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TITLE:
THE THERMAL STABILITY OF SODIUM METAL CATALYST SUPPORTED BY ACTIVATED CARBON

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ABSTRACT

A material is thermally stable if a substance does not break down when it heated up. The thermal stability of a substance can be determined using a thermogravimetric analyser (TGA). Catalyst is a substance that starts and speeds up the chemical reaction without changing the reactions itself. There is a limit on how many times the catalyst can be used before it worn out or turn into ashes due to the high temperature. This research focuses on determining the effect of the ratio on the mass loss of carbonized oil palm kernel shell (OPKS) and Na metal catalyst. There are few steps involve in this study. The OPKS needs to undergo the preparation of the raw materials where the OPKS needs to be cleaned from unwanted impurities after being collected from the palm oil industry. Next, the OPKS will be put into the furnace for physical activation and turned into activated carbon. Lastly, the process was continued with the wet impregnation process for the catalyst preparation. The TGA result determined that 1:3 is the best ratio of Na/Ac catalyst with a good thermal stability and lowest the mass loss. Thus, the result concludes that the best ratio should be used when dealing for transesterification of fatty acid methyl ester production.

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CHAPTER ONE
BACKGROUND

1.1 Introduction

A material is thermally stable if a substance does not break down when heated up. The thermal stability of a substance can determines using a thermogravimetric analyser (TGA). Catalyst is a substance that initiates and increases a chemical reaction without changing the reaction itself. Typically, very small amounts of catalyst are needed for a chemical reaction. Catalyst comes into two varieties which is homogeneous and heterogeneous. The most widely used method for producing fatty acid methyl ester (FAME) on an industrial scale around the world is homogeneous alkali catalysed transesterification, using substances like sodium methoxide, sodium hydroxide and potassium hydroxide as a catalyst (Kulkarni & Dalai, 2006). When compared to an acid catalyst, homogeneous alkali catalysed transesterification has a few advantages which is widely available and cheap, high conversion of methyl ester in a shorten time and methyl ester can undergo a reaction under mild reaction conditions. Unfortunately, the use of homogeneous catalyst has their drawback of being easily consumed throughout the process that can be resulting significant effluent production. Therefore, it is expected that more environmentally friendly heterogeneous catalyst would replace the traditional homogeneous catalyst (Bilgin et al., 2015).

There is evidence that biodiesel has several positive characteristics which is it can be renewable, nontoxic, biodegradable, contains little or no sulphur giving it a good emission characteristic and can be used in already existing engines without the need for significant modifications (Amenaghawon et al., 2022). Oils and fats are often transesterified to create a biodiesel. In this process, the fresh cooking oil is reacted with the methanol in the presence of prepared catalyst which is from the activated carbon of oil palm kernel shell to produce fatty acid methyl esters (biodiesel) and glycerol as a by-product. Tradition edible feedstocks including palm oil, corn oil, sunflower oil and soybean oil are discouraged due to land constraints and the controversy over whether they should be used for the food or fuel. For biodiesel to compete in the global energy market, the high manufacturing cost must be decreased. This has motivated the search for less expensive and more accessible feedstock with most of the attention presently being paid to inexpensive non-edible oils.

The production of fatty acid methyl ester can be done with various types of catalysts like homogeneous catalyst and heterogeneous catalyst. (Astuti & Mufrodi, 2019) employed a continuous process and a homogeneous catalyst to create biodiesel from leftover cooking oil. The disadvantage of homogeneous catalyst is the use of the catalysts that make the reactor corrosive, separation catalysts required high cost and this process produce the chemical waste (Gohain et., 2020). In operation, heterogeneous catalyst is typically easier to separate because the phase being used is different from the reaction result and they are also reusable. Shells, bones, zeolite, shale rocks, ashes from plants and trees, natural sources, and large-scale industrial waste are some examples of renewable sources from which heterogeneous catalyst can be made. These materials could be used to create catalysts that would increase the cost-effectiveness, sustainability and environment friendliness of the biodiesel product (Astuti et., 2018). In addition to the many natural ingredients, the cost is likewise low compared to other catalysts. This study suggests using palm kernel shells as a catalyst manufacturing material. Numerous benefits of activated carbon include availability, which is mostly waste management, low cost and stability at low temperatures and pressures. Additionally, activated carbon makes an excellent catalyst buffer due to its properties such as it is inert and has a modifiable surface.

1.2 Literature Review

1.2.1 Homogeneous and Heterogeneous Catalyst

Homogeneous catalysts are used frequently in industries because they are easy to use, take little time to complete, and only require a mild operating condition for the reactions to occur. In addition, when compared to an acid catalyst, homogeneous alkali catalysed transesterification has a few advantages such as it is widely available and cheap, high conversion of methyl ester in a shorter time and methyl ester can undergo a reaction under mild reactions condition (Chuah et al., 2021). However, using homogeneous catalyst has the weaknesses that it consumes easily during the process and produces a lot of wastewaters. According to Gohain (2020), there are others