UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A STUDY ON MECHANICAL,PHYSICAL AND ENVIRONMENT PROPERTIES FOR VARIED LENGTH ON THERMOPLASTICS CORNSTARCH COMPOSITE REINFORCED BY UNTREATED PINEAPPLE LEAF FIBRE

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

by

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I hereby, declared this report entitled a study on mechanical,physical and environment properties for varied length on thermoplastics cornstarch composite reinforced by untreated pineapple leaf fibre is the results of my own research except as cited in references.

Signature: ……

Author : MUHAMMAD IKMAL KHAZANY BIN MOHD ASRI

Date:

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

Signature : …….

Supervisor : NAZRI HUZAIMI BIN ZAKARIA

ABSTRAK

Pada masa kini, serat semulajadi telah mendapat perhatian dari penyelidik dan telah menjadi isu penting bagi penyelesaian alternatif dalam menggantikan serat sintetik untuk menyelesaikan masalah ekologi dan persekitaran. Antara jenis serat semula jadi adalah serat daun nanas (PALF) yang telah dipilih sebagai serat semulajadi yang digunakan dalam kajian ini kerana ia mempunyai sifat mekanik yang lebih baik dan ia juga mempunyai kos pengeluaran yang rendah. Serat daun nenas dari jenis Josapines mempunyai kandungan selulosa yang tinggi dan mempunyai ciri-ciri mekanik yang sangat baik. Serat daun nenas jenis Josapines akan digunakan sebagai bahan bertetulang manakala tepung jagung sebagai pengikat. Dalam kajian ini, kesan kandungan PALF dan panjang serat pada komposisi PALF/TPCS akan dianalisis. Lima komposisi PALF yang berbeza ditetapkan pada 20,30, 40, 50, dan 60 wt% manakala panjang serat pula adalah 2mm dan 10mm. Sampel komposit dibuat dengan menggunakan teknik pengacuan kompresi dengan orientasi PALF secara rawak. Sampel akan menjalani tiga ujian yang berbeza, iaitu ujian mekanikal, ujian fizikal dan ujian alam sekitar. Oleh itu, hasil yang lebih tinggi untuk ujian mekanikal dari segi panjang serat ialah serat yang mempunyai panjang 10mm. Kekuatan tegangan pada beban serat 40% menunjukkan hasil yang tertinggi iaitu 10.51MPa manakala untuk hasil ujian lenturan yang tertinggi adalah pada beban gentian 50% iaitu 15.55MPa. Akhir sekali bagi ujian impak di mana hasil yang paling tinggi adalah pada beban gentian 20% iaitu 6.58 MPa.

ABSTRACT

Nowadays, natural fibres have received considerable attention from researchers and have become an important issue for alternative solutions in replacing the synthetic fibre to solving ecological and environmental problems. Among the many types of natural fibre available, pineapple leaf fibre (PALF) has been selected as the natural fibre used in this study because it has a better mechanical properties and it also has a low production cost. The PALF from the Josapines type has high cellulose content and has excellent mechanical properties. In this study the PALF of the Josapines type will be used as reinforced material while cornstarch is a binder. In this study, the effect of the content of PALF and the fibre length of the composition of PALF / TPCS will be analyzed. Five different PALF compositions are set at 20, 30, 40, 50, and 60 wt.% while the length of the fibres is 2mm and 10mm. The composite samples were fabricated by using compression moulding techniques with PALF randomized orientations. The sample will undergo three different tests, which are mechanical testing, physical testing and environmental testing. The highest result of mechanical testing in term of length is 10mm fibre length. For the tensile strength at 40% fibre loading shows the highest result which is 10.51MPa while for flexural testing the highest results at the 50% fibre loading 15.55MPa. Lastly, for impact testing higher result in the 20% fibre loading at 6.58MPa.

DEDICATION

This project report is lovingly dedicated to my beloved family members, especially to my father, Mohd Asri Bin Salleh and my mother, Sarimah Binti Yaacob who have been my constant source of inspiration. They have given me the drive and discipline to tackle any task with enthusiasm and determination. Without their loves and support this project would not have been made possible.

