UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PRELIMINARY STUDY OF MECHANICAL PROPERTIES FOR DIFFERENT COMPOSITION OF KENAF MIX WITH NATURAL BINDER THROUGH IMPACT TESTING

This report is submitted in accordance with the requirement of the University Technical Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Maintenance) with Honours.

by

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2018

ABSTRAK

Tujuan kajian ini adalah untuk mencipta dan menganalisis satu komposisi baru dibuat daripada campuran bahan semula jadi resin dan sabut kenaf. Masalah yang dihadapi oleh masyarakat kini adalah sisa-sisa plastic yang terdampar di lautan dan darat. Sabut kenaf atau nama saintifiknya adalah *Hibiscus Cannabinus* ialah batang yang tidak berteras berasal daripada tangkai dalam keluarga Malvaceac. Untuk bahan semula jadi resin yang digunakan adalah beras pulut di mana ia berfungsi sebagai pengikat kepada bahan sabut kenaf. Campuran antara beras pulut dan sabut kenaf dijadikan sebanyak 24 spesimen dengan berbagai-bagai komposisi. Spesimen ini disediakan dengan mencampurkan beras pulut daripada lapisan ke lapisan dengan berbagai-bagai variasi dengan serat kenaf di tengah. Contoh uji kaji ini kemudian akan dikenakan ujian kemusnahan untuk mengetahui ciri-ciri mekanikal tersebut. 2 ujian kemusnahan tersebut adalah ujian ketegangan dan ujian hentaman charpy. Hasil ujian didapati bahawa komposisi terbaik untuk ujian ketegangan dan ujian hentaman charpy adalah 40% dan 45%. Konklusinya, ciri-ciri mekanikal untuk serat kenaf dengan beras pulut telah dikenalpasti.

ABSTRACT

The purpose of this research is to fabricate and analyse new composition of naturally made resin reinforced kenaf fibre and to identify the mechanical properties of kenaf mix with natural binder. The problem faced by community nowadays is the plastic waste that was left in the ocean and land. Kenaf or more commonly known as Hibiscus Cannabinus is an annual, herbaceous fibre which originates from the stems of a plant in Malvaceac family. The naturally made resin used is glutinous rice that acts as reinforcing substance for kenaf fibre. The reinforced between glutinous rice and kenaf fibre is made 24 samples by varying its composition. The samples were prepared by mixing the glutinous rice layer by layer with variations of kenaf fiber in the middle. The samples were tested using 2 destructive tests to identify its mechanical properties. The 2 tests are tensile test ASTM D-638 and charpy impact test D-6110 or ISO 179. The results obtained found out that the best in range of composition for tensile and charpy impact test are 40% and 45% respectively. As for the conclusion, the mechanical properties for kenaf fibre with glutinous rice were identified.

DEDICATION

A special thanks to my family for being very supportive to me in my project. A part of this success is also dedicated to my supervisor Encik Afdhal bin Shamsudin that was always there to guide me. Finally, thank you to my dedicated friend Muhammad Izzat bin Zainal, Muhammad Afiq bin Yasin and Chia Shong Hee.

ACKNOWLEDGEMENT

There are many challenges in completing this PSM project. However, all of the challenges were managed to be taken down by the help of my friends. Firstly, I want to thank my supervisor, Encik Mohd Afdhal bin Shamsudin for trusting me and giving me this golden opportunity. I am so grateful for all of his supports and assists that have been given to me from the beginning until the end of this project.

Next, I wanted to express my gratitude to my beloved family for supporting me from all the way back home, especially to my mother who has been very understanding for my busyness. My family has given me pieces of advice through my ups and downs. Without their prayers and encouragements, this project might not be able to be completed.

