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TITLE:

PREPARATION OF ACTIVATED CARBON FROM DATE PITS USING MECHANICAL MILLING METHOD

SUPERVISOR:

PUAN ZARINA BINTI OMAR

SCHOOL OF CHEMICAL ENGINEERING
COLLEGE OF ENGINEERING

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AUTHOR'S DECLARATION

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

Name of Student	:	Noor Syafiqah binti Mohd Ridzuan
Student I.D. No.	:	2022616778
Programme	:	Diploma in Chemical Engineering
College/School	:	College of Engineering/School of Chemical Engineering
Signature of Student	:	.....
Date	:	12 February 2025.

ABSTRACT

The growing demand for sustainable and cost-effective adsorbents has spurred research into alternative carbon sources for environmental applications. This study examines the preparation of activated carbon from date pits using the mechanical milling method. Chosen for their high carbon content and potential for value-added utilization, date pits are an abundant agricultural by-product. The activation process involved mechanical milling to reduce particle size, followed by thermal treatment to enhance porosity and surface area. The resulting activated carbon was characterized through scanning imaging to assess its textural and morphological properties. The findings show that mechanical milling effectively reduces particle size and increases surface area, thereby enhancing the adsorption potential of the produced activated carbon. This study demonstrates the feasibility of utilizing date pits as a sustainable precursor for activated carbon production, promoting waste valorization and environmental sustainability.

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CHAPTER ONE BACKGROUND

1.1 Introduction

Activated carbon is highly porous, hence possessing very good adsorption properties. Because of this, it finds widespread use in water treatment, gas adsorption, and many other industrial applications. More recently, a large number of agro-industrial by-products, such as coconut shells and fruit pits, has been transformed into promising precursors for the sustainable production of activated carbon. Among them, date pits represent an interesting feedstock, as they are rich in carbon and widely available at low cost, particularly in countries whose economies strongly rely on date cultivation.

This study presents the work involved in the preparation of activated carbon from date pits through mechanical milling. Contrary to conventional methods of activation, mechanical milling improves the surface area and adsorption properties of materials by reducing particle size and increasing structural defects. This report will discuss the methodology, characterization, and application of mechanically milled activated carbon from date pits with a focus on feasibility as an eco-friendly and cost-effective adsorbent.

With the acceleration of the world toward sustainable energy solutions, the demand for green materials in energy storage applications has been on the rise. Due to its extremely high surface area and excellent adsorption properties, AC finds applications in a number of energy storage technologies. The sustainability of AC production is greatly influenced by the kind of raw material used and the synthesis methods adopted.

Date pits are one of the most abundant agricultural by-products and, therefore, a very promising low-cost and eco-friendly precursor for AC production. In contrast to conventional feedstocks, such as coal or synthetic polymers, date pits offer a renewable and waste-reducing feedstock, thus fitting well within the circular economy concept. Their high carbon content makes them particularly suitable for AC synthesis, ensuring efficient adsorption properties for diverse applications.

The mechanical milling method has emerged as a scalable and energy-efficient method to produce AC from date pits. Unlike chemical or thermal activation, the method of mechanical milling improves the surface properties through a reduction in particle size, thereby forming structural defects that improve the adsorption capacity. It also reduces the use of aggressive chemicals, thus being more sustainable and economical.

Beyond conventional adsorption applications, AC derived from date pits has enormous potential in advanced energy storage. In hydrogen storage technologies, AC can improve hydrogen desorption in metal hydrides through the facilitation of gas diffusion and the reduction of activation energy. This is very important to develop efficient hydrogen storage systems-very crucial for future clean energy solutions.

This may be the potential use of agricultural waste for energy storage applications. Mechanically milled AC from date pits therefore presents a development toward greener and high-performance material in energy applications. Since industries are shifting toward greener alternatives, the incorporation of bio-based AC will drive innovation in energy storage toward a cleaner and greener future.