

UNIVERSITI TEKNOLOGI MARA

**DEVELOPMENT OF MIXED
BIOMASS ACTIVATED CARBON
FOR SO₂ GAS ADSORPTION**

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Sciences

July 2019

ABSTRACT

The utilization of single and mixed biomass activated carbon (AC) has gained significant interest due to their efficiency towards sulphur dioxide (SO₂) adsorption. This research focus on the effectiveness of mixed biomass activated carbon with and without the presence of coal fly ash as a natural catalyst for SO₂ adsorption. Activated carbon from biomass namely coconut shell (CS-AC), rubber seed pericarp (RSP-AC) and their blending (CSRSP-AC) was successfully produced by using ZnCl₂ as chemical activating agent. Activation process was performed in commercial microwave oven at fixed power of 600 W and 20 minutes respectively. The effects of various parameters such as mixed ratio of coconut shell: rubber seed pericarp (g g⁻¹) (0:100, 20:80, 50:50, 80:20, and 100:0), impregnation ratio of ZnCl₂: mixed precursor (g g⁻¹) (0.5, 1.0, 1.5) and percentage of ZnCl₂ concentration as activating agent (30%, 40% and 50%) towards the efficiency of activated carbon were performed. The activated carbon was then characterized according to proximate and ultimate analysis, iodine analyses, methylene blue (MB) analysis, scanning electron microscope (SEM), pore structure characterization, X-ray fluorescence (XRF) and fourier transform infrared spectroscopy (FTIR). Activated carbon was characterized and used as adsorbent for SO₂ gas adsorption by using evolved gas analyzer. In order to identify the factors affecting adsorption breakthrough time, four independent variables were chosen i.e. effect of mixed ratio of activated carbon (CS: RSP), effect of mass load in combustion cell, effect of adsorption temperature and effect of additional of fly ash/Ca(OH)₂ towards SO₂ adsorption. The results showed that CSRSP-AC had the highest surface area of 584.68 m² g⁻¹ in comparison to CS-AC and RSP-AC with 445.9 m² g⁻¹ and 462.5 m² g⁻¹. The iodine number and MB number increased as the ZnCl₂ concentration increase from 30% to 50%. It was found that the activated carbon prepared using ZnCl₂ possesses good surface area for iodine and methylene blue adsorption. These findings were also in consistent with the surface morphology of the sample from SEM image. The major elements composition present in the coal fly ash detected were SiO₂ followed by Al₂O₃> Fe₂O₃> TiO₂> CaO> K₂O> P₂O₅. In this research, the adsorption of SO₂ gas pollutant towards single activated carbon (CS-AC and RSP-AC) and mixed activated carbon (CSRSP-AC) with the aid of fly ash in fixed bed reactor were studied. The amount of SO₂ gas adsorbed by single and mixed adsorbent was expressed as adsorption breakthrough time of SO₂ from flue gas. The best breakthrough time was recorded towards activated carbon with the mixed ratio of 20:80 (CS: RSP) and 5.0 g of sample loaded in combustion cell at 25 °C. It was found that addition of fly ash gave superior performance on the reaction of SO₂ breakthrough time up to 36 minutes. Scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX) and FTIR spectra analyses also proved the mixed CSRSP-AC (20:80; CS: RSP) is a good adsorbent since the sulphur element was detected after SO₂ adsorption with new bands appeared at 3399 cm⁻¹, 2559 cm⁻¹, 1372 cm⁻¹ and 1116 cm⁻¹ which is associated to S-OH group, S-H group, S=O group and O-SO₃ group, respectively.

ACKNOWLEDGEMENT

In the name of Allah, the most merciful and the most gracious. Alhamdulillah, praise be to Allah S.W.T. for giving me the opportunity and strength to explore and complete this research study.

First of all, I wish to convey my deep and sincere appreciation, and special thanks to my main supervisor, Professor Dr. Hj. Khudzir Hj. Ismail and co-supervisors, Dr Raja Ridzuan Raja Deris, for their exemplary guidance, monitoring and constant encouragement throughout the course of this thesis. Thanks a lot for giving advice and suggestion throughout this research until the final form. I have been very fortunate to be under their guidance. May Allah bless all of you.

I would like to express my gratitude to Ministry of Science, Technology and Innovation (MOSTI) Malaysia for providing me with the financial under E-Science fund grant scheme in order to pursue and complete this research study. Moreover, with this opportunity, I am also want to express my profound gratitude towards Malaysian Higher Education (KPM) for providing me with the financial fees under the MyBrain15 program.

I also would like to acknowledge to those who are direct or indirectly involved in this research work such as staff from Faculty of Applied Sciences. Their cooperation is highly appreciated. I am highly indebted to the authorities of MARA University of Technology (UiTM) for providing me various infrastructures like library, Internet access and permission include copyright which have enabled me to complete my research work successfully.

Last but not least, my greatest appreciation to my parents [REDACTED] and my husband, Mohd Fitri Smatsani for constant moral support, prayers, patience and sacrifice in term of materials, financial and emotions during the journey of my master. I also would like to thank my parents' in law and the whole family members for their encouragement and understanding to me in order to finish this study. Finally, I hope that the ideas, outcomes and findings from this research work will benefit and contribute to this area of knowledge. This piece of victory is dedicated to all of you.

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