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wt%	-	Weight percent
mm	-	Millimetre
T	-	Temperature
P	-	Pressure

LIST OF ABBREVIATIONS

PALF	Pineapple Leaf Fibre
GF	Glass Fibres
FRP	Fibre-Reinforced Plastics
CO_2	Carbon Dioxide
SH	Starch
TPCS	Thermoplastic Corn-Starch
NaOH	Sodium Hydroxide
LDPE	Low density polyethylene composite
RH	Relative humidity

CHAPTER 1

INTRODUCTION

1.1 Background

Composites are an idea of the combination of two or more natural resource materials basically made up of two materials that are fibre and matrix. Composites also are the combined result of more than one ingredient that will produce new material and the properties of the substance also increase from the original individual component. This combination will give unique properties, especially in mechanical properties where thus properties are different from their each material. As an example of natural composites growing with natural processes are bone, wood, and stone. The leaf themselves comprises natural fibres with good mechanical properties, strong, lightweight, biodegradable and cheaper to be used to create new composite materials. Based on all the natural fibres that exist, pineapple leaf fibre can produce good mechanical properties because it has high cellulose content (Mashitah, 2015).

The fibre function is used to reinforce the material and prevent it from being fragile. Fibre can be obtained from the extraction of natural fibres from various sources such as banana leaf, pineapple leaf, kenaf, bamboo and coconut. The matrix serves as a binder to hold the fibre in the composite. The source of the matrix can be obtained from starch, carbon, animal fats and other materials. With this combination will give a unique characteristic in mechanical properties where its properties is differ from each of its

ingredients. Ever since then humans have done an innovation where using composite materials to upgrade their lives. For example, combining mud with hay to obtain better bricks in terms of mechanical properties. In this case the mud would act as a binder for holding hay and this will increase the strength of the material (Mashitah, 2015).

Nowadays, natural fibres or natural composites have high potential to replace the fibreglass composite and they are also widely used as polymer composite reinforcement. Among the causes of it being chosen as the replacement of glass fibre reinforced composites is low cost, low density and has good mechanical properties compared to glass fibre reinforced composites. In addition, there are many benefits that can be obtained from natural fibres. For example, its benefits to the technology and the environment when it is widely used in inorganic composites because of natural fibres having high strength and good stiffness quality despite its low density. Natural fibre composites have been widely used by many industries today as one of the materials used in their production (Mashitah, 2015).

For example, bamboo fibres have been used worldwide by the automotive company mitshubishi to produce car interior. In addition, natural fibres use lower energy during production based on previous studies, so it provides a positive impact such as lower abrasion on the machine and there is no human health risk especially during inhalation. Besides, it is more environmentally friendly because it is biodegradable and contains less carbon dioxide. Other than that, the natural fibre strength will also increase if undergoing chemical treatment and it also has good thermal permeability based on previous studies (Mashitah,2015).

1.2 Problem Statement

Recently, scientific research has been conducted on natural plant fibres as a potential alternative source of fibres in fibre-reinforced plastics. Natural fibres have the potential to replace synthetic fibres because synthetic fibres will damage the environment and it is also non-renewable in turn creating severe pollution of the soil. In addition, synthetic fibre is not biodegradable and is not environmentally friendly, although it has good mechanical properties. In addition, natural fibres have many advantages as they can be recycled, widely available, biodegradable, renewable, they are also made of neutral carbon dioxide (CO_2) and most importantly, it does not have health risks when inhaled during the process. In Malaysia pineapple is also a focus for the industry, but only on its fruit. This causes the unused pineapple portion to be removed and burned as soon as possible. By doing so, it will add further pollution to the environment. The pineapple leaf which has been removed and burned actually has good fibre sources and can be used in industrial use.

Among the various plant fibres, fibre with high cellulose content is the pineapple leaf fibre (PALF) obtained from the Josapine pineapple leaf. PALF has shown excellent mechanical properties and is highly potential to be used as reinforcement in polymer composites because it contains rich cellulose content of more than 70%. As a result of a combination of pineapple leaf fibre used as a reinforcing material and starch based composites as a matrix material, has produced a highly productive PALF composite for plastic industrial products because of its good mechanical properties.