



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**Characterization of Mechanical Properties on
Polystyrene/E-glass in the Absence and
Presence of Charcoal Particles**

Report submitted in accordance with partial requirements of the Universiti
Teknikal Malaysia Melaka for the Bachelor of Manufacturing Engineering
(Engineering Materials)

By

Lee Beng Choon

Faculty of Manufacturing Engineering

April 2008



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PSM

JUDUL: Characterization of Mechanical Properties on Polystyrene/E-glass in the Absence and Presence of Charcoal Particles

SESI PENGAJIAN: 2007/2008

Saya Lee Beng Choon

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 dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
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:

No 50, Jalan Rambai 3, Tmn Rambai
Indah, 42600 Kuala Langat, Selangor

Cop Rasmi:

Tarikh: _____

Tarikh: _____

* 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.



FAKULTI KEJURUTERAAN PEMBUATAN

Rujukan Kami (Our Ref) :

30 April 2008

Rujukan Tuan (Your Ref):

Pustakawan
Perpustakaan Universiti Teknikal Malaysia Melaka
UTeM, No 1, Jalan TU 43,
Taman Tasik Utama, Hang Tuah Jaya,
Ayer Keroh, 75450, Melaka

Saudara,

PENKELASAN TESIS SEBAGAI SULIT/TERHAD

- TESIS SARJANA MUDA KEJURUTERAAN PEMBUATAN (Bahan Kejuruteraan): Lee Beng Choon

TAJUK: Characterization of Mechanical Properties on Polystyrene/E-glass in the Absence and Presence of Charcoal Particles

Sukacita dimaklumkan bahawa tesis yang tersebut di atas bertajuk "Characterization of Mechanical Properties in the Absence and Presence of Charcoal Particles" mohon dikelaskan sebagai terhad untuk tempoh lima (5) tahun dari tarikh surat ini memandangkan ia mempunyai nilai dan potensi untuk dikomersialkan di masa hadapan.

Sekian dimaklumkan. Terima kasih.

"BERKHIDMAT UNTUK NEGARA KERANA ALLAH"

Yang benar,

.....
Pn. Zurina bt Shamsuddin
Pensyarah,
Fakulti Kejuruteraan Pembuatan

DECLARATION

I hereby declare that this report entitled “**Characterization of Mechanical Properties on Polystyrene/E-glass in the Absence and Presence of Charcoal Particles**” is the result of my own research except as cited in the references.

Signature :
Author's Name : **Lee Beng Choon**
Date : 26th March 2008

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*). The members of the supervisory committee are as follow:

Pn. Zurina bt Shamsuddin
(Main Supervisor)

ABSTRACT

This research presents the characterization of the mechanical properties on the Polystyrene/E-glass composite in the absence and presence of the charcoal particles. The purposes of doing this research are to determine the value of mechanical properties of the polystyrene/E-glass/charcoal hybrid composite upon the different charcoal loadings and to analyze the morphology behavior of the hybrid composite in relation to their mechanical properties. In this project, the charcoal particles, E-glass fiber with the length of 4mm and polystyrene pellet are used to form composite with the weight ratio 10:0:0, 7:3:0, 7:2:1, 7:1.5:1.5 and 7:1:2. The size of charcoal particles was characterized by using SEM. The specimens were fabricated by using the internal mixer, crusher and compression-moulding machine to form the composite sheet. The composite sheets were then cut into the dimension as required by ASTM 638 and ASTM 790. The specimens were divided into two categories; one was subjected to mechanical testing and another one was subjected to water absorption testing prior to mechanical testing. The effect of the charcoal loadings and water absorption on the tensile properties and flexural properties of the specimen were observed. The dry specimens were then further analyzed with the morphology analysis on the fracture surface of the specimen by using the SEM. The results showed that the charcoal filled composite had increased the tensile strength and tensile modulus as the charcoal loading increased. The optimal flexural properties of the PS/E-glass/charcoal hybrid composite were found at the weight ratio of 7:1.5:1.5 and leveled off at charcoal loading of 20wt%. The morphology behaviors showed were observed conformed to the obtained mechanical properties. The hydrophilic character of charcoal attributed the charcoal filled PS/E-glass specimens present improved of tensile stress and flexural modulus after of the water absorption. Additionally, the addition of charcoal into PS/E-glass was found reducing the density of the hybrid composite.

