UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A STUDY ON MECHANICAL, PHYSICAL, AND ENVIRONMENT PROPERTIES ON THERMOPLASTICS CORNSTARCH COMPOSITE REINFORCED BY UNTREATED PINEAPPLE LEAF FIBRE USING HYBRID METHOD

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

NURUL SYAZA IZZATY BINTI SAHARUDDIN

B071610973

95503-14-5332

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING TECHNOLOGY

2019

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: A STUDY ON MECHANICAL, PHYSICAL, AND ENVIRONMENT PROPERTIES ON THERMOPLASTICS CORNSTARCH COMPOSITE REINFORCED BY UNTREATED PINEAPPLE LEAF FIBRE USING HYBRID METHOD

Sesi Pengajian: 2019

Saya **NURUL SYAZA IZZATY BINTI SAHARUDDIN** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

☐ SULIT* Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

☐ TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

☒ TIDAK TERHAD

Yang benar,	Disahkan oleh penyelia:
....	....
NURUL SYAZA IZZATY BINTI SAHARUDDIN	TS. NAZRI HUZAIMI BIN ZAKARIA
Alamat Tetap:	Cop Rasmi Penyelia
Lot 7816 Kampung Paya Jaras Hilir	
47000 Sungai Buloh, Selangor	
Tarikh: 08//12/2019	Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled A STUDY ON MECHANICAL, PHYSICAL, AND ENVIRONMENT PROPERTIES ON THERMOPLASTICS CORNSTARCH COMPOSITE REINFORCED BY UNTREATED PINEAPPLE LEAF FIBRE USING HYBRID METHOD is the results of my own research except as cited in references.

Signature: ……………………………………

Author: NURUL SYAZA IZZATY BINTI SAHARUDDIN

Date: 08/12/2019

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 (Maintenance) with Honours. The member of the supervisory is as follow:

Signature: ……………………………………………….

Supervisor : TS. NAZRI HUZAIMI BIN ZAKARIA

ABSTRAK

Tujuan penyelidikan ini adalah untuk mengkaji sifat mekanikal, fizikal dan kesan alam sekitar pada komposit tepung jagung termoplastik (TPCS) yang diperkuatkan oleh serat daun nenas (PALF) yang tidak dirawat dengan menggunakan kaedah pembuatan hibrid. Komposit PALF/TPCS ini telah dihasilkan dengan menggunakan serat daun nanas yang berukuran 10 mm panjang dengan nisbah campuran 30 wt%, 40 wt%, 50 wt%, 60 wt%, dan 70 wt%. TPCS yang telah dibuat dengan menggunakan kaedah gaulan tangan dan pengkisar berkelajuan tinggi dengan mencampurkan 70 wt% daripada tepung jagung asli bersama 30% gliserol. TPCS dan PALF kemudian disusun menggunakan kaedah hibrid sehingga komposit TPCS/PALF mempunyai berat sebanyak 40g. Komposit TPCS/PALF telah diperiksa dan dibandingkan. Bagi sifat-sifat ujian mekanik, tegangan tertinggi ialah 10.0733 MPa pada 50 wt% manakala bagi sifat lenturan menunjukkan hasil tertinggi pada 60 wt% ialah 16.75661 MPa dan kesan hentakan tertinggi ialah 5.44725 kJ/m² pada 30 wt%. Bagi sifat fizikal, keputusan yang tertinggi untuk ketumpatan, kandungan lembapan dan penyerapan air masing-masing adalah pada 30 wt%, 40 wt% dan 50 wt% dengan nilai masing-masing adalah 1.39%, 13.32%, 133.73%. Bagi sifat persekitaran, kelarutan di dalam air dan penanaman di dalam tanah kedua-duanya menunjukkan sedikit penurunan bermula dari hasil tertinggi iaitu pada 30 wt%. Keputusan tertinggi untuk kelarutan air adalah 30.54% dan kesan penanaman di alam tanah adalah 62.96%. Oleh yang demikian, PALF/TPCS komposit mempunyai potensi untuk menggantikan komposit yang ada di pasaran.

ABSTRACT

The aim of this research is to study on mechanical, physical, and environment properties on thermoplastics cornstarch (TPCS) composite reinforced by untreated pineapple leaf fibre (PALF) using hybrid method. Composite has been manufactured with the use of 10mm length of pineapple fibre and has evaluated the ratio characteristics of the different loads of fibres of 30 wt.% and 40 wt.% of 60 wt.% and 70 wt.%. The sample had been manufactured using a hand-mixed and high-speed mixer to form TPCS by using 70 wt.% native cornstarch mixed with 30 wt% glycerol. TPCS and PALF were then stacked using a hybrid method, where TPCS/PALF composites had total weight of 40g. The composites TPCS/PALF were examined and compared. For the mechanical properties, the highest tensile is 10.0733 MPa at 50 wt.% while flexural shows highest result at 60 wt.% which is 16.75661 MPa and the highest impact is 5.44725 kJ/m^2 at 30 wt.%. For the physical properties, the highest result for density, moisture content and water absorption are 1.39%, 13.32%, 133.73% when they are at 30 wt%, 40 wt% and 50 wt% of fibre loading respectively. For the environment properties, water solubility and soil burial are both shows slightly decreased starting from their highest result which is at 30 wt%. The highest result for water solubility is 30.54% and for soil burial is 62.96%. As such, PALF/TPCS composites have the potential to replace the existing composites in the market.

DEDICATION

This thesis is dedicated to my father, Saharuddin Bin Asman who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, Ibsatulhaily Binti Ibrahim who taught me that even the largest task can be accomplished if it is done one step at a time. Both of them have encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started.

