THE STUDY OF OPTIMUM CONDITION TO PRODUCE RUBBER INDUCED POLYMER (POLYETHYLENE)

AHMAD FARIZ BIN FAIZAL LIM

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS TESIS*

JUDUL: THE STUDY OF OPTIMUM CONDITION TO PRODUCE RUBBER INDUCED POLYMER (POLYETHYLENE)

SESI PENGAJIAN : 2007-2008

Saya AHMAD FARIZ BIN FAIZAL LIM

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:
655, Jln TBK 2/16,
Tmn BKT Kepayang 2,
70200 Seremban, Ng. Sembilan.

Cop Rasmi:

Tarikh: _____ 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.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
Karung Berkunci 1200, Ayer Keroh, 75450 Melaka
Tel : 06-233 2421, Faks : 06 233 2414
Email : fkp@kutkm.edu.my

FAKULTI KEJURUTERAAN PEMBUATAN

Rujukan Kami (Our Ref) :
Rujukan Tuan (Your Ref):

15 May 2008

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

Saudara,

PENGKELASAN TESIS SEBAGAI SULIT/TERHAD

- TESIS SARJANA MUDA KEJURUTERAAN PEMBUATAN (FAKULTI KEJURUTERAAN PEMBUATAN): AHMAD FARIZ BIN FAIZAL LIM

TAJUK: THE STUDY OF OPTIMUM CONDITION TO PRODUCE RUBBER INDUCED POLYMER (POLYETHYLENE)

Sukacita dimaklumkan bahawa tesis yang tersebut di atas bertajuk **"THE STUDY OF OPTIMUM CONDITION TO PRODUCE RUBBER INDUCED POLYMER (POLYETHYLENE)"** 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 Binti Shamsudin
Pensyarah,
Fakulti Kejuruteraan Pembuatan

DECLARATION

I hereby, declared this thesis entitled "The Study of Optimum Condition to Produce Rubber Induced Polymer (Polyethylene)" is the results of my own research except as cited in references.

Signature	:	
Author's Name	:	AHMAD FARIZ BIN FAIZAL LIM
Date	:	15 MAY 2008

APPROVAL

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

PN. ZURINA BINTI SHAMSUDIN

(Main Supervisor)

"Insert the date and official stamp here"

ABSTRACT

The purpose of this study is to find the optimum condition to produce rubber induced polymer polyethylene (PE). In this research, the used waste rubber was taken from the old tires and the polyethylene, PE are use to produce new polymeric material that enhance their properties. The polymer blending that involved in this study was melt blending of two polymers which mixed up in their molten state. The methodology of this study is prepare the raw material, mixing process by using internal mixer, crashing process and lastly forming process of the polyethylene mix with waste rubber. The main concern of the mixing process is the parameter such as temperature, time and rotor speed of the mixer. The produced material of polyethylene (PE) and waste rubber are tested for its flexural strength using the Universal Testing Machine (UTM). The standard of the flexural strength used this study is ASTM D790. Based on the result of the flexural testing, the best composition for optimum condition of the polyethylene (PE) and waste rubber produced was 90wt% polyethylene with 10wt% waste rubber. It is found out that the rubber induced polymer polyethylene (PE) produced which is new polymeric material do enhances the properties. Besides that, by adding some homogenizing agent to the mixing process of the polyethylene (PE) and waste rubber can enhance the mechanical properties and physical properties of this new polymeric material.

ABSTRAK

Tujuan kajian ini dikendalikan adalah untuk mencari keadaan optimum untuk menghasilkan getah yang teraruh dengan polimer, politena. Dengan menggunakan getah terpakai daripada tayar lama dan juga politena untuk menghasilkan bahan polimer yang baru. Di dalam kajian ini, pengunaan getah terpakai yang diambil daripada tayar terbuang dan juga politena, PE digunakan untuk menghasilkan bahan polimer baru yang dapat mengubah sifat-sifatnya. Campuran polimer yang terlibat dalam kajian ini ialah campuran cair bagi dua polimer yang dicampurkan dalam keadaan cair. Kaedah yang digunakan dalam kajian ini ialah menyediakan bahan mentah, proses pembancuh iaitu mesin pembancuh, proses penghancuran dan juga proses pembentukan politena dengan getah terpakai. Bahan yang telah terhasil daripada politena dan juga getah terpakai telah diuji kekuatan lenturannya dengan menggunakan mesin bebas ujikaji. Piawai ujian kekuatan lenturan yang digunakan dalam kajian ini ialah ASTM D790. Di dalam proses pencampuran, parameter memainkan peranan penting seperti suhu, masa dan juga kelajuan pemutar. Berdasarkan keputusan daripada ujian kekuatan lenturan, komposisi optimum yang diperolehi yang paling bagus adalah 90wt% politena dengan 10wt% getah terpakai. Politena dan juga getah terpakai akan menghasilkan bahan polimer yang baru yang dapat mengubah sifat. Dengan menambahkan agen penghomogenan di dalam proses pencampuran politena dengan getah terpakai dapat menggubah sifat mekanikal dan juga sifat fizikal.

