UNIVERSITI TEKNOLOGI MARA

CHARACTERIZATION OF ZEOLITE AS A HETEROGENEOUS CATALYST DERIVED FROM SUNGAI SAYONG POTTERY WASTE

NORNADHIRAH BINTI HAMID

Thesis submitted in partial fulfillment
of the requirements for the degree of
Bachelor of Engineering (Hons) Chemical

Faculty of Chemical Engineering

July 2018

ACKNOWLEDGEMENT

In preparing this report, I would like to thank to my supervisor, Prof Madya Dr Kamariah Noor Ismail for the monitors and advices during this project. The continuous guidance given to make sure that the experiments conducted success are highly appreciated.

Special thanks to my parents Hamid Bin Hassan and for the support and encouragement given. Not forgetting, senior research officer, Mr Mohibah Musa for the continuous guidance in assisting me to complete the research project and all the technical lab staffs for lending the equipment used in the experiment . I also forward my sincere appreciation to my fellow friends Fhazlyn, Yusuf and Azizan for being supportive and cooperative while the research was conducted .

Last but not least, I sincerely thank all staffs of Faculty of Chemical Engineering for the guideline and valuable information in writing thesis through the workshop in previous semester as well as making us enjoyable cherish moments and rewarding.

ABSTRACT

Catalyst is a substance that speed up the rate of reaction without itself being worn out at the end of the reaction. Most of Conventional catalysts do not seem relevant anymore due to economical constrains, not environmental friendly, and waste disposal issue of raw materials and the treatment applied. Synthesis of Sungai Sayong pottery waste into zeolite to be used in industrial as catalyst, would give some add value to these ceramic industries such as a proper waste management and a cheaper alternative to existing commercialized catalyst. The purpose of this study is to prepare ZSM-5 zeolite acting as catalyst derived from Sungai Sayong pottery waste and to characterize physically and chemically of synthesized zeolite. This study start with preparation of raw material from Sungai Sayong pottery waste into powder by crushing, grinding and sieving of the waste. After that, the pottery waste was treated with different ratios of 1M Hydrochloric acid and 1M Hydrogen peroxide. The treated and untreated samples were then characterized by using analytical equipment that are Thermogravimetric Analyzer (TGA), X-ray Fluorescene, BET method and Temperature Programmed Reduction Analysis. The results obtained shows that (TGA) of sample 1, sample 3, sample 4 and sample 5 have the similar trend with the commercialized zeolite. Meanwhile, by comparing the amount of Al_2O_3 and SiO_2 in commercialized zeolite with sample produced, the percentage of SiO_2 in samples produced is higher than Al_2O_3 in contrary with commercialized zeolite. The SiO_2/Al_2O_3 ratio for commercialized zeolite is 0.91 and the closest ratio value is 1.05 by 500 μm pottery waste. However, BET surface area shows that all the samples prepared has higher surface area than commercialized zeolite and the highest surface area is from sample 1 that is 66.4731 m^2/g. On the other hand, sample 1 and sample 4 has the nearest pore diameter to commercialized zeolite that are 67.751 Å and 63.268 Å . TPR analysis shows that the highest temperature of reduction of sample produced is about 800℃ starting from 100℃ to 740℃ for commercialized zeolite. Unsieved pottery waste and sample 5 share same maximum temperature for reduction that is 800℃ but at different temperature of reduction that are 100℃ to 560℃ for unsieved pottery waste and 40℃ to 240℃ for sample 5. As conclusion, zeolite derived from Sungai Sayong pottery waste has similarity with the commercialized zeolite in term of temperature profile, elemental content, surface area, pore volume and pore diameter which may affect the efficiency of the catalyst produced.

TABLE OF CONTENT

CHAPTER ONE
INTRODUCTION

1.1 Research Background

Catalyst is substance that accelerate reaction rate without itself being worn out at the end of the reaction. Industrial catalysis are divided into homogeneous or heterogeneous. Homogeneous catalysis means that the catalyst and reactants are in the same phase, while heterogeneous is both are in the different phases. (Julkapli & Bagheri, 2015). However, heterogeneous catalyst is more favourable compared to homogeneous catalyst in industries as homogeneous catalyst tend cause difficulty to be separated from the reaction media (Debra, 2004)(Dan et al.,2007). Catalyst usually made up from metals. Due to environmental, costs and energy consumption issues, researches have been done to find more economical raw materials. Clay minerals, coal ashes, natural zeolites, municipal solid wastes and industrial sludge have been widely used as cheaper raw materials alternative for catalyst synthesis (Ayele, Pérez-Pariente, Chebude, & Díaz, 2016). Instead of beneficial in term of costing, those raw materials are highly available and may aid in reducing the cost of waste disposal hence environmental friendly. In order to sustain the development of social, economy and environment, selection of raw material from waste is highly recommended as mismanagement of the waste disposal has potential to cause pollution such as water and soil pollution. Water and soil pollution happened when there is impurities that will change their composition physically or chemically and give negative impacts to the living things, which may interrupt the development of society. In terms of economy, less cost will be required to handle the waste produced as it can transformed into new useful product.

Zeolite can be either natural or synthetic. Utilization of artificial zeolites as adsorption materials and heterogeneous catalysts have been done for almost 60 years and now become one of the essential role in developing green process of the new era (Liu et al., 2014). Properties of zeolites such as solid acid, shape selective and microporous are important as they have been used as adsorbents, ion exchangers and catalysts in industrial processes (Mohiuddin et al, 2017). Synthesis of Sungai Sayong