FABRICATION AND CHARACTERIZATION OF RUBBER SEED SHELL POWDER (RSSP) FILLED POLYPROPYLENE (PP) COMPOSITE

MOHAMED ASYRAF BIN RAFEEK AHMAD

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FABRICATION AND CHARACTERIZATION OF RUBBER SEED SHELL POWDER (RSSP) FILLED POLYPROPYLENE (PP) COMPOSITE

Project submitted in accordance with the partial requirements of the Universiti Teknikal Malaysia Melaka for the Degree of Bachelor of Engineering (Honours) Manufacturing (Engineering Material)

By

Mohamed Asyraf Bin Rafeek Ahmad

Faculty of Manufacturing Engineering

October 2007

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS*

JUDUL: **FABRICATION AND CHARACTERIZATION OF RUBBER SEED SHELL POWDER (RSSP) FILLED POLYPROPYLENE (PP) COMPOSITE**

SESI PENGAJIAN: 2/2006-2007

Saya **MOHAMED ASYRAF BIN RAFEEK AHMAD**

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
√	TIDAK TERHAD	

Disahkan oleh:

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:
22 Jalan 8/5, Taman Melati,
Setapak 53100,
Kuala Lumpur.

Cop Rasmi:

Tarikh: 28 March 2008

Tarikh: ______________________

* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).
** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

APPROVAL

This thesis submitted to the senate of UTeM and has been accepted as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Engineering Material). The members of the supervisory committee are as follow:

………………………………………….

Main Supervisor

(Official Stamp and Date)

………………………………………..

Co – Supervisor

(Official Stamp and Date)

DECLARATION

I hereby, declared this thesis entitled "Fabrication and Characterization of Rubber Seed Shell Powder (RSSP) Filled Polypropylene (PP) Composite." is the results of my own research except as cited in references

Signature	:	…………………………………………
Author's Name	:	Mohamed Asyraf Bin Rafeek Ahmad
Date	:	28 March 2008

ABSTRACT

The purpose of doing this project is to study the characteristics of rubber seed shell powder (RSSP) filled polypropylene (PP). The matrix material used in this study was based on commercially available unsaturated polypropylene, obtained from university's Polymer Laboratory. The natural bio-resources used in this project are rubber seed shell powder (RSSP). The rubber seed was collected at the rubber estate. The shell is separated with the seed after the seed was broken and cleaned using water for used as reinforcement in this project. The rubber seed shell then dried at 110°C for 24 hours to remove the storage moisture. The shells will be pulverized using variable rotor mills to transform the shells into powder. The pulverization process was conducted at University Tun Hussein Onn Malaysia (UTHM). The powder size is about 125µm-355 µm. Three weight fractions are used in the composite formulation which is 5%, 10%, and 15%. Two type of mold were used which is 2mm and 3mm to produce the sample regarding to the required standard. In order to examine the mechanical properties, tensile test, flexural test and impact test are carried out. With the test, 5% was the best composition compared to other. Adding the composition of RSSP cause a decrease in tensile strength and make the young's modulus, flexural modulus, flexural strength, impact strength increase. From the scanning electron microscope (SEM), the homogeneity, crack, fracture surface, bond failures and physical defects on the tensile fracture can be observed.

ABSTRAK

Tujuan utama dalam melaksanakan projek ini adalah mengkaji penghasilan dan sifat mekanikal serbuk tempurung biji getah (RSSP) dipe4nuhi dengan bijian polypropylene (PP). Bahan matrik yang digunakan dalam kajian ini adalah berpandukan bahan polypropylene yang yang tidak tepu dipasaran yang tersedia di makmal polimer. Bahan semulajadi yang digunakan dalam projek ini adalah serbuk tempurung biji getah (RSSP). Biji getah ini diperoleh dari ladang getah. Tempurung dipisahkan dr bijinya selepas biji getah dipecahkan dan dicuci menggunakan air untuk digunakan sebagai peneguhan dalam projek ini. Tempurung biji getah akan dikeringkan pada suhu 110°C selama 24 jam untuk membuang lembapan. Tempurung biji getah ini akan melalui proses penghancuran dengan menggunakan "variable rotor mills" untuk menjadikan tempurung tersebut kepada serbuk.Proses ini dijalankan di Universiti Tun Hussein Onn Malaysia (UTHM). Saiz powder adalah diantara 125µm-355 µm. dua jenis acuan digunakan iaitu 2mm dan 3mm untuk menghasilkan sample mengikut piawaian yg digunakan. Tiga jenis kandungan peratusan digunakan iaitu 5%, 10%, 15%. Untuk mengkaji sifat mekanikal, empat jenis ujian akan dijalankan iaitu ujian ketegangan, ujian kelenturan dan ujian hentaman. Dengan ujian-ujian ini. Komposisi 5% adalah yang terbaik dari komposisi yang lain. Dengan penambahan komposisi RSSP akan mngurangkan kekuatan ketegangan dan menjadikan modulus young,modulus kelenturan, kekuatan kelenturan dan kekuatan hentaman meningkat. Dengan penggunaan "scanning electron microscope" (SEM), kesekataan, rekahan, permukaan patah, masalah ikatan dan kesan fizikal dari kepatahan ketegangan dapat dilihat.

