

INVESTIGATION ON OIL PALM FIBER COMPOSITE MECHANICAL
PROPERTIES

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**Project submitted in fulfilment of the requirements for Bachelor Degree of
Mechanical Engineering (Structure & Materials)**

**Faculty of Mechanical Engineering
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JUNE 2013

DECLARATION

“I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.”

Signature :

Author : MUHAMAD SYAFIQ BIN MD NAJIB

Date :

Specially dedicated to my beloved father Md Najib Bin Ithnain and beloved mother Norliza Binti Tukimin, brothers and sisters, to all family members, lecturers and friends.

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ABSTRACT

This research investigates the mechanical properties of oil palm fiber empty fruit bunch (OPEFB) composite. Polypropylene (PP) is used as the matrix and Maleic Anhydride Polypropylene (MAPP) as the coupling agent for the composite. Fibers were treated before compounding to remove natural waxes and other non-cellulosic compounds to improve the composite's mechanical properties. Five different fibre content of 0, 10, 20, 30 and 40% by mass were mixed with polypropylene and MAPP to form composites using Haake internal mixer and hot press machine. The MAPP is set to 3% for every composition. The composites were characterized by tensile test, flexural test and hardness test. Tensile test and flexural test of the composites were carried out using Universal Testing Machine while hardness test were carried out using Digital Shore Durometer. Young Modulus and hardness value increases when the fiber content is increased. In the tensile test and flexural test, results shows that the best composition of oil palm fiber reinforced with polypropylene is at 30% of fiber content.

ABSTRAK

Kajian ini bertujuan untuk menyiasat sifat-sifat mekanik komposit gentian kelapa sawit (OPEFB). Projek ini menggunakan Polypropylene (PP) sebagai matriks dan Maleic Anhydride Polypropylene (MAPP) sebagai ejen gandingan untuk komposit. Gentian kelapa sawit dirawat terlebih dahulu menggunakan alkali untuk membuang wax semula jadi dan lain-lain sebatian bukan cellulosic untuk meningkatkan sifat-sifat mekanikal komposit ini. Lima kandungan serat yang berbeza daripada 0, 10, 20, 30 dan 40% telah dicampur dengan Polypropylene dan MAPP untuk membentuk komposit menggunakan Haake internal mixer dan mesin hot press. MAPP ditetapkan kepada 3% pada setiap komposisi. Komposit ini akan dinilai sifat-sifat mekanikalnya dengan ujian tegangan, ujian lenturan dan ujian kekerasan. Ujian tegangan dan ujian lenturan komposit telah dijalankan menggunakan mesin Instron manakala ujian kekerasan komposit telah dijalankan menggunakan Digital Shore Durometer. Peningkatan dalam Young Modulus dan nilai kekerasan meningkat apabila kandungan serat meningkat. Dalam ujian tegangan dan ujian lenturan, keputusan menunjukkan bahawa komposisi terbaik serat kelapa sawit diperkukuhkan dengan Polypropylene adalah pada 30% daripada kandungan serat.

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRAK	v
	ABSTRACT	vi
	TABLE OF CONTENT	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xiii
	LIST OF APPENDICES	xvi
CHAPTER I	INTRODUCTION	1
	1.1 Objectives	5
	1.2 Problem Statement	5
	1.3 Scope	5
CHAPTER II	LITERATURE REVIEW	6
	2.1 Composite	6
	2.1.1 Polymer Matrix Composite	8
	2.2 Matrix	9
	2.2.1 Polypropylene (PP)	9
	2.2.2 Maleic Anhydride-Polypropylene (MAPP)	9
	2.3 Reinforcement	10
	2.3.1 Natural Fiber	10

2.3.2 Oil Palm Empty Fruit Bunch (OPEFB)	11
2.4 Oil Palm Empty Fruit Bunch Treatment	13
2.5 Mechanical Testing	14
2.5.1 Tensile Test	14
2.5.2 Three Point Bend Test	16
2.5.3 Hardness Test	18
CHAPTER III METHODOLOGY	19
3.1 Materials	20
3.1.1 Reinforcement	20
3.1.2 Matrix	20
3.2 Specimen Preparation	22
3.2.1 Fiber Treatment	22
3.2.2 Fiber Chopping	23
3.2.3 Mix Fiber with Matrix	24
3.2.4 Crush into Pallet Size	25
3.2.5 Compress (Hot and Cold Press)	25
3.2.6 Cutting the Palm Fiber Composite	26
3.3 Mechanical Testing	28
3.3.1 Tensile Test	28
3.3.2 Three Point Bend Test	31
3.3.3 Hardness Test	32
CHAPTER IV RESULTS AND DISCUSSION	33
4.1 Introduction	33
4.2 Tensile Test Results	33
4.2.1 Tensile Test Result for PP/OPEFB 0% Composite	34
4.2.2 Tensile Test Result for PP/OPEFB 10% Composite	35
4.2.3 Tensile Test Result for PP/OPEFB 20% Composite	36

