



## **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

### **A STUDY ON NEW MATERIAL OF STORAGE TABLE FABRICATE FROM BIO COMPOSITE (COCONUT FIBER) BASED**

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

by

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**TAJUK: A STUDY ON NEW MATERIAL OF STORAGE TABLE FABRICATE  
FROM BIO COMPOSITE (COCONUT FIBER) BASED**

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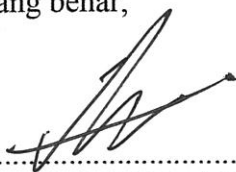
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## APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours. The member of the supervisory is as follow:



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## ABSTRACT

The aim of this research is to study the new composition of corn starch reinforced with coconut fiber and to test and analyse the new composition of corn starch and coconut fiber. Manufacturing of synthetic fiber produced by human presents has cause environmental and human health problem. The temperature of the world has increase every year and the pollution became worst such as the air pollution. This pollution is due to the heating process of making this synthetic fiber or material and the process of decomposing it require burning process which release polluted air and fume that dangerous for the environment and the population health. Coir or commonly known as coconut fiber is material which produce from the fruit of a ripe coconut fruit shell. The binder is made from corn starch with mix of epoxy resin to strengthen the mechanical properties. The reinforcement between the corn starch and coconut fiber has been made with 6 samples that varying of it composition. The sample was prepared by mixing the corn starch and coconut fiber with an added epoxy to enhance its properties. The specimen was tested using destructive test which is tensile test and flexural test is used to determine the mechanical properties from 0wt% of coconut fiber until 60wt% coconut fiber based on ASTM D3039 and D790. The maximum strength of tensile test is 8.96MPa and for flexural test is 11.502 MPa. Therefore, the percentage of coconut fiber is 20wt% since it has the optimum mechanical properties in tensile and flexural test. The design of a product is created and the material properties is applied. Based on the theories receive from the simulation, the scale product can withstand force up to 20N and still be able to turn back to its original shape. The design of the scale product also bringing affect toward the amount of force it can receive. Therefore, all objective of this project has been achieved.

## ABSTRAK

Tujuan penyelidikan ini adalah untuk membangunkan komposisi baru kanji jagung yang diperkuatkan dengan serat sabut kelapa dan untuk menguji dan menganalisis komposisi baru tepung jagung dan serat sabut kelapa. Pembuatan serat sintetik yang dihasilkan oleh kehadiran manusia menyebabkan masalah kesihatan dan alam sekitar. Suhu dunia meningkat setiap tahun dan pencemaran menjadi teruk seperti pencemaran udara dan bau. Pencemaran ini disebabkan oleh proses pemanasan untuk membuat serat atau bahan sintetik ini dan proses penguraiannya memerlukan proses pembakaran yang membebaskan udara dan asap tercemar yang berbahaya bagi alam sekitar dan kesihatan penduduk. Coir atau biasa dikenali sebagai serat kelapa adalah bahan yang menghasilkan dari buah cangkang kelapa tua. Pengikat dibuat daripada kanji jagung dengan campuran resin epoksi untuk memperkuat sifat-sifat mekanikal. Penguatan antara kanji jagung dan serat kelapa telah dibuat dengan 6 sampel yang berbeza dari komposisinya. Sampel disediakan dengan mencampurkan kanji jagung dan serat kelapa dengan epoksi tambahan untuk meningkatkan sifatnya. Spesimen itu diuji menggunakan ujian pemusnah yang merupakan ujian tegangan dan ujian lenturan digunakan untuk menentukan sifat mekanik dari 0wt% serat kelapa hingga 60wt% serat kelapa berdasarkan ASTM D3039 dan D790. Kekuatan maksimum ujian tegangan ialah 8.96MPa dan untuk ujian lenturan adalah 11,502 MPa. Oleh itu, peratusan serat kelapa yang dipilih ialah 20wt% kerana ia mempunyai sifat mekanik yang optimum dalam ujian tegangan dan lenturan. Reka bentuk produk dicipta dan sifat material digunakan. Berdasarkan teori-teori yang diterima daripada simulasi, produk berskala dapat bertahan sehingga 20N dan masih boleh kembali ke bentuk aslinya. Reka bentuk produk berskala besar juga memberi kesan terhadap jumlah daya yang boleh diterima. Oleh itu, semua objektif projek ini telah dicapai.