Moreover, special thanks should be given to all of my friends and seniors that have helped me to complete this project especially to the ones who were under the same supervision by Encik Afdhal as their supervisor. We have been sharing information together, reminding about the important tasks and were helping each other out throughout this project completion.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF SYMBOLS

C	-	Celsius
cm^3	-	Centimetre cube
g	-	gram
Gpa	-	Giga Pascal
J	-	Joule
m	-	Metre
mm	-	millimetre
MPa	-	Mega Pascal
OH	-	Hydroxide
O	-	Oxide
Si	-	Silicone
vol	-	Volume
x	-	Multiplication

LIST OF ABBREVIATIONS

ASTM	American Society for Testing & Material
CAD	Computer-aided design
CAE	Computer-aided engineering
CO^2	Carbon dioxide
CH2 CL2	Dichloromethane
DMA	Dynamic Mechanical Analysis
DMF	Dimethyl-formamide
ECO	Economic
HDPE	High-Density Poly Ethylene
ISO	International Standard Organization
LLDPE	Linear Low-Density Poly Ethylene
M	Mat
MAPE	Maleic Anhydride Polypropylene
MFA	Multi-fiber arrangement
NaOH	Sodium Hydroxide
PE	Polyethylene
NFC	Natural Fibre Composite
PLA	Poly-lactic Acid
PP	Polypropylene
TM	Trademark
TMA	Thermal Mechanical Analysis

UD	Unidirectional
W	Woven

CHAPTER 1

INTRODUCTION

1.1 Background

Fibers are a natural or inorganic substance from animals, plants, and minerals. It is a source of many products that can be seen nowadays like building, home appliances, furniture and more. Some fibers with high capabilities in terms of engineering material are used on the fabrication process while some fibers with lower capabilities are enhanced in terms of its chemical composition, structure, and properties. Fibers can be divide by 2 major classification which is natural and synthetic. All natural fibers are based on animals, plants, and minerals while synthetic fibers are chemically enhanced structure and composition of the fiber (R. Yahaya, 2016).

Kenaf or as the scientific name is Hibiscus Cannabinus L. is a natural fiber with a strong mechanical property such as high yielding crop which can be utilized into raw material in varying industrial applications such as building materials, fabric yarns, and composites. Kenaf is widely known in southern Asia due to through various manufacturing process, kenaf fiber can also be used in industrial automation like car parts. As stated by Steef J. J. Lips, et.al., (2013), kenaf is one of the many fibers of bast crop that is widely used in the market. One of the bast crops are jute, flax, hemp, ramie, roselle and mesta.

1.2 Statement of the Purpose

The purpose of this research is:

i. To fabricate and analyze the new composition of naturally made resin reinforced kenaf fiber.

ii. To identify the mechanical properties of kenaf mix with a natural binder.

1.3 Problem Statement

In a manufacturing industry, many designers used plastics as a base for their design. For instance, the use of plastic on a packaging, building construction, electronics, automotive, furniture and still counting has plastics on their product. The benefit of plastic in this industry is no doubt bringing more fortune than they could have bargained for. The production of plastics has increased 20 times since the 1960s. There are around 25.8 million tonnes of plastic usage was demanded by consumers in Europe every year. According to Brussels, et, al., (2018), it is expected that the number will keep increasing for the next 20 years due to the high demand from customers.

However, the increase of production in plastic usage would mean the increase in the incineration of plastic waste. According to the European Economic Press, the incineration of plastic waste gives rise of CO2. According to Jambeck, et. al., (2015), it is expected that approximately 400 million tonnes of CO2 were produced in a year during the incineration process.

Moreover, a large number of plastic wastes had been identified in the environment such as land masses and sea. More than 150000 to 500000 of plastic waste find their way to the oceans every year as stated by Bond et.al., (2016). This will affect marine life such as dolphin. In fact, this number is still a small scale compare to a global marine litter. This causality will come to affect human health through the food chain.

1.4 Scope

From the objectives, the study is narrowed down to become more specific in order to give a clearer view of the critical points. The scope includes in this studies are:

i. The equipment that will be used in this experiment is Charpy impact test ASTM D-6110 or ISO 179 and tensile test ASTM D-638.

ii. The binder used in the composition of kenaf mix is limited to an organic substance.

iii. This experiment is limited to the study of the mechanical properties which is the tensile test and impact test.

