UNIVERSITI TEKNIKAL MALAYSIA MELAKA

RESEARCH ON MECHANICAL PROPERTIES OF CHARCOAL COCONUT SHELL WASTE REINFORCED BY EPOXY RESIN

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BACHELOR OF DEGREE MANUFACTURING ENGINEERING TECHNOLOGY (PROCESS AND TECHNOLOGY) WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this Choose an item. entitled " Research On Mechanical Properties Of Charcoal Coconut Shell Waste Reinforced By Epoxy Resin " is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : Abdul Muiz Bin Mohd Sukri

Date : 25 January 2022

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours.

Signature : 

Supervisor Name : Dr Khairum Bin Hamzah

Date : 25 January 2022

DEDICATION

All thanks be to Allah for providing me with the strength, patience, direction, and knowledge to accomplish in this study. I am really grateful to God Almighty for allowing me to join this programme. A special award, this thesis I dedicated to my parents, Mohd Sukri Bin Ismail and Samsurina Binti Mohd Arif who have always been there for me. Finally, I'd like to thank my supervisor, Dr. Khairum Bin Hamzah and my co-supervisor, Ts. Dr Norfariza Binti Ab Wahab, for all of his help, guidance and advise in completing this thesis.

ABSTRACT

Being biodegradable and user-friendly, the distinctive composite formed of natural fibres has amazing potential for weight reduction in materials while also lowering the cost of materials due to its low cost. However, it has a disadvantage in that it has a lower strength than epoxy resin 100 percent, which is a disadvantage. Many research investigations have been conducted on two-hybrid composites that include natural and synthetic fibres, but only a few studies have been conducted to compare the mechanical properties of natural and synthetic fibres in the same composite. Namely, the purpose of this study is to investigate the effect of mechanical properties on the mixing of natural and epoxy resins, specifically charcoal coconut shell powder and epoxy resin in eco-friendly materials. To fabricate the recycle waste of charcoal coconut shell composite test samples with three different ratios, the hand mixed approach was used in conjunction with the tensile, impact, and flexural tests to determine the mechanical properties of the samples. The collected data were analysed using statistical analysis. Numerical and graphical results was presented to observe the mechanical properties of Charcoal Coconut Shell Powder (CCSP). All combination of CCSP composite with epoxy resin will be effected in different ratio.

ABSTRAK

Sebagai terbiodegradasi dan mesra pengguna, komposit tersendiri yang terbentuk daripada gentian semula jadi mempunyai potensi yang menakjubkan untuk pengurangan berat bahan di samping mengurangkan kos bahan kerana kosnya yang rendah. Walau bagaimanapun, ia mempunyai kelemahan kerana ia mempunyai kekuatan yang lebih rendah daripada resin epoksi 100 peratus, yang merupakan kelemahan. Banyak penyiasatan penyelidikan telah dijalankan ke atas komposit dua hibrid yang merangkumi gentian asli dan sintetik, tetapi hanya beberapa kajian telah dijalankan untuk membandingkan sifat mekanikal gentian asli dan sintetik dalam komposit yang sama. Iaitu, tujuan kajian ini adalah untuk menyiasat kesan sifat mekanikal terhadap pencampuran resin asli dan epoksi, khususnya serbuk tempurung kelapa arang dan resin epoksi dalam bahan mesra alam. Untuk mengarang sisa kitar semula sampel ujian komposit tempurung kelapa arang dengan tiga nisbah berbeza, pendekatan campur tangan digunakan bersama-sama dengan ujian tegangan, hentaman dan lentur untuk menentukan sifat mekanikal sampel. Data yang dikumpul dianalisis menggunakan analisis statistik analisis. Keputusan berangka dan grafik telah dibentangkan untuk melihat sifat mekanikal Serbuk Arang Tempurung Kelapa (CCSP). Semua gabungan komposit CCSP dengan resin epoksi akan dilaksanakan dalam nisbah yang berbeza.

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LIST OF SYMBOLS AND ABBREVIATIONS

CCSP55	-	55% of Charcoal Coconut Shell Powder and 45% of Epoxy resin
CCSP60	-	60% of Charcoal Coconut Shell Powder and 40% of Epoxy resin
CCSP65	-	65% of Charcoal Coconut Shell Powder and 35% of Epoxy resin
BC	-	Bamboo charcoal
BF	-	Bamboo Flour
CCSP	-	Charcoal Coconut Shell Powder
df	-	Degree of freedom
D,d	-	Diameter
HAZ	-	Heat affected zone
P	-	Laser power
l	-	Length
LDPE	-	Low-density polyethylene
V_{max}	-	Maximum cutting speed
MS	-	Mean Square
NBC	-	Nano-bamboo charcoal
PVC		Polyvinyl Chloride plastic roll
SEM	-	Scanning electron microscope
SS	-	Sum of Square
Ra	-	Surface roughness
UV	-	Ultraviolet
λ	-	Waze length

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, there are very high demand for eco-friendly materials based on recycling is in line with the industrial demand that affects the potential on the characteristic features from it. The development of technology and population as well as changes in habits in society have resulted in a substantial rise. Therefore, the issue of poor management becomes one of the major factors faced by the modern society of this compilation. Waste to the environment can help the industry produce an environmentally friendly product.

