UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EFFECT OF THERMOPLASTICS CORN STARCH COMPOSITE REINFORCED BY LONG TREATED PINEAPPLE LEAF FIBRE ON THE MECHANICAL, PHYSICAL AND ENVIRONMENT BEHAVIOUR

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

AHMAD TARMIZI BIN MOHAMAD

B071510455

960726-11-5391

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING TECHNOLOGY

2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: EFFECT OF THERMOPLASTICS CORN STARCH COMPOSITE REINFORCED BY LONG TREATED PINEAPPLE LEAF FIBRE ON THE MECHANICAL, PHYSICAL AND ENVIRONMENT BEHAVIOUR

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No 266 Felda Kerteh 3	
23300 Dungun	
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Author : AHMAD TARMIZI BIN MOHAMAD

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:

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Supervisor : NAZRI HUZAIMI BIN ZAKARIA

ABSTRAK

Pada masa kini, peningkatan dalam penyelidikan mengenai serat semula jadi yang boleh diperbaharui telah dilakukan untuk menjadi salah satu pilihan elektif dalam menggantikan serat sintetik. Selain itu, serat semulajadi mempunyai usaha pengeluaran yang minimum namun mempunyai ciri-ciri mekanikal yang baik dan boleh dilupuskan secara semula jadi. Antara sumber serat semulajadi adalah serat daun nanas (PALF) yang ditanam secara meluas di Malaysia. Dari kajian semasa, PALF mengandungi selulosa yang tinggi dan mempamerkan ciri-ciri mekanikal yang baik terutama daripada jenis Josapine. Oleh itu di dalam kajian ini, PALF dari jenis Josapine digunakan sebagai bahan penguat dan pengikatnya adalah kanji jagung termoplastik (TPCS), kesan komposisi PALF dan panjang PALF pada sifat mekanik, fizikal dan persekitaran komposit PALF / TPCS yang telah dirawat dianalisis. Komposisi campuran telah ditetapkan iaitu 20/80, 30/70, 40/60, 50/50 dan 60/40 diikuti dua jenis panjang PALF yang berbeza. PALF perlu menjalani rawatan alkali bagi meningkatkan kekuatan serat dan seterusnya menggunakan proses pembentukan bertekanan tinggi. Kesemua sampel telah menjalani sembilan ujian yang berbeza bagi menentukan sifat mekanikal, fizikal dan persekitaran komposit PALF/TPCS. Ujian yang telah dijalankan bagi menentukan sifat mekanikal adalah seperti ujian tegangan, ujian lenturan dan ujian impak manakala bagi menentukan sifat fizikal, ujian pengukuran ketumpatan, kandungan lembapan, penyerapan kelembapan dan penyerapan air dijalankan. Ujian untuk menentukan sifat persekitaran adalah ujian penguburan tanah dan kelarutan air. Bagi sifat mekanikal serat, pada komposisi 50% campuran PALF dengan panjang 10 mm menunjukkan nilai kekuatan tegangan dan kekuatan lentur yang paling tinggi iaitu 15.18 MPa dan 25.26 MPa. Hasil daripada 30 mm panjang PALF juga menunjukkan corak yang sama pada komposisi 50% campuran PALF adalah nilai tertinggi tetapi lebih rendah berbanding dengan panjang PALF 10 mm iaitu 13.47 MPa dan 18.70 MPa.

ABSTRACT

Nowadays, increasing in researches about renewable natural fibre had been done in order to become one of the elective arrangements in supplanting the synthetic fibre. Besides, the natural fibres have minimal effort of production yet have a good set of mechanical properties and natural well disposed. Among of the natural fibre resources is pineapple leaf fibre (PALF) that had been widely planted in Malaysia. For the current study, PALF contain high cellulose and exhibit great mechanical properties particularly from Josapine family. Therefore in this study, the PALF from Josapine was used as reinforced materials and the binder was thermoplastic corn starch (TPCS) and the effect of the PALF loading and PALF fibre length on the mechanical, physical and environmental properties of treated PALF/TPCS composites also have been analysed. Fibre loading was fixed since 20/80, 30/70, 40/60, 50/50 and 60/40 followed by 10 mm and 30 mm of PALF length. PALF has been undergoing alkaline treatment to increase the strength of fibre than proceed to hot press forming process. All samples have been undergoing nine different tests to determine the mechanical, physical and environmental properties of PALF composites. The test has been conducted to determine the mechanical properties including tensile test, flexural test and impact test and the physical properties are density measurement, moisture content, moisture absorption and water absorption. The test to determine environmental properties are soil burial and water solubility. On the mechanical properties of the fibre, 50% of the PALF loading with 10 mm in length shows the higher values of tensile strength and flexural strength which are 15.18 MPa and 25.26 MPa. Result from 30 mm in length also shows the same pattern which 50% PALF loading is the highest value, but lower compared to 10 mm fibre length which is 13.47 MPa and 18.70 MPa.