CHAPTER 2

LITERATURE REVIEW

2.1 Type of Fibre

Fibers are a natural or synthetic material that is often used in developments of other products such as automotive, building constructions and more. Research in fiber has undergone with such depth that natural fibers have been mixed as a composite with other materials to strengthen its mechanical properties, tensile strength, flexural, water absorber capability and more. The research has increased amass with a means to discover more about the natural abilities of fiber. A classification of natural and synthetic fiber is indicated in Figure 2.1.

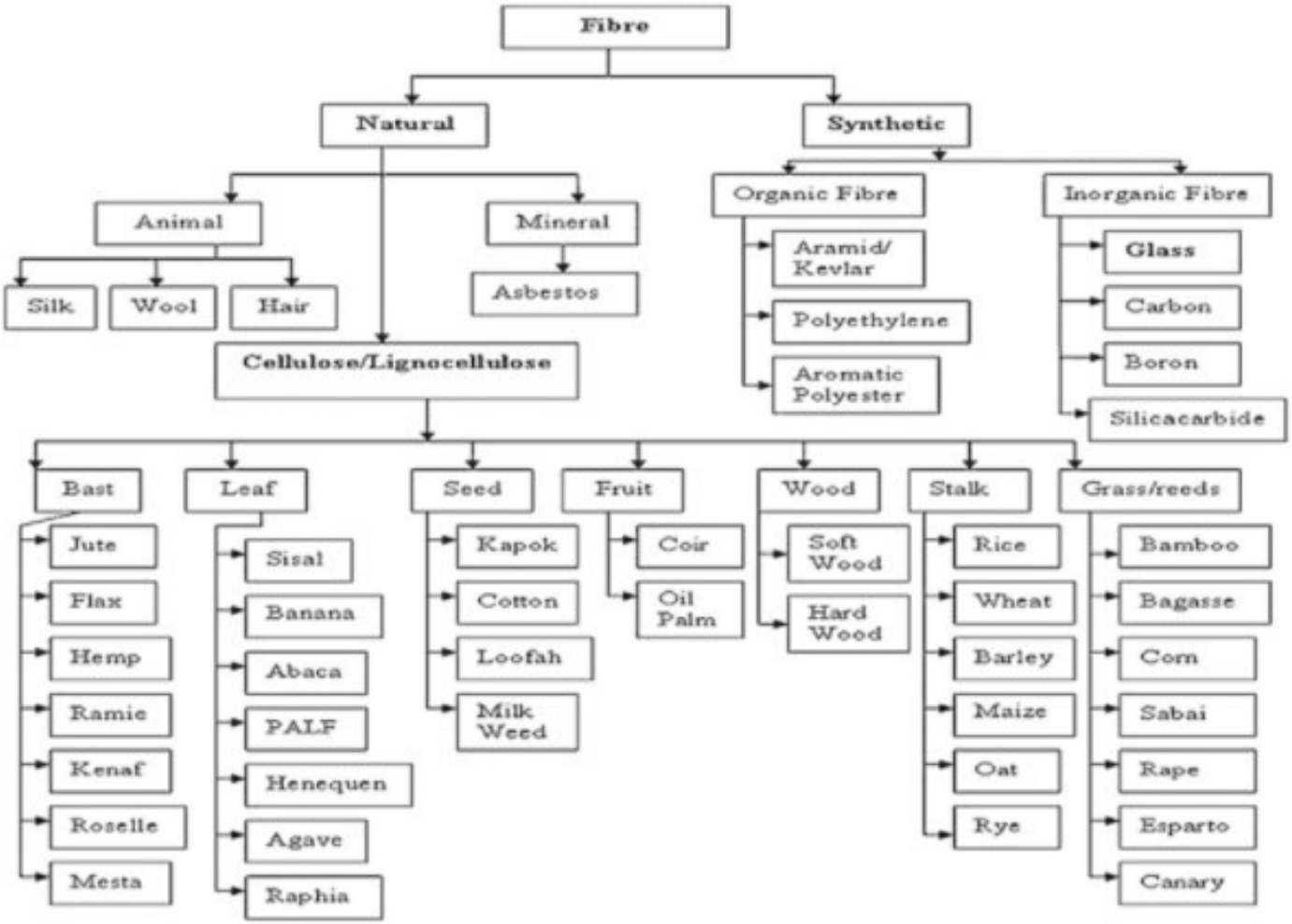

Figure 2.1: Classification of Natural and Synthetic Fibres (Saba, et.al., 2015)