DEDICATION

For all your advice and encouragement, this thesis is gratefully dedicated to my supervisor and lecturers that have give a lot of advice in completing this project and also to my family and friends. Thank you very much for your continuous support and effort towards the publication of this project.

ACKNOWLEDGEMENT

I would like to express my appreciation to the individuals who had played a part in ensuring a successful occurrence and flow of activities throughout the duration of my final year project. Endless appreciation and gratitude to my supervisor, Mr. Edeerozey Abd. Manaf and to my second examiner Mr. Haidir b. Maslan for their encouragement and support and for spending quite some time with myself, providing a lot of guidance and ideas for my project research. Their knowledge and experience really inspired and spurred myself. I truly relished the opportunity given in working with them. Last but not least, my appreciation to to all technicians involved in helping me giving lots of information to complete this project. Finally, my sincere appreciation is dedicated to my parents and family and as well as the friends for their priceless assistance and patronage throughout the process of data gathering.

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURE

LIST OF TABLE

LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

^{0}C	-	degrees Celsius
^{0}F	-	degrees Fahrenheit
%	-	Percent
+/-	-	plus or minus
ASTM	-	American Standard Testing Method
in	-	inches
kg	-	kilograms
m	-	Meter
PMCs	-	Polymer–Matrix Composites
PP	-	Polypropylene
PSM	-	Projek Sarjana Muda
RSSP	-	Rubber Seed Shell Powder
s	-	Second
SEM	-	Scanning Electron Microscope
UTeM	-	Universiti Teknikal Malaysia Melaka
UTHM	-	Universiti Tun Hussein Onn
UTM	-	Universal Testing Machine

CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, many scientist and engineers are giving their great attention to the natural bio-resources and at the same time study the properties and characteristics of the natural bio-resources material in many application. The government also encourages the scientist and engineers to make many researches in natural bio-resources. Natural bio-resources have many benefits, beside of low cost they offer low density, environmental harmless, good mechanical properties and also can reduce waste product.

The materials used in this research to produce a composite material are rubber seed shell powder (RSSP) and polypropylene (PP) granule. A mild steel is used as a mold in this project. The mixture of RSSP and PP then poured into the mold and then presses using hot press machine. Boards with different weight fraction of RSSP at constant density are achieved by changing the weight ratio of the PP and RSSP mixture.

1.2 Problem Statement

Despite having potential to improve fuel consumption in automobile, there are few studies that have focused on fabricating lighter and tougher composite using bio-composite. In this project, a lighter and tougher bio-composite using RSSP particles as reinforcement in PP will be fabricated. Samples with different percentage of RSSP powder will be prepared and the effect of the RSSP weight fraction will be studied by analyzing the mechanical properties of the composite.

1.3 Research Scopes

In this project, the composites are fabricated using hot press molding technique. Tensile, flexural and impact test are carried out to determine the mechanical properties of the composites. Their microstructures are observed using Scanning Electron Microscope (SEM).

1.4 Research Objectives

The purpose of this project is:

i. To fabricate rubber seed shell powder filled polypropylene composite.
ii. To study the mechanical properties of rubber seed shell powder and polypropylene composite.
iii. To study the effect of rubber seed shell powder weight fraction on rubber seed shell powder filled polypropylene composite.
iv. To study the bonding property between rubber seed shell and polypropylene in the composites.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A typical composite material is a system of materials composing of two or more materials (mixed and bonded) on a macroscopic scale. For example, concrete is made up of cement, sand, stones, and water. If the composition occurs on a microscopic scale (molecular level), the new material is then called an alloy for metals or a polymer for plastics.

Generally, a composite material is composed of reinforcement (fibers, particles, flakes, and/or fillers) embedded in a matrix (polymers, metals, or ceramics). The matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mechanical properties of the matrix. When designed properly, the new combined material exhibits better strength than would each individual material.

