UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EFFECTS OF MALEATED POLYPROPYLENE (MAPP) ON THE MECHANICAL PROPERTIES OF RUBBER SEED SHELL POWDER (RSSP)/ POLYPROPYLENE (PP) COMPOSITES

The report submitted in accordance with the requirements of the Universiti Teknikal Malaysia Melaka for the Bachelor Degree of Manufacturing Engineering (Engineering Materials) with Honours

by

RAJA MANISA BINTI RAJA MAMAT

FACULTY OF MANUFACTURING ENGINEERING

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Cop Rasmi:
PROF. MADYA DR. T. JOSEPH SAHAYA ANAND
Fakulti Kejuruteraan Pembuatan
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....

PROF.MADYA THANGARAJ JOSEPH SAHAYA ANAND
Pensyarah,
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka(UTeM)
Karung berkunci 1200, Ayer Keroh,
75450, Melaka

PROF. MADYA DR. T. JOSEPH SAHAYA ANAND
Profesor Madya
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Karung Berkunci 1200, Hang Tuah Jaya,
Ayer Keroh, 75450 Melaka.

DECLARATION

I hereby declare that this report entitled **"EFFECTS OF MALEATED PROPYLENE (MAPP) ADDITION ON THE MECHANICAL PROPERTIES OF RUBBER SEED SHELL POWDER (RSSP)/ POLYPROPYLENE (PP) COMPOSITES"** is the result of my own research except as cited in the references.

Signature	:	[signature]
Author's Name	:	Raja Manisa Bt Raja Mamat
Date	:	14th May 2009

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Engineering Materials) with Honours. The member of the supervisory committee is as follow:

(Signature of Supervisor)

....

(Official Stamp of Supervisor)

PROF. MADYA DR. T. JOSEPH SAHAYA ANAND
Profesor Madya
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Karung Berkunci 1200, Hang Tuah Jaya,
Ayer Keroh, 75450 Melaka.

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Engineering Materials) with Honours. The member of the supervisory committee is as follow:

(Signature of Principal Supervisor)

T. J. S. Anand.

....

(Official Stamp of Principal Supervisor)

PROF. MADYA DR. T. JOSEPH SAHAYA ANAND
Profesor Madya
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Karung Berkunci 1200, Hang Tuah Jaya,
Ayer Keroh, 75450 Melaka.

ABSTRACT

The main purpose of doing this project is to study the effects of maleated polypropylene (MAPP) addition to the properties of rubber seed shell powder (RSSP)/ Polypropylene (PP) composites fabrication by using mechanical testing methods. For sample preparation, firstly the rubber seed shell is separated from its seed then cleaned by water. After being dried, this rubber seed shell is pulverized by rotor mills. This pulverization process is carried out to transform the shell into the powder form. This process is conducted at Material Laboratory, UTeM. Four different compositions of MAPP concentration are used which are 0 wt %, 3 wt %, 7 wt % and 9 wt %. A mould with dimension 400 mm x 400 mm x 3 mm is used to fabricate the composite. The sample fabrication is done through mixing, extrusion, crushing and hot pressing process. After that, the testings are done in order to assess the mechanical properties of composites. The test methods used are tensile test, flexural and impact test. From these testing, it can be concluded that the strength of composite is increased when the MAPP is added, the optimum weight percentage of MAPP is 3 wt % for better mechanical properties.

