Cawangan Terengganu
Kampus Bukit Besi

TITLE:

PRODUCTION OF FATTY ACID METHYL ESTER USING POTASSIUM METAL SUPPORTED ON OIL PALM KERNEL SHELL ACTIVATED CARBON

SUPERVISOR:
MISS NORKAMRUZITA BINTI SAADON

SCHOOL OF CHEMICAL ENGINEERING
COLLEGE OF ENGINEERING

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ABSTRACT

Traditional fossil fuels can be replaced by biodiesel, which is produced from renewable resources including animal and vegetable fats. However, a catalyst is often needed to transform triglycerides into fatty acid methyl esters (FAMEs), the main constituent of biodiesel. It has been demonstrated that heterogeneous catalysts, which combine a solid catalyst with a liquid reactant, are efficient at accelerating this reaction. In this study, an oil palm kernel shell (OPKS) and potassium (K)-based heterogeneous catalyst was created. According to the study's findings, this heterogeneous catalyst converts triglycerides to FAMEs very well, with conversion rates as high as 96%. The catalyst was also discovered to be reusable and to have high stability over numerous reaction cycles.Traditional biodiesel catalysts can be replaced with heterogeneous catalysts that are more affordable and environmentally beneficial by using resources that are abundant and sustainable, such K and OPKS. Being a byproduct of the palm oil industry, which plays a substantial role in deforestation, the utilisation of oil palm kernel shell as a source of the solid catalyst is remarkable. This waste product's transformation into a practical catalyst will not only lessen environmental impact but also open up a new source of income for the palm oil sector. The study's findings demonstrate that a heterogeneous catalyst made of K and OPKS is extremely successful in producing biodiesel and that the catalyst is reusable, stable, and environmentally beneficial. The new method of using oil palm kernel shell as a source of the solid catalyst not only helps to make the manufacture of biodiesel more sustainable, but it also makes use of a waste product.

TABLE OF CONTENTS

CHAPTER ONE
BACKGROUND

1.1 Introduction

As a result of rapid industrialization and urbanization, the need for energy continues to rise. Due to the nonrenewable nature of petroleum, coal, and natural gas, these nonrenewable energy sources are dwindling day by day. Due to a substantial reliance on petroleum as a primary source of fuel for transportation and energy generation, petroleum prices have recently reached historical highs (Sahar et al., 2018)As a result, there is a pressing need for renewable and alternative fuels like biodiesel. An environmentally beneficial, clean, and renewable fuel made from animal and vegetable fats is biodiesel(Sarno & Iuliano, 2019).

The production of biodiesel can be made by various types of catalyst such as homogeneous and heterogeneous catalysts. Biodiesel production using heterogeneous catalysts is more preferred as it has more advantages such as it has a high conversion rate of glycerides to biodiesel. (Jayakumar et al., 2021)The Trans-E process prefers the heterogeneous base catalyst due to its quicker reaction time, lower reaction temperature, and economic viability. Additionally, depending on the catalyst's life, regeneration, reuse, and building of these catalysts might result in enhanced selectivity and longer-lasting activity(Jayakumar et al., 2021).

The most widely used method for producing biodiesel, which involves three processes, is transesterification. Triglyceride and alcohol react in the first step, resulting in monomolecular FAAE and diglyceride. Afterward, diglyceride and alcohol combine to form monomolecular FAAE and monoglyceride. Finally, monoglyceride and alcohols combine, forming monomolecular FAAE and glycerol as a result. Distinct types of catalysts have different effects on the transesterification pathway.(Ma et al., 2021)

1.2 Literature Review

1.2.1 Transesterification

The process of transesterification is also referred to as "alcoholysis." In organic chemistry, transesterification is the process of exchanging the organic group of an ester for the organic group of an alcohol. The transesterification reaction is governed by four distinct variables.They are reaction time, temperature, the ratio of methanol to oil, and the concentration of the catalyst(Gupta & Pal Singh, 2022). Alcohol is a crucial reactant in the transesterification reaction, resulting in the alkylation of esters during the reaction phase. It dissolves more quickly in a base catalyst than in an acid catalyst. Homogeneous or heterogeneous catalysts may be used in the transesterification reaction. Homogeneous catalysts are linked to soap formation, difficulty in product isolation, catalyst recovery, and the production of wasted water.(Etim et al., 2022).

For the production of biodiesel, various procedures are used to synthesize biodiesel such as microemulsion esterification, pyrolysis, supercritical, and transesterification process. Among them, the transesterification reaction is the most cost-effective and simplest method.(Cao et al., 2022). The mechanism of the catalytic transesterification reaction is defined by the dissociation of the catalyst and methanol, which results in the release of CH3O (methoxide anion) from the reaction of methanol (CH3OH) and a hydroxide ion (OH). The carbonyl carbon of the triglyceride is attacked in three steps by the anion (CH3O) to form a mole of methyl ester in addition to di-glyceride and/or mono-glyceride in the first and second processes. In the third and final stage, 3 mol of methyl ester and 1 mol of glycerol are produced.(Cao et al., 2022) Next,The nature of the transesterification reaction is significantly slower due to the immiscibility of the reactants.Therefore, proper mixing of reaction phases is essential to improve the process kinetics.(Khatibi et al., 2021)

In conclusion, the transesterification process is widely used for the production of biodiesel from vegetable oils and animal fats. The process involves the reaction of triglycerides with an alcohol in the presence of a catalyst to produce biodiesel and glycerol. Key parameters such as catalyst selection, alcohol to oil molar ratio, reaction temperature, and reaction time can greatly affect the yield and quality of the biodiesel