TITLE:
THE THERMAL STABILITY OF POTASSIUM METAL CATALYSTS AT DIFFERENT CARBONIZATION TEMPERATURE

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ABSTRACT

As the semester begins, all of the semester five students are required to take a final year project course as requirement for the chemical engineering diploma. the title for my research is the thermal stability of potassium metal catalysts at different carbonization temperature. This experiment is about the process of the making the activate carbon using oil palm kernel shell with the impregnation of the potassium metal. This is the first step to produce fatty acid methyl ester, or the other name is biodiesel. For this experiment problem statement, heterogeneous acid and enzyme catalyze system suffers from serious mass transfer limitation problems and therefore are not favourable for industrial application.The other problem is that the existing catalysts for the biodiesel production consists of strong metal alkaline such as natrium hydroxide and potassium hydroxide are too expensive. To overcome this situation, the objective of this research is to determine the effect of the temperature on mass loss of carbonized oil palm kernel shell and to determine the effect of the temperature on mass loss of k metal catalysts. For the methodology, the first step that is required to conduct the research is to prepare the raw material. After that, carbonize process take place as soon as the preparation stage complete. Next is the impregnation process and the last step is calcination process. The result for this experiment is that the activated carbon at 900 °C carbonization temperature are the best value that lead to the highest % of FAME yield.

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CHAPTER ONE
BACKGROUND

1.1 Introduction

- Activated carbon has developed pore structure, large specific surface area, good adsorption performance and high mechanical strength. These properties have made it widely used in wastewater treatment, gas purification, solvent extraction, removal of harmful substances and adsorption thermal energy storage. Activated carbon was mostly prepared from carbon resources. Generally, activated carbon can be divided into wood-based activated carbon and coal-based activated carbon. Wood-based activated carbon is derived from fruit shells, wood chips and other lignocellulosic raw materials and has excellent decolorization, depuration and purification performance, but usually has a higher cost. In contrast, coal-based activated carbon usually presents lower cost, easier to obtain and has better surface properties. Coal-based activated carbon is usually prepared in two stages: carbonization and activation. Carbonization refers to the pyrolysis of raw materials in a high temperature and anoxic environment, during which volatile components are separated, and the raw material forms certain cracks and pits. These crack and pit structures further form a more abundant pore structure in the subsequent activation process, which refers to the series of treatments (both physical and chemical) on the carbonized material to improve its pore structure, specific surface area, and surface chemical characteristics (Ge et al., 2023).

1.2 Literature Review

1.2.1 Biodiesel

Biodiesel is a renewable, biodegradable fuel manufactured domestically from vegetable oils, animal fats, or recycled restaurant grease. Biodiesel meets both the biomass-based diesel and overall advanced biofuel requirement of the Renewable Fuel Standard. Renewable diesel, also called “green diesel,” is distinct from biodiesel.

Biodiesel is a liquid fuel often referred to as B100 or neat biodiesel in its pure, unblended form. Like petroleum diesel, biodiesel is used to fuel compression-ignition engines. See the table for biodiesel's physical characteristics.

Biodiesel performance in cold weather depends on the blend of biodiesel, the feedstock, and the petroleum diesel characteristics. In general, blends with smaller percentages of biodiesel perform better in cold temperatures. Typically, regular No. 2 diesel and B5 perform about the same in cold weather. Both biodiesel and No. 2 diesel have some compounds that crystallize in very cold temperatures. In winter weather, fuel blenders and suppliers combat crystallization by adding a cold flow improver. For the best cold weather performance, users should work with their fuel provider to ensure the blend is appropriate (Alleman et al., 2016).

1.2.2 FAME

Fatty Acid Methyl Esters (FAME) are esters of fatty acids. The physical characteristics of fatty acid esters are closer to those of fossil diesel fuels than pure vegetable oils, but properties depend on the type of vegetable oil. A mixture of different fatty acid methyl esters is commonly referred to as biodiesel, which is a renewable alternative fuel. FAME has physical properties like those of conventional diesel. It is also non-toxic and biodegradable.

Some properties of biodiesel are different from those of fossil diesel and for correct low temperature behaviour and for slowing down oxidation processes biodiesel requires a different set of additives than fossil diesel. Impurities, such as metals, in FAME must be limited for use as a motor fuel.

1.2.3 Transesterification (Trans-E)

By using the transesterification process, biodiesel can be created from oil or fat. Canola, soya bean, sunflower, coconut, peanut, and palm oil are among the vegetable oils used to make biodiesel, which competes with their primary use as food. Additionally, due to its accessibility in numerous locations and suitability for consumption, biodiesel made from inedible oils like Pongamia pinnata, Jatropha curcas, cotton seed, moringa, Croton megalocarpus, salmon oil, and others is gaining attention globally. Biodiesel is also made using animal fats like pork, beef, fish, and poultry fats as well as animal waste. Algal lipids derived from microalgae have recently become a new generation of feedstock for the production of biodiesel. (Atabani et al., 2012; Gorji and Ghanei, 2014). The most typical method for reducing oil viscosity during biodiesel production is called Trans-E. Mono-, di-, or triglycerides react with alcohols in the Trans-E process to produce by-products (esters and glycerol). During the reaction, the ester (R') alkyl group replaces the alkyl (R) alcohol group. Usually, to accomplish this, an acid or base catalyst is added to the reaction mixture. (Koberg and Gedanken, 2013). The most popular method for reducing oil viscosity through conversion when making biodiesel is called Trans-E. Alcohols are reacted with by-products produced by the Trans-E process, such as mono-, di-, or triglycerides (esters and glycerol). Ester (R') alkyl group is substituted for the alkyl