Natural wastes such as agricultural and industrial waste are too much in Malaysia. The waste can be recycled and reused. The increase in population will indirectly increase waste. In addition, there is also waste that does not decompose easily and will remain in the environment. In Malaysia, there are various environmental materials such as oil palm, wood, rice, coconut, rubber and so on. This material has the potential to replace the main material from the waste due to its hard and non-perishable composition.

Figure 1.1 shows the proportions of trash generated by Malaysia's rice, palm oil, and rubber, coconut, and forest products industries (United Nations Economic and Social Commission for Asia and the Pacific 2002). The figure below shows the types of natural waste in malaysia. Based on the picture found that palm oil is one of the highest waste

materials compared to coconut, wood, rice and rubber. coconut is the least waste material in Malaysia.

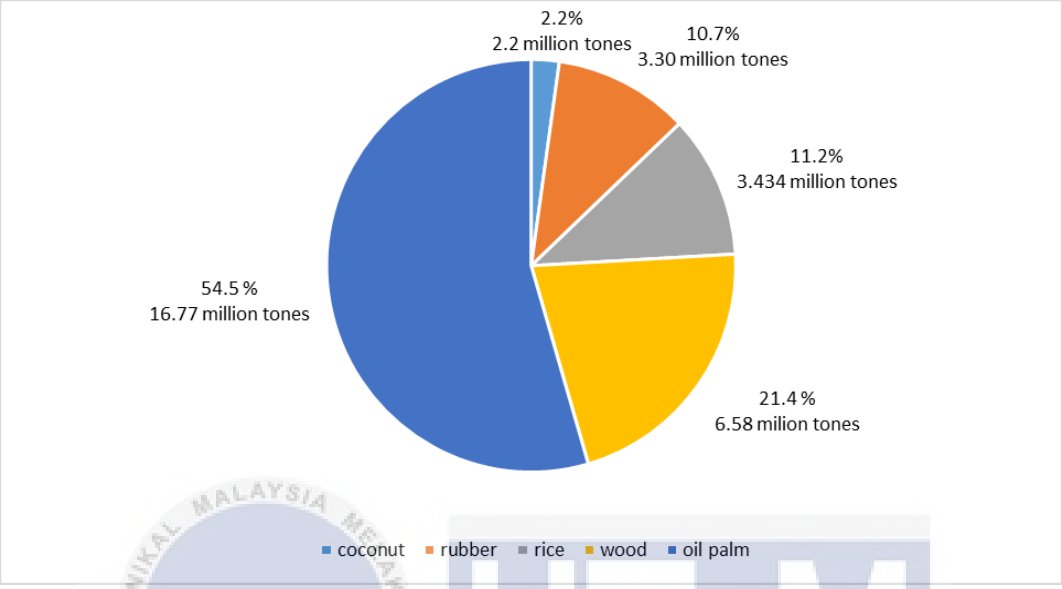

Figure 1.1 The proportions of trash generated by Malaysia's
(United Nations Economic and Social Commission for Asia and the Pacific 2002)

Material required for this composite that is coconut shell. Coconut shell composite more attractive because of their great strength, small weight, less density, they are ecological and eco-friendly. Coconut shell is a common natural filler found in forest nations for example Asian country, as Indonesia, Malaysia, Sri Lanka, Thailand, and India are among the countries involved. Coconut shell are also easy to obtain, low cost and easy to process. Coconut plantations occupy a large portion of Malaysia's agricultural area. The operations of the Malaysian coconut industry contribute a little amount to the Malaysian economy with a 0.08 percent contribution to export revenues in 2006.

The decline in coconut plantation area due to increased area of oil palm plantations. Composite materials combine the properties of two or more components. When the fibers

and matrix act independently, such qualities are impossible to accomplish. Fiberglass-reinforced composites have a high strength-to-weight ratio 2007.

Table 1.1 Coconuts production and area planted in Malaysia (Sivapragasam 2008)

YEAR	TOTAL PRODUCTION (Metric tonnes)	TOTAL AREA UNDER COCONUT (Hectare)	RATIO
2001	457,560	151,004	3.0301
2002	358,460	136,915	2.6181
2003	400,000	131,709	3.0369
2004	429,267	143,089	3
2005	391,443	130,481	3
2006	344,847	114,949	3
2007	382,000	109,185	3.4986

Table 1.1 shows the ratio area was at 3.0301 in 2001, and it gradually expanded to 3.4986 acres in Moreover, its excellent fatigue resistance makes it increasingly common in various fields. Aerospace, marine, aeronautical and automobile technology applications often use fiber-reinforced composites. Maritime and pipeline industries, laminated fiberglass reinforced composite materials are used. This is because it is more resistant to the elements, has a higher damage tolerance to high impact loads, and has a unique strength and stiffness (Sivapragasam 2008).