ABSTRAK

Kertas kerja ini menerangkan projek bertajuk “Characterization of the mechanical properties on the PS/E-glass in the absence and presence of the charcoal particles”. Tujuan menjalankan kajian ini adalah untuk menentukan perbezaan sifat mekanikal pada PS/kaca-E komposit jika serbuk arang ditambah dengan peratus pengisian yang berbeza dan mengkaji sifat morfologi pada PS/kaca-E/arang berhubung dengan sifat mekanikalnya. Dalam projek ini, serbuk arang digunakan sebagai pengisi manakala kaca-E dengan panjang 4mm digunakan sebagai penetulang untuk menghasilkan PS/kaca-E/arang komposit hibrid pada nisbah berat 10:0:0, 7:3:0, 7:2:1, 7:1.5:1.5 and 7:1:2. Saiz pada serbuk arang ditentukan melalui analisis mikroskop. Komposit hibrid dibentuk ke dalam kepingan dengan menggunakan mesin pencampur dalaman, penghancur and pemampat. Kepingan komposit yang dihasilkan seterusnya dipotong berdasarkan dimensi yang ditetapkan dalam ASTM 638 and ASTM 790. Sampel-sampel yang dihasilkan dibahagikan kepada dua kumpulan, satu untuk ujian mekanikal dan satu lagi untuk ujian penyerapan air sebelum menjalani ujian mekanikal. Kesan-kesan setiap pengisian arang pada sifat mekanikal seperti sifat ketegangan dan sifat kelenturannya sampel ditentukan melalui ujian ketegangan dan ujian kelenturan. Kemudiannya, sifat morfologinya pada permukaan yang telah retak dikaji dengan menggunakan SEM. Hasil ujian mekanikal menunjukkan penambahan pengisian serbuk arang ke dalam komposit meningkatkan sifat ketegangannya. Sifat kelenturan pada komposit hibrid didapati paling optima pada nisbah berat 7:1.5:1.5 dan menurun pada pengisian arang sebanyak 20 wt%. Sifat morfologinya didapati akur dengan sifat mekanikalnya. Kesan ujian penyerapan air, penambahan arang yang berciri hidrofilik ke dalam PS/kaca-E komposit menunjukkan peningkatan pada kekuatan ketegangan dan modulus kelenturannya. Selain itu, penambahan serbuk arang juga didapati mengurangkan ketumpatan komposit hibrid.

DEDICATION

For my beloved mother and father.

ACKNOWLEDGEMENTS

I would like to take this opportunity to express my appreciation to those who have aided me throughout the completion of this report. Thanks especially to Pn. Zurina bt Shamsuddin, my superior supervisor for her guidance and teaching throughout the training, I am forever grateful for those. Thanks also to others co-supervisors such as Dr. Azizah bt Shaaban and Ms. Zaleha bt. Mustafa, for their guidance, expounds and knowledge regarding the study. Without those, the completion of study might not be possible. To Pn. Zurina bt Shamsuddin, my academic supervisor, thank you for your comments and suggestions on the draft of this report, your help is priceless. To all the technician of the Faculty Manufacturing Engineering, especially the technician in polymer and material laboratory, thank you for providing the experiences and knowledge for me while I undergoes my research. Besides those mentioned, I also would like to express our gratitude to Universiti Teknikal Malaysia Melaka for providing the opportunity to me undergo my research. Not forgetting my course mates, for their caring, concern, remind and information while training. Finally, I would like to thank everyone reading this report for his or her time.

