UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Effect of Process Parameters on the Mechanical Properties of RSSP/PP Composites

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

By

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **EFFECT OF PROCESS PARAMETERS ON THE MECHANICAL PROPERTIES OF RUBBER SEED SHELL POWDER (RSSP)/POLYPROPYLENE (PP) COMPOSITE**

SESI PENGAJIAN: 2008/2009 Semester 2

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DECLARATION

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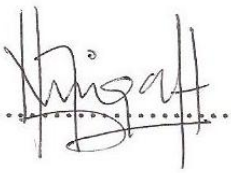
Signature : 

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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 (Materials Engineering) with Honours. The member of the supervisory committee is as follow:

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ABSTRACT

The main goals of this research are to characterize the mechanical properties of rubber seed shell filled polypropylene and to investigate the effect of process parameters on its mechanical properties. This research is conducted by recycle rubber seed shell; which will be used as a reinforcement of RSSP/polypropylene composite. The composites will be fabricated using different process parameters and the mechanical properties of this composite will be measured and compared to see the effect of the process parameters. Processes involved in producing this composite is crushing, pulverizing, mixing, and hot pressing. The purpose of doing the above processes is to ensure that rubber seed shell powder mix well and homogenously with polypropylene. Mechanical properties that determined are flexural strength, tensile strength and impact strength. All tests for this material are according to the American Standard Materials Testing (ASTM) for composite material. The result for tensile testing ware divided to three properties that is tensile strength, Young's modulus and the elongation of material. While for flexural was divided two properties that is flexural modulus and flexural strength and for impact test is impact strength. The conclusions from these testings are the process parameter was affected the mechanical properties. The good result for the tensile properties is 190^{o}C/15 minutes. On the other hand, for the flexural testing the 200^{o}C/15 minutes was given the higher compression properties. While the impact test is 210^{o}C/5 minutes and shows the increasing mechanical results due to increase in temperature and decrease in time. The process in producing the composite plate also affected to the mechanical properties.

ABSTRAK

Tujuan utama kajian ini adalah untuk menghasilkan dan mengenal sifat mekanikal komposit cangkerang biji getah (RSSP)/PP (poly propylene) serta mengenal pasti kesan parameter proses terhadap komposit ini. Kajian ini dilakukan untuk mengitar semula cangkerang biji getah di mana cangkerang ini dijadikan bahan penguat/tetulang dan diproses bersama polypropylene sebagai komposit. Komposit ini akan di hasilkan menggunakan parameter proses yang berlainan dan sifat-sifat mekanikal komposit ini akan di ukur dan dibandingkan untuk melihat kesan parameter proses terhadapnya. Proses terlibat dalam menghasilkan komposit ini termasuklah proses menghancurkan cangkerang biji getah (crushing), menyebatikan serbuk cangkerang biji getah dengan polypropylene (mixing) dan membentuk kepingan komposit pada suhu dan tekanan tinggi (hot pressing). Tujuan kesemua proses tadi dibuat adalah untuk memastikan serbuk cangkerang biji getah ini dicampur dan diadun sebati dengan polypropylene. Ujian kelenturan, ujian terikan, dan ujian impak akan dilakukan mengikut American Standard Materials Testing (ASTM) untuk bahan komposit. Keputusan untuk ujian terikan dibahagikan kepada tiga jenis sifat iaitu kekuatan terikan, Young's modulus dan pemanjangan bahan. Manakala untuk ujian kelenturan dibahagikan kepada dua sifat iaitu modulus kelenturan dan kekuatan kelenturan dan untuk ujian impak ialah sifat kekuatan impak. Kesimpulan daripada ujian yang dilakukan adalah, proses parameter mempengaruhi sifat mekanikalnya. Keputusan terbaik untuk sifat terikan adalah parameter proses untuk 190^{o}C/15 minit. Walaubagaiamana pun, untuk ujian kelenturan 200^{o}C/15 minit parameter proses memberikan nilai kekuatan tekanan tertinggi. Sementara itu, ujian impak menunjukkan peningkatan nilai impak kerana meningkatnya suhu dan munurunkan masa proses. Cara-cara proses menghasilkan komposit ini juga turut mempengaruhi sifat mekanikalnya.

DEDICATION

“Special thanks to my parent,dedicated supervisor; Mr. Edeerozey Abd Manaf and Professor Madya Dr T. Joseph Sahaya Anand, my family, my friends and all involved in completing this report for their support and guidance”

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LIST OF SYMBOLS

ε_f	Strain in the outer surface, [%]
σ	Tensile strength
σ_f	Stress in outer fibers at midpoint, [MPa]
%	percentage
ASTM.	American standard testing material
b	width of beam tested
C	celcius
$CaCO_3$	wollastonite
CMC	ceramic-matrix composites
Eb	Flexural modulus
h	thickness of beam tested
L	specimen length between two support points.
m	initial slope of the load vs. deflection curve
MAH-PP	maleic anhydride polypropylen
MB	methylene blue
MMC	metal-matrix composites
PBT	Polybutylene terephthalate
PC	Polycarbonate
PE	polyethelene
PET	Polyethylene terephthalate
PMC	polymer-matrix composites
PP	polypropylene
PS	polystyrene
RSS	rubber seed shell
RSSP	rubber seed shell powder
RSSP/PP	composite of rubber seed shell with polypropylene
Sdn Bhd	sendirian berhad
SI units	International Standard
SiC	silicon carbide
SMC	ceramic matrix composite

T_g	glass transition temperature
T_m,	melting temperature
UTeM	Universiti Teknikal Malaysia Melaka
UTM	Universal Testing Machine
v	volume fraction

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CHAPTER 1
INTRODUCTION

1.1 Background

During the past decade, increasing environmental awareness, new global agreements, and international governmental policy and regulations have been the driving attractiveness of a plant-based fiber as an alternative reinforcement material comes from its high specific strength and stiffness, natural availability, and environmental 'friendliness'.

