The Chitransh Academic & Research
International Journal of Multidisaciplinary Reseaech
An Online Peer Reviewed / Refereed Journal
Volume 01| Issue 4September|2025
ISSN: 3049-303X (Online)
Website: www.thechitranshacadmic.in

DECOLORISATION STUDY OF DYE EFFLUENT USING AN EFFECTIVE ADSORBENT

[1]Dr. Poonam Parihar, [2]Dr. Sarita Garg, [3]Dr. Sanjay Kumar Bansal,[4]Ruchi Rathore &[5] Dr. Manmohan Singh

[1,2,3]Professor,Jaipur Engineering College and Research Centre, Jaipur, Rajasthan

[4,5]Assistant Professor, Jaipur Engineering College and Research Centre, Jaipur, Rajasthan

ARTICLEDETAILS

Research Paper

Received: **30/08/2025**

Accepted: **10/09/2025**

Published: **30/09/2025**

Keywords: Adsorption kinetics, Adsorbents, malachite green.

ABSTRACT

The research aims to find out how well carbonblack coated with polyvinyl alcohol treats wastewater with low dye concentrations. The adsorption isotherm was investigated in relation to pH, concentration, and dose. Studies conducted to assess the ability of coated carbon black to adsorb dye from wastewater was found to be as an much effective adsorbent. An isotherm and batch kinetic experiment were carried out.

Introduction:

More than tonnes of dyes are produced each year, and there are many dyes that are sold commercially[1]. Wastewater containing coloured dye is produced as a byproduct of the dye's manufacture as well as its application in the textile and other industries. It is estimated that 10% of dyes produced each year are released into the environment by the textile and related industries, and 2% are released into the environment by manufacturing processes[2]. Wastewater from the dying process has high dissolved solids, high BOD, high COD, high color, and is alkaline[3]. Given that they are carcinogenic and detrimental to both humans and aquatic life, coloured wastes such as dyes and pigments are bad for the environment, Basic dyes are the brightest class of dyes and are used extensively.

The removal technique is ultimately determined by the sustainability, effectiveness, adaptability, and cost-effectiveness of the technology being validated. However, these technologies have drawbacks, such as high operating and maintenance costs, when it comes to handling large volumes of wastewater with low dye concentrations. Based on these factors, the adsorption method is deemed most appropriate for use in India. The primary adsorbent utilized in industry is activated charcoal. Depending on its intended use, activated charcoal is made in a range of physical forms, including granular forms for use in adsorption columns and powder forms for batch adsorption followed by filtering[4]. High-quality water can be produced through the economically feasible process of adsorption[5]. Adsorbents that are

Materials and Methods :*Preparation Of Activated Carbon From Jatropus curcus* :

The removal technique is ultimately determined by the sustainability, effectiveness, adaptability, and cost-effectiveness of the technology being validated. However, these technologies have drawbacks, such as high operating and maintenance costs, when it comes to handling large volumes of wastewater with low dye concentrations. Based on these factors, the adsorption method is deemed most appropriate for use in India. The primary adsorbent utilized in industry is activated charcoal. Depending on its intended use, activated charcoal is made in a range of physical forms, including granular forms for use in adsorption columns and powder forms for batch adsorption followed by filtering[4]. High-quality water can be produced through the economically feasible process of adsorption[5]

Preparation Of Coated Carbon Black:

1 gm of PVA is dissolved in 10 ml hot water (10% solution) as a result gel formation occurs. It is now mixed with 3, 5 and 7 grams of furnace black to make a thick paste. After that, activated carbon from *Jatropus curcus* dried stem is added to this paste. The obtained thick paste is then dried until lumps form.

CorrespondingAuthor:poonamparihar.chem@jecrc.ac.in

Fine powder is produced by further grinding the lumps. As an adsorbent, this coated carbon black powder is utilized.