DEDICATION

To my family and my friends, thank you very much for your support and effort towards my publication of thesis.

ACKNOWLEDGEMENT

I would like to express my gratitude and appreciation to the individuals who involve in ensuring a successful occurrence and flow of activities throughout my final year project. My appreciation and gratitude towards my supervisors, Mr Muhammad Zaimi Bin Zainal Abidin, Mrs Pn Zurina Binti Shamsudin and also to my second examiner Mr Edeerozey Abd. Manaf for their encouragement and support and for spending time with me by providing a lot of guidance and ideas for my project research. With their knowledge and experience really inspired and spurred myself to learn a lot of things from them. I'm lucky to have an opportunity to work with them and not least, my appreciation to Hairulhisham Bin Rosnan, and Azhar Shah Bin Abu Hassan for their time and guidance to complete my research at the laboratory. Finally, my sincere appreciation is dedicated to my parents Mr Faizal Lim Bin Abdullah, Mrs Alawiyah Binti Ghazali and as well as the friends for their assistance and patronage throughout the process of data gathering and their sharing knowledge.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

NOMENCLATURE

° C	- Degree celcius
m	- Meter
mm	- Milimeter
N	- Newton
rpm	- Rotor per minute
Pa	- Pascal
Avg	- Average
Tg	- Glass Transition Temperature
Mpa	- Mega Pascal
Max	- Maximum
min	- Minutes
SEM	- Scanning Electron Microscope
ASTM	- American Standard Testing Material
PE	- Polyethylene
HDPE	- High Density Polyethylene
LDPE	- Low Density Polyethylene
UHMWPE	- Ultra High Molecular Weight Polyethylene
PP	- Polypropylene
PVC	- Polyvinyl chloride
PS	- Polystryene
V	- Vinyl

CHAPTER 1
INTRODUCTION

1.1 Introduction of rubber induced polymer

The use of recycled rubber taken from old tires into polymer, polyethylene and other types of common use polymer to produce various type of characteristic polymer. These waste rubbers from old tires suggested to be crushed into tiny bits before mixing it with polymer resin. Polymer blend or mixing is a mixture of two or more polymers with improvement in the properties. The important of mixing two or more polymers are to achieve enhanced properties such as toughness, strength, processability, chemical resistance, weatherability, heats stability, and flow behavior. The optimum condition to produce polymer blend can be determined by studying the mechanical properties of the blend. It depends on the composition of blend elements and method of producing it such as internal mixer. Main components that are needed to be consider in producing Rubber-polyethylene, PE polymer are the ratio of material (waste rubber and polyethylene, PE), particle size, process parameter (temperature and time) and method of producing it such as internal mixer, machine and hot press for forming the rubber induced polymer. After the polymer blend has been produce, flexural test is conducted to determine the best composition and process parameter in producing the waste rubber induce polypropylene polymer blend.

1.2 Statement of purpose

The purpose of this research is to study and analyzed the flexural strength of the optimum condition to produce waste rubber induced polymer (Polyethylene, PE) that depends on the composition of the material, the process of blend and the parameter setting during blending process.

1.3 Problem statement

Rubber and commonly used polymer such as polyethylene (PE) have different characteristics for example elasticity, heat resistance and also durability. By combining these various characteristics of the both material hope to get a new polymeric material that have a good flexural strength based on the composition of the material. The correct method of mixing the both material need to be determine so that the suitable process and parameter would create a new polymeric material.

1.4 Objectives

The objectives of this study are:

i) To study the method of producing the waste rubber induced polymer, polyethylene (PE).
ii) To analyze the flexural strength of the waste rubber induced polymer, polyethylene (PE).
iii) To find the optimum condition of waste rubber induced polymer, polyethylene (PE).

1.5 Scope of study

The polymer material (Polyethylene, PE) induced the waste rubber only will be cover in this study. By doing mixing process on both materials based on the composition, the ideal temperature and mixing time are obtain to produce new polymer. The process that involve in the study is the mixing process by using internal mixer machine, where else there are forming process such as hot press involved in this study concerning about the optimum condition to produce waste rubber induced polymer (Polyethylene, PE). The mechanical testing that involve in this study is flexural testing that based on ASTM D790. This study does not cover the others mechanical testing such as impact test, tensile test and thermal test.

