



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

HYBRID COMPOSITE USING RECYCLE PLASTIC BAG

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

By

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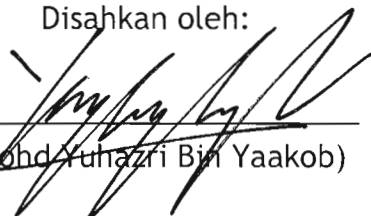
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APPROVAL

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HYBRID COMPOSITE USING RECYCLE PLACTIC BAG

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ABSTRACT

Based on the statistic, Malaysian citizen wasted the sources of recycle about RM476 million two years ago. One of the biggest wastes is plastic which contribute 9 percent from the whole waste or RM163 million the same situation also occur in Britan where billions of plastic has been throw even for the first time use. One piece of plastic takes 5000 years to decay. This problem indirectly lead to the Global Warming issue that occurs every year. As a solution to reduce the waste of plastic bag, the research entitle '*Hybrid Composite Using Recycle Plastic Bag*' has been propose. The objectives of this research are to identify and select the best lamination ratio and arrangement for recycle material as well as to study the mechanical properties of the hybrid material. The material has been used in this project are recycle HDPE plastic bag, bamboo, and fibre glass. The recycle plastic bag is used for matrix while the bamboo and fibre glass as a reinforcement in laminate. The hybrid composite is made through the weight percent ratio HDPE:FG:BFPR; 0:100:0, 0.0:100, 100:0:0, 83:0:17, 75:7:17, 69:14:17, 62:21:17, 55:28:17. The method approach in this research is by using hot press where the laminate has been heated by assigned temperatures. The mechanical properties has been analysed based on the result obtained from four main testing which are tensile, impact, flexural, and hardness testing. From analysis, this research shows that the bonding of layers in laminate is reinforce by the increasing of fibre glass percent weight. The increasing of fibre glass in composite improves the mechanical properties of composite. Additionally, the selection of laminate is made based of the best mechanical properties obtained from all the testing. This research choose ratio of S/N 6 due to its strong bonding between layers in laminate that leads to the maximum tensile strength, flexural stress, impact strength, and hardness which are 69.53MPa, 54.784MPa, 0.123J/mm⁻² and 59.3.

ABSTRAK

Menurut perangkaan, rakyat Malaysia membuang sumber kitar semula bernilai RM476 juta dua tahun lalu. Antara sumber buangan terbesar ialah plastik iaitu 9 peratus atau RM163 juta. Keadaan yang sama disaksikan di Britain apabila berbilion helai plastik dibuang sewenang-wenangnya walaupun baru sekali digunakan. Sehelai beg plastik dipakai mengambil masa 500 tahun untuk mereput. Ia secara langsung menyumbang kepada pembentukan gas rumah hijau yang memberi kesan kepada pemanasan global yang dialami pada setiap tahun. Sebagai langkah untuk mengurangkan pembuangan bag plastik secara berleluasa, kajian yang bertajuk '*Hybrid Composite Using Recycle Plastic Bag*' dilakukan. Objektif pelaksanaan projek ini adalah untuk mengenal pasti dan memilih nisbah laminat yang terbaik dan tatacara susunan lapisan nisbah peratusan berat bahan mentah dan menganalisis sifat-sifat mekanikal bahan komposit hibrid. Bahan mentah yang digunakan di dalam projek ini ialah bag plastik HDPE (BP) yang terbuang, buluh (B) dan juga gentian kaca (GK). Bag plastik yang terbuang berfungsi sebagai matri manakala buluh dan gentian kaca sebagai tetulang di dalam laminat. Laminat komposit hibrid dihasilkan melalui nisbah pecahan isipadu gentian BP:GK:B; 0:100:0, 0.0:100, 100:0:0, 83:0:17, 75:7:17, 69:14:17, 62:21:17, 55:28:17. Kaedah yang digunakan untuk membuat laminat ialah *hot press* di mana nisbah laminate tersebut akan dipanaskan pada suhu yang berbeza. Sifat-sifat mekanikal setiap laminat dianalisis melalui ujian dijalan mekanikal seperti ujian terikan, hentaman, fleksural, dan ujian kekerasan. Melalui analisis yang dilakukan, kajian ini membuktikan ikatan lapisan-lapisan di dalam laminat diperkuat dengan peningkatan berat peratus GK. Penambahan GK di dalam komposite membantu memperbaiki sifat mekanikal komposite ini. Ini dapat dibuktikan melalui ujian mekanikal seperti ujian terikan, hentaman, fleksural, dan ujian kekerasan.. Melalui analisis keputusan ujian komposit hibrid, kajian ini telah memilih ratio S/N 6 kerana nilai maximum untuk daya tarikan, tegangan lentur, kesan kekuatan dan kekerasan ialah 69.53MPa, 54.784MPa, 0.123J/mm⁻² dan 59.3.