Characterization study of chemically activated charcoal:

S.No.	Parameters	Result
1	Moisture content	7.32 %
2	Ash content	4.23 %
3	Nitrogen content	2.45 %
4	Carbon content	95.39 %
5	Fixed carbon content	87.05 %
6	Volatile content	0.38 %
7	Nitrogen content by Kjeldahl method	0.86 %
8	pH	05-Jul

Adsorption Experiment:

Using a stock solution, the adsorbent-adsorbate system was set up in batch mode at room temperature. Adsorption of the bromo cresol purple dye the adsorbents, coated carbon black and activated wood carbon, at varying pH values was compared. Dye solutions with varying concentrations (10–40 ppm) and pH values of 3, 5, 8, 10, and 12 were employed in the adsorption measurement. The system was constantly agitated throughout the experiment, and the solution was centrifuged and filtered through Whatman filter paper at the conclusion of each experiment. A UV-VIS spectrophotometer used to measure the dye's concentration at time intervals using a wavelength of abs. max

Isotherm of adsorption: The adsorption process, mechanism, and performance are frequently examined using the adsorption isotherms and kinetics. Imperatively, isotherms establish a relationship between adsorbates and adsorbents and provide information about adsorption systems, the adsorption process, and the surface properties of the adsorbents. Numerous characterization techniques and theoretical calculations are used to investigate the most fundamental sorption mechanisms. Known isotherm models like Freundlich and Langmuir isotherm fit the adsorption equilibrium data of dye.

CorrespondingAuthor:poonamparihar.chem@jecrc.ac.in

Results:

The result showed that the % removal of bromocresol purple for 40 ppm was found to be 86% and 94.2% at doses of 3g and 5g resp. at time 120 min. The adsorbent removes maximum of 82.5%, 81.8% and 75.35% of bromocresol purple dye at initial dye conc. of 40 ppm and 80 ppm at 90 min. While for the dye concentration of 40 ppm and 80 ppm it removes 86% and 78.4%. The adsorption of dye with adsorbent dose at various time intervals indicates that removal of dye initially increases with time. The % removal decreases with increase in dye concentration.

The data shows the amount of dye adsorbed at different times shows that the amount of dye (adsorbate) removed initially rises with time but eventually reaches equilibrium. The percentage of removal was found to decrease as the dye concentration increased. With an increase in time interval, the AW carbon, as an adsorbent, could remove dye at an initial dye concentration . It was found that when the concentration of dyes increases from 40 to 60 ppm, the percentage of dye removal decreases. According to the results, an adsorbent with an adsorbate concentration of 40 ppm was able to remove 90% and 80% of the dye from PVA-coated wood carbon and AW carbon, respectively, using 3 gm in 100 minutes. However, when 7 gm of adsorbents were used, the percentage removal rate of dye on Coated charcoal and Activated charcoal increased to 93% and 83%, respectively. Because of the adsorbent's increased surface area, the percentage of dye removed rises as the dose does. However, because of the adsorbent's saturation capacity, maximum adsorption is achieved after a specific dose.

Time(min)	% Ads (40ppm)	% Ads (60 ppm)	% Ads (80 ppm)
15	71.54	69.9	68.11
30	80.7	78.4	74.49
45	84	82	79.54
60	87.1	84.5	83.11
75	90	88	84.92
90	92	90.2	87
105	93.8	91.7	88
120	94.2	92.3	88.9

Table 1: Effect of contact time on adsorption of different concentration of a bromo cresol purple dye at an optimum dose of 5g.