CHAPTER 2

LITERATURE REVIEW

2.1 Polymer

2.1.1 General view of polymer

The word *polymer* is derived from the classical Greek words *poly* meaning "many" and *meres* meaning "parts" (Joel R. Fried, 2003). Simply stated, a polymer is a long-chain molecule that is composed of a large number of repeating units of identifical structure. Certain polymers, such as proteins, cellulose, and silk, are found in nature, while routes. Polymers naturally can be produced synthetically. Polymers that are capable of high extension under ambient conditions find important application as elastomers. Others polymer may have characteristics that permit their formation into long fibers suitable for textile applications.

In the contrast to the usage of the word *polymer*, those commercial materials other than elastomers and fibers that are derived from synthetic polymers are called plastics. A typical commercial plastic resin may contain two or more polymers in addition to various additives and fillers. These are added to improve a particular property such as process ability, thermal or environmental stability, or modulus of the final product.

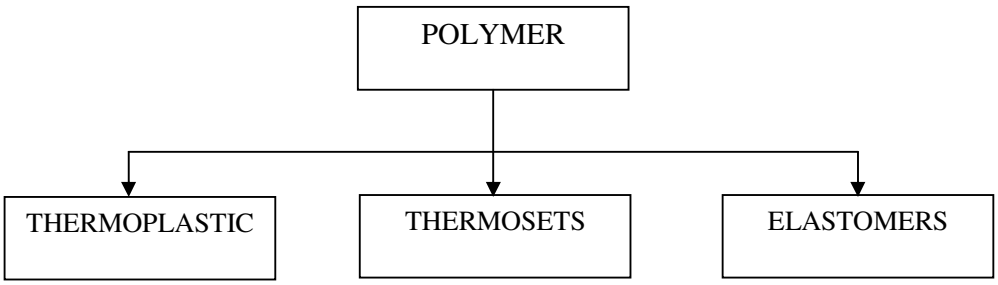

Figure 2.1: Polymer categories

2.1.2 Advantages of polymer

The advantages of the polymer that have been widely used in the application today in term of the following characteristics:

1. Corrosion resistance and resistance to chemicals
2. Low density
3. Low electrical and thermal conductivity
4. High strength-to-weight-ratio, particularly when reinforced
5. Noise reduction
6. Wide choice of colors and transparencies
7. Ease to manufacturing and complexity of design possibilities
8. Relatively inexpensive

2.1.3 Structure of polymer

2.1.3.1 Linear polymer

Linear structure (Refer Figure 2.2) has a sequential structure based on the properties of the polymer that depends on the monomers and the arrangement of the molecular structure. A linear molecular is not necessarily straight in shape. Generally, a

polymer may consist of more than one type of structure; a linear polymer may contain some branched and cross-linked chains. As a result of branching and cross-linking, the polymer's properties might change (R.A Higgins, 1998).

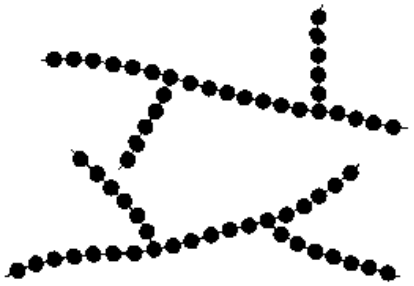

Figure 2.2: Linear chain structure

2.1.3.2 Branched polymer

Branched polymer is determined by the properties of the polymer that depends on the type of monomers and the arrangement of the molecular structure. The branched polymers are side-branch chains that attach to main chain during the synthesis of the polymer. The branching interferes with the relative movement of the molecular chains as for the result, deformation resistance and stress crack are increased (R.A Higgins, 1998). The density of the branched polymer might also effect the efficiency of the packing polymer chains. The entanglement of the branches makes the movements more difficult, a phenomenon akin to increased strength.

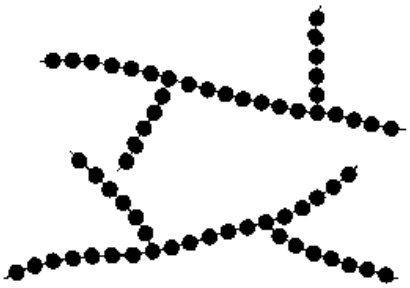

Figure 2.3: Branches chain structure