DEDICATION

For My Beloved Family:

HJ MOHAMAD BIN BABA
HJH HALIPAH BINTI HJ NAAM
FAZILAH BINTI HJ MOHAMAD
JAHIDAH BINTI HJ MOHAMAD
SHAFARIE BINTI HJ MOHAMAD
HAFIZAH BINTI HJ MOHAMAD

For My Adored Friends:

WAN NAERAH BINTI WAN ZAINUDDIN
NUR YASMIN BINTI ZULKIFLI
DORA YONG
SARAH NADIA

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LIST OF ABBREVIATIONS

ASTM	-	America Standard Testing Method
BFC	-	Bamboo Fiber Composite
BFRP	-	Bamboo Fiber Reinforced Plastic
BM	-	Bamboo Mat
BP	-	Bamboo Plate
BMC	-	Bamboo Mat Composite
BOSM	-	Bamboo Orthogonal Strip Mat
GFRP	-	Glass Fiber Reinforced Plastic
HLC	-	Hybrid Laminate Composite
HDPE	-	High Density Polyethylene
LDPE	-	Low Density Polyethylene
UTM	-	Universal Testing Machine
PMC	-	Polymer Matrix Composite

CHAPTER 1

INTRODUCTION

In advance sciences and technology nowadays, many industries are to create new composite from synthetic elements. Generally, composite from synthetic elements has proven to be the best their application. The means of composite is combination mixing of two or more elements. Besides that, composite also has different microscopic stage to be new material and component (Yuhazri, M.Y., 2008). In the world composite, hybrid is a relatively of new fiber-reinforced composite. Hybrid composite is combining two or more different types of fiber in single matrix (Jamal, M., *et al.*, 2007).

Nowadays, hybrid composite high demand in the market but the price for this composite is different. In the research and development today, hybrid composite has combination of synthetic material and natural material as a solution to produce the products. The purposes are low cost, strong renewable, abundant resources and also low health risks. So that, the title of this project about hybrid composite using recycle plastic bag. The purposes of this resresearch, to develop and characterize a hybrid composite material that are low cost, light-weighted, with improve durability, and processes adequate strength and stiffness for building exchange mechanical properties, construction application, save an environment from plastic pollution and auxiliary the local industries which involved composite material.

In this research, the raw materials will be using are hybrid composite, bamboo, HDPE recycle plastic bag, glass fiber. In this research, matrix material are used as combination of glass fiber and carbon glass as bonding agent and provides support to be filler to be stand in a position (Yuhazri, M.Y., 2008). Combination of carbon glass and fiber glass are often in used in the same polymeric resin matrix composite to

form hybrid composite. For this research, HDPE recycle plastic bag as synthetic element to replacement the nature fiber such kenaf, jute, hump, flax, and sisal. HDPE recycle plastic bag are used in this research because HDPE in the group thermoplastic which melt when heated and solid when cooled. No new cross-links form when a thermoplastic cools and harden. Thermoplastics may be reprocessed to many times. Molecules of most of thermoplastics combine long polymer chains alternating with monomer units (Yuhazri, M.Y., 2008). Thermoplastic suitable for this research because have the mechanical properties such good impact strength, good chemical resistance, good flexibility and good hot formability.

The weight percentages ratio of raw materials used in research are 100:0:0, 83:0:17, 75:7:17, 69:14:17, 62:21:17 and 55:21:17 for hybrid composites. For this research, all raw materials are compressed at different temperature such 160 °C, 170 °C, 175 °C and 180 °C in upper mould and melt based on the weight percentages ratio. Then after melting, the raw materials are cooled in a lower mould. The previous research, lamina refer to combination of more than two lamina layer arrange in order (Yuhazri, M.Y., 2008). The elements in laminate of hybrid composite are very important for strength of the structure such as matrix material, fiber, and core. Although, mechanical properties of a hybrid composite very important which depend upon the properties of the matrix and reinforcement in this research (Jamal, M., *et al.*, 2007).

