UNIVERSITI TEKNOLOGI MARA

CONVERSION OF GRASS WASTE INTO ACTIVATED CARBON VIA PYROLYSIS ASSISTED H_3PO_4 AND KOH ACTIVATION FOR METHYLENE BLUE DYE REMOVAL

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
(Environmental Science and Technology)

Faculty of Applied Sciences

August 2023

ABSTRACT

Dye contamination in wastewater is one of the major sources which can cause water pollution and human health problem. Grass (*Imperata cylindrical*) (GIC) well knows as "*Lalang*" are agricultural wastes largely available in Malaysia, and it was disposed without non-economically values. In this study, GIC was utilized as a low-cost adsorbent, in order to prepare activated carbon by pyrolysis using phosphoric acid (H_3PO_4) and photassium hydroxide (KOH) activation method for adsorptive removal of methylene blue, a toxic dye from aqueous solution. The physical properties of the prepared raw grass cutting (RGC), modified grass cutting activated carbon acid (MGCACA), and modified grass cutting activated carbon base (MGCACB) were calculated through bulk density, iodine test, ash content, and moisture content. The characterization of RGC, MGCACA, and MGCACB were carried out using Elemental analyzer (CHNS-O), Brunauer-Emmet-Teller (BET) surface area, Scanning Electron Microscope (SEM), Fourier Transform Infra-Red Spectrometer (FTIR) and Point of Zero Charge (pH_{pzc}) method. Batch adsorption experiments were performed to evaluate the effect of the adsorbent dosage (0.02 – 0.14 g), pH solution (3 – 11), initial concentration (50 – 300 mg/L), and contact time (50 – 450 min) on the adsorption of the methylene blue dye. The result showed that the efficiency methylene blue removal was highest at dosage (0.04 g and 0.08 g) for MGCACA and MGCACB under adjusted pH (7) for MGCACA and pH (6.8) MGCACB respectively. Validation method from BBD-RSM model was prove that the efficiency methylene blue was highest at the similar condition with batch adsorption study. The Langmuir model describes the adsorption behavior at equilibrium. The maximum adsorption capacities of MGCACB (287.92 mg/g) are higher than MGCACA (268.32 mg/g). Meanwhile, Freundlich model for MGCACB was highest correlation coefficients (R^2=0.99) then MGCACA. However, for the Temkin model, both of the results were higher correlation coefficients (R^2) which are MGCACA (R^2=0.99) and MGCACB (R^2=0.99) respectively. The adsorption kinetics for MGCACA (R^2= ~0.99) and MGCACB (R^2= ~0.99) followed the Pseudo-Second-Order model. BET surface area of MGCACA and MGCACB was 616.26 m^2/g and 712.19 m^2/g respectively. The total pore volume of MGCACA and MGCACB was 4.05 nm and 12.22 nm, which mean mesoporous structure both of the samples. Therefore, the adsorption removal of methylene blue dye onto MGCACA and MGCACB was spontaneously with the condition behavior and parameters. The results showed the potential use of modified activated carbon developed from grass agricultural waste for the efficiency removal of methylene blue.

ACKNOWLEDGEMENT

Firstly, I wish to thank Allah SWT for giving me the opportunity to embark on my master's degree and for completing this long and challenging journey successfully. Words cannot express to my supervisor Dr. Nurul Nadiah Binti Mohd Firdaus Hum for his invaluable patience, endless support throughout the journey. His massive guidance in my journey will never be forgotten.

My appreciation goes to the lab assistances, Mr. Mumtaz, Mr. Faizal, Mrs. Najwa, Mrs. Nabila, and others who has helped me throughout the research work and for his availability for me to utilize the lab after office hours. Other than that, I would like to shoe my gratitude to the Faculty of Applied Sciences for the good facilities and convenience laboratory for my lab work process I would like to recognize my co-supervisors PM Ts. Dr. Tay Chia Chay who generously provided moral support along the process.

Special thanks to my colleagues and friends for helping me with this research. I am also grateful to my senior – Ms. Nurul Najwa binti Abdul Malek (PhD) for her never-ending support, late-night feedback sessions, moral support, and entertainment from the entire research work.

Lastly, I would be remiss in not mentioning my family especially my father – and also my siblings. Their belief in me has kept my spirits and motivation high during this process and for financially supporting me throughout the studies This piece of victory is dedicated to both of you. I would also like to thank both of my eldest sisters- Mrs. Nur Asma Hazwani and Mrs. Nur Aisyah for their advice to boost my confidence level and carry this battle to the end. Precious thanks to my beloved grandmother and my aunty, Noriah Binti Idris and Zakiah Binti Zakaria for her prayers for me to succeed from the start until submission of my thesis Alhamdulillah's.

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INTRODUCTION

1.2 Research Background

Recently, wastewater is one of the environmental problem, which can causes major effect to living and non – living organisms (Bharagave 2018; Murali & Uma, 2016) and it can be defined as effluent discharged from domestic and industrial. Domestic wastewater refers to the wastewater derived principally from dwellings, business buildings, institutions and the like; sanitary and sewage wastewater. As for the industrial wastewater, it can be defined as waste from the indsutrial process includes any activity of industrial, manufacturer and trade or business (Godswill & Somtochukwu, 2017).

Wastewater from the industries contain various of contaminants that leads to adverse effect on both human health and environment. However, some of the contaminants are nutrients such as nitrogen and phosphorus, heavy metals, hydrocarbon, organic matter, microbes and endocrine disruptors (Adejumoke et. al., 2018; Akpor et. al., 2014). Serious environmental impact could also come from dyes which can provoke the environmental impact on the neighboring receptor water bodies due to the presence of toxic reactive dyes, basic dye, azo dye, chrolignin residues and dark coloration (Hameed, 2008). Therefore, the first contaminant to be recogized in fresh water is dye and it has to be removed from wastewater before discharging into water bodies (Sharifi & Shoja, 2018; Edokpayi et. Al., 2017).

Various of industrial manufacturing uses dyes of their source. Textile, paper and pulp, plastic, food, cosmetic, distilleries, rubber and pharmaceutics are some of the industry which can cause water pollution to the environment (Sharifi & Shoja, 2018; Deshpande et. al., 2017). However, textile industry is one of the major industry produces the largest amount of dyes to colour fabric and it has been discharge into the water bodies (Yunus, 2013; Rita Kant, 2012). Without a proper wastewater treatment, the discharge of dyes into