BIOBASED COMPOSITE HETEROGENEOUS CATALYST FOR BIODIESEL PRODUCTION

INTAN SURAYA BINTI JOHARI

Final Year Project Report Submitted in
Partial Fulfilment of the Requirements for the
Degree of Bachelor of Science (Hons.) Chemistry with Management
in the Faculty of Applied Sciences,
Universiti Teknologi MARA

FEBRUARY 2024

ACKNOWLEDGEMENTS

First and foremost, praises and thanks to Allah, the Almighty, for His showers of blessings throughout my research work to be completed successfully.

I would like to express my deep and sincere gratitude to my supervisor, Dr. Siti Norhafiza binti Mohd Khaazai, Senior Lecturer, Science Study Center (Chemistry), Faculty of Applied Science, University Technology of Mara (Pahang) for giving me the opportunity to do research and providing invaluable guidance throughout this research. I greatly appreciate her help, patience, tolerance, sincerity, and motivation. She has taught me the methodology to carry out the research and to present the research works as clearly as possible. It was a great privilege and honour to work and study under her guidance. I am extremely grateful for what she has offered me. I am extending my heartfelt thanks to her family for their acceptance and understanding during the discussion I had with her on research work and thesis preparation.

I also would like to express my deep and sincere gratitude to Miss Sarah Laila bt Mohd Jan, my examiner for her willingness to evaluate me and for her understanding and kindness towards me. I am extremely grateful to my parents and family for their love, prayers, caring and sacrifices for educating and preparing me for my future. My special thanks go to them for continuously supporting me. I would like to say thanks to my friends for their constant encouragement, help and motivation. I express my special thanks to Mr. Nik Mohd Zamani bin Nik Ismail, Senior Assistant Science for his genuine support and his kindness throughout this research work. My thanks also go to all the laboratory staff for their help and kindness.

Finally, my thanks go to all the people who have supported me to complete the research work directly or indirectly.

(Intan Suraya binti Johari)

TABLE OF CONTENTS

ABSTRACT

BIOBASED COMPOSITE HETEROGENEOUS CATALYST FOR BIODIESEL PRODUCTION

This research focuses on addressing the higher production costs associated with biodiesel as an alternative fuel to crude oil. To overcome this challenge, biobased catalysts are proposed, derived from three different biomasses: eggshell, sawdust, and sugarcane bagasse. By utilizing these three biomasses, the limitations of a single metal catalyst can be mitigated. The objective of this study is to develop heterogeneous base catalysts for palm oil transesterification as an alternative to homogeneous counterparts. The process involves drying waste eggshell, crushing it into powder, and subjecting it to calcination at 900°C for 3 hours. Sugarcane bagasse is dried, ground into fine powder, and undergoes calcination at 550°C for 6 hours. Similarly, sawdust is dried and subjected to calcination at 550°C for 6 hours. The palm oil used in the study exhibited an acid value of 0.5 mg KOH/g, a density of 908 kg/cm^3 at 26°C, and a viscosity of 65.5 mm^2/s. Various catalysts, derived from calcined eggshell, sugarcane bagasse, and sawdust, were characterized using Fourier transform infrared (FTIR) analysis and Scanning Electron Microscopy (SEM). The calcined eggshell displayed a deformed spherical shape due to aggregation during calcination at 900°C, while calcined sugarcane bagasse exhibited irregular sheet-like pellets, and calcined sawdust showed stable agglomerates and irregularly accumulated particles. The elemental composition, analysed through EDX, confirmed the presence of specific components in each catalyst. The CaO-SiO_2-AC catalyst, with a BET surface area of 6.5431, pore volume of 0.015918, and pore size of 9.7309, induced a colour change in phenolphthalein and 4-nitroaniline solutions, indicating strong basic sites. Optimized parameters, including a 9:1 methanol to oil molar ratio, 6 wt% catalyst loading for Batch 1, 3 wt% for Batch 2, and reaction times of 3 hours for Batch 1 and 2 hours for Batch 2, resulted in high biodiesel conversions of 82.94% and 77.10%, respectively.