# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## THE INVESTIGATION ON MECHANICAL, PHYSICAL AND ENVIRONMENT PROPERTIES FOR DIFFERENT METHOD OF FABRICATION ON CORNSTARCH COMPOSTIES REINFORCED BY 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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**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

Tajuk: THE INVESTIGATION ON MECHANICAL, PHYSICAL AND ENVIRONMENT PROPERTIES FOR DIFFERENT METHOD OF FABRICATION ON CORNSTARCH COMPOSTIES REINFORCED BY PINEAPPLE LEAF FIBRE

Sesi Pengajian: 2018

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## DECLARATION

I hereby, declared this report entitled THE INVESTIGATION ON MECHANICAL, PHYSICAL AND ENVIRONMENT PROPERTIES FOR DIFFERENT METHOD OF FABRICATION ON CORNSTARCH COMPOSTIES REINFORCED BY PINEAPPLE LEAF FIBRE is the results of my own research except as cited in references.

Signature: ……

Author : MUHAMMAD NUR FUDHAIL BIN AZMI

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

## ABSTRACT

This research intends to ensure the compatibility of using thermoplastic cornstarch (TPCS) and reinforced by pineapple leaf fibre (PALF) as a replacement for synthetic fibre. Besides that, this research also to study the effect on the properties by using different methods of preparations TPCS reinforced by PALF composites. The variable of testing has been used to the sample of PALF/TPCS which is mechanical, physical and environment as it gives a different result of each method of preparation. Furthermore, by using the different compositions of PALF / TPCS which is 20:80, 30:70, 40:60, 50:50 and 60:40, it is also affected the results of mechanical, physical and environmental testing. For the mechanical testing such as tensile test, it shows that the mixture method has the higher result of tensile strength (10.51 MPa) compared to the layer method (9.69 MPa) at 40:60 wt%. As for the conclusion, it can be concluded that the sample that are going through mixture method has the highest and best result in mechanical, physical and environmental properties compare to the sample that are fabricated by using layer method.

## ABSTRAK

Kajian ini bertujuan untuk memastikan kesesuaian penggunaan tepung jagung termoplastik (TPCS) dan diperkuat oleh serat daun nenas (PALF) sebagai pengganti serat sintetik. Selain itu, kajian ini juga bertujuan untuk mempelajari kesan ke atas sifat – sifat pengunaan TPCS yang diperkuat oleh PALF menggunakan kaedah penyediaan yang berbeza. Pelbagai jenis ujian telah dijalankan terhadap sampel PALF/TPCS ini seperti ujian mekanikal, fizikal dan persekitaran yang mana telah memberikan keputusan yang berbeza bagi setiap kaedah penyediaan. Penggunakan komposisi PALF/TPCS yang berlainan iaitu 20:80, 30:70, 40:60, 50:50 dan 60:40 juga telah mempengaruhi keputusan yang dihasilkan oleh ujian mekanikal, fizikal dan persekitaran. Di dalam ujian mekanikal seperti ujian tegangan, keputusan menunjukkan bahawa kaedah campuran (mixture) telah menghasilkan keputusan yang lebih tinggi iaitu 10.51 MPa berbanding keputusan menggunakan kaedah lapisan (laminate) iaitu 9.69 MPa pada komposisi 40:60 wt%. Oleh itu, hasil daripada kajian ini dapat disimpulkan bahawa sifat-sifat PALF/TPCS komposit yang dihasilkan melalui kaedah campuran (mixture) telah memberikan keputusan yang lebih baik bagi ujian mekanikal, fizikal dan persekitaran berbanding keputusan yang dihasilkan oleh kaedah penyediaan melalui lapisan (laminate).

## DEDICATION

This report is dedicated to my beloved parents, my family members and my friends who always give me full support and encourages completing my final year project. In addition, my final year group mates who giving me guidance and assists during the project.

## ACKNOWLEDGEMENTS

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| | |
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| **PALF** | Pineapple leaf fibre |
| **TPCS** | Thermoplastic cornstarch |
| **FRP** | Fibre reinforced polymer |
| **GF** | Glass fibre |
| **SPS** | Sugar palm starch |
| **HIPS** | High impact polystrene |

# CHAPTER 1

# INTRODUCTION

## 1.1 Overview

The idea of combining two or more natural resource materials that are basically made up of Fibres/Reinforced and Matrix/Binder is called Green composites. In which the mixture of both materials will infuse unique properties and those properties will be differ than each material. Banana leaf, pineapple leaf, kenaf, bamboo and coconut are known to be the various sources of extradition of natural fibre that are the examples of Fibre/Reinforced materials. As for matrix/binder materials, the examples are starch, epoxy and polypropylene. For centuries, the composite materials have been used to enhance life condition of a mankind. As per example, in order to ensure mud brick is more solid or durable, it will be combined with straw and the mud has become the glue that sticks the straw together. This combination will ensure the construction of the buildings become firmer.

As in present day, natural fibre or green composites are being used frequently as a backup in polymer composites and have high potential in substituting the fibre glass reinforced composites This is due to their low cost, low density but have good sets of mechanical properties compared to fibre glass reinforced composites.

Fact is, natural fibre offers various technological and environmental advantages when it is used as backup, composite such as high strength and good in stiffness feature even though it has a low density. Furthermore, natural fibre originated from various resources that contained fibre such as plant itself; bamboo fibre, coconut fibre, pineapple

leaf fibre, hemp fibre and jute fibre. Nowadays there are a lot of industrial companies that changed into using the natural fibre composites.

For example, Mitsubishi, a worldwide automotive company, is trying to use bamboo fibre to produce internal cars and more. In addition, from previous studies that have been done, it shows that natural fibres use lower energy during production, resulting in lower abrasion to the machine and there is no risk to human health especially during inhalation. In addition, based on previous studies, natural fibres also have good thermal permeability and fibre strength will increase if they undergo chemical treatment. Furthermore, it also contains less carbon dioxide and biodegradable replication that makes it more environmentally friendly on earth.

## 1.2 Objective

The objectives of this project are:

1. To study the effect of properties by using different method of fabrication of thermoplastic cornstarch (TPCS) and reinforced by pineapple leaf fibre (PALF).
2. To determine the effect of using TPCS and reinforced by PALF.
3. To fabricate the composite of PALF/TPCS by using laminate method.
4. To fabricate the composite of PALF/TPCS by using mixture method.

## 1.3 Problem Statement

Lately, scientific researchers have identified natural plant fibre as a replacement to glass fibre (GF) in fibre-reinforced polymer (FRP). 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, and 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 leaves which have been removed and burned have 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 Josephine pineapple leaves. 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 wt%. 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.

## 1.4 Scope

In this study, the effect of PALF loading and PALF fibre length on PALF / TPCS composite mechanical properties will be studied. The effect of different method during preparation of PALF/ TPCS will also be studied. The different method will be given a different result by using a testing method such as tensile test, hardness test, flexural test and density measurement. The composition ratio in PALF / TPCS composites has been set at 20:80, 30:70, 40:60, 50:50, 60:40 wt%. Besides that, for PALF length has been fixed at 10mm. The mechanical properties of PALF/TPCS composite will be determined using the tensile, impact and flexural test. Other than that, physical testing also will be conducted with moisture content, water absorption and moisture absorption. The environmental testing also will be conducted with soil solubility and water solubility.