UNIVERSITI TEKNOLOGI MARA

CHARACTERIZATION OF COMBUSTIBLE LIQUID FROM THERMAL CRACKING OF CRUDE PALM OIL BY USING ZSM-5 DERIVED FROM SUNGAI SAYONG POTTERY WASTE

YUSUF BIN AHMAD

Thesis submitted in fulfilment
of the requirements for the degree of
Bachelor Eng. (Hons)

Faculty of Chemical Engineering

July 2018

ABSTRACT

Demand of fossil fuels is increasing by year as the global consumption of fossil fuels also increase. Both of the problem will lead to depletion of fossil fuels. Hence, many researchers conducting research and development to find an alternative fuels for future needs. The thermal cracking process is cracking process of large organic molecular into a smaller size. There are many studies on thermal cracking of edible and non-edible oils. Hence, thermal cracking of crude palm oil (CPO) using ZSM-5 derived from Sungai Sayong pottery waste in a combustion reactor was conducted. The combustible liquid recovered from the process were characterized using bomb calorimeter, Fourier Transform Infrared Spectroscopy (FTIR) analysis and Gas Chromatography Mass Spectrometry (GCMS) analysis. The results showed that using derived ZSM-5 as a catalyst in the cracking process, producing combustible liquid with an average value of calorific which is 9144 kcal/kg. During the elemental analysis, there are presence of Carbon and hydrogen. From the GCMS analysis, the highest compound that been identified is estragole followed by hexadecanoic acid methyl ester. These are proven as during the FTIR analysis, there is three type of functional group which alkyl, carboxylic acid and alcohol-phenol group. The derived ZSM-5 is not suitable to the all type of oil as referring to the performance in stearin cracking process.

ACKNOWLEDGEMENT

Final year project really teaches me on how to be independently and motivational in doing this project. A great thankful to Allah, The Great Almighty, for the strength, guidance and also blessing until I managed to complete this research. Firstly, I would like to thank my supervisor, Associate Professor Kamariah Noor Ismail for all the guidance and support that she had gave to me through the duration of the research. Without her support, I don't think I could finish up my research. Special thanks are expressed to Faculty of Chemical Engineering, University Teknologi Mara (UiTM) Shah Alam for providing good facilities for me to do the research. A sincere thanks to my beloved parents, Ahmad Bin Abu Bakar and for their endless love, support and blessing. The final year project is dedicated for both of you.

TABLES OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Research Background

Thermal cracking is one of the decomposition process or breaking down large organic molecules into lower molecular weight products (Speight, 2003). This method is one of the oldest method to convert feedstock to require desired products. The process usually take place in a very high temperature which can reach until 1000˚C. The product that formed from the process is depends on the temperature process. In addition, there also formation of coke at the end of the process.

However, the usage of very high temperature makes the process become less efficient as high energy need to create to achieve the process condition. Hence, by introducing the suitable catalyst, the process can be completed with a lower operating temperature. According to (Wilczura-Wachnik, 2002), the catalyst accelerate the chemical reaction without affecting the chemical equilibrium. The catalyst reduce the activation energy needed by the chemical reaction to be completed.

The catalytic process can defined in four step of process. The reaction start with the reactants attach to the catalyst. Then, the intermediate catalysts-reactant complexes are formed. After that, the reaction can performs and produce the product. The products will detached from the catalyst and the catalyst become its initial state. Commonly, the suitability of catalyst in industrial process is depends on this three factor which is activity, selectivity and stability (Wilczura-Wachnik, 2002).

According to previous study (Edama et al., 2013), it is been reported that Sungai Sayong clay can be applied as a supporting material for immobilization of biocatalyst in the bioconversion of wastewater into a biofuel. The research also reported that the clay is belong to kaolin group. (Lafi, Matam, & Hodali, 2015) also reported that high silica kaolinite is able for synthesis of zeolite ZSM-5. ZSM-5 is a commercialized zeolite as it is being used for many researchers to further the study about cracking of hydrocarbons. Therefore, the derived ZSM-5 is expected to act as commercialized ZSM-5 which is catalyst in cracking process.