Faculty of Mechanical and Manufacturing Engineering Technology

DEVELOPMENT AND ANALYSIS OF BIODEGRADABLE PRODUCT FROM PINEAPPLE LEAF FIBRE

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Bachelor's Degree of Manufacturing Engineering Technology (Product Design) with Honours

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NORFAIZAL BIN NURODDIN

A thesis is submitted in fulfilment of the requirement for bachelor's degree of Manufacturing Engineering Technology (Product Design) with Honours

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DEDICATION

This final year I would like to dedicate to my beloved mother and father, also my family and friends on the encouragement and enthusiasm given to me. I wanted to dedicate to my supervisor on assist me to success this final year project. This project would not success without support from everybody around me.

ABSTRACT

Biodegradable product is product that produced from natural fibre source such as pineapple leaf fibre. Pineapple fruits is one of the popular and delicious fruit especially in Malaysia. The problem is people only uses fruit, while its leaves are disposed of. The pineapple leaves have been wasted material. Pineapple leaves that has been burned can causes air pollution. The usage of plastics in nowadays can causes landfill problem. The aim for this research is to study the potential application of pineapple leaf fibre in industries sectors, to develop a biodegradable product from pineapple leaf fibre and to anaylse the mechanical strength and biodegradable of pineapple leaf fibre. There are several rough stages that should be followed to complete this research which are identifying the problems of the research, have some research on the previous researchers that related, select the material and machines involved along the manufacturing process, design a product using SolidWorks software which is mini tray prototype, through a mechanical testing and biodegradable testing on the composite products and then manufacture mini tray. There are two mechanical testing conducted in this research which tensile test and biodegradable test. The highest values of tensile test strength for sample PALF reinforced PP was 8.32189 MPa., while for sample of PALF reinforced tapioca starch was 1.40927 MPa. The highest value of Young's Modulus for mixture of PALF with tapioca starch was 2890.40007 MPa, while for mixture of PALF with PP was 1088.41727 MPa. In biodegradable testing, the result shown there is a weight changes occurred for mixture of PALF reinforced with tapioca starch. But, for mixture of PALF reinforced PP, the biodegradable testing was conducted to proven either this mixture could be degraded in soil or vice versa. From the result, it proven that mixture of PALF with PP could not be degraded in soil due to PP characteristics which classified as polymer that can be degraded only through burning process. Bioplastics are degraded by various kind of microorganism. In this research, several things have been discussed such parameter of mixture, temperature and heating press time, types of mould used, and types of sample tensile test. The conclusion for this research is biodegradable product of mini tray from pineapple leaf fibre has successfully made, and the result of tensile test and biodegradable testing for every samples has been recorded successfully.

ABSTRAK

Produk 'biodegradable' ialah suatu produk yang dihasilkan daripada sumber fiber semula jadi seperti fibre daun nenas. Buah nenas merupakan salah satu buah-buahan yang terkenal dan sedap terutamanya di Malaysia. Masalah yang terjadi ialah manusia cuma mahukan buahnya, manakala daun nenas dibuang. Daun nenas telah menjadi bahan buangan. Daun nenas telah dibakar dan menyebabkan pencemaran udara. Penggunaan plastik pada hari ini boleh menyebabkan masalah pembuangan sampah. Tujuan kajian ini ialah untuk mengkaji kebolehupayaan serat daun nenas dalam pelbagai aplikasi untuk sector industri, menghasilkan produk biodegradable daripada serat daun nenas dan dan menganalisis kekuatan dan 'biodegradable' serat daun nenas. Terdapat beberapa susunan kasar yang perlu diikuti untuk melengkapkan kajian ini iaitu mengenalpasti masalah kajian, membuat kajian terhadap kajian pengkaji sebelum ini yang berkaitan dengan kajian, memilih bahan-bahan dan mesin-mesin yang digunakan dalam proses pembuatan, mereka bentuk suatu product menggunakan perisian SolidWorks iaitu dulang mini, menjalankan ujian mekanikal dan ujian biodegradable terhadap produk komposit dan menghasilkan dulang mini.Terdapat dua ujian mekanikal yang dapat dilakukan dalam kajian ini iaitu ujian ketegangan dan ujian pelupusan. Nilai tertinggi kekuatan ujian tegangan untuk sample PALF campur PP adalah 8.32189 MPa, manakala untuk samel PALF campur tepung ubi adalah 1.40927 MPa. Nilai tertinggi modulus young untuk campuran PALF dengan tepung ubi adalah 2890.40007 MPa, manakala untuk campuran PALF dengan PP adalah 1088.41727 MPa. Dalam ujian 'biodegradable', hasil yang diperolehi menunjukkan terdapat beberapa perubahan untuk campuran PALF dengan tepung ubi. Tetapi, untuk campuran PALF dengan PP, ujian biodegradable yang dijalankan untuk membuktikan sama ada campuran ini boleh dilupus melalui tanah ataupun sebaliknya. Dari hasil yang diperolehi, ianya terbukti bahawa campuran PALF dengan PP tidak dapat dilupuskan kerana ciri-ciri PP yang diklasifikasikan sebagai polimer yanghanya boleh dihancurkan melalui pembakaran. Bioplastik dihancurkan oleh pelbagai jenis mikroorganisma. Dalam kajian ini, beberapa perkara telah dibincangkan seperti paramter campuran, suhu dan pemanasan masa menekan, jenis acuan yang digunakan dan jenis ujian tegangan untuk sampel. Kesimpulan penyelidikan ini ialah produk 'biodegradable' iaitu dulang kecil hasil dari serat daun nenas telah berjaya dihasilkan, hasil ujian tegangan dan ujian 'biodegradable' untuk setiap sampel berjaya direkodkan.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ABBREVIATIONS

