UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE STUDY OF THERMOPLASTICS CORN-STARCH COMPOSITE REINFORCED BY SHORT ALKALINE TREATED PINEAPPLE LEAF FIBRE ON MECHANICAL, PHYSICAL AND ENVIRONMENTAL PROPERTIES

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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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: …….

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ABSTRAK

Komposit adalah teknologi material pada masa kini dan masa depan, ini adalah kerana kelebihannya yang begitu banyak. Walau bagaimanapun, sebahagian besar komposit hari ini diperbuat daripada serat sintetik yang sebahagian besarnya tidak boleh degradasi dan membahayakan alam sekitar. Dalam kajian ini, komposit biodegradasi sepenuhnya yang menggunakan serat semulajadi sebagai bahan pengukuhan dan kanji termoplastik sebagai pengikat telah dikaji. Selain itu, serat semulajadi yang telah digunakan dalam kajian ini adalah serat daun nanas (PALF) dan bahan pengikat adalah polimer terbiodegradasikan yang diperbuat daripada serbuk tepung jagung yang telah dicampur dengan gliserol (TPCS). Antara sebab PALF dipilih untuk bahan pengukuhan adalah kerana kandungan selulosanya yang tinggi yang menunjukkan sifat mekanikal yang baik. Selain itu, PALF di Malaysia adalah berlebihan dan kebanyakannya dianggap sebagai bahan buangan. Seterusnya, PALF dalam kajian ini telah dirawat dengan alkali (NaOH) selama 1 jam dan ini dilakukan untuk mengkaji kesan pengubahsuaian permukaan pada lekatan komposit PALF / TPCS. Jenis-jenis ujian yang telah dijalankan untuk mengkaji sifat-sifat PALF yang dirawat dan tidak dirawat pada pengukuhan PALF / TPCS adalah ujian mekanikal, fizikal dan persekitaran. Selain itu, kesan kandungan serat pada sifat mekanikal, fizikal dan alam sekitar juga dikaji, komposisi serat bermula dari 20, 30, 40, 50, dan berakhir pada 60wt%, hasil daripada ujian yang dijalankan, serat berkomposisi 50wt% menunjukkan keputusan mekanikal yang tertinggi. Ujian mekanikal yang telah dijalankan adalah ujian tegangan, lenturan, dan impak. Sementara itu, ujian fizikal yang telah dilakukan adalah ketumpatan, penyerapan kelembapan, kandungan lembapan, dan penyerapan air. Akhir sekali, keupayaan degradasi di dalam tanah dan keupayaan degradasi di dalam air adalah ujian yang telah dilakukan untuk ujian alam sekitar. Secara ringkasnya, dari keputusan ujian yang telah dijalankan, ia dapat disimpulkan bahawa sifat-sifat PALF / TPCS komposit untuk kebanyakan ujian telah ditingkatkan dengan rawatan alkali PALF, disebabkan oleh lekatan yang lebih baik antara bahan pengukuhan dan pengikat.

ABSTRACT

Composite is the present and future of material technology owing to its many advantages. However, most of today's composite is made from synthetic fibre that makes most of its non-degradable and harmful to the environment. In this study, fully biodegradable composite which uses natural fibre as reinforcement material and thermoplastic starch as the binder are being studied. Furthermore, the natural fibre that has been used in this study is pineapple leaf fibre (PALF) and the binder material is a biodegradable polymer made from powdered cornstarch that have been plasticized with glycerol. The reason PALF is chosen for the reinforcement material is due to its high cellulose content that indicates good mechanical properties. Besides, PALF in Malaysia is redundant and mostly regarded as waste material. Afterwards, the PALF in this study is treated with an alkaline (NaOH) for 1 H, this is done to study the effect of surface modification on the adhesion of PALF/TPCS composite. The types of test that has been conducted to investigate the properties of alkali treated and untreated PALF/TPCS are mechanical, physical and environmental tests. Moreover, the effect of fibre content on mechanical, physical and environmental properties is also being studied, the fibre composition starts from 20, 30, 40, 50, and ends at 60wt%, for most of the mechanical testing 50wt% fibre composition shows the highest result. The mechanical testing that has been carried out are tensile, flexural, and impact test. Meanwhile, the physical testing that have been done are density, moisture absorption, moisture content, and water absorption. Last but foremost, soil burial and water solubility are the tests that have been performed for environmental. Conclusively, from the results, it can be assured that the properties of PALF/TPCS composite for most of the testing has been improved with alkali treatment or mercerization of the PALF, due to better adhesion between reinforcement and binder material.

DEDICATION

This report that has been done for the Bachelor Degree Project, is dedicated to my mother, the most loving mother that has loved me unconditionally and never stop supporting me to further my studies, Al-Fatihah. Secondly, it is dedicated to my father that has taught me to be passionate and to never stop pursuing knowledge. Lastly, my final year project group mates that has guide and help me through thick and thin in completing the project.

