MECHANICAL PROPERTIES OF PAADY-HUSK POLYPROPYLYENE COMPOSITE

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THE MECHANICAL PROPERTIES OF PADDY-HUSK POLYPROPYLENE COMPOSITE

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A repot submitted in fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering

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DECLARATION

I declare that this thesis entitled "The Mechanical Properties of Paddy husk Polypropylene Composite" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality of the award of the degree of Bachelor of Mechanical Engineering.

Signature	:……………………………
Name	: En. Shamsul Bahari Bin Azraai
Date	:……………………………

DEDICATION

A special dedication to my parents, Sulayan bin Indanan and Intan Baiduri binti Maaripat and also not forgotten to beloved family who always supported me in everything I do.

ABSTRACT

The demand for eco-friendly materials, the degradation frequency, and the petroleum-based plastics prices and pressing environmental regulations have all triggered growing interest in composite materials. Natural fiber is used as an alternative to conventional fiber reinforcement as it is cost-effective and environmentally friendly. This project investigates the mechanical properties of Paddy-husk reinforced polypropylene with different filler loading which are 20%, 30% and 40% of paddy-husk powder (PHP). The PHP was weighed according to their respective filler loading and then mixed with polypropylene in the internal mixer. Hot press machine was used to press the sample into a board. The board was then cut into shapes according to the standard ASTM for each testing. Three tests were carried out which are hardness test (ASTM D2240), tensile test (ASTM D039) and flexural test (ASTM D790). The data from the experiments were then tabulated and analysed to know their properties. The mechanical properties of the sample reduced as the paddy husk powder was not treated. Based on the experiments with increasing PHP filler loading of 20%, 30% and 40%, the hardness decrease, the tensile stress increased, the Young modulus increased. When the PHP filler loading increased, the flexural strength decreased, and the flexural modulus increased.

ABSTRAK

Permintaan untuk bahan mesra alam, frekuensi degradasi, dan harga plastik berasaskan petroleum dan peraturan persekitaran yang mendesak semuanya telah memicu minat yang meningkat terhadap bahan komposit. Serat semula jadi digunakan sebagai alternatif untuk pengukuhan serat konvensional kerana ia menjimatkan kos dan mesra alam. Projek ini menyiasat sifat mekanik polipropilena bertetulang padi-sekam dengan muatan pengisi yang berbeza iaitu 20%, 30% dan 40% serbuk padi-sekam (PHP). PHP ditimbang mengikut muatan pengisi masing-masing dan kemudian dicampurkan dengan polipropilena dalam pengadun dalaman. Mesin tekan panas digunakan untuk memasukkan sampel ke papan. Papan kemudian dipotong menjadi bentuk mengikut ASTM standard untuk setiap ujian. Tiga ujian dijalankan iaitu ujian kekerasan (ASTM D2240), ujian tegangan (ASTM D039) dan ujian lenturan (ASTM D790). Data dari eksperimen kemudian ditabulasi dan dianalisis untuk mengetahui sifatnya. Sifat mekanik sampel berkurang kerana serbuk sekam padi tidak dirawat. Berdasarkan eksperimen dengan peningkatan beban pengisi PHP sebanyak 20%, 30% dan 40%, kekerasan menurun, tegangan tegangan meningkat, modulus Muda meningkat. Apabila pemuatan pengisi PHP meningkat, kekuatan lenturan menurun dan modulus lenturan meningkat.

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I have met many people during this time who are friendly and share their knowledge and experience of this study with me. I have learned a great deal from them. If they had their expertise and advice, the project would not have been feasible. So, I will use this time to thank both. In the other hand, it is a pleasure for me to give a token of thanks to all my friends and family who participate in this work directly or indirectly. Finally, I hope this research may be useful as a reference point for future works.

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LIST OF ABBREVIATIONS

PH	Paddy husk
PP	Polypropylene
PHP	Paddy husk powder
MCM	Metal matrix composite
PMC	Polymer matrix composite
CMC	Ceramic matrix composite
NFC	Natural Fiber composite
FRP	Fiber reinforced polymer
PRP	Particle reinforced polymer
AMC	Advanced composite materials
ASTM	American society for testing and materials
UTM	Universal testing machine

CHAPTER 1

INTRODUCTION

1.1 Background

Increasing demand for eco-friendly materials, the degradation frequency, and the pe troleum-based plastics prices and pressing environmental regulations have all triggered gro wing interest in composite materials (A.N.Netravali, 2003). Composite materials are prod uced by combining two or more materials to enhance the properties of their original comp onents. When one or more of the materials used are derived from biological origins, they are then defined as biocomposites (P.A. Fowler, 2006).