ABSTRAK

Tujuan utama projek ini dijalankan adalah untuk mengkaji kesan penambahan "maleated polypropylene (MAPP)" terhadap sifat-sifat mekanikal komposit yang dihasilkan daripada serbuk cangkerang biji getah dan polipropilin. Kesan-kesan ini dikaji menerusi kaedah penyiasatan mekanikal. Proses penyediaan sampel dimulakan dengan mengasingkan cangkerang biji getah daripada bijinya kemudian dibersihkan menggunakan air. Selepas dikeringkan, cangkerang biji getah ini akan melalui proses penghancuran menggunakan "rotor mills". Proses penghancuran ini dijalankan bertujuan untuk menukarkan cangekerang kepada bentuk serbuk. Semua proses ini dijalankan di dalam Makmal Bahan, UTeM. Empat komposisi komposit dengan peratusan berat MAPP yang berbeza digunakan iaitu 0 wt %, 3 wt %, 7 wt % dan 9wt %. Satu acuan berukuran 400 mm x 400 mm x 3 mm digunakan untuk menghasilkan komposit ini. Penghasilan sampel dilakukan menerusi proses pecampuran, penyemperitan, penghancuran semula dan pemanasan tekanan. Selepas itu, ujikaji-ujikaji dijalankan untuk mengkaji sifat-sifat mekanikal komposit yang terhasil. Kedah-kaedah ujikaji in termasuklah "tensile test, flexural test dan impact test". Menerusi ujikaji, sifat kekuatan komposit meningkat apabila ditambahkan dengan MAPP dan sifat mekanikal terbaik dicapai pada peratusan MAPP optimum 3 wt %.

DEDICATION

For all advices and encouragement, this study is gratefully dedicated to my supervisor, lecturers, my family, friends and individuals that involves in this study. Thank you very much for continuous support and guidance.

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LIST OF ABREVIATIONS

ASTM	-	American Society Testing Material
CA	-	Coupling Agent
CMC	-	Ceramic Matrix Composite
GPa	-	Giga Pascal
MA	-	Maleaic Anhydride
MAPP	-	Maleated Polypropylene
MMC	-	Metal Matrix Composite
MPa	-	Mega Pascal
PMC	-	Polymer Matrix Composite
PP	-	Polypropylene
RSS	-	Rubber Seed Shell
RSSP	-	Rubber Seed Shell Powder
SEM	-	Scanning Electron Microsope
UTeM	-	Universiti Teknikal Malaysia Melaka
°C	-	Celcius Degree
Tg	-	Glass Transition Temperature
Wt %	-	Weight Fraction

CHAPTER 1
INTRODUCTION

1.1 Background

Technological development coupled with consumer expectations continues to increase demands on the Earth's resources, leading to major issues relating to material availability and environmentally sustainability. Recently, a general consensus with regard to the large contribution made by humans to the current phase of global warming has been reached. This will add further emphasis to the awareness of the need to act in an environmentally responsible manner. This awareness also led to increase interest in material derived from more sustainable resources that can be processed with lower energy consumption requirements as well as recyclable materials including those from which energy can be recovered, as found within spectrum of natural fiber composites.

One major area of development over the past decade has been in the use of compression molded natural fiber reinforced thermoplastics panels that have been widely adopted in the European automotive industry for parts such as door panels, dashboards and others. Since 2000, the steady growth of the use of natural fibers in cars has been observed increasing in Germany. For example, from 10 000 tonnes in 2000, it is increase to 19 000 tonnes in 2005 as summarized by Preusser, S. (2006). Indeed, much research effort has focused on improving mechanical performance of natural fiber thermoplastic composite which could enable extension of their application. Much of the research has been aimed at the improvement of interfacial strength for which a range of fiber treatments and coupling agents have been assessed. Pickering and Ji (2004) said that the most successful in terms of mechanical benefits along with the ease of use has been obtained with maleated polypropylene (MAPP) as a coupling agent, giving strength and stiffness improvement of greater than 100% compared with uncoupled composites.

In this research, the effect of compatibilizer on the polymer composites which contains the composition of polypropylene and rubber seed shell powder (RSSP) will be investigated and analyzed, mainly on their mechanical properties. Meanwhile, maleated polypropylene (MAPP) is used as compatibilizer. Through this research, MAPP is used as a coupling agent for the PP and RSSP which is derived from rubber seed shell. Different sets of composites panels are prepared starting with powdering the rubber seed shell then mixed together with PP then MAPP is added at various concentrations (different weight percentage, wt %) during extrusion. The composite is then subsequently molded with hot press under specified temperature and pressure for the test specimen preparation. The effects of the MAPP addition on the mechanical properties such as tensile, flexural and impact strength are then observed.