4.2.4 Tensile Test Result for PP/OPEFB 30% Composite	37
4.2.5 Tensile Test Result for PP/OPEFB 40% Composite	38
4.2.6 Tensile Test Discussion	39
4.3 Flexural Test Result	42
4.3.1 Flexural Test Result for PP/OPEFB 0% Composite	42
4.3.2 Flexural Test Result for PP/OPEFB 10% Composite	43
4.3.3 Flexural Test Result for PP/OPEFB 20% Composite	44
4.3.4 Flexural Test Result for PP/OPEFB 30% Composite	45
4.3.5 Flexural Test Result for PP/OPEFB 40% Composite	46
4.3.6 Flexural Test Discussion	47
4.4 Hardness Test Result	49
4.4.1 Hardness Test Result for PP/OPEFB 0% Composite	49
4.4.2 Hardness Test Result for PP/OPEFB 10% Composite	49
4.4.3 Hardness Test Result for PP/OPEFB 20% Composite	50
4.4.4 Hardness Test Result for PP/OPEFB 30% Composite	50
4.4.5 Hardness Test Result for PP/OPEFB 40% Composite	50
4.4.6 Hardness Test Discussion	51
CHAPTER V CONCLUSION AND RECOMMENDATIONS	53
5.1 Introduction	53

5.2 Conclusion	53
5.3 Recommendations	54
REFERENCES	55
APPENDICES	61

LIST OF TABLES

NO.	TITLE	PAGE
2.1	Properties of Oil Palm Empty Fruit Bunch Fibre (OPEFB) (M.Z.M. Yusoff et. al. 2009)	11
2.2	Standard percentage of fibre length (Hamzah, 2008)	14
3.1	Composition for PP, OPEFB Fiber and MAPP	24
4.1	Ultimate Tensile Stress, Strain and Young Modulus of PP/OPEFB 0% Composites	34
4.2	Ultimate Tensile Stress, Strain and Young Modulus of PP/OPEFB 10% Composites	35
4.3	Ultimate Tensile Stress, Strain and Young Modulus of PP/OPEFB 20% Composites	36
4.4	Ultimate Tensile Stress, Strain and Young Modulus of PP/OPEFB 30% Composites	37
4.5	Ultimate Tensile Stress, Strain and Young Modulus of PP/OPEFB 40% Composites	38
4.6	Average Value of Ultimate Tensile Stress and Young Modulus for Different Composite Composition	39
4.7	Ultimate Flexural Stress of PP/OPEFB 0% Composites	42
4.8	Ultimate Flexural Stress of PP/OPEFB 10% Composites	43
4.9	Ultimate Flexural Stress of PP/OPEFB 20% Composites	44

4.10	Ultimate Flexural Stress of PP/OPEFB 30% Composites	45
4.11	Ultimate Flexural Stress of PP/OPEFB 40% Composites	46
4.12	Average Value of Flexural Strength for Different Composites Composition	47
4.13	Hardness Scale for PP/OPEFB 0% Composite	49
4.14	Hardness Scale for PP/OPEFB 10% Composite	49
4.15	Hardness Scale for PP/OPEFB 20% Composite	50
4.16	Hardness Scale for PP/OPEFB 30% Composite	50
4.17	Hardness Scale for PP/OPEFB 40% Composite	51
4.18	Average of Shore-D Hardness Number of All Composition Composites	51

LIST OF FIGURES

NO.	TITLE	PAGE
1.1	Classification of Fiber(http://www.globalspec.com , 2006)	2
2.1	Composite Composition (K.V. Rijswijk et. al. 2001)	7
2.2	Specimen For Tensile Test (M.Z.M. Yusoff et. al. 2010)	14
2.3	Tensile Strength versus Volume Fraction of Chopped Random Fiber Composite (M.Z.M. Yusoff et. al. 2010)	15
2.4	Flexural stress of OPEFB/PF composite (M.Y.M. Zuhri et. al. 2009)	17
2.5	Maximum load for OPEFB/PF composite (M.Y.M. Zuhri et. al. 2009)	17
2.6	Effect of fibre content on the hardness of PF-EFB boards (L.L. Chai et. al. 2009)	18
3.1	Project Methodology Flow Chart	19
3.2	Oil Palm Empty Fruit Bunch Fiber (OPEFB)	20
3.3	Polypropylene (PP)	21
3.4	Maleic Anhydride Polypropylene (MAPP)	21
3.5	Specimen Preparation Flow Chart	22
3.6	Fiber Treatment	23
3.7	Crusher Machine	23
3.8	Haake Internal Mixer	25
3.9	Schematic Diagram of Mold	26
3.10	Hot Press Machine	26