DEDICATION

This thesis work is dedicated to my beloved parents, Mohamad bin Yahya and Timah binti Talib, who have always loved me unconditionally and whose good examples have taught me to work hard for the things that I aspire to achieve. This work is also dedicated to my fiance, Nuraqilah Syahindah, who has been a constant source of support and encouragement during the challenges of graduate school and life. I am truly thankful for having you in my life. And lastly to my brothers, sisters, mentor, friends, and classmates who shared their words of advice and encouragement to finish this study.

ACKNOWLEDGEMENTS

First and foremost, Alhamdulillah and full of gratefulness to Allah the Almighty for his kindness and bless that helps me to finish the Bachelor Degree Project Report fluently and successfully. To my family, lots of thanks for supporting me through the whole process of my Bachelor Degree Project and lots of thanks to Universiti Teknikal Malaysia Melaka (UTeM) for giving me an opportunity and chances to full fill my Bachelor Degree Project report.

I would like to express my deepest gratitude to my advisor, Sir Nazri Huzaimi bin Zakaria for his excellent guidance, caring, patience, providing full information and ideas since the day I started to prepare the report until the end of the preparation of the report. I'm very thankful for his invaluably constructive criticism and advice in order for me to finish up this report.

Besides, many thanks to committee members of the Bachelor Degree Project, technician in Fasa B, Mohd Rizal bin Roosli that providing guidance and providing helps the whole process of this course nicely and smoothly. I am also using this opportunity to express my warm gratitude to everyone who supported me throughout this report. I am very thankful for their aspiring guidance and friendly advice during preparing the report.

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LIST OF ABBREVIATIONS

TPCS	Thermoplastic Corn starch
PALF	Pineapple Leaf Fibre
GF	Glass Fibre
FRP	Fibre-Reinforced Plastic
MMC	Metal Matrix Composite
CMC	Ceramic Matrix Composite
PMC	Polymer Matrix Composite
LDPE	Low Density Polyethlene
HDPE	High Density Polyethlene

CHAPTER 1

INTRODUCTION

1.1 Background

Green composites are a thought of the mix of at least two regular assets, materials fundamentally made up of two materials that are Fibre/Reinforced and Matrix/Binder. This mix will give extraordinary properties, particularly in mechanical properties where accordingly properties are distinction from their every material. The cases of Fibre/Reinforced materials are extraction of natural fibre from different sources, for example, banana leaf, pineapple leaf, kenaf, bamboo and coconut. The case of network/covers materials are starch, epoxy and polypropylene. In the previous history, the humanity had been utilized the composite materials as advancement to enhance the personal satisfaction. For instance, to influence the mud blocks to wind up more studier, the mud will be joined with the straw that is otherwise called adobe. For this situation, the mud will turn into the fastener by holding the straw together. In this way it will expand the quality of the development of the building itself.

These days, natural fibres or green composites are in effect progressively utilized as a fortification in polymer composites and have high potential in supplanting the fibre glass reinforced composites. This is because of their minimal effort, low thickness, however have great arrangements of mechanical properties contrasted with fibre glass reinforced composites. After that, natural fibre offers numerous innovative and ecological advantages when it utilized as a part of fortified composite, for example high quality and great in solidness quality despite the fact that it has low thickness.

Additionally, natural fibres are originated from numerous assets that are initially from the content of fibre in the plant itself, for example, bamboo fibre, coconut fibre, pineapple leaf fibre, hemp fibre and jute fibre. These days, numerous industrial or companies have been changed in utilizing the natural fibre composites as one of the materials utilized as a part of their creation.