Among thermosetting polymers, epoxy resins are by far the most prevalent used in our daily lives and in industry. Epoxy resins are a popular type of thermosetting resin used in the coatings and adhesives industries, with global production estimated at 2 million tons in 2010. Epoxy resins are typically cured by thermal chemical treatments and irreversibly cross-linked products. The cured epoxy resins have remarkable physicochemical qualities, including outstanding chemical resistance and mechanical qualities. Consequently, epoxy resin is a binder used to bond glass fiber and coconut shell.

Many researchers have been done to cutting the material by using several machine such as Bandsaw machine (Gautam and Singh, 2018; Stock et al., 2012; Rodrigues et al., 2018). Since the very fast cutting speed and no contact with the product are an advantage. Unconventional processes are a factor possessed by bandsaw and that is increasingly popular for cutting composite materials. Bandsaw machining provides advantages such as a harsh mode of cutting and there are no damage since no mechanical force or contact force occurs on the work piece surface.

Bandsaw cutting machine is a thermal technique that is unaffected by the physical qualities of the work piece material, such as strength and hardness. According to Gautam and Singh (2018), the impact of different machining factors in term of performance responses of carbon fiber reinforced polymer such as surface roughness and heat-impacted zone are noticed in their study.

There are various methods for testing specimens among them are mechanical properties. The mechanical characteristics of a material are the physical qualities that it exhibits when subjected to a force. There are two type of classification of testing destructive testing and non-destructive testing. For example destructive testing is tensile testing, three point bending and so on. For nondestructive testing, is ultrasonic testing, radiographic testing, electromagnetic testing, and magnetic particle testing and so on. There are many type of mechanical testing. Among one of them is tensile testing.

Many researchers have been done testing their material while using tensile strength testing method (Gautam and Singh, 2018; Vasu et al., 2017; Misha, 2017). Tensile strength testing are to determine a number of important material properties such as yield strength,

modulus elasticity, ultimate tensile strength, reduction in an area at fracture and elongation at fracture. According to Gautam and Singh (2018), study the waste of coconut shell reinforced epoxy composite. Tensile testing are the procedures employed used to determine the strength of the material being tested. The result show the strength at 20% coconut shell reinforced epoxy resin are the most strength between 5% and 10%.

Lastly, Mishra (2017) evaluated mechanical properties of tensile and flexural of coconut shell dusk reinforced epoxy fly ash hybrid composites. The experimental finding revealed that the tensile characteristics of composites improve and tensile testing is one of the method while testing the specimens. Vasu et al. (2017) evaluated on the mechanical characteristics of coconut shell powder. In their experimental, there are three type of testing to be done which is tensile testing, bending testing and impact testing.

1.2 Problem Statement

Recently, the manufacturing industry in Malaysia has increased. Therefore, the use of materials will also increase in the manufacturing industry to produce new products as well as in daily life. The high demand for recycled materials in the manufacturing industry will also involve an increase in demand for crude aggregate.

In this situation, it is also not suitable if we only rely on one source because it is feared that there will be a shortage and will not be able to meet demand in the future. Therefore, some new alternatives need to be created to cover in the future. From the results of the observations made, there are several studies conducted to achieve the material

requirements. A large number of materials are produced from recycled or from environmentally friendly such as stones, discarded durian skins, and so on.

In this study, an alternative made from environmentally friendly waste is coconut shell. The majority of Malaysians use coconut in their daily cooking. Coconut shells are often discarded and burned. Coconut shell also has the potential to replace aggregate from waste due to its hard and not easily damaged composition.

Furthermore, the recent lack of garbage collection points is a major cause of environmental problems and garbage disposal is becoming increasingly important as we lack natural resources. In addition, the properties of different natural materials. Eco-composite materials have problems for cutting performance. Natural materials have different effects such as strength and elongation. Then, to determine a good ratio of composite it must be analyzed against the tested material. The strength of the material from charcoal coconut shell in accordance with the objective to be achieved.

1.3 Research Objective

The main aim of this research is to research on mechanical properties of charcoal coconut shell waste reinforced by epoxy resin. Specifically, the objectives are as follows:

a) To fabricate the recycle waste of charcoal coconut shell

b) To perform the composite of charcoal coconut shell into the testing specimen

c) To analys the mechanical properties of material

1.4 Scope of Reasearch

This research will focus on research on mechanical properties of charcoal coconut shell waste reinforced by epoxy resin. This project consists of charcoal coconut shells powder and epoxy resin. In order, to fabrication the recycle waste of charcoal coconut shells powder. The process that will use to perform this coconut shells is hand mixed lay-up technique. The bandsaw cutting machine is the process to perform cutting of specimen test to be done. The mechanical properties of the experimental material will be evaluated using tensile test, impact test and flexural testing. The data will using excel to analysis of the experiment specimen. Based on three different testing process, we will deciding which one could be a better result for quality, strength of material ratio and mechanical properties of specimen material.