3.11	Oil Palm Fiber Composite	27
3.12	Rectangular Shape Specimen	27
3.13	Sample Cutting Machine	27
3.14	Mechanical Testing	28
3.15	Tensile Test Machine (Model: Instron 5585)	29
3.16	Specimen is tested	29
3.17	Ultimate Tensile Stress versus Strain Graph for PP/OPEFB 0% Composites	30
3.18	Three Point Bend Test	31
3.19	Digital Shore Durometer Model 54-762-001	32
4.1	Tensile Stress versus Strain Graph for PP/OPEFB 0% Composites	34
4.2	Tensile Stress versus Strain Graph for PP/OPEFB 10% Composites	35
4.3	Tensile Stress versus Strain Graph for PP/OPEFB 20% Composites	36
4.4	Tensile Stress versus Strain Graph for PP/OPEFB 30% Composites	37
4.5	Tensile Stress versus Strain Graph for PP/OPEFB 40% Composites	38
4.6	Tensile Stress versus Fiber Content Graph of All Composition Composites	40
4.7	Young Modulus versus Fiber Content Graph of All Composition Composites	41
4.8	Flexural Stress versus Strain Graph for PP/OPEFB 0% Composites	42
4.9	Flexural Stress versus Strain Graph for PP/OPEFB 10% Composites	43
4.10	Flexural Stress versus Strain Graph for PP/OPEFB 20% Composites	44
4.11	Flexural Stress versus Strain Graph for PP/OPEFB 30% Composites	45
4.12	Flexural Stress versus Strain Graph for PP/OPEFB	46

	40% Composites	
4.13	Ultimate Flexural Stress versus Fiber Content Graph of All Composition Composites	48
4.14	Shore-D versus Fiber Content Graph of All Composition Composites	52

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Specimen Before and After Tensile Test (Sample: 30% of fiber content)	62
B	Specimen Before and After Flexural Test (Sample: 30% of fiber content)	63

CHAPTER I

INTRODUCTION

Nowadays, there is a huge public concern for reducing damage to our environment. This project focuses on composites that are created from natural fiber reinforced polymer matrix. Composites are hybrid materials made of polymer resin reinforced by fibers, which combine the high mechanical and physical performance of the fibers and appearance, as well as bond the physical properties of polymers. The composites may result in inconsistent fiber quality and can lead to impact failure. Natural composites have various benefits due to its friendly characteristics that are no skin irritation and lightweight property of the products.

Natural fibers form an interesting alternative for the most widely applied fiber in the composite technology, that is glass. Recent research have shown that these aspects can be improved considerably. Knowing that natural fibers are cheap and have a better stiffness per weight than glass which results in lighter components (P.D. Bhanawat et. al. 2012), the grown interest in natural fibers is clear. Secondly, the environmental impact is smaller since the natural fiber can be thermally recycled and fibers come from a renewable resource. Their moderate mechanical properties restrain the fibers from being used in high-tech applications, but for many reasons they can compete with glass fibers.

Fibers are classified into natural fibers and man-made fibers.

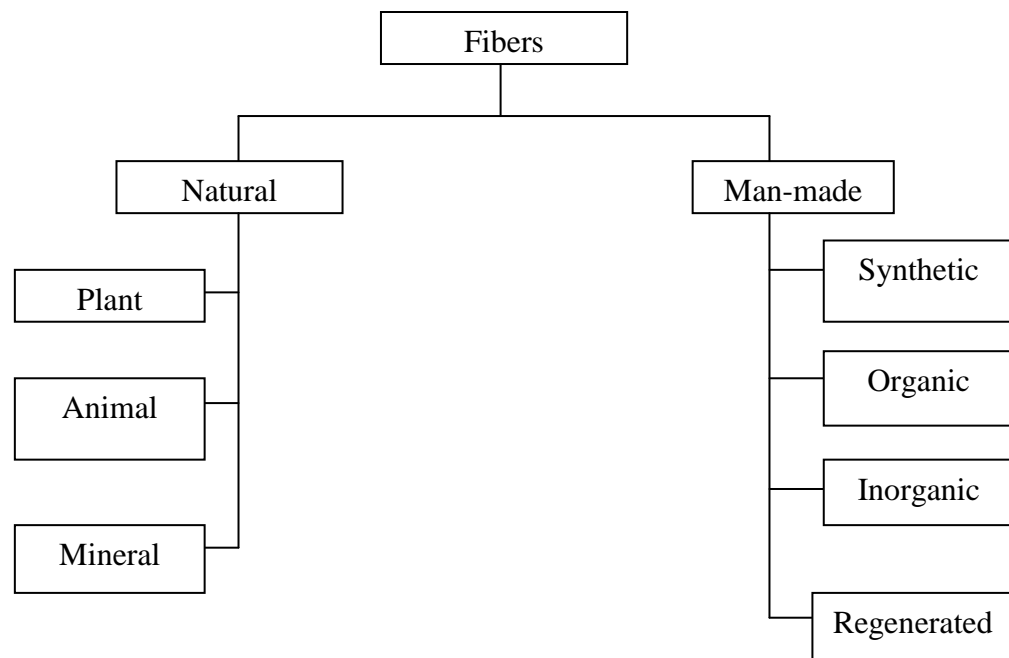


Figure 1.1: Classification of Fiber

(<http://www.globalspec.com/reference/43331/203279/classification-of-fibers>, 2006)