TABLE OF CONTENTS

Declaration	i
Approval	ii
Abstract	iii
Abstrak	iv
Dedication	v
Acknowledgements	vi
Table of Contents	vii
List of Figures	ix
List of Tables	xvii
List of Abbreviations, Symbols, Specialized Nomenclature	xviii

CHAPTER 1: INTRODUCTION

1.1	Background	1
1.2	Problem Statements	3
1.3	Objectives of the Study	3
1.4	Scope	4

CHAPTER 2: LITERATURE REVIEW

2.1	Introduction	5
2.2	Composite	5
2.2.1	Introduction	5
2.2.2	Particulate Reinforced Composite	7
2.2.3	Fiber Reinforced Composite	7
2.2.3.1	Glass Fiber Reinforced Composite	8
2.3	Matrix	13
2.3.1	Introduction	13

2.3.2	Thermoplastic	13
2.3.3	Polystyrene	16
2.4	Reinforcement	18
2.4.1	Introduction	18
2.4.2	Fiber Reinforcement	19
2.4.2.1	E-glass Fiber	21
2.5	Filler	24
2.5.1	Introduction	24
2.5.2	Charcoal Filler	29
2.6	Hybrid Composite	31
2.7	Morphology	34
2.7.1	Introduction	34

CHAPTER 3: METHODOLOGY

3.1	Introduction	43
3.2	Flow Chart of the Methodology	44
3.3	Materials	45
3.3.1	Polystyrene	45
3.3.2	E-glass	46
3.3.3	Charcoal	46
3.4	Methods	47
3.4.1	Characterization	47
3.4.1.1	Particle Size	47
3.4.1.2	Density Measurement	47
3.4.2	Sample Fabrication	48
3.4.2.1	Compounding	48
3.4.2.2	Mixing Process	48
3.4.2.3	Crushing Process	49
3.4.2.4	Compression Molding Pressing	49
3.4.2.5	Specimen Cutting Process	50
3.4.2.6	Water Absorption Testing (24 h.)	50

3.4.3	Mechanical Testing	51
3.4.3.1	Tensile Testing	51
3.4.3.2	Flexural Testing	52
3.4.4	Morphology Investigation	53
3.5	Gantt Chart	54

CHAPTER 4: RESULTS

4.1	Introduction	56
4.2	Characterization	56
4.2.1	Particle Size	56
4.2.2	Density	57
4.3	Observation of Sample Preparation Process	58
4.4	Tensile Testing	60
4.4.1	Fracture Surface Morphology of Tensile Specimen	62
4.5	Flexural Testing	66
4.5.1	Fracture Surface Morphology of Flexural Specimen	68
4.6	Water Absorption Testing	72
4.6.1	Effect of Moisture Absorption on Mechanical Properties	74

CHAPTER 5: DISCUSSION

5.1	Introduction	77
5.2	Tensile Properties	77
5.2.1	Relationship between Morphology and Tensile Properties	80
5.3	Flexural Properties	85
5.3.1	Relationship between Morphology and Flexural Properties	87
5.4	Water Absorption Behavior	90
5.4.1	Effect of Water Absorption on Tensile Properties	90
5.4.2	Effect of Water Absorption on Flexural Properties	91

CONCLUSION 92

REFERENCES 95

APPENDICES

- A Stress versus Strain Graph of Tensile Test
- B Stress versus Strain Graph of Flexural Test
- C Calculation of Density of Sample
- D Calculation of Charcoal Particle Size

LIST OF FIGURES

2.1	Modulus versus Material Cost GF-filled Plastics and Unfilled Plastics	9
2.2	Tensile versus Material Cost GF-filled Plastics and Unfilled Plastics	9
2.3	Composite Properties versus Average Fiber Diameter	10
2.4	Normalised Mechanical Properties versus Fibre Contents	11
2.5	Cumulative Volume Fraction versus Fiber Contents (19-74%)	12
2.6	Various Orientation Parameters versus Fiber Content (19-74%)	12
2.7	Modulus versus Material Volume Cost for Common Plastics	14
2.8	Yield Strength versus Material Volume Cost for Common Plastics	14
2.9	Impact Strength versus Material Volume Cost for Common Plastics	15
2.10	Modulus versus Filler Content for Common Fillers in PP	25
2.11	Yield Stress versus Filler Content for Common Fillers in PP	25
2.12	Impact Resistance versus Filler Content for Common Fillers in PP	26
2.13	Flexural Response of 100% PP Fibre Compared with Glass/PP Hybrid (20:80) Composite	32
2.14	Flexural Response of Hybrid Composite with Different Hybrid Combinations	33
2.15A	SEM micrographs of the fracture surfaces of the composites.100% PA 6,6 in the PA 6,6/PP matrix system.	36

