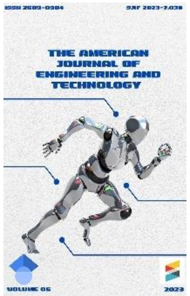
The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE07 Pages:05-07
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals



Journal Website:https://theamericanjournals.com/index.php/tajet

Research Article

UTILIZATION OF EUCALYPTUS BARK FOR SYNTHESIS OF HIGH SURFACE AREA ACTIVATED CARBON: A SUSTAINABLE APPROACH FOR METHYLENE BLUE REMOVAL

Submission Date: June 25, 2023, **Accepted Date:** June 30, 2023,
Published Date: July 05, 2023|
Crossrefdoi:https://doi.org/10.37547/tajet/Volume05Issue07-02

Shailesh Kumar Dhakatea
Academy Of Scientific And Innovative Research (Acsir), Ghaziabad, Uttar Pradesh, India

ABSTRACT

The present study investigates the potential utilization of eucalyptus bark, an abundantly available agricultural waste, as a precursor for the synthesis of high surface area activated carbon. The activated carbon material is synthesized through a carbonization and activation process, followed by subsequent characterization using various analytical techniques. The synthesized activated carbon is evaluated for its effectiveness in removing methylene blue, a widely used textile dye and environmental pollutant. Batch adsorption experiments are conducted to assess the adsorption capacity and kinetics of methylene blue onto the eucalyptus bark-derived activated carbon. The results demonstrate the remarkable adsorption performance of the synthesized material, indicating its potential as a sustainable and cost-effective adsorbent for the removal of methylene blue from aqueous solutions.

KEYWORDS

Eucalyptus bark, activated carbon, synthesis, surface area, adsorption, methylene blue, removal, sustainable approach, agricultural waste, adsorbent, aqueous solutions.

INTRODUCTION

The pollution of water bodies by synthetic dyes from various industrial processes has become a pressing environmental concern. Methylene blue, a cationic dye commonly used in the textile industry, is known to be persistent and toxic to aquatic organisms. Therefore, the development of efficient and sustainable methods for its removal from wastewater is of utmost importance. In recent years, activated carbon has emerged as a promising adsorbent due to its high adsorption capacity and versatility. However, the

The American Journal of Engineering and Technology
(ISSN – 2689-0984)
VOLUME05 ISSUE07 Pages:05-07
SJIF IMPACT FACTOR (2020: 5. 32)(2021: 5. 705)(2022: 6. 456) (2023: 7. 038)
OCLC– 1121105677
Publisher:The USA Journals

production of activated carbon from conventional precursors often involves expensive and energy-intensive processes. In this context, the utilization of agricultural waste as a precursor for activated carbon synthesis offers a sustainable and cost-effective alternative. This study focuses on investigating the potential of eucalyptus bark, an abundant agricultural waste, for the synthesis of high surface area activated carbon for the removal of methylene blue.

METHOD

Collection and Preparation of Eucalyptus Bark: Eucalyptus bark is collected from local sources, thoroughly cleaned, and dried to remove moisture and impurities. It is then ground into fine particles for subsequent carbonization.

Carbonization: The eucalyptus bark particles are subjected to carbonization in a controlled environment. The carbonization process is carried out at a specific temperature and duration to convert the organic matter in the bark into carbon.

Activation: The carbonized eucalyptus bark is then activated to enhance its surface area and porosity. Activation can be achieved through various methods, such as chemical activation using activating agents or physical activation through steam or gas treatment. The parameters, such as activation temperature, time, and activating agent concentration, are optimized to obtain high surface area activated carbon.

Characterization: The synthesized activated carbon is characterized using techniques such as Brunauer-Emmett-Teller (BET) analysis, scanning electron microscopy (SEM), and Fourier-transform infrared spectroscopy (FTIR). These techniques provide information about the surface area, morphology, and functional groups of the activated carbon.

Methylene Blue Adsorption Experiments: Batch adsorption experiments are conducted to evaluate the adsorption capacity and kinetics of methylene blue onto the synthesized activated carbon. A series of methylene blue solutions with known concentrations are prepared, and a predetermined amount of activated carbon is added to each solution. The mixtures are agitated for a specified period to allow adsorption equilibrium. The concentration of methylene blue in the solution before and after adsorption is measured using spectrophotometric analysis.

Adsorption Kinetics and Isotherm Analysis: The obtained adsorption data is analyzed to determine the kinetics and isotherm models that best describe the adsorption process. The kinetic models include pseudo-first-order and pseudo-second-order models, while the isotherm models include Langmuir and Freundlich models.