ACKNOWLEDGEMENT

First and foremost, I am very grateful to the almighty ALLAH S.W.T for letting me to finish my Final Year Project 2 and give me strength that I need in order to fulfill my duty as a bachelor student.

Here, I wish to express my sincere appreciation to my supervisor, TS. Nazri Huzaimi bin Zakaria for encouragement, guidance, suggestions, critics and friendship throughout finishing this project. A lot of thanks to Universiti Teknikal Malaysia Melaka (UTeM) for giving me an opportunity and chances to full fill my Bachelor Degree Project report.

Most importantly, special thanks also to my family with sincere gratitude for their unconditional support through the whole process of my Bachelor Degree Project and especially my friends for encouraging me to finish this project. Without their support the ideas could not have been realized.

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 would also thank to all of them who helped us to complete this project especially to my teammates which are Ridhayullah Islam Bin Joni Amri, Akalili Asilah Binti M. Azman, Nur Rohaiza and Nur Zaakhir Bin Mokti.

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.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE **TITLE** **PAGE**

LIST OF APPENDICES

LIST OF SYMBOLS

TS	-	Tensile stress
EM	-	Elastic modulus
E	-	Elongation at break
UTS	-	Ultimate tensile stress
v	-	Volume
m	-	Mass
Wo	-	Weight original
Wi	-	Weight initial
Wf	-	Weight final

LIST OF ABBREVIATIONS

PALF	Pineapple Leaf Fibre
TPCS	Thermoplastic Cornstarch
TPS	Thermoplastic Starch
SEM	Scanning Electron Microscope
LDPE	Low Density Polyethylene
PE	Polyethylene
HM	Hybrid Method/Process
UTM	Universal Testing Machine
ASTM	American Society for Testing and Materials

CHAPTER 1

INTRODUCTION

1.1 Background

Environment-friendly, ‘‘green’’ composite materials dependent on natural cellulosic fibres and polymer resins are increasingly being developed for numerous applications as replacements for synthetic materials derived from unique forms of petroleum assets. Unlike petroleum resources, natural polymer–based materials are found richly in nature and are of sustainable nature. Natural cellulosic fibres have several advantages over their synthetic counterparts among different types of natural materials and have been used as reinforcing materials for different types of matrices in the past (Gurukarthik Babu *et al.*, 2018). There is a wide range of cellulose fibres that can be used to strengthen various types of polymer matrices such as thermoplastics and thermosetting polymer resins. These include various agro-based fibres such as stems, leaves, stalks, bast, and seed hairs, along with wood fibres. These fibres are abundantly available throughout the world (Izwan and Sapuan, 2018).

Natural fibres, depending on the part of the plant from which they are taken, can be classified into different types. The properties of these fibres depend on the source, age, and separating techniques of the fibres from their parental sources. The quality of the raw components is very important when manufacturing a bio-based material (Thakur, Singha and Thakur, 2012). Because of inexpensive cost and a renewable resource, natural fibres are increasingly being used every year. There are three primary groups of vegetable fibres that have been arranged follows to their morphological structure, which are, (1) Bast fibres – made from plant stems, (2) produced from plant's leaves and (3) seed-hair fibres – produced from plant seed or fruit. Hemp is a versatile natural fibre that can be found in countries like India, China and so on. Natural fibre like hemp is used to make a wide range of products, including rope, paper, textiles and bank notes. There are a wide range of vegetable fibres, including sisal, kenaf, jute, coir, cotton, linseed and abaca (Dunne *et al.*, 2016)

These days, natural fibre is a sort of sustainable sources a new generation of polymer-based material reinforcements and supplements. Due to growing environmental awareness, the development of natural fibre composite materials or environmentally friendly composites has recently been a hot topic. It is one such competent material that substitutes for applications requiring less weight and energy conservation synthetic materials and their related products. The use of natural fibre reinforced polymer composites and natural resins to replace existing synthetic polymer or glass fibre reinforced materials in huge quantities (Ho *et al.*, 2012; Sathishkumar, Navaneethakrishnan and Shankar, 2012).

Pickering, Efendy and Le (2016) stated that due to their potential capacity as a substitute for synthetic fibres, natural fibres have gained increasing interest and use in recent years. Natural fibres have valuable characteristics such as low density and high specific strength and rigidity. Besides economical reason, natural fibres are a renewable useful resource for which manufacturing requires less strength, with CO^2 absorption, and returning oxygen to the surroundings.

.

1.2 Problem Statements

Alrahman, Raja and Rahman (2013) declared that one of the foremost developing worries over all of the industries is to improve awareness for the environment. This consciousness has pushed regulation bodies to study their legislation and regulations concurring issues, together with recycling, discount of carbon dioxide (CO^2) emissions and safety of assets. As the modifications in rules and policies, industry is forced to look for lighter and less environmentally harmful substances. The use of natural fibres, which could be extra environmental-friendly in the industrial world, has brought renewed concern. One of the best measures to reduce environmental pollutants is the use of natural fibre materials.

The planet has a restricted amount of land, and when it discards non-biodegradable materials, people misuse it. Products which are not naturally decomposed may dwell in landfills and occupy any longer space than biodegradable materials. Some non-biodegradable waste may not even make it into landfills when people litter. Rather, it might advance into forests, parks, fields, and the ocean. Styrofoam is a non-biodegradable substance, otherwise called foamed polystyrene, which can cause environmental issues when it ends up litter. For example, when temperatures rise, styrene, a high-dose neurotoxin, can leach from polystyrene materials (Oniszczuk *et al.*, 2016).

Biodegradable and disintegrable in a short time must be a product to be defined as compostable, or rather it must be converted from the microorganisms into water, carbonic and fertile anhydride compost (Siracusa *et al.*, 2008). Finally, in order to be defined as decomposable, the manufactured article must be compatible with a