UNIVERSITI TEKNOLOGI MARA

SYNTHESIS OF ALKALI FREE MG-AL LAYERED DOUBLE HYDROXIDE CATALYST VIA HYDROTHERMAL RECONSTRUCTION METHOD FOR BIODIESEL PRODUCTION OF WASTE COOKING OIL

ERMA HAFIZA BINTI IBRAHIM @ ABD AZIZ

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

Faculty of Applied Science

April 2021

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Erma Hafiza binti Ibrahim @Abd Aziz
Student I.D. No.	:	2017341309
Programme	:	Master of Science (Applied Chemistry)- AS757
Faculty	:	Applied Sciences
Thesis Title	:	Synthesis of Alkali Free Mg-Al Layered Double Hydroxide Catalyst via Hydrothermal Reconstruction Method for Biodiesel Production of Waste Cooking Oil
Signature of Student	:	……..
Date	:	April 2021

ABSTRACT

Biodiesel has attracted a great deal of attention worldwide because of its biodegradable, nontoxic, clean and renewable characteristics. It was produced via transesterification of vegetable oil with methanol in the presence of homogeneous and heterogeneous catalyst. Some of the challenges in this process are the high cost of biodiesel feedstock and the alkali catalyst that can contribute to saponification problem. In this study, the Mg-Al layered double hydroxide (LDH) with varying the Mg/Al ratios were prepared by alkali free co-precipitation method. Different Mg/Al ratios which were 2:1, 3:1 and 4:1were used in the synthesis of Mg-Al LDH precursors. Then, the precursors were thermally decomposed at 450 ^{0}C and the derived mixed oxides reconstruct back to layered structures using hydrothermal reconstruction method. The results show that the physicochemical properties of the synthesized catalysts (precursors, mixed oxides and reconstructed LDH) weakly depend on the Mg/Al ratios. XRD pattern for precursor show fingerprint pattern of LDH. This pattern loss after calcination and appeared again after reconstruction indicated that the hydrothermal treatment was successfully restored the LDH structure. The catalytic activity of the reconstructed Mg-Al LDH was further evaluated in the biodiesel production from waste cooking oil (WCO) at the identified reaction conditions. Optimum operating conditions were established through response surface methodology (RSM) for promising options. It is observed that Mg-Al LDH for molar ratio 4:1 is the most active catalyst which gives the best biodiesel yield of 37.45 % using 34:1 methanol to oil ratio after 11.9 h at reaction temperature 68.3 ^{0}C and catalyst loading 1.125 %. Moreover, the fuel properties of the prepared biodiesel from the WCO at the optimal process conditions have been found to comply with the ASTM and EN standard specifications.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for giving me the opportunity to embark on my master and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Dr Noraini Hamzah and Dr Nazrizawati Ahmad Tajuddin as a co-supervisor

My appreciation goes to the Faculty of Applied Science and all the staff who provided the facilities and assistance during lab work sessions. Special thanks to my colleagues and friends for helping me with this project.

Finally, this thesis is dedicated to the loving father and mother for the vision and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulilah.

TABLE OF CONTENTS