

## **SUPERVISOR DECLARATION**

**“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Structure & Materials)”**

Signature: .....

Supervisor: DR. HADY EFENDY

Date: .....

**GREEN TECHNOLOGY OF SYNTHETIC RUBBER FOR THE FUTURE  
TIRE**

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**This reports is submitted in fulfilment of the requirements for the award of  
Bachelor of Degree of Mechanical Engineering with Honours (Structure &  
Materials)**

**Faculty of Mechanical Engineering  
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## DECLARATION

“I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.”

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*I dedicated this project to my lovely parents, Haji Radzi b Mahyiddin and Hajjah Norma bt Oman for giving me a moral, financial and mentally support from beginning till end of my final year project research.*

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## ABSTRACT

Natural resources and human life are inseparable. We are in the same natural ecosystem. People have the unique capability of manipulating parts of the entire ecosystem, but we must always recognize that there are natural limits. However, our natural resources are becoming increasingly stressed as greater demands are placed on their ability to provide us with their life giving services. In tire industries, the applications of rubber plants were widely used. Thus, this project aims to produce synthetic rubber for substitute a natural rubber implicated in tire. But the synthetic rubber use environment friendly materials. The rubber synthetic are developed with 3 different compositions which are 50 (PVA): 50 (Carbon powder), 25 (PVA): 75 (Carbon powder) and 75 (PVA): 25 (Carbon powder). Based on the result obtained, the density for composition A (50:50) is  $1207.06 \text{ kg/m}^3$ , composition B (25:75) is  $1463.75 \text{ kg/m}^3$  and composition C (75:25) is  $1445.73 \text{ kg/m}^3$ . Composition C shows the greater tensile strength with  $5.7214 \text{ MPa}$  and composition A was the lowest tensile strength with  $3.3667 \text{ MPa}$  respectively. Greater amount of PVA enhance the tensile strength also makes the extension longer. Referred to microstructure analysis, pores obviously see on the surface of composition A. There is less pores on the surface of composition B and composition C. This happened due to insufficient amount of PVA to react with carbon powder to form a rubber. Data obtained was put in the table and some of the data interpret by graphs.

## ABSTRAK

Sumber semulajadi dan kehidupan manusia tidak dapat dipisahkan. Kita semua berada dalam satu ekosistem semulajadi yang sama. Manusia berupaya untuk memanipulasikan keseluruhan ekosistem yang sedia ada, tetapi kita mesti sedar bahawa terdapat had semulajadi. Walaubagaimanapun, sumber semulajadi kita semakin berkurangan kerana permintaan tinggi oleh sesetengah pihak untuk kepentingan mereka dalam memberi perkhidmatan kepada kita. Dalam industri tayar, penggunaan getah adalah meluas. Oleh itu, projek ini fokus dalam menghasilkan getah sintetik untuk menggantikan penggunaan getah semulajadi pada tayar. Tetapi getah sintetik ini menggunakan bahan-bahan yang mesra alam. Getah sintetik ini dihasilkan dalam tiga komposisi yang berbeza iaitu 50 (PVA): 50 (serbuk karbon), 75 (PVA): 25 (serbuk karbon), 25 (PVA): 75 (serbuk karbon). Berdasarkan keputusan yang diperolehi, ketumpatan untuk komposisi A (50:50) adalah  $1207.06\text{kg/m}^3$ , komposisi B (25:75) adalah  $1463.75\text{kg/m}^3$ , dan komposisi C (75:25) adalah  $1445.73\text{kg/m}^3$ . Komposisi C menunjukkan kekuatan tegangan yang paling tinggi iaitu  $5.7214\text{MPa}$  dan komposisi A adalah kekuatan tegangan yang paling rendah iaitu  $3.3667\text{MPa}$ . Jumlah PVA yang banyak meningkatkan kekuatan tegangan dan juga pemanjangan. Merujuk pada analisis strukturmikro, lubang dapat dilihat dengan jelas pada permukaan komposisi A. Pada permukaan komposisi B dan C jumlah lubang adalah kurang. Hal ini berlaku disebabkan kekurangan jumlah PVA untuk bertindak balas dengan serbuk karbon untuk menghasilkan getah. Data yang telah diperolehi diletakkan dalam jadual dan ada juga data dipersembahkan dalam bentuk graf.

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## LIST OF SYMBOLS

$\sigma$  – Tensile strength, MPa

P – Load, kN

V – Volume, m<sup>3</sup>

$\rho$  – Density, kg/m<sup>3</sup>

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## CHAPTER 1

### INTRODUCTION

Chapter 1 describes on the introduction of the Final Year Project of Degree. It contains brief explanations of subchapters such as problem statements, objectives, scopes of project, and methodology used.