Natural fibers are hair-like threads obtained directly from plants, animals, and mineral sources. Botanically, a natural fiber is a collection of cells having long length and negligible diameter. They are obtained as discrete elongated pieces similar to thread.

Natural fibers include those made from animal, mineral and plant sources. Animal fiber generally comprise of animal hair, silk fiber, and avian fiber. Man-made fibers comprise of asbestos, ceramic fibers, and metal fibers. Examples of plant fibers are like seed, leaf and skin fibers.

This research is carried out using oil palm empty fruit bunch (OPEFB) fiber. Oil palm (*Elaeis guineensis*) has become the most important economic plantation crop in Malaysia. It is the major source in the production of edible oil which is extracted from fruits palm oil empty fruit bunch (EFB) (A.C. Lua, and J. Guo,

1998). However, palm oil mills produce a large amount of solid wastes. The remainder of the oil palm consists of huge amount of lignocellulosic materials such as oil palm fronds, trunks and empty fruit bunches. The solid wastes contain about 7.0 million tonnes of oil palm trunks, 26.2 million tonnes of oil palm fronds and 23% of EFB per tonne of Fresh Fruit Bunch (FFB) processed in oil palm mill. The fresh oil palm fruit bunch contains about 21% palm oil, 6-7% palm kernel, 14-15% fiber, 6-7% shell, and 23% empty fruit bunch (M.Z.M. Yusoff et al, 2009). Exploiting this kind of waste materials not only maximizes the use of oil palm but also helps to preserve natural resources and maintain ecological balance (D.C.L Teo et al, 2006).

OPEFB fibers have depicted a great potential in use as reinforcing materials in a polymers (H.D. Rozman et al, 2001). These OPEFB fibers show specific properties that can be used by reinforcing them with polymers to develop biocomposite materials. Conversely, if these fibers are not used resourcefully, it may not only lead to disposal problems but consequently lead to environmental problems, or could also result in forfeiture of substantial economic value, which would have been induced by its suitable applications. Hence, palm oil producing countries, in particular, can generate revenue out of this waste product which till date is considered to be challenging. The sustainable, non-hazardous, non-carcinogenic, eco friendly, biodegradable product developed from these fibers will surely benefit the human kind across the globe in broad-spectrum. Previous research show that the oil palm shell can be used as structural concrete and it has good potentials as a coarse aggregate for the production of structural lightweight concrete (D.C.L Teo et al, 2006). In previous research, the OPEFB is used in Stone Mastic Asphalt. This investigation aims to improve the service properties of the Stone Mastic Asphalt (SMA) mixes by forming plant to prevent drain-down of asphalt so as to increase the stability and durability of the pavement mix (R. Muniandy et al, 2004).

This project uses Polypropylene (PP) as the matrix and Maleic Anhydride Polypropylene (MAPP) as the coupling agent for the composite. Polypropylene is a semi-crystalline polymer that is used extensively due to its unique properties, cost and easy fabrication. Meanwhile, MAPP is an effective functional molecule for the reactive compatibility between PP and OPEFB. MAPP can improve the bonding between PP and OPEFB fibers.

For this research, the tensile properties, flexural properties, and hardness properties of this oil palm fiber reinforced with matrix Polypropylene will be investigated.

1.1 Objectives

The objective of this project is:

- i. To investigate the tensile properties of oil palm fiber composite.
- ii. To investigate the flexural properties of oil palm fiber composite.
- iii. To investigate the hardness properties of oil palm fiber composite

1.2 Problem Statement

In recent years, natural fibers have drawn considerable attention as substitutes to the synthetic fibers such as glass and carbon fibers. Natural fiber is also renewable and cheaper so it can be an attractive reinforcement in the making of composites and for its various applications. The synthetic fibers such as glass fiber, rock wool, or asbestos are concern with the possible health effects and it is required high standard practice to take safety precaution when installing or handling fiber glass or rock wool. Therefore, by using natural fiber we can reduce the possible health effect. The possibility of finding use for oil palm fibers in fiber composite will open a new market for what normally considered waste or used in low value products.

1.3 Scope

Oil palm fiber composite with different compositions of polypropylene will be used to study their effects on the mechanical properties.