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Environmental Nanotechnology, Monitoring and Management

Volume 16, December 2021, Article number 100594

Optimization study of caffeine adsorption onto large surface area wood activated carbon through central composite design approach(Article)

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Abstract

Activated carbon from Acacia mangium wood was prepared by chemical activation using H_3PO_4 under optimum conditions (OAMW-AC). In this study, a rotatable central composite design of response surface methodology was used to optimize the adsorption capacity of OAMW-AC against caffeine molecules. The maximum removal capacity of the OAMW-AC was found to be 29.2 mg/g under optimized conditions. The experimental results established optimized conditions for maximum caffeine removal were; 61 min of contact time, 3.0 g/L of adsorbent dosage, 100 mg/L of initial caffeine concentration, and 7.60 solution pH. The surface morphology, surface elemental composition, and surface functional group changes on the OAMW-AC were monitored by field emission scanning electron microscopy images, energy dispersive X-ray spectroscopy, and Fourier transform infrared spectroscopy, respectively. The characterization data showed OAMW-AC had a Brunauer-Emmet-Teller (BET) surface area of 1767 m^2/g with dominated mesopore area (94.8 %). The pH at the point of zero charges (pHzpc) was 2.25, and the negative value of proton binding capacity (Q = −0.23 mmol/g) showing proton dissociation from the carbon surface at pH above pHzpc. A desorption study of the caffeine through 95 % ethanol solution was also carried out. It was observed that 37.2 % of the adsorbed caffeine could be reclaimed from activated carbon. © 2021 Elsevier B.V.

SciVal Topic Prominence

Topic: Iodine Value | Activated Carbon | Adsorption

Prominence percentile: 99.313

Author keywords

Activated carbon | Adsorption | Caffeine | Optimization | Wood

Funding details

Funding sponsor	Funding number	Acronym
Deutscher Akademischer Austauschdienst See opportunities by DAAD		DAAD
Universiti Sains Malaysia	1001/PKIMIA/8011070	

Funding text #1

Funding information: This work was funded by the Universiti Sains Malaysia Research University Grant: 1001/PKIMIA/8011070 . Janine Birnbach was supported by DAAD RISE Worldwide grant for funding during the research internship.

Funding text #2

The authors are thankful to Universiti Kuala Lumpur-Malaysian Institute of Chemical and Bioengineering Technology (MICET), the School of Chemical Science, and the School of Industrial Technology, Universiti Sains Malaysia (USM) for providing research facilities during the study. Funding information: This work was funded by the Universiti Sains Malaysia Research University Grant: 1001/PKIMIA/8011070. Janine Birnbach was supported by DAAD RISE Worldwide grant for funding during the research internship.

ISSN: 22151532
Source Type: Journal
Original language: English
DOI: 10.1016/j.enmm.2021.100594
Document Type: Article
Publisher: Elsevier B.V.

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