In this research, bamboo is used for strength and strong structure. The bamboos in thin plate are used as symmetry in laminate. It is understood now that both the strength and stiffness of short fiber composite depend on fiber concentration, fiber aspect ratios, fiber-matrix adhesion, as well as fiber orientation and dispersion. In this research, will be using bamboo, and glass fibers were as reinforcement to HDPE recycle plastic bag as matrix (Mai, Y.W., 2001). In the manufacture process, this research will use the compression molding to produce a laminate. It is caused the hybrid composite as group in the Polymer Matrix Composite (PMC). Polymer Matrix Composites are very popular due to their low cost and simple fabrication methods. So that, in this project the chair is product will be produce. It is caused the properties of hybrid composite are suitable such as high elongation fiber, light weight structure, corrosion resistance, wear resistance, high strength, low cost, and reliability. The mechanical properties of hybrid composite can be tailed based upon end use

application such as sandwich structure.

The findings this research can help local industries involved in the production of defense products to have some ideas to produce high quality plastic hybrid composite products which can reduce the dependency on imported material. So that, this research can reduce air pollution from recycle chemical material such as plastic bag in environment.

1.1 Problem Statement

The mind mapping in Figure 1.1 shows problems of previous research and to setup of this research. The comparison between in this case are very important to improve or development this research.

