Cawangan Terengganu
Kampus Bukit Besi

TITLE:

THE THERMAL STABILITY OF SODIUM (Na) METAL SUPPORTED BY ACTIVATED CARBON (Na/AC) CATALYST FOR FATTY ACID METHYL ESTER PRODUCTION

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ABSTRACT

Sodium is a chemical element in the periodic table that belongs to group 1 and is also known as an alkali metal because elements in group 1 will produce alkali when reacted with water, and it can be used as a catalyst to produce fatty acid methyl ester by transesterification. Before it can be utilized in the process, we should know how stable the catalyst is when being heated, because the catalyst can be broken down into its components if it is overheated. So, I experimented to investigate the thermal stability of sodium metal catalysts for fatty acid methyl ester production. The objectives of this experiment are to determine the effects of temperature on the mass loss of sodium (Na) metal catalysts and the effects of temperature on the mass loss of carbonized oil palm kernel shell (OPKS). As a starter, I rinsed the OPKS with clean water and then left it under the sun to dry. Next, I heat the OPKS for 4 hours in two different furnaces at 800°C and 900°C, respectively. Then, I let the furnaces cool down for several hours before I brought the OPKS out. The carbonized OPKS or also known as activated carbon (AC), is sieved using a 250 µm sieve to separate the ashes from it. The process followed by the impregnation of OPKS with sodium from sodium hydroxide (NaOH) in a pellet form which needs to be diluted with distilled water before being mixed with the OPKS. After the impregnation process is done, put the AC-Na mixture in the furnace again at 500°C for 3 hours and let the furnace cool down after that before bringing the activated carbon out of the furnace. The next step in the experiment is I analyse the samples of carbonized OPKS and AC-Na by putting them in the thermogravimetric analysis (TGA) instrument to study the effects of temperature on the mass loss of carbonized OPKS and sodium metal catalyst. The results of the analysis will be shown in the Result and Discussion section, which includes reasons why the materials used have a mass loss after being heated. In conclusion, the temperature does have an effect on the mass loss of the carbonized OPKS and sodium metal, which are having a significant drop in mass when being heated at certain temperatures, and it can be proven by looking at the graph of the TGA. For the recommendation, I hope that future researchers will add the sample used for the analysis, which is being heated at many more temperatures, to show how the mass loss occurred at any temperature, like every 50 °C, 100 °C, and so on.

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CHAPTER ONE
BACKGROUND

1.1 Introduction

Sodium**:** What is it? The chemical element sodium, which is in Group 1 of the periodic table, is also known as an alkali metal because, when it reacts with water, it creates an alkaline solution that may explode if the reaction were to take place in an uncontrolled environment (David et al., 2019). In this experiment, activated carbon from oil palm kernel shell (OPKS) serves as a support. It is impregnated with sodium hydroxide (NaOH), then calcined and employed as a catalyst (Faria et al., 2020)for fatty acid methyl ester production by transesterification (Ramos et al., 2019).

A suitable catalyst is essential before beginning the transesterification process because of how slowly it proceeds (Mofijur et al., 2021). To determine their thermal stability, sodium (Na) and activated carbon from OPKS must first be tested using thermogravimetric analysis (TGA) (Alves et al., 2022). The catalyst is made by mixing activated carbon with NaOH diluted in distilled water. OPKS should be carbonised at 800°C and 900°C to form activated carbon, which should then be used to make samples for further analysis by the TGA.

Thermogravimetric analysis (TGA) is applied because it offers details on various materials' thermal, physical, and chemical characteristics, including the kinetics and thermodynamics of combustion, pyrolysis, and decomposition. For instance, the controlled thermal degradation of organic materials like polymers and solid fuels like biomass and coal, liquid fuels, and inorganic materials like catalysts and minerals has been widely studied using TGA. To identify the stages of degradation and the fractions in charge of the observed degradation signals, further analysis of the degradation patterns known as TGA curves are possible (Alves et al., 2022).

1.2 Literature review

1.2.1 Activated carbon

In the context of this research, oil palm kernel shells (OPKS) are utilised to generate activated carbon. Activated carbon is defined as powdered charcoal that has been cleaned up, as stated by Jackson (2020). Activated carbon from OPKS has a relatively complex porous structure (Jasri et al., 2023) and a wide surface area, which allows it to support the sodium catalyst while it is being impregnated. This is necessary for the process of activating the carbon. In order to complete the method described above (Faria et al., 2020), the sodium hydroxide must first be dissolved in distilled water. Only then may the OPKS be added to the solution. In the process of transesterification for fatty acid methyl ester, activated carbon from OPKS can be utilised as a support for sodium catalyst, which can then be used in the process, and it can also assist sodium in speeding up the reaction time.

1.2.2 Thermogravimetric analysis (TGA)

Thermogravimetric analysis, also known as TGA, offers data on the thermal, physical, and chemical properties of various materials, including their rate of breakdown. TGA is utilized to determine the influence that temperature has on the mass loss of activated carbon derived from OPKS at 800°C and 900°C as well as the mass loss of catalyst prepared at carbonization temperature at 800°C and 900°C for this project. The sample will be heated in the TGA instrument from room temperature to 1000 degrees Celsius in a controlled environment in which nitrogen gas will flow into the sample surrounding to prevent the sample from oxidation and disrupting the result later on. The temperature range for the TGA instrument is from about 25 degrees Celsius to 1000 degrees Celsius (Alves et al., 2022).

1.3 Problem Statement

According to Crini (2006), the catalyst will become less effective if it is subjected to high temperatures and used multiple times.