1.2 Problem Statement

This research is justified by the importance to create environmentally friendly materials. Even though, a few researches about natural fibers have been undertaken by previous researcher, there is almost none research is done on rubber seed shell (RSS) polymer composites. The common research only focuses on another natural fiber such as jute and kenaf. Even if related to the rubber, normally research is done through natural rubber, rubber seed or rubber leaf. Through this project, the effects of MAPP addition on this type of composites (RSSP/ PP composites) will be studied. Besides, the utilization of RSSP as filler will also add value to the rubber seed shell (RSS) which is currently treated as agricultural waste.

1.3 Research Scopes

These composites are fabricated by using hot press molding technique. Tensile, impact, flexural and others test are carried out to determine the mechanical properties of composites when MAPP addition is added into these composites.

1.4 Research Objectives

The objectives of this thesis are:

(a) To fabricate the RSSP/ PP composites.

(b) To study the effects of the MAPP addition to the properties of the RSSP/PP composites.

(c) To study the mechanical properties of RSSP/PP composites by several testing methods.

CHAPTER 2
LITERATURE REVIEW

2.1 Composite

Composite can be defined as a material in which two or more materials (matrix and filler) are binds together to form a new material with new properties.

2.1.1 Introduction to Composite

Composite materials are the most advanced and adaptable engineering materials. A composite is a heterogeneous material created by the synthetic assembly of two or more components constituting reinforcing matrix and a compatible matrix in order to obtain specific characteristics and properties as stated by Lugin G (1982). The matrix may be metallic, ceramic or polymeric in origin. The matrix gives a composite its shape, surface appearance, environment tolerance and overall durability while the fibrous reinforcement carries most of the structural loads, thus giving macroscopic stiffness and strength. It is the behavior and the characteristics of the interface that generally control the properties of a composite. Development of advanced composite materials having superior mechanical properties opened new horizons in the engineering field. Advantages such as corrosion resistance, electrical insulation, reduction in tooling and assembly costs, low thermal expansion, higher stiffness and strength, fatigue resistance, such as greater stiffness at lower weight than metal have made the polymer composites widely acceptable in structural applications. However, the disadvantages of composite materials cannot be ignored. Their complex nature, lack of experience of designers, little knowledge of materials database and difficulty in manufacturing are barriers to large-scale use of composites.

2.1.2 Definition and Classification of Composite

According to the Encarta Dictionary, composite in term of material science is something made from different parts. Composite also defined as a mixture of two or more distinct constituents or phases. However, according to F.L Matthews and R.D Rawlings (1999), three certain criteria need to be considered to have a full definition of composite. The first is the both constituents should be present in an acceptable composition. Secondly, the properties of both constituents are different as well as composite properties. Lastly, composite is a mixed of materials to produce a new material. Then, this is a true composite material.

Composite are classified by various criteria according to convenient of the industry. Common classification is by differentiating the type of matrix. The most common designations based on matrix type are Polymer Matrix Composite (PMC), Ceramic Matrix Composite (CMC) and Metal Matrix Composite (MMC). **Table 2.1.2** lists the some mechanical characteristics between those three matrices.

Table 2.1.2: Mechanical Characteristics between Three Matrices.

Type of Matrix	Designation	Matrix Properties			Effective Reinforcement
		Strength (msi)	Stiffness (ksi)	Ductility	
Polymer	PMC	Low (0.2-0.5)	Low (0.5-5)	Low (< 2%)	Continuous fiber
Metal	MMC	Moderate (6-16)	High (10-150)	High (20 %)	Continuous and discontinuous fiber
Ceramic	CMC	High (20-80)	High (20-80)	Low (< 1%)	Discontinuous fiber/ Whisker/ Particulate

Composites can be classified based on the form of their structural components which are fibrous (composed of fibers in a matrix), laminar (composed of layers of materials, and particulate (composed of particle in a matrix). The particulate class can be further subdivided into flake and skeletal. In general, the reinforcing agents can be fibrous, powdered, spherical, crystalline or whiskered and either an organic, inorganic, metallic or ceramic material. The classification of composite can be summarized as **Figure 2.1.2 (a) and Figure 2.1.2 (b)**.