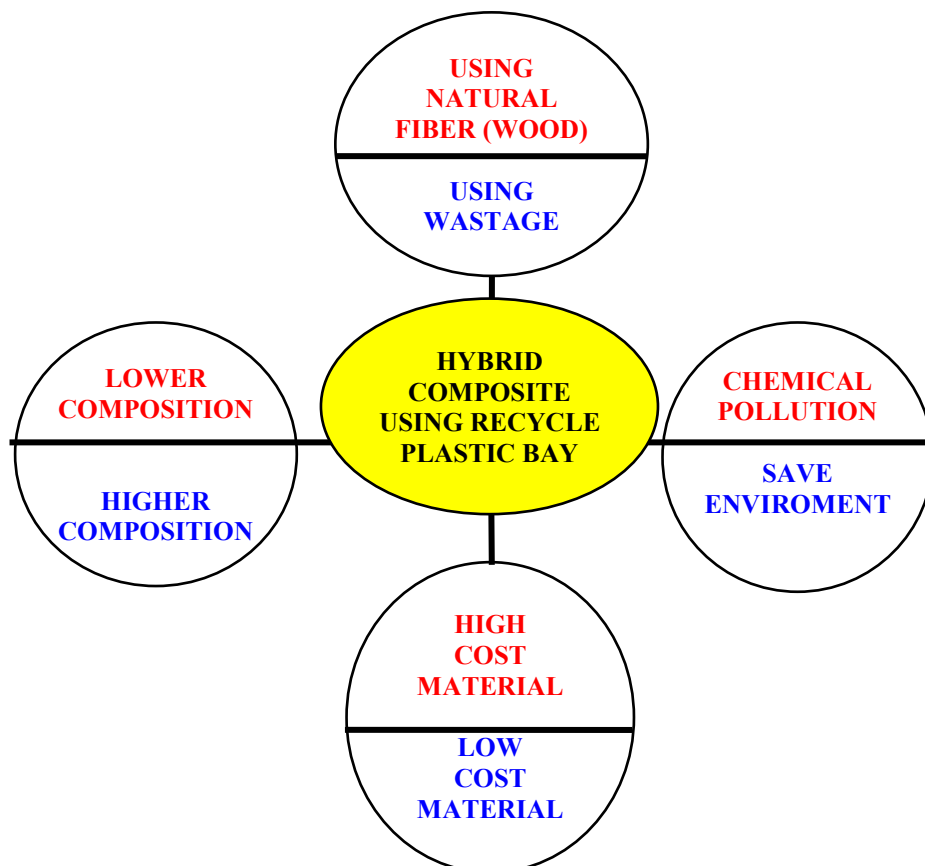


Figure 1.1: Mind mapping for problem statement

From the mind mapping above, the previous research used the natural fiber such as jute, sisal, coir, pineapple leaf, bamboo, sun hemp, straw, and wood fiber to produce the hybrid composite (Moe, M.T., *et al.*, 2000). The disadvantage wood plastic composite of previous researches are moisture sorption susceptibility to mould and decay remains. Beside that water can penetrate into wood-plastic composite, albeit at much lower rate and level to solid wood or other wood composites. So that, in this research where using wastage material such as recycle plastic bag for replacement the wood plastic composite. The purpose is recycle plastic bag can waterproof when it used in hybrid composite.

Nowadays, with the development plastic technology, the world was happen chemical pollution. It is because the human used plastic material as no limitation in everyday. This problem is very dangerous for human and environment cause the recycle plastic bag have high chemical material and difficult to banish. The recycle plastic is dangerous for the health cause to cancer to the human. So that, in this research uses the recycle plastic bag for save the environment and reduce the cancer.

Based that, with uses the nature fiber can high material cost. It is because the nature fiber need for plant, fertilize, harvest, drying and gyration. All this work needs the worker for do that and the high cost because pay the salary of worker. The long time to get the nature fiber cause the tree must be mature before harvest, drying and gyration. So that, in this research uses the recycle plastic bag can low material cost because not need plant and pay the salary of worker. In the same time the recycle plastic bag easy to get and no take time because no need to plant.

The composition is very important in structure of the something product. Based on the previous research the wood-plastic composite have low composition such as difficult to processes, poor surface quality and void, high cost, cannot paint, lower stiffness than wood and thermal expansion (Yamada, V., 2006). In this research, the mechanical and physical properties such as strength, stiffness, impact resistance, density and color, lower cost are important consideration in many application different application take advantages of properties that wood-plastic composite offer.

The strength of the structure based on the combination or mixture materials in laminate hybrid composite. The crack and damage will be decrease when the structure and surface are stiffness. Combination glass fiber and bamboo in this project because are often used in the same polymeric resin matrix to form hybrid. The combination two elements with the same matrix possible to achieve a balance between the properties of bamboo and glass fiber reinforced plastic. Based that, combining bamboo and glass fiber a reduction in modulus might be acceptably traded for increase fracture resistance and failure strain.

1.2 Objective

- (a) To identify and select the best lamination ratio and arrangement for recycle material
- (b) To study the mechanical properties of the hybrid material

1.3 Scope

The scopes in this project are to identify and select the best lamination ratio and arrangement for recycle material and study the mechanical properties of the hybrid material. For choose the best laminate is very important especially in strength structure and toughness. The hybrid laminate are receiving considerable attention due to their good specific strength and stiffness and in particular. In this research, the laminate includes HDPE recycle plastic bag, bamboo, and fiber glass. As overall this research analysis different of 8 weight percentages ratio where describe detail in chapter 3. All weight percentages ratio will be compress at different high temperature and will be cool by using hot press machine. The mixture or combination all materials are very important because it can give the effect of mechanical properties of laminate. In this research also study the mechanical of hybrid composite such increase the strength, light weight structure, high elongation fiber, and high stress and strain. All the mechanical properties will be test such as tensile test, hardness test, flexural test and impact test by using 5 specimens for each test at end research. It is very important to get the best result and comparison of previous research. All the

data of each test will record and doing the research or analysis especially the mechanical properties.

1.4 Rational of Research

The rational of research in this project are to reduce the recycle plastic bag from environment pollution and replacement the synthetic natural fiber into disposable.

1.5 Thesis Frame

In the Chapter 1 are described about introduction, problem statement, objective, scope and rational of research for this project. Next, Chapter 2 are includes the literatures review for hybrid composite, glass fiber, high density polyethylene (HDPE), plastic bag, bamboo, hot press machine and summary of journal. Chapter 3 are described about methodology where includes the material selection, material preparation, mould fabrication, fabrication of composite and testing and analysis. Next chapter is result and discussion as chapter 4 will be describe about analysis data for 4 types of testing likes tensile test, impact test, flexural test and hardness test. In this research, the last chapter is conclusion and recommendation where include describe overall in this research and recommendation to improvement the future research,