PALF	-	Pineapple leaf fibre
KF	-	Kenaf fibre
PP	-	Polypropylene
UTM	-	Universal testing machine
TBR	-	Tapioca based bioplastics resin
g/cm^3	-	Gram per centimetre of cube
MPa	-	Mega pascal
GPa	-	Giga pascal
N/mm^2	-	Newton per millimetre of square
g/mol	-	Gram per mol
℃	-	Celsius
℉	-	Fahrenheit
T	-	Thickness
W	-	Width of narrow selection
L	-	Length of narrow selection
WO	-	Width overall

ABBREVIATIONS

LO	-	Length overall
G	-	Gauge length
D	-	Distance between grip
R	-	Radius of fillet

CHAPTER 1

INTRODUCTION

1.1 Introduction

Basically, one of the main sectors that plays role of economy in Malaysia was agricultural sector. The agricultural sector had become major contributor to national income and export earnings. In traditional, agricultural has been shipped away for processing. In order to encourage the economic to growth in stable in Malaysia, the variation of industries should be focused. In this South East Asia, Malaysia and Philippines are listed on top 11 countries as main nation that export the fresh pineapple in the world. Both countries contribute 15 percent export from amount of pineapple where 13 percent from Philippines while 2 percent from Malaysia. In Malaysia, there many types of pineapple such as N36, Morris, SARAWAK, Josapine and other more. Variety of N36 is more focused only in Malaysia, while varieties of Morris, SARAWAK and Josapine had interested the International market. In state of Malaysia, Johor, Sarawak and Negeri Sembilan are the state that had the cultivation of pineapple.

In general, pineapple plants are grown on the peat soil. In Johor, Pontian, Batu Pahat, Kluang and Muar are the area that had cultivation of pineapple plant. Johor had cultivated the pineapple in area of 8934 hectare and produced around 273,950 metric tonnes, RM 350.2 million or 68 percent of pineapple in Malaysia with the varieties of Morris, Josapine, MD2, SARAWAK and some more. Nowadays, one of the waste materials that need to be considered and used as much as possible is pineapple leaves. So, the natural fibre from pineapple leaves can be used in the industries as a material that has no involved any cost.

Pineapple is one of the popular and delicious fruit especially in Malaysia which is one of the nations that located in tropical and subtropical region of the world. Basically, bio composite material contains the combination of natural fibre and matrix material. Low cost, low density and low energy consumption are the advantages of using PALF to produce bio composite products. PALF can also be disposed of by burning that will be contributed to wasted material. Selection of pineapple leaves are important to be considered which is the first step and crucial for the preparation of fibre.

A young leaf of fibre is basically soft and weak. In order to obtain stronger and suitable leaves, moderately mature leaf from the Pineapple plant which have been grown partly are suitable for extraction process of pineapple leave to get its fibre. Extraction process can be done either using retting method or using mechanical method. Extraction process means that separation of fibre that obtained from pineapple leaves. There are some applications of using Pineapple leaf fibre, PALF in the industrial sector. PALF is basically used for producing textile fabrics. Nowadays, it can be seen and proven that PALF is used for producing textile, sport items, baggage, automobiles, cabinets, mats and other more. Other than that, PALF can be used for automotive components and some furniture due to the Young's modulus of PALF that had highest tensile strength when compared to another natural fibre.

1.2 Problem statement

Nowadays, natural fibre from Pineapple leaf fibre, PALF became a crucial material to be focused and considered from became a waste material. In agricultural sector, pineapple leaves are burned which will leads to waste the material that can be used for industrial sector. The problem is how to utilize the number of PALF from become waste material.

Air pollution is also a problem that need to be considered. In agricultural sector, burning the pineapple leaves are usually done to clear the land for cultivation the new pineapple plants. Air pollution can give bad effect to humans such as reduce visibility, make hazard safety and make a nuisance.

Landfill problem can be also considered as the problem in this research. The usage of plastic bags in nowadays is increased from day to another day. Plastics that not used are disposed of to the landfill which causes landfill problems. There are many effects of landfill problem which are causes toxins, leachate and greenhouse gas.

1.3 Objectives

In this project, there are three objectives that should be considered and be achieved. These are as follows.

1) To study potential application of pineapple leaf fibre in industries sectors.
2) To develop a biodegradable product from PALF as natural fibre which are compounding respectively both of Polypropylene, PP material and tapioca starch as matrix material.
3) To analyse the mechanical strength and biodegradable of pineapple leaf fibre.