## **DEDICATION**

To my beloved parents Zainab Binti Mohd Zain who have provide me with motivation and my supervisor Mr Mohd Afdhal bin Shamsudin who have help and guide throughout the project. To my friend who support and help in time needed.

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## LIST OF SYMBOLS

mm	-	millimetre
m	-	metre
cm	-	centimetre
N/m <sup>2</sup>	-	Newton over metre square
Pa	-	Pascal
MPa	-	Mega Pascal
N	-	Newton
Kg	-	Kilogram
g	-	gram
m <sup>3</sup>	-	metre cube
V	-	volume
cps	-	centimetre poise per second

## CHAPTER 1

### INTRODUCTION

#### 1.0 Background

There is number of environmental issue that happen due to air pollution from the process of synthetic production. This happen because the process involves heating process to hard the product with a mixture of proxy. This research is focus on the application and the effect of the new material and new binder based on natural resources which is corn starch. Strength and rate of the force absorbed by the impact towards the changed product and how to improve the combining ratio will be study based on that new material. The type of binder for the new material also being study in effort to increase the strength of the product and the design of the output product. Material and design of the specimen is analysed until reach the best structure and shape. The corn starch specimen structure is constructed based on bio composite element with empty fruit bunch as an additional mixture of reinforcement inside the corn starch. Impact test data from the experiment is compared to the FEA analysis result for the validation purpose. (Roper, 2002)

Coconut fibre is a fibrous material of pure biological origin. Coconut fibre can be easily obtain from many region and places. The fibre from a fully ripened coconut has stong and highly resistant to abrasion, the method of processing the fibre also protect its from be damaged by sunlight. Due to the coconut fibre highly resistant to abrasion, many tool and applience are made with it. Futhermore, it has a strong resistant to weather making it to have a better durability, a bio-degradable and can use to hold water.

Cornstarch derived from corn grain and is commonly used as food ingredient for thickening agent. Cornstarch is a carbohydrate extracted from the endosperm of a corn, it is used in many culinary, household, and industrial purposes. Moreover, corn starch has been used to manufacture bioplastic. It contains glucose that can act as a binder since it contains starch and can be solidified when the extrusion variable and chemical concentration are known with the right amount of water and temperature. (Pan, 1998). Mixing the cornstarch into a cool or room temperature liquid then heated it up can cause a thickening reaction. Cornstarch can easily absorb moisture making it critical to be kept in an air-tight space container and needed to be avoided from freezing it to prevent the starch matrix from breaking down.

## **1.1 Problem Statement**

In this day, the use of synthetic product made of plastic is widely used (Glen Bell, 2010) and has caused many pollutions due to its processing and production process where many unnecessary fumes are released when processing it. The type of pollution produced by this production is air pollution and water pollution that cannot be filtered by the production company due to the heating process. Waste pollution also comes from the factor that the synthetic is not bio-degradable. Moreover, the synthetic material production is heavily relying on chemical treatments such as petroleum, soda, sulphuric acid and formaldehyde during the manufacturing and curing of the material. Even after the finishing process the material will still contain toxins that can be harmful if exposed to certain conditions such as heat or moisture (Kamel, 2019). The heating process of synthetic material produces hazardous substances that can cause many harmful effects to the worker or people around it, such as lung infection, irritated skin and suffocation due to chemical compound release in the gas during the heating process. Based on Bahng, 2014 the synthetic material does not trap air pockets and provides poor insulation unlike natural material. Furthermore, the synthetic material burns

more rapidly because it is prone to heat damage and cause skin irritation due to enzyme that its not suitable for human skin and the biggest issue is that it is not bio-degradable. The usage of wood also become a needed material in many product and with the increase of demanded wood product, the higher of wood logging activity has become. Furthermore, the processing of wood can release wood dust which is harmful to human lung that even can cause cancer and improper treatment to a finishing wood product can also cause the user of the product to be affected with health problem such as asthma and allergies. In this research the exchange of wood and synthetic product by using alternative resource, that is corn starch as binder and coconut fibre as the reinforcement. Coconut fibre has a high toughness among the natural fibre, it has the potential to be used as reinforcement in a low-cost structure. Coconut fibre has been used as reinforcement in low density poly material. The natural bond of the natural waxy surface provides a good fibre matrix bond. (Brahmakumar, 2005). Cornstarch can have a result of high bonding strength than a native starch with the right dry method of degree of substitution. (Zhou, 2007)

