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TITLE:

THE CORRELATION OF THERMAL DECOMPOSITION BEHAVIOUR WITH THE FUNCTIONAL GROUP COMPOSITION OF NA/AC CATALYST WITH DIFFERENT MASS RATIO OF NA:AC FOR BIODIESEL PRODUCTION

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AUTHOR’S DECLARATION

I hereby declare that this report is the resow my own work except for quotations and summaries which have been duly acknowledged.”

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ABSTRACT

The study of my research titled "**The Correlation of Thermal Decomposition Behaviour with the Functional Group Composition of Sodium Supported by Activated Carbon Catalysts (Na/AC) at Different Mass Ratios for Biodiesel Production**" using transesterification reaction investigates the noteworthy relationship between the thermal stability and functional group composition of Na/AC, which are essential in optimizing biodiesel production from palm kernel shell waste. As the environmental issues increase because of palm kernel shell disposal and greenhouse gas emissions, Malaysia's position is light, known as a palm oil exporter, where biodiesel emerges as a renewable energy solution that can reduce CO_2 emissions up to 78% compared to petroleum diesel.

By using Thermogravimetric Analysis (TGA) and Fourier Transform Infrared (FTIR) Spectroscopy, the study explores how different mass ratios of Na to AC affect both thermal stability and catalytic performance. The observations indicate that heterogeneous catalysts, especially sodium hydroxide (NaOH), significantly improve biodiesel yield by increasing selectivity and reducing by-product generation compared to conventional homogeneous catalysts.

The results' main points that vary the Na:AC mass ratios, specifically at 1:3 and 1:4, notably affect the thermal properties and distribution of functional groups within the catalysts, thereby enhancing their performance in biodiesel production. Eventually, this study underscores the potential of Na/AC composites in facilitating sustainable biodiesel production while effectively managing palm kernel shell waste and aiding in the reduction of greenhouse gas emissions.

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CHAPTER ONE

BACKGROUND

1.1 Introduction

Malaysia was known as the second largest exporter of palm oil in 2022 as the soil here is very suitable for the oil palm trees to grow because of the pH value of the soil and the tropical climate in Malaysia (Teh et al., 2024). Palm kernel shell waste is produced in massive quantities due to the rise in demand for palm oil, and it is frequently disposed of carelessly, raising environmental issues (Uchegbulam et al., 2022). In addition, the problem of greenhouse gas emissions, which are brought on by both natural and human-caused processes like landfills and deforestation, has gotten worse over time. One solution to this problem is the use of biodiesel, a renewable energy source that can cut CO_2 emissions by up to 78% when compared to petroleum diesel (Narowska et al., 2019). The biodiesel production is usually from waste materials like palm kernel shells, animal fat, waste cooking oil, and many more (Hosseinzadeh-Bandbafha et al., 2023).

The waste of palm kernel shell was used as the activated carbon and supported the catalyst which is sodium hydroxide (NaOH) to produce the biodiesel, fatty acid methyl ester (FAME), using the transesterification reaction. NaOH was used as a heterogeneous catalyst as it is supported by the solid material, activated carbon, and it is easy to separate from the biodiesel product (Narowska et al., 2019). It also reduces the side reactions where the specific active sites that enhance the selectivity, which leads to higher biodiesel yield and more efficient process, are provided by heterogeneous catalysts and minimize the undesired reactions (Faruque et al., 2020). The homogeneous catalyst is also used in biodiesel production but unfortunately, it has many disadvantages the reaction is slow, it can only be used a single time, and the presence of fatty acids causes saponification issues (Faruque et al., 2020).

Heterogeneous catalysts provide considerable benefits compared to homogeneous catalysts in biodiesel production. They are simpler to separate from the reaction mixtures following transesterification and can frequently be reused several times with minimal reduction in effectiveness (Mandari & Devarai, 2022). Sodium hydroxide (NaOH) is widely recognised as an effective heterogeneous catalyst for facilitating transesterification reactions. Potassium hydroxide (KOH) is also a strong catalyst (Mandari & Devarai, 2022). Other catalysts such as calcium oxide (CaO) have demonstrated the ability to process high-free fatty acid feedstocks without generating soaps. This makes them promising alternatives for improving biodiesel