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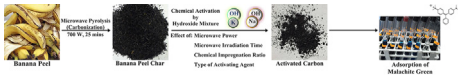
Microwave pyrolysis with KOH/NaOH mixture activation: A new approach to produce micro-mesoporous activated carbon for textile dye adsorption

Rock Keey Liew[a], Elfina Azwar[a], Peter Nai Yuh Yek[a,b], Xin Yi Lim[a], Chin Kui Cheng[c], Jo-Han Ng[d], Ahmad Jusoh[e], Wei Haur Lam[f], Mohd Danial Ibrahim[g], Nyuk Ling Ma[h], Su Shiung Lam[a,*]

[a] Pyrolysis Technology Research Group, Eastern Corridor Renewable Energy Group, School of Ocean Engineering, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[b] School of Engineering and Technology, University College of Technology Sarawak, Lot 88, Persiaran Brooke, 96000 Sibu, Sarawak, Malaysia
[c] Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia
[d] Faculty of Engineering and the Environment, University of Southampton Malaysia Campus, Iskandar Puteri, Johor, Malaysia
[e] School of Ocean Engineering, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[f] State Key Laboratory of Hydraulic Engineering Simulation and Safety, Tianjin University, Peiyang Park Campus, 135 Yaguan Road, Haihe Education Park, Tianjin 300350, People's Republic of China
[g] Department of Mechanical & Manufacturing, Faculty of Engineering, Universiti Malaysia Sarawak, Jalan Dato Mohd Musa, 94300 Kota Samarahan, Sarawak, Malaysia
[h] School of Fundamental Science, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia

GRAPHICAL ABSTRACT



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ABSTRACT

A micro-mesoporous activated carbon (AC) was produced via an innovative approach combining microwave pyrolysis and chemical activation using NaOH/KOH mixture. The pyrolysis was examined over different chemical impregnation ratio, microwave power, microwave irradiation time and types of activating agents for the yield, chemical composition, and porous characteristic of the AC obtained. The AC was then tested for its feasibility as textile dye adsorbent. About 29 wt% yield of AC was obtained from the banana peel with low ash and moisture (< 5 wt%), and showed a micro-mesoporous structure with high BET surface area ($\leq 1038\ m^2/g$) and pore volume ($\leq 0.80\ cm^3/g$), indicating that it can be utilized as adsorbent to remove dye. Up to 90% adsorption of malachite green dye was achieved by the AC. Our results indicate that the microwave-activation approach represents a promising attempt to produce good quality AC for dye adsorption.

1. Introduction

The global exportation of banana had shown an increment from USD 9 billion to USD 11 billion in 2015 (Workman, 2016), which indicated an increasing world demand for banana. Consequently, a significant amount of banana peel was generated by household and food processing industries after consumption. Banana peel is commonly disposed via landfilling that subsequently releases undesirable landfill gases (e.g. methane and carbon dioxide) to the atmosphere through microbial decomposition. These gases can absorb heat energy arising from the earth surface and in turn increase the earth temperature to promote global warming. Therefore, efforts should be made to mitigate global warming by reducing the source of these gases, which are derived from the large amount of waste disposed to the landfill.

Waste recovery using pyrolysis techniques represents a promising solution to divert banana peel from landfilling. Pyrolysis is a thermal decomposition process performed in an inert environment that can produce mainly three types of pyrolysis products: solid char, liquid oil,

* Corresponding author.
E-mail addresses: lam@umt.edu.my, sushiung@gmail.com (S.S. Lam).

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