UNIVERSITI TEKNIKAL MALAYSIA MELAKA

HEAT INSULATOR FROM NATURAL FIBER COMPOSITE

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

by

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FACULTY OF MANUFACTURING ENGINEERING

2009

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PSM

JUDUL:

Heat Insulator From Natural Fiber Composite

SESI PENGAJIAN:
Semester 2 2008/2009

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

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Mohd Yuhazri Bin Yaakob

(Principle Supervisor)

ABSTRACT

Due to high interest in high quality but low cost material, many researches have been done by the researcher and engineers to develop new material that will save the cost especially from natural fiber. Together with the increasing usage of composite material from mixture of natural materials nowadays, this technical report will proposed a research entitled heat insulator from natural fiber composite. Coconut fiber and natural rubber is the material selected for this research as it offers lots of advantages which has high quality as well as easy to found especially in Malaysia. This mixture of coconut fiber and natural rubber is mixed together in a mold and through the cold press process to fabricate the composite with twelve different compositions of natural rubber of five percent to 60 percent. For the specimen preparation, a ten millimeters thick mold is fabricated using several machining process. A specimen of 100 percent coconut fiber also fabricated, as well as an existing product sample as a comparison to the specimens with natural rubber for its mechanical properties. The product is made of 100 percent synthetic rubber. All the specimens will then be tested with heat absorption test test, tensile test, compression test and moisture absorption test to examine the properties of the specimens. From the results obtained, an evaluation will be done to choose the best specimen for heat insulator application. The best specimen for heat insulator application is 30 percent of weight percent of rubber.

ABSTRAK

Selaras dengan permintaan yang tinggi untuk bahan yang berkualiti dan berkos rendah, banyak kajian telah di lakukan oleh para pengkaji dan jurutera. Sejajar dengan penggunaan bahan komposit daripada campuran bahan semula jadi yang semakin meluas masa ini, laporan teknikal ini membentangkan hasil kajian yang bertajuk penebat haba daripada komposit gentian semulajadi. Sabut kelapa dan getah asli semula jadi adalah bahan mentah yang digunakan dalam kajian ini disebabkan oleh kelebihan bahan ini yang mempunyai kualiti yang tinggi disamping mudah didapati terutamanya di Malaysia. Campuran sabut kelapa dengan getah asli semula jadi dihasilkan menerusi proses mampatan menggunakan kaedah mampatan acuan untuk mengfabrikasi 12 komposisi komposit dengan peratus kandungan getah asli semula jadi yang berbeza dari 5 peratus hingga 60 peratus. Plat acuan setebal 10 milimeter di fabrikasi dengan beberapa process mesin sebagai acuan untuk penyediaan sampel. Sampel sabut kelapa sepenuhnya juga difabrikasi, dan satu sampel produk yang sedia ada diperolehi untuk tujuan perbandingan sifat mekanik nya dengan sabut kelapa yang diisi dengan getah asli semula jadi. Sampel produck adalah 100 peratus getah sintetik. Kesemua sampel ini akan diuji dengan ujian resapan haba, ujian tegangan, ujian mampatan dan ujian kelembapan untuk dibuat penilaian. Daripada keputusan yang diperolehi, hasil yang terbaik akan dijadikan produk yang sesuai untuk aplikasi penebat haba. Sampel yang terbaik adalah 30 peratus kandungan getah untuk aplikasi penebat haba.

DEDICATION

I would like to dedicate this report to myself, my beloved parents and family, my supervisor an also my fellow friends. Without these people's support and help it would be difficult for me to complete this research.

ACKNOWLEDGEMENT

First of all I would like to thank God for giving me this opportunity and time to complete this report for 'Projek Sarjana Muda' (PSM). I would also prolong my appreciation especially to my beloved supervisor, Mr. Mohd Yuhazri Bin Yaakob for his continuous support, help and guidance during the completion of this report. Next, I also thank to UTeM's technician, Mr. Hisyam and Mr. Azhar Shah for helping me out with the equipment in the material lab. Finally, I also want to thank all my family, fellow friends and whoever that helping me during the completion of this report. For those who read this report, thank you for your time and I really appreciate it.

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LIST OF ABBREVIATIONS

ASTM	-	American Society for Testing and Materials
SI	-	International System of Units
UTeM	-	Universiti Teknikal Malaysia Melaka
UTM	-	Universal Testing Machine
Sdn. Bhd.	-	Sendirian Berhad
UTS	-	Ultimate Tensile Strength
Min	-	Minimum
Max	-	Maximum
Ave.	-	Average

LIST OF SYMBOLS

%	-	percent
cm	-	centimeter
s	-	second
min	-	minute
g	-	gram
L	-	length
rms	-	root mean square
m	-	meters
m/s	-	metres per second
m/s^2	-	metres per second squared
γ	-	specific weight
V	-	volume
W	-	water absorption
S-t	-	strength immersion time
ε	-	strain
E	-	elasticity
MPa	-	mega Pascal
GPa	-	giga Pascal
NBR	-	nitrile elastomers
RPDM	-	Ethylene-propylene rubbers
σ	-	stress
P_{MAX}	-	Maximum load before failure
P_i	-	load at X data point
A	-	cross sectional
°C	-	degree Celsius
°F	-	degree Farenheit

CHAPTER 1
INTRODUCTION

1.1 Background

Heat is a form of energy that is associated with the atoms and molecules movement or vibration. Heat that is transferred from one body to another can cause the increasing in temperature and also can change the phase of the body. Excessive heat can cause thermal stress to the environment especially to the peoples surrounds. Thermal stress is net heat load experienced to individual due to environment factors such as air temperature, radiant temperature, air velocity and humidity. This can cause negative impact to occupational health, reduce productivity and increase of accidents and errors by people affect from the heat in environment.

