Faculty of Mechanical and Manufacturing Engineeering Technology

EFFECT OF RICE HUSK ASH ON NATURAL RUBBER COMPOUND AS GREEN FILLER

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DECLARATION

I declared that this thesis entitled –Effect Of Rick Hush Ash On Natural Rubber Compound As Green Filler" is the results of my own research except as cited in references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : …….

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Date : ……

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Manufacturing Engineering Technology (Process & Technology) with Honours.

Signature : …….

Supervisor Name : ……

Date : ……

DEDICATION

This report is specially dedicated to Mr. Hairul Effendy Bin Ab. Maulod for without his early inspiration, coaching and enthusiasm, none of this would have happened. This dedication is especially dedicated to my parents and family who always support me with their unconditional love that motivates me to set a higher target in completing this final year project. This dedication is also dedicated to my beloved friends which is very supportive and always surround me with positive words.

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ABSTRACT

As the greenhouse effects and global warming issues focus their stand in the fast changing modern world, more efforts are being done towards manufacturing products, which are environment-friendly and recyclable. One of the favourites subjects is the utilization of agricultural waste into useful value-added product. Rice husk which is generated by the rice mills during rice processing composes mainly organic siliceous material. Together with its abundance supply and attractive price, rice husk has the potential to be used as filler in polymeric materials especially rubber. This study focuses on the effect of physical and tensile properties of natural rubber (NR) compound with different amount of rice husk ash (RHA) as a filler. The optimum compounding formulation of the material compound of natural rubber and rice husk ash based on 100 phr of the natural rubber (NR) and different amount of rice husk ash (RHA) at 1, 3 and 5 phr. In order to improve the interfacial interaction between NR and RHA, Si 69 was used as coupling agent at composition of 1 phr. The materials undergo the mixing process using internal mixer and open roll mill. Then, the compound is compressed into a square mold by hydraulic molding press at 180℃ in 8 minute. Afterward, the cutting process into dumbbell shape was done by using waterjet machine according to ASTM dimensions and then tensile test, hardness test and density test was performed to determine their physical and mechanical properties. The morphological study of the compound was done by using optical microscope and scanning electron microscopy (SEM). Based on the result from the tensile testing that has been conducted on the sample compounding, with increasing the amount of RHA decreasing the tensile strength of natural rubber. In addition, the value of hardness increase when the amount of RHA used is increased because as filler particles are introduced into the rubber, the elasticity of the rubber chains is reduced, resulting in more rigid vulcanization.

ABSTRAK

Memandangkan kesan rumah hijau dan isu pemanasan global memberikan tumpuan dalam dunia moden yang berubah pantas, lebih banyak usaha sedang dilakukan terhadap produk pembuatan yang mesra alam dan boleh dikitar semula. Salah satu tajuk kegemaran ialah penggunaan sisa pertanian menjadi produk nilai tambah yang berguna. Sekam beras yang dihasilkan oleh kilang padi semasa pemprosesan beras terdiri daripada bahan silika organik. Bersama dengan bekalan yang banyak dan harga yang menarik, sekam beras memiliki potensi untuk digunakan sebagai pengisi bahan polimer terutama getah. Kajian ini menumpukan kepada kesan sifat fizikal dan tegangan kompaun getah asli dengan jumlah abu sekam beras yang berlainan. Formulasi pengkomposan yang optimum dari sebatian bahan getah asli dan abu sekam beras berdasarkan 100 peratus getah asli dan jumlah abu sekam beras yang berbeza pada 1, 3 dan 5 per seratus getah. Untuk meningkatkan interaksi interfasial antara getah asli dan sekam beras, Si 69 digunakan sebagai agen gandingan pada komposisi 1 phr atau 2.78 gram. Bahan-bahan ini menjalani proses pencampuran menggunakan mesin pengadun dalaman dan mesin gulung terbuka. Kemudian, kompaun itu dimampatkan menjadi acuan persegi dengan penekan acuan hidraulik pada 180 °C dalam 8 minit. Selepas itu, proses pemotongan dilakukan dengan menggunakan mesin air jet mengikut dimensi ASTM dan kemudian ujian tegangan, ujian kekerasan dan ujian ketumpatan dilakukan untuk menentukan sifat fizikal dan mekaniknya. Kajian morfologi kompaun itu dilakukan dengan menggunakan mikroskop optik dan mikroskop elektron scanning (SEM). Berdasarkan hasil dari pengujian tegangan yang telah dilakukan pada penggabungan sampel, dengan meningkatkan jumlah RHA menurunkan kekuatan tegangan getah asli. Di samping itu, nilai kekerasan meningkat apabila jumlah RHA digunakan meningkat kerana sebagai zarah pengisi diperkenalkan ke dalam getah, keanjalan rantai getah dikurangkan, mengakibatkan pemvulkanan yang lebih tegar.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