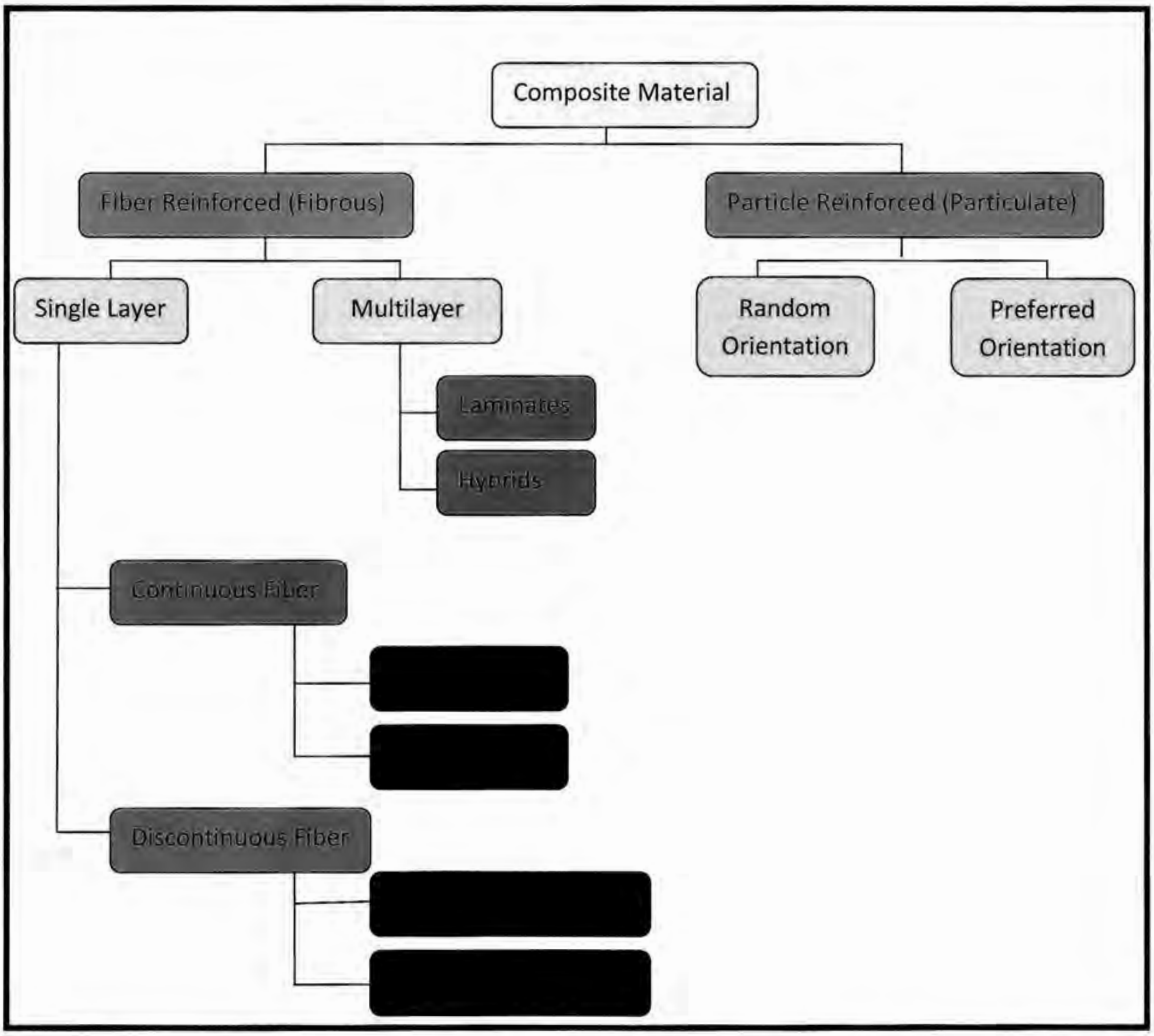

Figure 2.1.2 (a): Classification of Composite Materials. Source: Matthews and Rawlings (1999)