2.15B	SEM micrographs of the fracture surfaces of the composites. 75% PA 6,6 in the PA 6,6/PP matrix system.	36
2.15C	SEM micrographs of the fracture surfaces of the composites 50% PA 6,6 in the PA 6,6/PP matrix system.	36
2.15D	SEM micrographs of the fracture surfaces of the composites 25% PA 6,6 in the PA 6,6/PP matrix system.	36
2.15E	SEM micrographs of the fracture surfaces of the composites 0% PA 6,6 in the PA 6,6/PP matrix system	36
2.16A	The morphologies of the fracture surfaces of 40 wt% SGF reinforced PA 6,6/PP composites. 100% PA 6,6 in the PA 6,6/PP matrix system.	37
2.16B	The morphologies of the fracture surfaces of 40 wt% SGF reinforced PA 6,6/PP composites. 75% PA 6,6 in the PA 6,6/PP matrix system.	37
2.16C	The morphologies of the fracture surfaces of 40 wt% SGF reinforced PA 6,6/PP composites. 50% PA 6,6 in the PA 6,6/PP matrix system.	37
2.16D	The morphologies of the fracture surfaces of 40 wt% SGF reinforced PA 6,6/PP composites. 25% PA 6,6 in the PA 6,6/PP matrix system.	37
2.16E	The morphologies of the fracture surfaces of 40 wt% SGF reinforced PA 6,6/PP composites. 0% PA 6,6 in the PA 6,6/PP matrix system.	37
2.17	Scanning Electron Micrographs of Fracture Surfaces Taken From Glass Fibre Reinforced Polypropylene Mouldings Broken in the Tensile Test	38
2.18a	SEM of Cryogenically Fractured Surface for PEKK	39
2.18b	SEM of Cryogenically Fractured Surface for PEKK/GF/mica composites with weight ratio 70:15:15	39

2.19a	SEM micrographs of fracture surfaces after fracture mechanical test for PP hybrid composites at 350 times magnification: LGF/CaCO ₃ = 12.9/0 vol% Crack growth direction is from left to right.	40
2.19b	SEM micrographs of fracture surfaces after fracture mechanical test for PP hybrid composites at 350 times magnification: LGF/CaCO ₃ = 14.6/6.6 vol%. Crack growth direction is from left to right.	40
2.20a	Figure 2.20: SEM micrographs of fracture surfaces after fracture mechanical test for PP hybrid composites: LGF/CaCO ₃ = 12.9/0 vol%, 750· magnification, 1500· magnification. Crack growth direction is from left to right.	41
2.20b	Figure 2.20: SEM micrographs of fracture surfaces after fracture mechanical test for PP hybrid composites: LGF/CaCO ₃ = 14.6/6.6 vol%, 1500· magnification. Crack growth direction is from left to right.	41
2.21	SEM of Charcoal Made from Birch	42
3.1	Four Main Stages Involved in Completion of This Study	43
3.2	Flow Chart of the Methodology	44
3.3	Polystyrene Pellets	45
3.4	E-Glass Fibers	46
3.5	Charcoal Particles	46
3.6	Density Measurement of E-glass Fiber	47
3.7	Compression Molding Operations	49
3.8	Cutting Process of Tensile Specimen	50
3.9	Universal Testing Machine	51
3.10	Alignment of the Support and Loading Nose at Flexural Test	52
3.11	Scanning Electron Microscopy SEM Evo 50	53
3.12	Mounted of Specimens on SEM Stubs	53

