INVESTIGATION ON OIL PALM FIBER COMPOSITE MECHANICAL PROPERTIES

MUHAMAD SYAFIQ BIN MD NAJIB

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Penyelia: DR. SIVAKUMAR DHAR MALINGAM

Tarikh: ……..

SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Structure and Materials)"

Signature : …….

Supervisor : DR SIVAKUMAR DHAR MALINGAM

Date : …….

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MUHAMAD SYAFIQ BIN MD NAJIB

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

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

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DECLARATION

"I hereby declare that the work in this report is my own except for summaries and quotations which have bkeen 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.

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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.

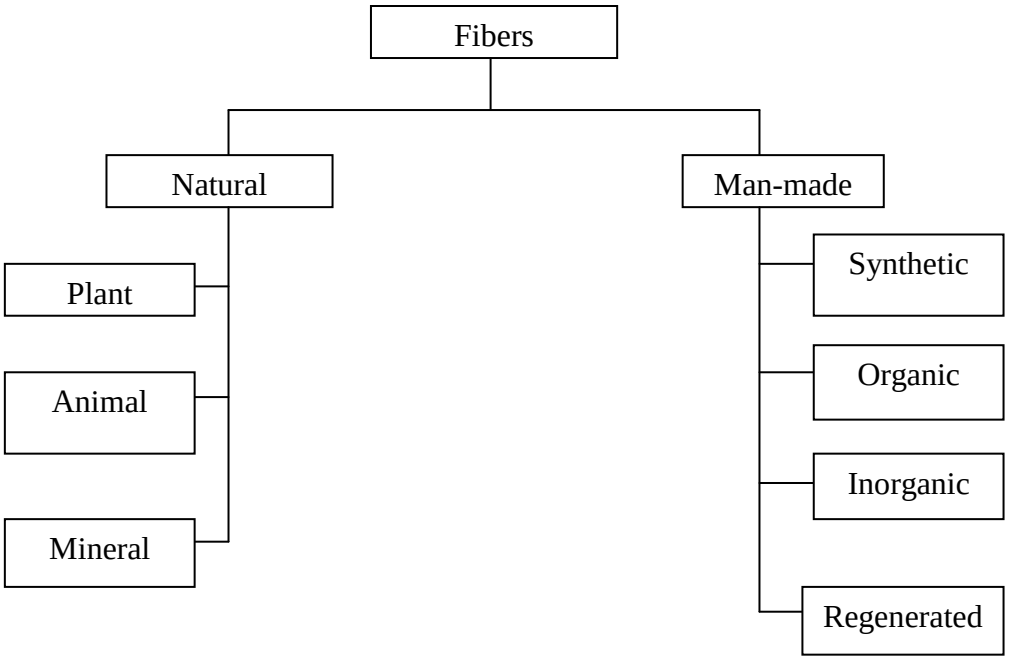

Figure 1.1: Classification of Fiber
(http://www.globalspec.com/reference/43331/203279/classification-of-fibers, 2006)

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 guaineensis) 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 havebeen 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 course 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.