#### 1.1 Introduction

It is important for us to understand the severity of energy depletion that is taking place on this earth. We see it in movies, read it in newspapers and watch news channels repeating themselves like parrots about how the world's natural resources are being used up fast by the human race. Therefore, we must strive to find efficient ways to replace the use of limited resources of energy into unlimited ones instead. That is where green technology comes in. all technological advances done in relation to preserving the natural habitat of life on earth, preserving non-renewable sources of energy and striving towards efficient utilization of them can be categorized as "Green Technology"

## 1.2 Problem Statement

Reduction of using natural rubber in tire industries is must because the problems of destruction of the environment and natural resources are widely spread. Furthermore, renewable materials produce levels of carbon emissions and rising concentrations of carbon dioxide are warming the atmosphere. Renewable resources are reliable and plentiful and will potentially be very cheap once technology and infrastructure improve. It also will increase health levels and the quality of life. Therefore, the best way to limit the usage of natural rubber is produce rubber synthetic as alternative to use in tires industries.

## 1.3 Objectives

The objectives of this project are as the following:

- a. To produce a synthetic rubber
- b. To extract and synthesize from palm Carnell Shell
- c. To characterize the physical and mechanical properties of rubber product

## 1.4 Scopes

The scopes of this project are limited to as the following:

- a. To find new materials for substitute a natural rubber and implicated in tire industries.
- b. The new materials should using environment friendly such as waste and thermoplastic polymer

## CHAPTER 2

### LITERATURE REVIEW

Chapter 2 is the most important step to retrieve information related with the topic. Literature review can be done by searching all the information from internet, journals, books, magazines and other sources. In this chapter, the history of tire, information about natural rubber and synthetic rubber and the preparations were investigated.

#### 2.1 Tires

Tires are critical components of the vehicles on which they are used. Functions of vehicle tires are support the weight of the vehicle, passengers, and cargo, transmit the motor torque to propel the vehicle and absorb road vibrations and shock to provide a comfortable ride (John Wiley, M.P. Groover, 2002). Tires are used on automobiles, trucks, buses, farm tractors, earth moving equipment, military vehicles, bicycles, motorcycles and aircraft (John Wiley, M.P. Groover, 2002).

##### 2.1.1 Tires Construction

A tire is an assembly of many parts. The internal structure of the tire known as the *carcass*, consists of multiple layers of rubber coated cords, called *plies*. The cords are strands of nylon, polyester, fibre glass, or steel, which provide inextensibility to reinforce the rubber in the carcass. Three basic tire constructions are diagonal ply, belted bias and radial ply (John Wiley, M.P. Groover, 2002)

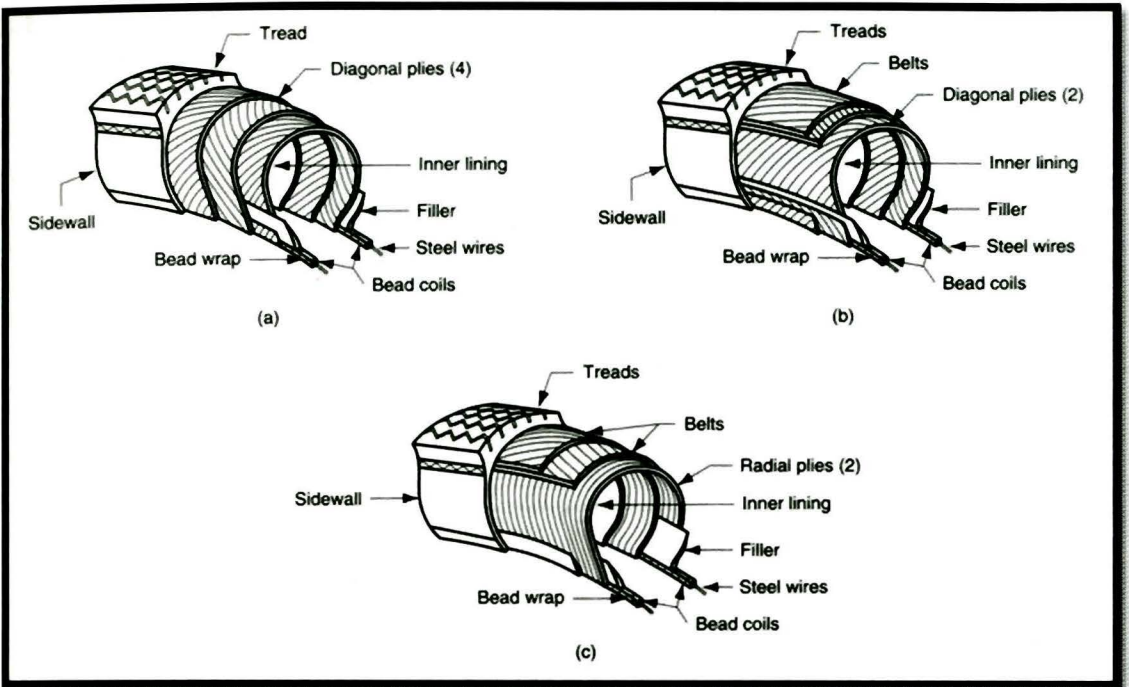


Figure 2.1 Three tire constructions: (a) diagonal ply, (b) belted bias, and (c) radial ply