μm	-	Micrometer
%	-	Percent
ASTM	-	American Standard Testing Method
˚C	-	Degree Celcius
cm	-	Centimetre
CBS	-	N-Cyclohexyl-2-Benzothiazole Sulphenamide
Cal	-	Calorie
CB	-	Carbon Black
Cm	-	Centimetre
CSH	-	Calcium Silicate Hydrate
DNA	-	Deoxyribonucleic Acid
FEF	-	Fine Extrusion Furnace
FTIR	-	Fourier-transform Infrared Spectroscopy
g	-	Gram
Gs	-	Gigasecond

h	-	Hour
HCl	-	Hydrochloric Acid
HSA	-	Human Serum Albumin
H_2SO_4	-	Sulfuric Acid
kgf	-	Kilogram-Force
mGOe	-	Mega Gauss Oersted
ml	-	Mililitre
Mg_2Si	-	Magnesium Silicide
MPa	-	Megapascal
NaOh	-	Sodium Hydroxide
NR	-	Natural Rubber
OE	-	Oersted
pH	-	Potential of Hydrogen
phr	-	Per hundred Rubber
PP	-	Polypropylene
PMMA	-	Poly(methyl methacrylate)

PVC	-	Polyvinylchloride
RHA	-	Rice Husk Ash
S	-	Second
Si 69	-	Bis[3-(Triethoxysilyl) Propyl] Polysulfide
SiO_2	-	Silicone Dioxide
TMTD	-	Tetra Methyl Thiarum Disulphide
U.S.	-	United State
UV	-	Ultraviolet
V	-	Volt
XRD	-	X-ray Powder Diffraction
ZnO	-	Zinc Oxide
6PPD	-	3-Dimethyl Butyl-N‘-Phenyl Paraphenylene Diamin

CHAPTER 1

INTRODUCTION

This chapter will explain the overview of the study and the main purpose of this study. The chapter includes the background of the study, problem statement, objective that is expected to be achieved and the scope of the study that is going to be conducted.

1.1 Background of the study

Natural Rubber (NR) is the elastomer one of the most common types of material used in Malaysia due to their ease of use. The demand for natural rubber is driving expansion of automotive industry. The application of rubber components in automobiles continues to be on rise. The biggest demand for natural rubber is in the automotive sector which is principally tires. Close to 70% of the global natural rubber demand comes from the tire manufacturing industries (Ibrahim, 2008).

The Malaysian rubber industry has growing through the years and transformed itself into a more coordinated industry where the rapid developments of the mid and downstream industries have made the industry a multi-billion ringgit. This was supported by the introduction of the three Industrial Master Plans which gave greater encouragement to the evolution of rubber manufacturing sectors.

The used of rubber in industries continues to be on rise. In fact, all major industries make use of rubber and rubber products. Rubber industry is considered as an essential

resource based industry sector and globally has witnessed a strong growth. There are remarkable unique features of rubber which makes it an important product which finds use in diverse fields as material handling, transportation, health care, and sport and leisure activities. The rubber industry services a range of downstream industries including manufacturing, construction, and agriculture due to the diversity of rubber products manufactured.

In general, rubbers are rarely utilized as a part of their structure because of they are too weak to fulfill practical requirements for many applications. For example lack of hardness, strength properties and wear resistance, but when addition of particulate fillers, the strength could be increasing 10 times. The utilizing of the additives such as fillers, accelerators, stabilizers, plasticizers, pigments and others (Adnan, 2017).

