UNIVERSITI TEKNOLOGI MARA

PREPARATION AND CHARACTERIZATION OF MOLYBDENUM OXIDE SUPPORTED ACTIVATED CARBON FOR OXIDATIVE-EXTRACTIVE DESULFURIZATION

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science
(Applied Chemistry)

Faculty of Applied Sciences

September 2022

ABSTRACT

Activated carbon derived from empty fruit bunch (AC-EFB) is seen as a potential catalyst to perform a desulfurization of fuel. However, due to its naturally small surface area and only relying on the activated carbon only, the desulfurization efficiency was not satisfying. Hence, surface modification and metal impregnation were subjected to the AC-EFB. This work aimed to investigate the performance of the potassium hydroxide (KOH) treated AC-EFB impregnated with molybdenum oxide (MoO_3) as a catalyst to remove organosulfur compound dibenzothiophene (DBT) from the model diesel, isooctane at an optimised reaction condition. The carbonized EFB was treated with pore activator potassium hydroxide (KOH) and impregnated with series of concentration of MoO_3 (5%, 10%, 15% and 20% wt%). The prepared catalysts were subjected to qualitative and quantitative characterizations such as thermal gravimetric analysis (TGA), X-ray diffraction (XRD), scanning electron microscopy (SEM), Brunauer–Emmett–Teller (BET) and X-ray fluorescence (XRF). The pore diameter of treated AC-EFB showed tremendous pore enlargement up to 4 ± 1 nm measured using Image J. The presence of MoO_3 impregnated on EFB was successfully identified using XRD and the BET analysis revealed that the surface area, pore volume and pore size of the carbonised EFB was initially 7.90 m^2g^{-1}, 0.02 cm^3g^{-1} and 8.04 nm while the EFB activated were significantly improved to 1575.50 m^2 g^{-1}, 0.83 cm^3g^{-1} and 2.12 nm, respectively, after subjected with KOH treatment. The actual wt% concentration of element MoO_3 impregnated on AC/ MoO_3 5%, AC/ MoO_3 10%, AC/ MoO_3 15% and AC/ MoO_3 20% was analysed using XRF showed a success of impregnation of 0.48%, 0.51%, 0.56% and 0.59% respectively. The highest result of desulfurization was obtained after performed the oxidative-extractive desulfurization (OEDS) under optimal conditions of oxidation (800 ppm DBT, 10 mL model diesel, 1:2 oxidant to sulfur (O:S) molar ratio and 10 minutes stirring at 30 °C with 0.1 g of AC/MoO_3 20%) followed by extraction (15 mL DMF, 30 °C and 5 minutes reaction time) that giving the maximum 98.3% of sulfur removal. The large surface area of the treated EFB provided large space for the MoO_3 20% to be dispersed widely on the EFB surface, allowing a more active site to interact with the DBT compound leading to approximately 100% of sulfur removal.

ACKNOWLEDGEMENT

First of all, thousands of grateful for The Almighty for giving me the chance and strength to complete my master degree pursue. With His blessing's, I made it through the end successfully.

As for my dearest supervisor, Dr Mohd Lokman Bin Ibrahim, countless thank you for always being there for me, restless giving morale support, endless motivational push, decent level of patience, sincerity and professionalism, encouragement and believe, all the kindness you had shown me. To my co-supervisor Dr Wan Nur Aini Wan Mokhtar, I cannot express enough how I was grateful for you had shown me the light and cleared my lost path and also not forgetting to Assoc Prof Raja Razuan Raja Deris. May Him granted them endless blessings.

I would like to thank all the laboratory assistants for their assistance and had shared knowledge throughout this enrolment. Special thanks to the Faculty of Applied Sciences (FSG) and Institute of Sciences (IOS) of Universiti Teknologi MARA (UiTM) for the facility aids.

The joy and great memories from my lab mates will always be remembered as they were parts of my journey in completing the study. Thank you for all the knowledge sharing, support, tolerance and understanding you've shown me all the time. They were one of my inspiration to keep on moving forward and improving to be a better person.

I also want to take this opportunity to express my deep gratitude to my family for being the superior support and believe in my journey. Thank you for this amazing experience.

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