## **1.2 Objective**

1. To study natural material as binder and reinforcement by using alternative source
2. To test and compare the mechanical properties of the natural material

## **1.3 Scope**

1. Developing new material for storage table with corn starch as a binder and coconut fibre as the reinforcement.
2. Testing done by using Universal Testing Machine for Tensile test and Flexural test.
3. Comparing the mechanical properties using simulation.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.0 Introduction

In this chapter the information that related and contain in this project is explain. Many theories have been proposed for this project and some of it has been review repeatedly for further understanding the theories has been stated. The main reason for this chapter to ensure the research is not come from baseless study and deduction.

Moreover, in this chapter the topic of fiber and binder is review for further understanding. The method for fabrication and type of testing that will be used in this project will also be review.

#### 2.1 Synthetic fiber

Fiber-reinforced polymer are multipurpose materials that are made by humans with chemical mixtures that are widely used and employed in many advanced applications due its high stiffness and strength properties. Synthetic fibers are very highly demand by the many industries because of fast production it can supply and the price is affordable for many small company and those with an intention to reduce cost. The properties of synthetic fiber matrix have been considerably enhancing throughout the decade with the help of dedicated study. The brittle of the fiber is the follow up of low stiffness and fracture toughness that lead to low matrix domination properties such as fracture toughness. (Ghalia, 2019)

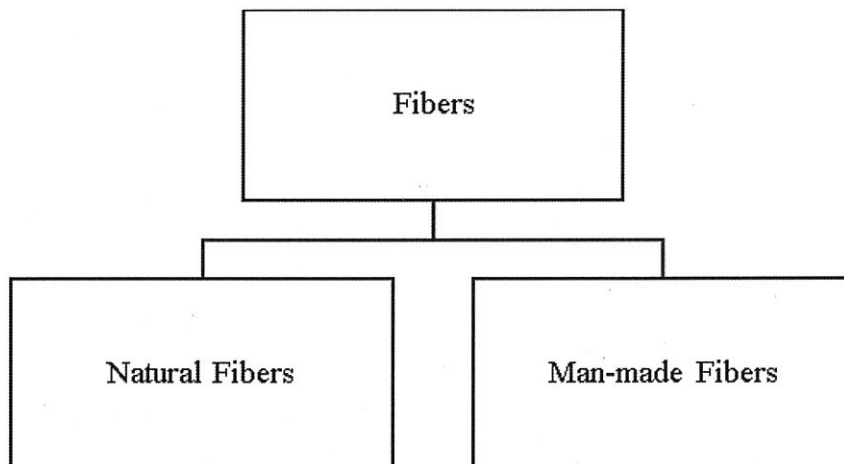
The chemical process for this process is called polymerization which multiple combination of chemicals is process through the formation of macromolecules through a repetition of basic units. Where the chemical is converted, dissolved and turned into

thick liquid. Furthermore, the process of synthetic is forward by spinning process which the fiber had to go through a multiple of small diameter to achieved filament string shaped. The process is further with twisting process, where the all the filament is twist together to create a strand of fiber.