4.1	Morphology of the Charcoal Particles	57
4.2	Density of the PS/E-glass/Charcoal at Different Composition	58
4.3	Extrudate Product of the PS/EGF Composite	58
4.4a	Tensile Specimen	59
4.4b	Flexural Specimen	59
4.5	Tensile Strength of the PS/E-glass/Charcoal at Different Composition	61
4.6	Tensile Modulus of the PS/E-glass/Charcoal at Different Composition	61
4.7a	The SEM Fractured Surface Pure PS at 60 x Magnification	63
4.7b	The SEM Fractured Surface Pure PS at 500 x Magnification.	63
4.8a	SEM Fractured Surface for PS/E-glass Composite at 60 x	63
4.8b	SEM Fractured Surface for PS/E-glass Composite at 500 x Magnification	63
4.9a	SEM Fractured Surface for PS Hybrid Composite with 10 wt% Charcoal Loading at 60 x Magnification	64
4.9b	SEM Fractured Surface for PS Hybrid Composite with 10 wt% Charcoal Loading at 500 x Magnification	64
4.10a	SEM Fractured Surface for PS Hybrid Composite with 15 wt% Charcoal Loading at 60 x Magnification	64
4.10b	SEM Fractured Surface for PS Hybrid Composite with 15 wt% Charcoal Loading at 500 x Magnification	64
4.11a	SEM Fractured Surface for PS Hybrid Composite with 20 wt% Charcoal Loading at 60 x Magnification	65
4.11b	SEM Fractured Surface for PS Hybrid Composite with 20 wt% Charcoal Loading at 500 x Magnification	65
4.12	Flexural Strength of the PS/E-glass/Charcoal at Different Composition	67
4.13	Flexural Modulus of the PS/E-glass/Charcoal at Different Composition	67

4.14a	SEM Bending Surface of Pure PS at 60 x Magnification	69
4.14b	SEM Bending Surface of Pure PS at 500 x Magnification	69
4.15a	The SEM Bending Surface of PS/E-glass Composite (70/30) at 60 x Magnification	69
4.15b	The SEM Bending Surface of PS/E-glass Composite (70/30) at 500 x Magnification	69
4.16a	The SEM Bending Surface of PS/E-glass/Charcoal Hybrid Composite (70/20/10) at 60 x Magnification	70
4.16b	The SEM Bending Surface of PS/E-glass/Charcoal Hybrid Composite (70/20/10) at 500 x Magnification	70
4.17a	The SEM Bending Surface of PS/E-glass/Charcoal Hybrid Composite (70/15/15) at 60 x Magnification	70
4.17b	The SEM Bending Surface of PS/E-glass/Charcoal Hybrid Composite (70/15/15) at 500 x Magnification	70
4.18a	The SEM Bending Surface of PS/E-glass/Charcoal Hybrid Composite (70/10/20) at 60 x Magnification	71
4.18b	The SEM Bending Surface of PS/E-glass/Charcoal Hybrid Composite (70/10/20) at 500 x Magnification	71
4.19	Percentage of Water Gain at Room Temperature for 24 hours for Different Specimen Composition	73
4.20	Tensile Stress versus Composition of Specimens	75
4.21	Tensile Modulus versus Composition of Specimens	75
4.22	Flexural Strength versus Composition of Specimens	76
4.23	Flexural Modulus versus Composition of Specimens	76
5.1	Tensile Properties and Morphology Behavior (1500 x Magnification) of the Pure PS, PS/E-glass Composite and Charcoal Filled PS/E-glass Hybrid Composite	80
5.2	Properties and Morphology Behavior of the Sample in the Increasing of the Charcoal Loading	82

5.3	SEM Fractured Surface for PS Hybrid with 10 wt% Charcoal Loading	83
5.4	Flexural Properties and Morphology Behavior of the Pure PS, PS/E-glass Composite and PS Hybrid	87
5.5	Flexural Properties and Morphology Behavior of the Sample in the Increasing of the Charcoal Loading	88

LIST OF TABLES

2.1	Properties of Polystyrene Homopolymer	16
2.2	Mechanical Properties for Glass and Carbon Fiber	20
2.3	Properties of Fiber Reinforced Polymer	21
2.4	E-glass Composition	22
2.5	Properties of the E-glass	22
2.6	Nominal Glass Tensile Properties	23
2.7	Composition of Charcoal	29
2.8	Physical Properties and Mechanical Properties of Charcoal	29
3.1	Properties of PS	45
3.2	Gantt Chart for PSM I	54
3.3	Gantt Chart for PSM II	55
4.1	Tensile Properties (average \pm standard deviation) of Pure PS and PS/E-glass Composite with the Absence and Presence of the Charcoal Particles	60
4.2	Flexural Properties (average \pm standard deviation) of Pure PS and PS/E-glass Composite with the Absence and Presence of the Charcoal Particles	66
4.3	The Weight Gain and Weight Deflection of PS/EG/Charcoal at Different Composition	73

LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

°C	-	Celcius
ASTM	-	American Society of Testing Materials
A-W	-	Apatite-Wollastonite
eg.	-	Example
F ₂	-	Gas Fluorin
Fig	-	Figure
FM	-	Flexural Modulus
FRP	-	Fiber Reinforced Polymer
FS	-	Flexural Strength
GF	-	Glass Fiber
GFN6,6	-	Glass Fiber/Nylon 6,6
GFPP	-	Glass Fiber/Polypropylene
LF	-	Long Fiber
min	-	Minutes
mm	-	Milimeter
MPa	-	Mega Pascal
OCL	-	Organo Bentonite Clay
OH	-	Hydroxyl
PA	-	Polyamide
PBT	-	Polybutylene terephthalate
PC	-	Personal Computer
PEKK	-	Polyetheretherketone
phr	-	Parts Per Hundred Resin
PMC	-	Polymer Matrix Composite
PP	-	Polypropylene
PS	-	Polystyrene

PS/E-glass	-	E-glass Reinforced Polystyrene Composite
PS/E-glass/Charcoal	-	Charcoal Filled E-glass Reinforced Polystyrene Hybrid Composite
PVA	-	Polyvinyl Acetate
SEM	-	Scanning Electron Microscope
SFRP	-	Short Fiber Reinforced Polymer
TEM	-	Transmission Electron Microscope
TM	-	Tensile Modulus
TS	-	Tensile Strength
UTM	-	Universal Testing Machine
UTS	-	Ultimate Tensile Strength
vol %	-	Volume Percentages
W	-	Weight Fraction
wt%	-	Weight Percentages
ρ	-	Density

CHAPTER 1

INTRODUCTION

1.1 Background

The use of the hybrid composite has become popular in recent years. Hybrid composite is a composite material in which two or more high-performance reinforcements are combined to make the enhanced the composite properties. Its behavior which bringing together different properties of the reinforcement appears more favorable compared to others since it improved performance with a balance in cost. The goals of the design of hybrid composites mainly include high strength and stiffness on a weight basis.

Throughout the past, E-glass fibers have being used as the reinforcement for thermoplastic matrices in order to improve the mechanical properties of the composite. The E-glass fiber reinforced composite was confirmed to have greater performance of the composite as the glass fibers content loading increases. However, the increasing of the glass fibers content loading are tend to bring up the cost of the composite as well. Owing to that, the replacement of glass fibers with less expensive fillers was advisable if the performance levels are accessible.

Fillers very versatile because of their two distinct advantages comprise improved performance or cost ratio and access to properties not attainable from unfilled polymers. Traditionally, the common filler material used for composites comprised of glass, black carbon, silica and others. However, presently, more attentions have been paid to utilization of economical fillers such as charcoal, fly ash, wood flour, limestone and mineral instead of conventional fillers for the search of reducing cost of composites as well as to impart some desirable properties.

Domestic charcoal is the blackish porous residue consisting of impure carbon produced by heating wood in the absence of oxygen. In recent decades, the utilization of low cost charcoal as a replacement for synthetic fibers in advanced materials has gained interest among researchers throughout the world due to its pronounce effect and advantages such as low density, unlimited availability, low cost, and reduced energy consumption over traditional glass fibers (Byrne *et al.*, 1997; Qiao *et al.*, 2001). However, there was little quantitative study regarding the knowledge of competence of charcoal, particularly regarding the effect of charcoal loading on morphology and mechanical properties.

There are several considerations have to make taken into account in the design of charcoal filled hybrid composite. One of the most important issues is the degradation behavior of the hybrid composites exposed to environmental conditions such as humidity, sunlight or microorganisms. Generally, all polymer composites absorb moisture in humid atmosphere and when immersed in water. Thus, the poor resistance of the filler to water absorption can attribute undesirable effects on the mechanical properties of the polymer composites such as leads to the degradation of fiber-matrix interface creating a poor stress transfer efficiencies resulting in reduction of mechanical properties.