CorrespondingAuthor:poonamparihar.chem@jecrc.ac.in

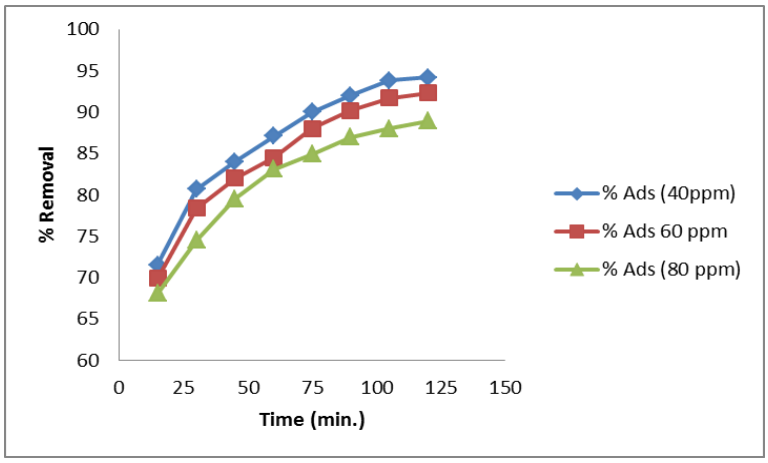
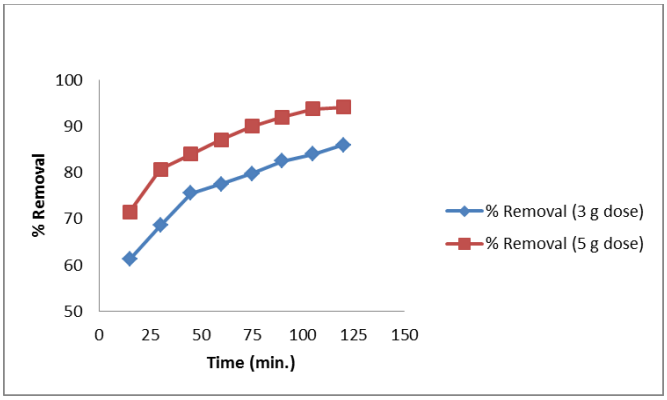


Fig.1. Effect of contact time on adsorption of different concentration of a bromocresol purple dye at an optimum dose of 5g.

Time(min)	% Removal (3 g dose)	% Removal (5 g dose)
15	61.22	71.54
30	68.56	80.7
45	75.5	84
60	77.5	87.1
75	79.8	90
90	82.5	92
105	84	93.8
120	86	94.2

Table 2: Effect of dose of activated charcoal on removal of bromocresol purple dye at constant concentration of 40 ppm



CorrespondingAuthor:poonamparihar.chem@jecrc.ac.in

Fig. 2: Effect of dose of activated charcoal on removal of bromocresol purple dye at constant concentration of 40 ppm.

Conclusion:

At low pH levels and concentrations, coated charcoal adsorbent is more efficient at removing the bromo cresol purple. When Coated wood charcoal is used as an adsorbent, both the amount of dye adsorbed and the rate of adsorption are higher than when activated charcoal is used.

1. REFERENCES

2. Francisco j.Cano.,*etal* (2024), *Adsorption of Dyes by Charcoal and Activated Charcoal from Moringa Oleifera Leaves.*
3. T.Robinson, G.Mc.Mullan, R.Marchant, P.Nigam,(2001) *Biores.Technol*
4. J.R.Easto , Ed.P.Cooper, Soc. , (1995) *Dyers colour in dyehouse effluent, colorists, The Alden Press,Oxford,*
5. Rajeshwari Sivaraj, Sivakumar, S., Senthilkumar, P., Subburam, V. (2001*) Carbon from cassava peel, an agricultural waste, as an adsorbent in the removal of dyes and metal ions from the aqueous solution. – Bioresource Technol*
6. Raghuvanshi, S. P. Raghav, A. K. Singh, R. and Chandra, A: (2002), *Investigation of Sawdust as Adsorbent for the Removal of Methylene Blue Dye in Aqueous Solutions, In Proceedings of International Conference for Water and Wastewater. – Perspectives in Developing Countries, (WAPDEC), International Water Association*
7. Singh, R. P., Singh Y., Gupta, N., Gautam, A., Singh, S., Chauhan, M. S., Kulshrestha, R. R., Bhati, M.,: (2001) *Decolarization of water containing Crystals Violet, Methylene Blue, Malachite Green and Rhodamine B using activated carbon, flyash, baggase and baggase. – Proc. 10th National Symposium on Environment India.*
8. Arivoli S, (2007) *Kinetic and thermodynamic studies on the adsorption of some metal ions and dyes onto low cost activated carbons .*

CorrespondingAuthor:poonamparihar.chem@jecrc.ac.in