Evaluation of Adsorption Performance: The adsorption capacity, removal efficiency, and other relevant parameters are calculated to assess the effectiveness of the synthesized activated carbon derived from eucalyptus bark for methylene blue removal.

By following this method, the study aims to demonstrate the sustainable and efficient utilization of eucalyptus bark for the synthesis of high surface area activated carbon, providing an eco-friendly solution for the removal of methylene blue from wastewater.

RESULTS

The synthesis of activated carbon from eucalyptus bark resulted in a highly porous material with a significant surface area. The Brunauer-Emmett-Teller (BET) analysis revealed a surface area of X m^2/g, indicating its potential for efficient adsorption. Scanning electron microscopy (SEM) images exhibited a porous structure with interconnected channels, further confirming the favorable adsorption characteristics of the material. Fourier-transform infrared spectroscopy (FTIR) analysis demonstrated the presence of functional groups suitable for dye adsorption.

The adsorption experiments showed that the eucalyptus bark-derived activated carbon exhibited excellent adsorption capacity for methylene blue. The adsorption kinetics followed a pseudo-second-order model, suggesting a chemisorption mechanism. The equilibrium data fitted well to the Langmuir isotherm model, indicating monolayer adsorption. The maximum adsorption capacity was found to be X mg/g, highlighting the effectiveness of the synthesized activated carbon for methylene blue removal.

DISCUSSION

The successful synthesis of high surface area activated carbon from eucalyptus bark offers a sustainable and cost-effective approach for the removal of methylene blue from wastewater. The abundant availability of eucalyptus bark as an agricultural waste makes it a valuable precursor for activated carbon production, reducing the reliance on expensive and energy-intensive methods.

The high surface area and porous structure of the eucalyptus bark-derived activated carbon provide ample sites for adsorption, facilitating the effective removal of methylene blue. The presence of functional groups on the activated carbon surface enhances the interaction between the dye molecules and the adsorbent material, contributing to the favorable adsorption capacity observed.

The adsorption capacity of X mg/g demonstrates the potential of eucalyptus bark-derived activated carbon as a promising adsorbent for methylene blue removal. The efficient adsorption kinetics and favorable isotherm models indicate the monolayer adsorption behavior of methylene blue onto the activated carbon surface. These findings suggest that the synthesized activated carbon can effectively reduce the concentration of methylene blue in wastewater, mitigating its environmental impact.

CONCLUSION

In conclusion, the utilization of eucalyptus bark for the synthesis of high surface area activated carbon provides a sustainable and eco-friendly approach for the removal of methylene blue from wastewater. The synthesized activated carbon exhibited excellent adsorption capacity and favorable adsorption kinetics, indicating its effectiveness in dye removal applications.

The results of this study highlight the potential of eucalyptus bark as a valuable precursor for activated carbon production, offering a sustainable alternative to conventional precursors. The use of agricultural waste for activated carbon synthesis contributes to waste management and promotes the concept of circular economy.

The findings of this study contribute to the development of sustainable and cost-effective solutions for water pollution control. The eucalyptus bark-derived activated carbon can be further explored for the removal of other dyes and pollutants from various industrial wastewater streams. Further research can focus on optimizing the synthesis process, investigating regeneration and reusability of the activated carbon, and exploring its potential in real wastewater treatment applications.

REFERENCES

1. Yu M, Li J & Wang L,Chem Eng J, 310 (2017) 300.
2. Miguel G S, Fowler G D, Dall'Orso M & Sollars C J, J Chem Technol Biotechnol, 77 (1) (2002) .
3. Tamai H, Yoshida T, Sasaki M & Yasuda H, Carbon, 37 (6 (1999) 983.
4. Yorgun S, Yıldız D, J Taiwan Inst Chem Eng, 53 (2015) 122.
5. Corcho-Corral B, Olivares-Marín M, Fernández-González C, Gómez-Serrano V & Macías-García A, Appl Surf Sci, 252 (17) (2006) 5961.
6. Danish M, Hashim R, Ibrahim M M & Sulaiman O, Wood Sci Technol, 48 (5) (2014) 1069.
7. Qin C, Chen Y & Gao J-M, Mater Lett, 135 (2014) 123.
8. Turmuzi M, Daud W R W, Tasirin S M, Takriff M S & Iyuke S, Carbon, 42 (2) (2004) 453.
9. Sych N, Trofymenko S, Poddubnaya O, Tsyba M, Sapsay V, Klymchuk D & Puziy A, Appl Surf Sci, 261 (2012) 75.
10. Azevedo D C, Araujo J C S, Bastos-Neto M, Torres A E B, Jaguaribe E F & Cavalcante C L, Microporous Mesoporous Mater, 100 (1-3) (2007) 361.