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PALF:	Pineapple Leaf Fibre
GF:	Glass Fibre
FRP:	Fibre Reinforced Polymer
CO_2:	Carbon Dioxide
SH:	Starch
TPCS:	Thermoplastic Corn-Starch
TPS:	Thermoplastic Starch
NaOH:	Sodium Hydroxide
RH:	Room Humidity
WS:	Water Solubility

CHAPTER 1

INTRODUCTION

1.1 Background

Natural based composites are considered the material of the future for their mechanical properties and eco-friendly characteristics. It consists of natural fibre as the reinforcement, and biodegradable matrix such as thermoplastic starch, epoxy or polypropylene as the binder, thus makes it fully biodegradable and environmental friendly. In addition, this combination of two biodegradable materials not only produces fully biodegradable composite, but also gives an interesting mechanical properties where the properties vary for each material. The example of biofibre for the reinforcement material can be extracted from various sources such as coconut, bamboo, pineapple leaf, kenaf and banana leaf. In the previous history, the humanity had been utilized the composite materials as an advancement to enhance the quality of life. For instance, to influence the mud bricks to become more studier, the mud will be joined with the straw that is otherwise called adobe. For this situation, the mud will turn into the folio by holding the straw together. Consequently, it will expand the quality of the development of the building itself.

In recent years, natural based composites/biofibre are growing vastly in automotive and material technologies for their ability to replace man-made composites such as fibre glass reinforced composites. This is related to the fact that the biofibre are low cost, low density yet has better sets of mechanical properties compared to fibre glass reinforced composites.

On top of that, under considerations, many industrial or companies have made an adjustment by utilizing the natural fibre composites as one of the materials used in their production. For example, Mitsubishi that is a worldwide automotive company trying to use bamboo fibre to produce automobile interior part and many more. Furthermore, from the past research that had been done, it demonstrates that the natural fibre devour lesser energies during generation, make lesser abrasion to the machines and no hazard to human wellbeing particularly during inhalation. Besides that, it also contained less carbon dioxide imitation and biodegradable that makes it more ecologically friendly to the earth. Moreover, in view of past investigation, the natural fibres additionally have great thermal permeability and the quality of the fibre will be expanded if it undergoes a chemical treatment.

1.2 Objectives

There are two main goals to achieve in this project:

a) To induce the ramifications of pineapple leaf fibre (PALF) loading on properties pineapple leaf fibre/thermoplastic cornstarch composite (PALF/TPCS).

b) To compare the effectiveness and strength between alkaline treated and untreated pineapple leaf fibre (PALF) on the reinforcement of PALF/TPCS composites for mechanical, physical and environmental testing.

1.3 Problem Statement

In recent times, glass fibres (GF) in fibre-reinforced plastics (FRP) can be replaced by natural fibres that have been utilized in scientific research as an appealing option. In addition, these lignocelluloses fibre have lower densities, cost relatively lower, employ lesser energies during production, make lesser abrasion to the machines and have no hazard on human wellbeing amid inhalation, in respect to glass fibres. Other than that, natural fibres are also broadly available, sustainable, recyclable, and biodegradable and made of carbon dioxide (CO_2) neutral (Wambua, Ivens and Verpoest, 2003). Despite the fact that synthetic fibre has good mechanical properties, it is also one of the causes for pollution as it is non-biodegradable and non-renewable, this means it can't naturally decomposed, therefore contaminates the soil. (Khalil, Alwani and Omar, 2006). In Malaysia the focus of pineapple industry is the fruits and somehow produced abundant of bio waste in the form of the leaves mainly composted or burned thus wasting the great capability of fibre sources. In Malaysia, the main focus of pineapple industry is that the fruits and somehow made galore of bio waste in sort of leaves principally composted or burned so wasting the best capability of fibre sources. Besides, environmental pollution issues can be caused by the burning process of the leaves (Mohamed et al., 2009).

1.4 Scope

In this research, the effect of various fibre compositions and alkali treatment of PALF on PALF/TPCS mechanical, physical, and environmental properties will be studied. The scope of this research are:

I. The various fibre composition of PALF/TPCS composite will be selected at the ratio of 20:80, 30:70, 40:60, 50:50 and 60:40.

II. The PALF length will be fixed at 10 mm.

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. Environmental testing will also be carried out in this research using soil burial testing and water solubility.

CHAPTER 2

LITERATURE REVIEW

2.1 Composite

As many years before, mankind had been aware of the function of composite materials. For example, ancient pharaohs made their slaves used bricks with straw to make the building become more studier and even last longer. The cotemporary composites come from the continuous research and innovation for the past few decades that produce glass fibre used as automobile bodies, particulate composites for the aerospace and other applications (Santos Rosa & Maria, 2013).

Furthermore, composites shouldn't be considered only as a mix of two materials (Chard, Creech, Jesson, & Smith, 2013). In the more extensive essentialness, the distinctive properties of the blend have its own particular characteristic. On top of that, composite is better than a single component, in terms of quality and resistance to heat. Moreover, heterogeneous materials comprising a minimum of two strong phases, which are in intimate contact with each other on a microscopic scale, are clarified as composite material.

The characteristic of constituent material, the distribution and the interaction among the materials are unequivocally subjected to the properties of the composite. On the other hand, the capacity to meet diverse design necessities with significant weight savings as well as strength-to-weight proportion is the benefits of composites over their conventional