2.2 Synthetic Fibre

Synthetic fiber is a man-made fiber formed through several chemical processes. One of the biggest advantages of synthetic fiber is renewable resources. According to Shen et.al., (2014) stated that synthetic fiber can be recycled endlessly to form new products. One such synthetic fiber that can be recycled is a polymer that can be made from renewable resources.

2.3 Natural Fibre

Natural fibers can be classified into 3 types which are animal, mineral and cellulose/lignocellulose. Natural fibers are a lignocellulosic material originates from trees or plants and are only constitute by bio-polymers while synthetic fibers such as nylon, polyethylene, and polypropylene are from the petroleum-based product. O. Onuaguluchi, et.al., (2010) stated that the main difference between natural and synthetic fiber is located in its inherent polymer constituents.

2.4 Animal Fibre

One of the fibers that were produced by animals or insects alike is mulberry silk. It is used by the larvae as part of the cocoon, in which the silk give its occupant a shelter and protection against pupation. Based on Anja Glisovic et.al., (2010), its mechanical properties are high tensile strength and are able to resist from chemical resistance to bioactivity. The structure is semi-crystalline polymer embedded in amorphous protein matrix.

2.5 Mineral Fibre

Mineral fibers are made up of long, thin filaments of a mixed diameter that bonds and entangled together. The vitreous material of the mineral fiber has no preferred cleavage plan that breakage tends to take place across the narrow transverse section (Saba, et.al., 2015). Thus, it will produce shortened segments of varied length with an unchanged diameter which may release as a dust. There is a possibility that a thinner original fiber breaks into shorter lengths than the thicker one.

2.6 Cellulose/Lignocellulose

Cellulose is an organic compound and one of the natural fibers frequently used as a binder and a dispersing agent. Its chemical properties are insoluble in most organic solvent and water. One of the rare uses of cellulose is the binder for electric double-layer capacitor electrode. This cellulose mix binder provides good properties in terms of electricity and a low-cost alternative to cellulose nano-fiber. As portrayed by Brotta Andresa etal., (2018), further study portrays an excellent performance as a dispersing agent in aqueous graphite dispersions.

2.7 Leaf

Leaf fiber is rough and tough which originates from leaf tissue in agave tissue (Agavaceae) using a method known as hand scraping. Before the method of hand scraping, the fiber should have a retting process or mechanical extraction process. Generally, leaf fiber can be used as fabric, rope, mat and more due to its unusual high tensile strength (O. Onuaguluchi, et.al., 2010).

2.8 Seed

Seed fiber is a plant extract from pod or plants seeds. For instance, calotropis (calotropis procera), poplar (populous tremula), kapok (ceiba pentandra), coir (cocos nucifera) and cotton (gossypium) is a plant extract from pod or plant seeds. As stated by O. Onuaguluchi et.al., (2010),seed fibre can be used as a material such as water safety equipment, mattress product, textile and more due to its unusual softness and buoyancy . Besides that, cotton fiber has a multi-layered structure that comes from the genus Gossypium plant where the purest of cellulose ever in nature.

2.9 Bast

Bast fiber is a plant originates from the outer bark of a stem. The examples of bast fiber can be portrayed in Table 2.1 which indicate its mechanical properties. Retting process is a method to extract the bast fiber from the stem through biological or chemical degradation. As depicted by O. Onuaguluchi et.al., (2010) bast fiber serves as utilities such as rope, textile, clothing and more due to its unusual high tensile strength.