For instance, Mitsubishi that is an overall car organization attempt to utilized bamboo fibre to deliver car inside part and some more. Moreover, from the past research that had been done, it demonstrates that the natural fibre devour lesser energies amid generation, make the lesser scraped area the machines and no hazard to human wellbeing particularly amid inward breath. Other than that, it additionally contained less carbon dioxide impersonation and biodegradable that makes it more ecological benevolent to the earth. In addition, in view of past investigation, the natural fibres likewise have great thermal permeability and the quality of the fibre will be expanded in the event that it experiences a chemical treatment.

1.2 Problem Statement

As of late, natural plant fibres have been utilized as a part of scientific research as potential other options to glass fibres (GF) in fibre-reinforced plastics (FRP). With respect to glass fibres, these lignocellulose fibres have brought down densities, cost moderately lower, expend lesser energies amid generation, represent no scraped area to machines and have no wellbeing hazard when breathed in. Moreover, natural fibres are additionally generally accessible, inexhaustible, recyclable, and biodegradable and made of carbon dioxide (CO_2) impartial (Wambua, Ivens, & Verpoest, 2003). The utilized of natural fibre as reinforced composites will influence nature and make contamination the dirt as there are non-inexhaustible, non-biodegradable and not eco-accommodating despite the fact that it has great mechanical properties (Khalil, Alwani, & Omar, 2006).

In Malaysia the focal point of pineapple industry is the foods grown from the ground created a rich of bio squander educate of leaves mostly treated the soil or consumed along these lines squandering the great capability of fibre sources. The consuming procedure of the leaves will prompt ecological contamination issues (Mohamed, Sapuan, Shahjahan, & Khalina, 2009).

Since a substantial determination of plant filaments, pineapple leaf fibres (PALF) acquired from the leaves of the pineapple plant of Josapine have the most astounding cellulose substance which makes the filaments mechanically stable (Vinod B1 & Engg, 2013). PALF show astounding mechanical properties because of the rich cellulose substance of over 70%, which are potential to be utilized as a fortification in polymer composites (Mohamed, Sapuan, & Khalina, 2010). In this manner, the blend of pineapple leaf fibre utilized as reinforced material and the starch based composite as the matrix materials that are absolutely both green composites materials used to create PALF/TPCS composite may uncover a decent potential outcome in mechanical properties particularly for plastic business items.

1.3 Objective

The specific objectives of this research were:

i. To determine the characterization of treated long pineapple leaf fibre (PALF) reinforced of thermoplastic corn starch (TPCS) composite.
ii. To study the effect of PALF length between short and long PALF on the properties of treated PALF/TPCS composite.

1.4 Scope

This research will determine the characterization of PALF loading and the PALF length of the PALF/TPCS composites. The scope of this research is stated below:

i. The various ratios of PALF/TPCS composite will be selected and the ratio of fibre loading in the PALF/TPCS composite was fixed in 20:80, 30:70, 40:60, 50:50 and 60:40.
ii. The PALF length will be fixed to short and long PALF at 10 mm and 30 mm only.
iii. The mechanical properties of PALF/TPCS composite will be determined using tensile test, flexural test and impact test.
iv. Physical testing also will be conducted such as moisture content, moisture absorption, water absorption, and density measurement.
v. An environmental testing also be conducted in this research using soil burial testing and water solubility

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the last decade, researchers and experts in diverse area have already drawn close attention to the many environmental problems brought about by petrochemical waste. Because of that, to obtain the environmentally friendly materials, many researchers have put forward the use of biodegradable polymers. Recently, more attention has been paid on starch because of its biodegradability in soil and water and its worldwide availability at low cost. However, because of poor mechanical performance and their water sensitivity it is very difficult to achieve industrialization production. Therefore, the starch-based materials have to be modified physically or chemically to take the place of conventional petroleum-based polymers (Guo, Zhou, & Lv, 2013).

Starch is promising biopolymers for creating bio composite materials since it is inexhaustible, totally biodegradable, and effortlessly accessible with ease. The improvement of bio composites based on starch has been extending persistently because of the way that thermoplastic starch (TPS) can be gotten after the interruption and plasticization of local starch. Different kind of plasticizers, for example, glycerol, water, and sorbitol has been utilized to prepare TPS. Contrasted with the normal thermoplastic polymers, TPS has two min disadvantages including poor mechanical properties and high water sensibility. The use of reinforcing agent in the starch matrix is a successful intends to defeat these downsides and a few sorts of biodegradable reinforcements, for