This research will find a new composite material that can use as heat insulator for the better living. The new materials are from natural fiber and can offer lower cost of fabrication and materials itself.

1.2 Problem Statement

Heat as mention earlier can cause thermal stress to the people in the environment effected by excessive heat. Better heat insulator in the environment is needed to reduce the thermal stress. Some product of heat insulator that exists in market today is effective but high in cost. For example, the use of fiber glass as heat insulator in roof top of

building which is good and effective but with the cost of fiber glass that is high it can be a liability.

Nowadays, the need for efficient yet low cost material or product is increasing gradually because of higher cost of normal material used. The materials used in today application can be the major factor that can determine the cost efficient of the applications. Higher cost means lower productivity and so it can reduce the profit. So, alternative materials that can have same properties with the normal material is continuously been research as it can offer lower cost but still with same or sometimes better in properties compared to the normal materials. One of the alternative materials that widely been research is natural fiber. These materials are very easy to get and it is low in cost yet it still have some very good properties that can be used in various applications. Example of natural fiber that is widely used today is cotton, hemp, flax, jute, kenaf and coconut. These materials can easily be found and have properties such as light weight, low density and high ductility. If compared to several materials that are now used such as steel, plastic and ceramic, natural fiber sometime is better yet low in cost.

1.3 Objective

The objectives of this research are:

(a) To identify the mechanical properties of natural fiber and natural rubber that will suit the heat insulator application

(b) To design and fabricate the heat insulator material from natural fiber composite with the use of coconut fiber as the reinforcement and the rubber as the binder or the matrix material.

1.4 Scope

This research is about to find the best material from natural fiber for heat insulator application. The scope for this research are to do survey on existing product for the same application, to research and develop a new composite material from natural fiber for heat insulator application, to test and analyze the strength and weakness of the new composite materials that have been fabricated and finally to summarize and choose the best materials for the heat insulator application.

1.5 Rational of Research

Rational of this research is to apply the new natural fiber composite materials for various applications especially when it comes to heat insulator. It then can replace the existing material used nowadays that have higher cost. This material can solve the major problem of today engineering problem which is the cost. Although this new material cost less, it still produces better heat insulator application.

1.6 Research Frame

This report is divided into 5 chapters. The first chapter, Introduction, describe overview of the research. Second chapter, literature review, is about definition of the research. Third chapter, methodology, tells about how the research is carried out and tested. Forth chapter, results and discussion, discussed about results obtain from test and lastly, fifth chapter, conclusion and recommendation, conclude all the research by choosing the best composition and some recommendation as stated for future research. All the references and appendix also put in the report.

1.7 Expected Results

After all the process of fabricating the composite is done, it is expected that the new composite material will be produced and by doing all the necessary testing process, the ultimate composite composition will be get and can be use as heat insulator.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This research is conducted to find the best composite material from natural sources which are coconut fiber and natural rubber for heat insulator applications. Both material to be combine as a composite is from natural as it has high resistance to heat and easy to find as well as process. To get the best results out of these composite, the geometry of the reinforcement, the ratio of matrix and the reinforcement and also method to produce the composite should be suitable to the application.

2.2 Heat

Heat is a form of energy which is stored in molecules as molecular vibration. More vibration produces higher temperature. Material that has higher amount of molecules will vibrate faster thus will produces higher temperature. The higher the density of material (more molecules) the better heat can be produces and become more conductive. Less density material is the better heat insulator. (Dolores G., 2004)

Heat moves in three ways which are conduction, convection and radiation. In conduction, heat transfer through a medium which has contact to each other. In convection, heat moves through freely in gas or liquid in circulate motion. These two

mechanism work only if there is intervening medium to enable them. In radiation, the heat is reflected on a surface to other.

2.2.1 Conduction

Solids, particularly metals, whose molecules are packed relatively close together, are the best materials for conduction. Molecules of liquid or nonmetallic solids vary in their ability to conduct heat, but gas is a poor conductor, because of the loose attractions between its molecules.

The qualities that make metallic solids good conductors of heat, as a matter of fact, also make them good conductors of electricity. In the conduction of heat, kinetic energy is passed from molecule to molecule, like a long line of people standing shoulder to shoulder, passing a secret and, just as the original phrasing of the secret becomes garbled, some kinetic energy is inevitably lost in the series of transfers. As for electrical conduction, which takes place in a field of electric potential, electrons are freed from their atoms; as a result, they are able to move along the line of molecules. Because plastic is much less conductive than metal, an electrician uses a screwdriver with a plastic handle as so a metal cooking pan typically has a wooden or plastic handle.

2.2.2 Convection

Wherever fluids are involved, convection is a common form of heat transfer. Convection involves the movement of heated material, whether it is air, water, or some other fluid. Convection is of two types which are natural convection and forced convection, in which a pump or other mechanism moves the heated fluid. When heated air rises, this is an example of natural convection. Hot air has a lower density than that of the cooler air in the atmosphere above it, and, therefore, is buoyant; as it rises,