamble,Rajshree V.Kashalkar and Nirmala R. Deshpande,

2010. “Removal of Methylene Blue from Aqueous Solution Using Biosorbent,” Der Pharma Chemica, 2(3):171-177.

[8] M.Sarioglu and U.A.Atay, 2006. “Removal of Methylene Blue by using Biosolid,” Global Nest Journal, 8(2):113-120, 2006.

[9] Alau K.K., Gimba C.E. and Kagbu J.A, 2010.“Removal of Dyes from Aqueous Solution Using Neem (Azadirachta Indica) Husk as Activated Carbon,” Applied Science Research, 2(5):456-461.