The utilization of fillers was done with various different parts called compounding ingredients. The use of fillers in rubber products is almost as old as the use of rubber itself because most of rubber applications is modified by joining with particulate fillers such as improve the process-ability, properties, performance and life of the final product, impart its color and reducing the cost.

The types of fillers selection that used in natural rubber is depend on the property requirement of the end rubber product. On the other hand, natural rubber are to be improve with the modification of their properties to reduce the use of natural rubber for the manufacturer according to the higher demand.

1.2 Problem Statement

Natural rubber (NR) is extensively used in many applications due to its high elasticity (reversible deformability). The demands for rubber based products are increasing by time. Meanwhile the current price of natural rubber based on Malaysian Rubber Board is about RM12 per kg and is increasing by day. So, in economical view, it is not possible to

produce rubber products by just using natural rubber only. In addition, the tensile modulus and strength of neat of natural rubber are low. In this case, a few materials are required which could be mixed with natural rubber to create a better quality up to the customer expectations. For a number of applications, therefore, addition of a reinforcing phase is necessary (Wunpen Chonkaew, 2011). It is found that fillers can be the added substances in natural rubber and also functioning to improve the process ability, mechanical strength and to reduce cost.

Nowadays, the environmental preservation is a permanent concern and, in this respect, several studies are being envisaged with the aim to transform rejects into useful materials, which could be disposed of with no damage to the environment, or even better, into utilizable goods becoming, thus, very attractive from both the ecological and economic points of view. Besides, the application of biodegradable material as an alternative choice is increasingly applied (H. M. da Costa, 2011).

Silica are known as commercial fillers due to the use of rice husk ash as a filler in rubber compounding has attracted increasing interest because of its low cost, environmental preservation benefit, and an increased emphasis on the use of renewable resources. Rice husk, usually regarded as agricultural waste, can be used as a filler for natural rubber. Rice husk ash consists primarily of amorphous silica from incomplete combustion. The amount of silica in the ash varies depending on the combustion conditions. As to the method of improving the performance of natural rubber properties by filler, very limited references have studied its reinforcement effect on the mechanical and properties of natural rubber. The combination of both materials will be expected to produce results that could enhance the physical and mechanical properties of the composite.

1.3 Objectives

The objectives of the project is to:-

i. To characterize the formulation of natural rubber (NR) with rice husk ash (RHA)

ii. To prepare the compound of natural rubber with different amount of rice husk ash.

iii. To study the effect of physical and mechanical properties of natural rubber compound with different amount of rice husk ash as a filler.

1.4 Scope

The study on this topic can be benefit for certain circumstances. This project –Effect rice husk ash on natural rubber compound as green filler" will be performed through the mixing material using internal mixer, open roll mill machine and compressed by hydraulic molding press and tests their physical and mechanical properties. The scopes of this study is focusing more on characterize the formulation of natural rubber with rice husk ash, preparing the compound of natural rubber with different amount of rice husk ash and analyzed by studying the tensile, density and hardness of the compound. The findings will be further supported by the analysis from optical microscope and scanning electron microscopy (SEM).

1.5 Organization of Research Study

This study is divided into five chapters that discuss the analytical and experimental research performed. This dissertation shows the effect rice husk ash for natural rubber compound as green filler. The effects of using rice husk ash for rubber compounding have been studied. The organization of this research study is as follows. This dissertation has been organized into 5 chapters. The first chapter begins with an introduction about the

research study and also brief about objectives, problem statement, significant of study and the thesis overview.

Chapter two begins on the literature background of this study. It discusses on the history of rubber, the structure, properties and application of natural rubber. The important element that included in this chapter is about the properties and application of rice husk ash, the functionalization of rice husk ash and also the production of rice husk ash.

Chapter three provides details explanations on the methodology used for overall research work, raw materials, procedure property analysis that had been done. In chapter four, provide the expected outcome or results on effect of rice husk ash for natural rubber compound as green filler. The final chapter (Chapter 5) concludes the overall results obtained from this research. In this chapter, it explains either the objectives of this study are achieved or not. The recommendation for future project also has been included in this Chapter 5.