Based on the form of reinforcement, common composite materials can be classified as follows:

1. Fibers as the reinforcement (Fibrous Composites):

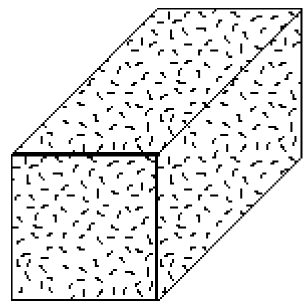

Figure 2.1: Random fiber (short fiber) reinforced composites

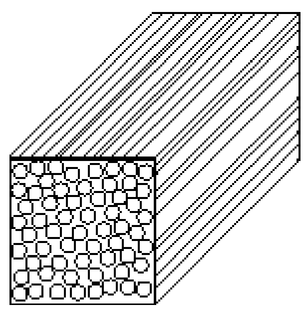

Figure 2.2: Continuous fiber (long fiber) reinforced composites

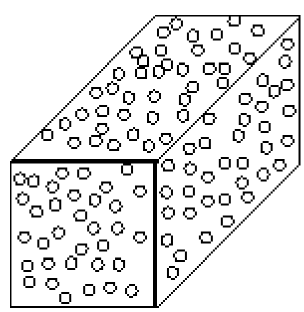

Figure 2.3: Particles as the reinforcement (Particulate composites)

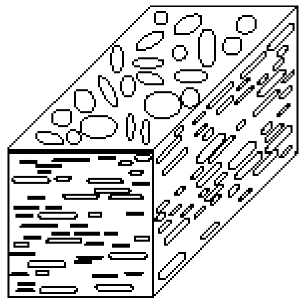

Figure 2.4: Flat flakes as the reinforcement (Flake composites)

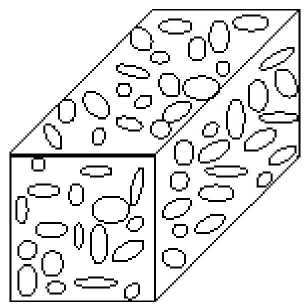

Figure 2.5 Fillers as the reinforcement (Filler composites)

The benefits of using composite are due to the types of material used. Different materials are suitable for different applications. When composites are selected over traditional materials such as metal alloys or woods, it is usually because of one or more of the following advantages:

- Cost:
  - Prototypes
  - Mass production
  - Part consolidation

- Maintenance
- Long term durability
- Production time
- Maturity of technology

- Weight:
  - Light weight
  - Weight distribution
- Strength and Stiffness:
  - High strength-to-weight ratio
  - Directional strength and/or stiffness
- Dimension:
  - Large parts
  - Special geometry
- Surface Properties:
  - Corrosion resistance
  - Weather resistance
  - Tailored surface finish
- Thermal Properties:
  - Low thermal conductivity
  - Low coefficient of thermal expansion
- Electric Property:
  - High dielectric strength
  - Non-magnetic
  - Radar transparency

2.2 Polymer Matrix Composite (PMC)

In this project, the type of composite used is PMC because the matrix that used are in polymer category. PMC consist of polymer resin as a matrix with fibers as the reinforcement medium. These materials are in the greatest diversity of composite application, as well as in the largest quantities, in light of their room temperature properties, ease to fabrication and cost. In general the mechanical properties of polymers are inadequate for many structural purposes. In particular their strength and stiffness are low compared with metals and ceramics. This meant that there was a considerable benefit to be gained by reinforcing polymers and that the reinforcement, initially at least, did not have to exceptional properties. Processing of PMC need not involve high pressures and does not require high temperature. It follows that problems associated with the degradation of the reinforcement during manufacture are less significant for PMC than for composites with other matrices. Also the equipment required for PMC may be simpler. For these reasons polymer matrix composites developed rapidly and soon became accepted for structural applications. Today glass-reinforced polymers are still by the far most used composite material in term of volume with the exception of concrete.

The main disadvantages of PMC are their low maximum working temperatures, high coefficients of thermal expansion and hence dimensional instability, and sensitivity to radiation and moisture. The absorption of water from the environment may have many harmful effects which degrade mechanical performance, including swelling, formation of internal stresses and lowering of the glass-transition temperature.

2.3 Matrix

The matrix is the continuous phase of the composite that holds the reinforcement in place. The functions of the matrix include: holding the fibers in place, protecting the fibers from reaction with the environment, transmitting load from fiber to fiber and protecting the fibers from mechanical abrasion. Each type of matrix has unique