Natural fibres are additionally frequently utilized as reinforcements. For example, jute, hemp and flax are commonly utilized as reinforcing material in composites. The composite can be relegated as thermosetting or thermoplastic polymer to compose a composite that has propitious properties like low energy engenderment, biodegradable and low manufacturing hazard (Bambach M.R, 2017). However, composite with natural fiber consist of intrinsic vigor that this potential can be enforced in many sector and industry as long as we understand to analyse the mechanical deportment.

Paddy husk (PH) is one of the new natural fiber that has gained popularity. Paddy (Oryza sativa L.) is a primary food source for billions of people and one of the world's biggest crops. This occupies nearly 1% of the surface of the earth (F. Adam J. N., 2012).

Statistics show that the average annual global rice production in the 2010–2013 period was 725 million metric tons, with Asia alone supplying more than 90 percent of total global rice production (J.FAO,2012). Paddy husk (PH) is an inexpensive byproduct of rice processing and is separated from rice grain during the rice milling process. It is reported that, for every ton of rice produced, about 0.23 tons of PH is formed. Rice milling is one of the most important industries in countries such as China, India, Indonesia, Malaysia, and Bangladesh (E. Aprianti, 2015).

In general, polymer composites consist of a polymer resin as the matrix and one or more fillers are added to serve specific objectives or requirements. For example, composites for aerospace and sports applications require high mechanical and thermal properties. Traditionally synthetic fibers such as carbon or glass fibers have been used to reinforce composites and are able to produce such properties. However,with the growing global environmental concerns, their slow biodegradability is a disadvantage.Therefore researchers are finding other viable approaches to enhance or accelerate the biodegradability of polymeric composites. For this reason natural fibers provide good prospective as reinforcements fillers in thermosets, thermoplastics, and elastomers. Some main advantages of using natural fibers in composites are low cost, sustainability, light weight, and being nonabrasive and nonhazardous and more importantly they can accelerate biodegradability of the polymeric composites (K.P. Kumar, 2014).

Filler-reinforced polypropylene has been a popular subject to accept numerous types of fillers and reinforcements due to the flexibility of polypropylene. In recent years, the use of filled polypropylene in electrical and automotive engineering has increased mainly due to its excellent rigidity properties, which enable it to replace conventional materials in demanding engineering applications. Fillers that merely increase the volume of bulk and therefore reduce the price are known as extender fillers, while those that improve mechanical properties are known as reinforcing fillers, in particular tensile strength. Plastic fibers, plastic balls, talc, asbestos, wood starch, calcium carbonate, silica and mica are common fillers and reinforcements for polypropylene.

1.2 Problem Statement

Conventional synthetic fibers used these days have more difficulty than natural fibers. Natural fiber is used as an alternative to conventional fiber reinforcement as it is cost-effective and environmentally friendly through the use of natural fillers or reinforcement in composite polymer (Salmah. H et al, 2013).

Past studies show that the use of natural fiber composite as reinforcing material has better mechanical properties, reduced wear of implements, unlimited availability, low price, and free disposal of dilemmas due to the less abrasive nature of natural fibers. The use of natural fibers creates a safer working environment than the synthetic fibers. Cutting and installing glass fiber components causes skin vexation and respiratory diseases among employees due to the glass fiber particles. For example, some evidence of a condition of asbestos form emerged from fiber handling (Cheremisinoff, N.P, 1990).

Paddy husk rises in agro-waste. This means the paddy husk will be discarded after being used in cultivation. Therefore, it is important to produce a sample set of composites to analyze the mechanical properties using paddy husk as an agro-waste to ensure a healthy environment in the future through the use of agro-waste in composite. This is important for the future development of composites to be used in many fields in the future, such as construction materials, marine cordage, fish networks, furniture and other household appliances (Karthikeyan and Udhayasankar, 2015).

1.3 Objective

Natural fibres, which are plentiful in nature, are low-cost raw material, and renewability is of greater interest.Natural fibres, including carbon glass and aramid, are cheaper than man-made fibres. The project knows samples with high mechanical properties are produced at low cost, which is strictly environmentally friendly. The engenderment of synthetic fibre depends mainly on fossil fuels and needs more energy as compared to natural fibre. The objectives of this project are as follows;

1. To determine the mechanical properties of the paddy husk polypropylene composite.
2. To determine the Young modulus.
3. To compare experimental data with other natural fibers.