### 2.1.2 Tire Production Sequence

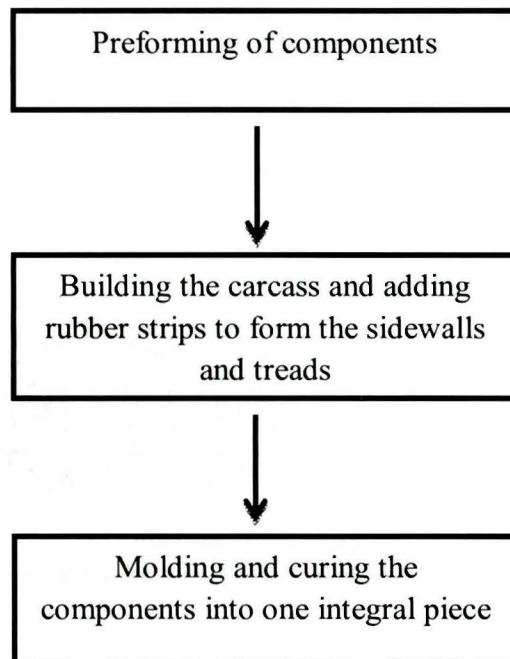


Figure 2.2 Tire production sequence (John Wiley, M.P Groover, 2002)

Figure above shown typical steps in processing depending on construction, tire size and type of vehicle on which the tire will be used.

#### (a) Preforming of Components

The carcass consists a number of components. Most of them are rubber or reinforced rubber. As well as the sidewall and tread rubber, are produced by continuous processes and then pre-cut to size and shape for subsequent assembly. The components include: bead coil, plies, inner lining, belts, tread and sidewall (John Wiley, M.P Groover, 2002).

### (b) Building the Carcass

The carcass is traditionally assembled using a machine known as building drum, whose main element is a cylindrical arbor (John Wiley, M.P Groover, 2002).

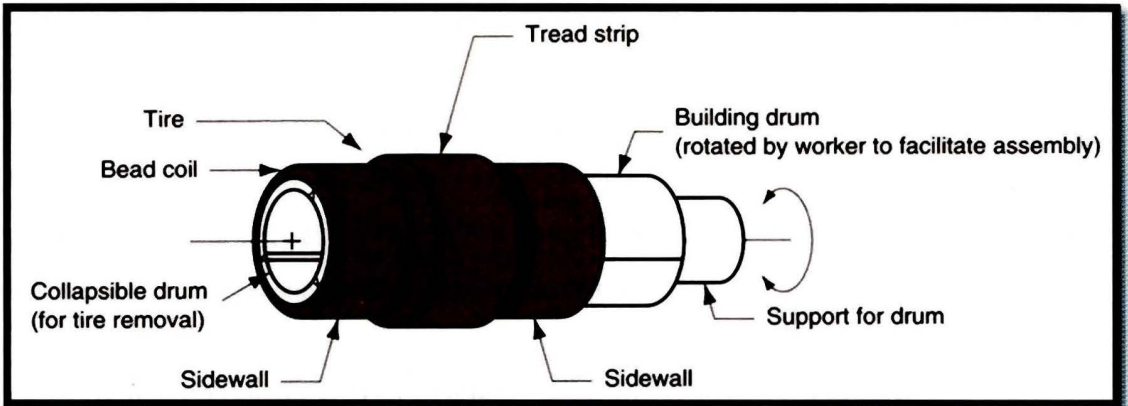


Figure 2.3 Tire just before removal from building drum, but prior to molding and curing (John Wiley, M.P Groover, 2002)

### (c) Molding and Curing

Tire molds are usually split molds and contain the tread pattern to be impressed on the tire (John Wiley, M.P Groover, 2002).