### **2.1.1 Problem of synthetic fiber**

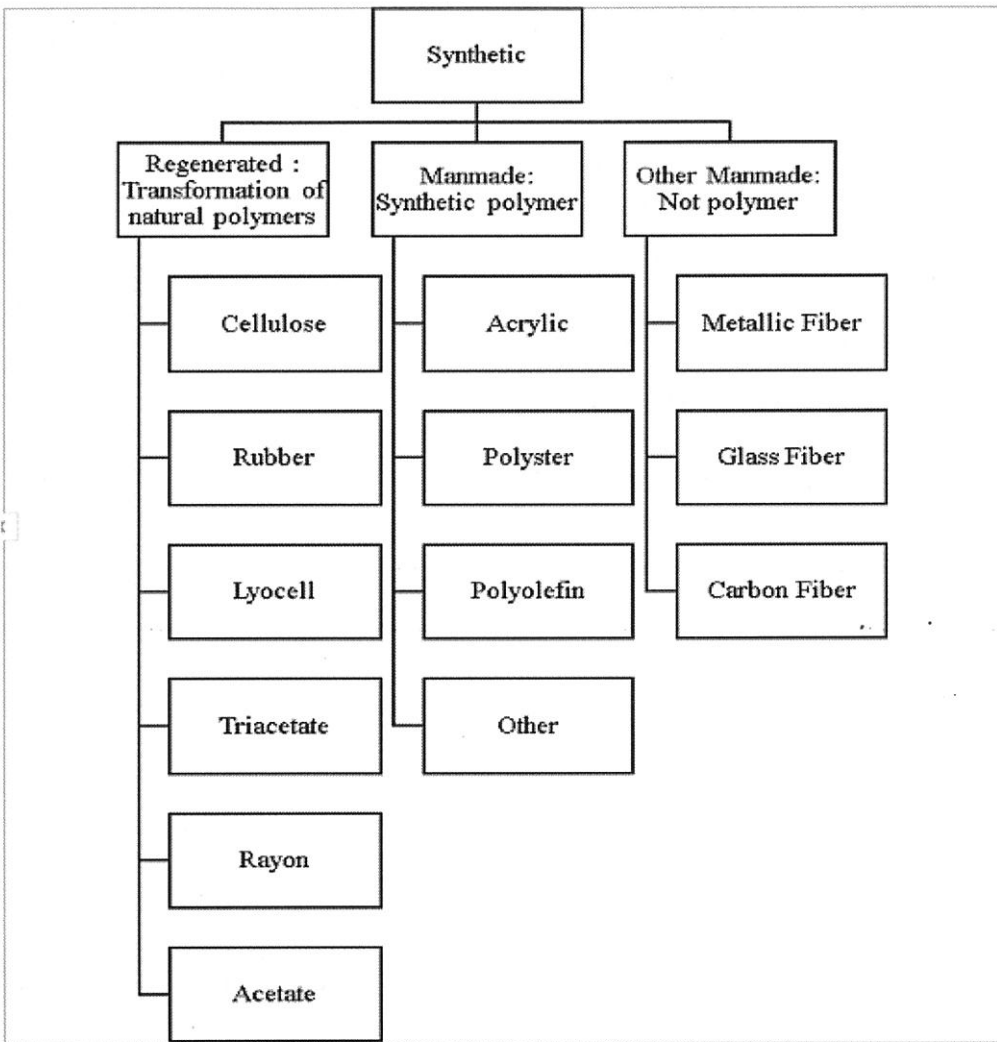
Fiber has been used in many occasion such as in manufacturing or other material. Natural fibre has been long used by civilization to manufactured material with higher strength to endure impact and can receive more strain while the material performs its intended function. With the help of advanced technology, synthetic fibers such as polyester and nylon are become more preferable by people due its convenient. This major change has cause the used of synthetic fiber to be used in manufacturing and designing to be more popular than natural fiber. A few reason why the abundance usage of synthetic fiber or man-made material to become a problem issue. The reason is the synthetic fiber cause pollution toward the environment by contributing a huge amount of chemical waste and carbon emission during production and disposal. The reason it is still be used is because the synthetic fibers are cheap and easier to produce in a large quantity.

Based on Mirza Nadeem Ahmad (2017), synthetic material has become a problem since the increase of production is increasing at alarming rate and most of this material are been throw out before the material condition become unavailable has become one of the main contribution toward environmental waste pollution. Therefore, natural degradable materials are a better substitute to control the adverse effect of such risky materials and reduce the current problems. Fibers consist of two type which have been use throughout the history. In Figure 2.1 shows the classification of the fiber.



**Figure 2.1 Classification of fiber (L.C. Hao, 2018)**

Synthetic fibers are generally produced based on polymers through chemical reactions, which are sodium hydroxide and carbon disulphide which are derive from the non-renewable resource such as coal, natural gas, crude oil and uranium. The example of synthetic fiber or man-made fibers is shown in Figure 2.2.



**Figure 2.2 Example of man-made fibers (L.C. Hao, 2018)**

## 2.2 Type of natural fiber

Natural fiber is a renewable fiber which classified into three, which is plant fiber, animal fiber and mineral fiber which shown in Figure 2.3. Natural fiber is obtained from natural origin, thus has low chemical processing or even some of it does not need any chemical processing. Some of the natural fibers are originally a waste product where the material is disposed before it used to be realized. Therefore, some of this material has a low priced compare to the other natural fibers. (Chun-kit Ho, 2012). There is higher demand for superior material in nowadays and surface