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TITLE :

PREPARATION OF ACTIVATED CARBON FROM PALM KERNEL SHELLS USING MECHANICAL MILLING METHOD

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AUTHOR'S DECLARATION

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

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ABSTRACT

The purpose of this study was to use mechanical milling and carbonization at various temperatures to prepare and characterize activated carbon (AC) from palm kernel shells (PKS). Using elemental analysis (EA), X-ray diffraction (XRD), microscopic imaging, and pressure composition temperature (PCT) analysis, the procedure comprised of preparing the raw materials, milling them, carbonizing them, and characterizing the samples. However, because of equipment limitations, the prepared samples showed properties more similar to biochar than activated carbon, according to the results. Lacking vacuum and inert gas control in the carbonization-using muffle furnace resulted in partial pyrolysis. Though it was still below the predicted range for AC, EA confirmed an increase in carbon content. Limited pore development was shown by microscopic imaging, but an amorphous structure was suggested by XRD analysis. The material's lack of catalytic activity was further demonstrated by PCT analysis, which revealed no improvement in hydrogen desorption characteristics. These results emphasize the necessity of process optimization, specifically enhancing pyrolysis conditions and utilizing chemical activation methods to produce high-grade Palm Kernel Shell (PKS)-derived activated carbon.

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CHAPTER ONE
BACKGROUND

1.1 Introduction

Environmental concerns about waste disposal and the growing need for sustainable materials have enlarged the need for biomass-based solutions. Due to its high surface area and exceptional porosity, activated carbon is highly versatile in various chemical storage, adsorption, and catalysis applications. One of the effective and sustainable ways of producing activated carbon (AC) is from agricultural waste.

An abundant, carbon-rich biomass with substantial potential for AC production is the palm kernel shells (PKS), a byproduct of the palm oil industry. It is the right precursor for advanced activated carbon due to its minimal ash content and chemical stability. Conventional techniques for creating activated carbon, however, can be energy and time-intensive. An effective substitute for improving the structural qualities of activated carbon is mechanical milling, which speeds up and improves the sustainability of the production process.

In this research, palm kernel shells (PKS)-derived activated carbon (AC) is prepared by mechanical milling before being carefully characterized in terms of its phase structure, surface form, and elemental composition. Furthermore, using PKS-based AC, this research explores the dehydrogenation characteristics of complex metal hydrides, offering important new information for material advancements in the field of chemical storage systems.

1.2 Literature Review

Biomass has gained significant attention as a sustainable precursor for activated carbon (AC) production due to its abundance, renewability, and high carbon content (Heidarinejad et al., 2020). Agricultural residues such as palm kernel shells (PKS), bamboo, coconut shells, and date pits have been successfully used to produce activated carbon with desirable properties for adsorption and chemical applications.

1.2.1 Biomass as a Source of Activated Carbon

Activated carbon (AC) made from biomass is an economical and sustainable substitute for artificial carbon. It is usually produced by carbonization and activation processes, which produce a high-surface-area porous structure that is necessary for catalysis and adsorption. Utilizing materials from agricultural waste not only gives byproducts more value but also helps with waste management. Research has highlighted the effectiveness of various biomass sources for AC production. For