1.4 Scope of Project

The flaw of composites is conventionally the cost which the raw material is often sumptuous. Consequently, the material cull for this project is circumscribed due to budget constraint.

The scopes of this project are:

1. To formulate paddy husk polypropylene composite.

2. To conduct experiments testing the hardness, tensile and flexural properties of paddy husk polypropylene.

3. To compare the experimental data with other natural fibers.

4. Filler concentration of composite varies from in weight (g) 10%, 20%, 30% and 40% only. Previous studies show that the mechanical properties are poor if the filler is too concentrated in the composite.

CHAPTER 2

LITERATURE REVIEW

2.1 Building materials using composites

Research and innovation in natural fiber composite (NFC) have been growing rapidly today. This is due to the advantages of NFC over other types of fibers, such as synthetic fibers. NFC is claimed to have a lower environmental impact as well as a low cost that has potential to be used in a variety of applications. As a result, demand for ecological building materials is growing rapidly on the market, especially with regard to materials for the isolation of renewable resources. Many researchers initiated the study of these natural materials, primarily researching their thermal insulation and mechanical properties (Maria, 2017).

Jute (Korjenic, 2011), cork (Silva, 2005), corncob (Pinto, 2012), sugarcane (Kodah, 1999), wood wool and rock wool (Ren, 2007), loose-filled cellulose (Nicojsen, 2005), and hemp (Dalmay, 2010) are the most studied fibers. A great deal of effort has been made to increase their mechanical efficiency to expand this class of materials capacities and applications.

Based on research by (Maria, 2017), the tests showed a maximum ultimate strength varying from 5.82 to 12.91 MPa and an almost continuous flexural resistance equal to 6.00 MPa in terms of mechanical properties.Samples with a smaller amount of fibers have been shown to be more resilient, but, on the other hand, have a more delicate nature, as shown by the lack of plastic activity in the curve. Compared to a mixture of lime and hay, the mechanical tests performed on the biocomposite showed that the replacement of lime with resin as binder greatly increases the mechanical properties of the biocomposite.

In order to improve the thermal and mechanical properties of the biocomposite, further analysis must be carried out. A thorough study on the preparation of the mix is currently underway in this regard. In more depth, the role of the amount and granulometry of shives in the solution, the pressure applied when filling the mould and the impact on the mechanical properties of the biocomposite of the length and modality of the drying process were studied.

2.2 Introduction to Composite

Polymer Matrix Composites (PMC) is the type of composite to be generated and studied in this section. Broadly speaking, matrix identification can be made based on the composite matrix material. Which are:

i) Ceramic Matrix Composites (CMC)

ii) Metal Matrix Composites (MMC)

iii) Polymer Matrix Composites (PMC)

CMC are kenned for its fiber attribute to resist temperature. Ceramic fibers can be found abundant as alumina and silicon carbide. They are salutary in very high temperature applications, and where environment assailment is an issue. Poor properties of ceramic fibers results in tension and shear, and due to these attributes, most applications of ceramic fibers as reinforcement are mostly particulate form. Ceramic Matrix Composites (CMC) are use in environments with high temperature since it is able to resist temperature, the matrix is reinforced with short fibers, or whiskers made from silicon carbide and boron nitride.

Metal Matrix Composite (MMC) is commonly used as housings, pipes, wires, heat exchangers, structural component due to high transverse strength, low corrosion resistance and higher categorical unit positive qualities over monolithic materials. The high density is the downside for composites of the metal matrix and therefore results in poor categorical mechanical properties relative to composites of the polymer matrix.

Polymer Matrix Composite (PMC) can be relegated into according its matrix, either thermosets or thermoplastic polymer. The material utilized as matrix are polymer that will determine the properties PMC. In PMC, vigor and stiffness of PMC are lower if in comparison to MMC and CMC. In order to surmount this quandary, reinforcing other materials to the polymer can elucidate the matter. In integration, fabrication of PMC does not require high temperature and pressure and involute equipment. PMC can be divided into two relegation classes, that are Fiber Reinforced Polymer (FRP) and Particle Reinforced Polymer (PRP). These composites show higher overall properties to individual components of polymer and ceramic.

Ceramics, glasses, metal particles such as aluminum and amorphous materials are the parts used in PRP. Particles are used as a composite matrix to elevate the matrix modules. It resulted in a decrease in the matrix's ductility. The incentive to use particles is to minimize the composites ' costs.