Most of the composite materials used in different sectors are principally fabricated using thermosetting matrices. Disadvantages stemming from the use of thermosets include brittleness, lengthy cure cycles and inability to repair or recycle damaged or scrapped parts. These disadvantages have led to the development of the thermoplastic matrix composite system. Compared with thermosets, composites fabricated from thermoplastic materials typically have a longer shelf life, higher strain to failure, are faster to consolidate and retain the ability to be repaired, reshaped and reused as need arises.

Rubber seed shells are already being used to abstract methylene blue (MB) from aqueous solution. Carbonizes rubber seed shell is also being used to produce thermal aging properties and molecular transport of solvents through vulcanizates prepared from thioglycollic acid modified epoxidized low molecular weight natural rubber blends filled with admixtures of carbon black and carbonized rubber seed shell.

1.2 Problem statement

Most of the composite materials used in different sectors are principally fabricated using thermosetting as a matrices. Disadvantages of thermosets include brittleness, lengthy cure cycle and inability to repair damaged parts. These disadvantages have led to the development of the thermoplastic matrix composite system. Composites fabricated from thermoplastic materials typically have a longer shelf life, higher strain to failure, are faster to consolidate and retain the ability to be repaired, reshaped and reused as need arises [S. Mukhopadhyay, R.Srikanta.2008]. Have a few studies that focused on fabricating lighter and tougher composite using bio-composite. In this project, a lighter and tougher bio-composite will be fabricated. Samples with different process parameters will be prepared and the effect of that will be studied by analyzing the mechanical properties of the composite. One of the significant points in this research is by applying the RSSP in the polymer composites; it could contribute towards the environmentally friendly. Furthermore there is almost none research done using rubber seed shell in composite, while many other natural plant-based fibers composites have been researched before. It is hoped that, this project will contribute for the knowledge in composite research.

1.3 Objectives of the study

(i) To fabricate the RSSP/ PP composite sample
(ii) To study the mechanical properties of RSSP/PP composite
(iii) To study the effects of the process parameters to the composite

1.4 Scope of study

In this project, the effect of the process parameters on the mechanical properties of rubber seed shell powder (RSSP)/ polypropylene (PP) composites will de discussed.

The varied of process parameters are used when fabricating. The steps involved are preparation of the material that is RSSP and PP and it will be mixed using the manually mixer, mixer machine, and extrusion. After that these will be crushed using crusher before fabricate using the hot press machine. At this step the varied temperature and time were setup. The material produce will be cut into the standard specimen size for each testing. The mechanical properties of this project will be studied through the tensile test, impact test and flexural test.

CHAPTER 2
LITERATURE REVIEW

2.1 Composite

Generally, a composite material is composed of reinforcement (fibers, particles, flakes, and/or fillers) embedded in a matrix (polymer, 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.

Composite material is a combination of two or more materials (reinforcing elements, fillers, and composite matrix binder; the example of the fiber used is woven carbon fiber filaments as Figure 2.1), differing in form or composition on a macro scale. The constituents retain their identities; that is, they do not dissolve or merge completely into one another although they act in concert. Normally, the components can be physically identified and exhibit an interface between one another.

Composite materials (or composites for short) are engineered materials made from two or more constituent materials with significantly different physical or chemical properties and which remain separate and distinct on a macroscopic level within the finished structure. These combinations must contain more than 5 % for each material. Basically, the composites are not only used for their mechanical properties applications but also used for physical properties such as water absorption. The properties that exposed by the composite materials is dissimilar with initial materials.

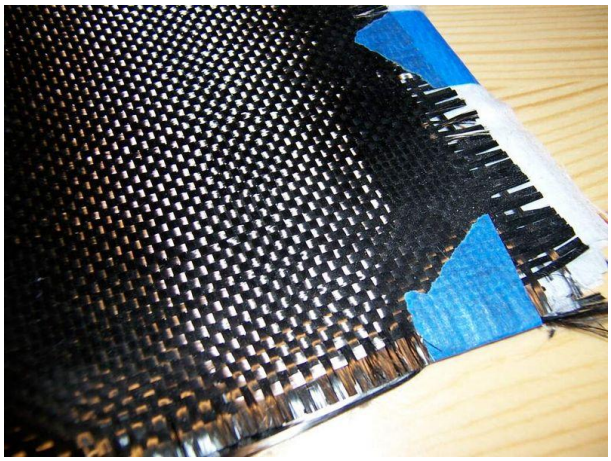

Figure 2.1: Cloth of woven carbon fiber filaments; common element in composite materials

Composite can be classified into two types which is matrix and geometry of reinforcement. First, the classification based on geometry of reinforcement divide by four categories which is flake, whiskers, fiber composites and particulate composites. The second types is classification based on matrix, there are three kind of matrix which are metal-matrix composites (MMC), polymer-matrix composites (PMC) and ceramic-matrix composites (CMC). The ratio can be expressed either by the weight fraction (w), which is related to fabrication or by the volume fraction (v), which normally used in property calculations.

Rules of mixture:

$$Xc = X_f V_f + X_m (1- V_f)$$

There are two categories of constituent materials: matrix and reinforcement. At least one portion of each type is required. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties.

Matrix is the phase in composite that continuous and surrounds the other phases that are reinforcement. Matrix is being melted and that mean some of their properties are changed. The problem of brittleness in reinforcement can be solved by using matrix. The