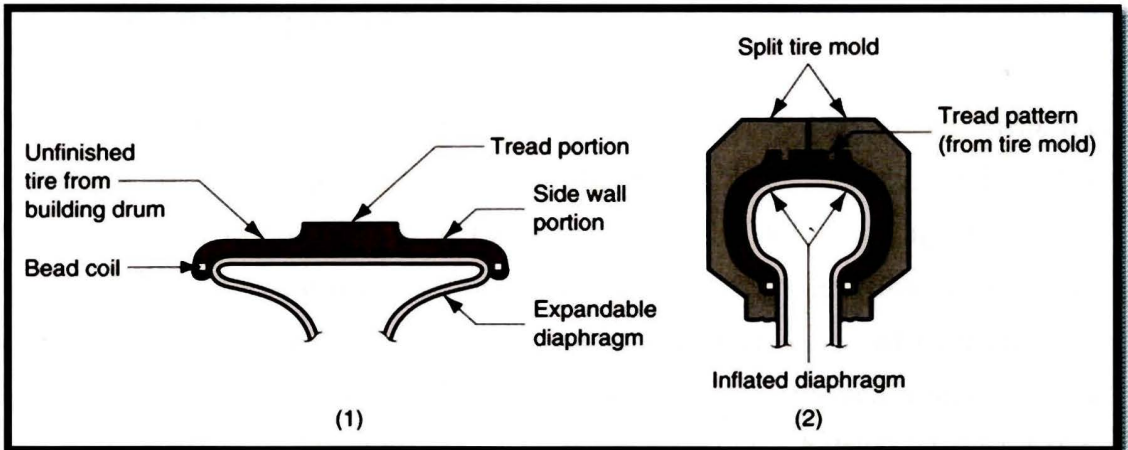


Figure 2.4 Tire molding: (1) uncured tire placed over expandable diaphragm; (2) mold is closed and diaphragm is expanded to force uncured rubber against mold cavity, impressing tread into rubber; mold & diaphragm are heated to cure rubber.



## **2.2 Rubber Compounding**

Two major ingredients in rubber compound are rubber itself and the filler. To optimize performance in wet or dry conditions or to achieve the best rolling resistance, thus the careful selection of one or more types of rubber along with the type amount of filler to blend with the rubber should be considered. In general, there are four major rubbers used: natural rubber, styrene-butadiene rubber (SBR), polybutadiene rubber (BR) and butyl rubber (How tire is made, 2012). The first three are primarily used as tread and sidewall compounds, while butyl rubber and halogenated butyl rubber are primarily used for the inner liner or the inside portion that holds the compressed air inside the tire (How tire is made, 2012).

### **2.2.1 Rubber Compounding Mixing**

The mixing operation is typically a batch operation. The mixer is sophisticated piece of heavy equipment with a mixing chamber that has rotors inside. Its function is to break down the rubber bale, fillers, and chemicals and mix them with other ingredients (Dinsmore, R.P& Juve, R.D, 1954).

## **2.3 The Durability of Tires**

There are several factors that affect the durability of tires. Among them, the quality of the material used to make the tire and technology used in the manufacturing process. However, the most factors that affecting the tire wear is durability. The tire wear is also greatly affected by the driving habits of the driver, the condition and types of roads driven on road surface and road geometry, the balance of the wheels, the size and the weight of the car, the age and condition of the car, climate, etc. The tire durability is more important than balance of the wheels. The variation in tire wear can be attributed to the variation in each of several variables affecting the tire wear.

## 2.4 Natural Rubber

Rubber is a highly elastic material that enhances the quality of modern life. It is a unique material that it stretches many times its length without breaking, and recovers to original shape. Thus, makes rubber an indispensable material for various applications such as automobile tires, conveyor belt, gloves and any more. The top five largest consumers of rubber are the United States, Russia, Japan, China and Germany (Barlow et al, 1994).

Natural Rubber (NR) is tapped from rubber tree as latex which is a milky colloid. Latex is a colloidal dispersion of solid particles of the polymer *polyisoprene* in water (Barlow et al, 1994). To obtain latex, plants producing latex is tapped on the bark. Latex is collected in bucket which is placed just below the incision.

The preferred method of recovering rubber from latex involves coagulation – adding an acid such as formic acid (HCOOH); coagulation takes about 12 hours (John Wiley, M.P.Groover, 2002). The coagulum, now soft solid slabs, is then squeezed through a series of rolls which drive out most of the water and reduce thickness to about 3 mm. the sheets are then draped over wooden frames and dried in smokehouses (John Wiley, M.P.Groover, 2002).

The resulting rubber, now in form called ribbed smoked sheet. In some cases, the sheets are dried in hot air rather than smokehouses, and term air-dried sheet is used; this is considered to be a better grade of rubber (John Wiley, M.P.Groover, 2002). NR is not an important polymer for commercial purpose because of its softness and sticky properties. Softness of NR increases with the increase in temperature while brittleness increases at low temperature. The ideal temperature for using rubber is 283-335K where its elasticity is maintained (Robert T. Morrison, Robert N. Boyd, 1992). The properties of NR can be improved by a process called Vulcanization.