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

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PRELIMINARY STUDY ON THE EFFECT OF COMPOSITION TO THE MECHANICAL PROPERTIES OF EPOXY LALANG COMPOSITES

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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."

Signature : ……..

Author : ……..

Date : ……...

Dedicated to my family especially for my mum and dad

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ABSTRACT

The use of natural fibers for different application has been increase every year due to its advantages. Advantages of using natural fiber include low density, low cost, renewable, environmental friendly, lightweight and high specific mechanical performance. In this thesis, the effects of lalang fiber composition on the physical and mechanical properties of Epoxy Lalang Composite were investigated. Lalang fiber was chosen in preparation of polymer composites because of several advantages such as low cost, eco-friendly, abundance, renewable, and biodegradable. For the first step in preparation of fiber, lalang grass was soaked in 5% Sodium Hydroxide (NaOH) solution. After that, the fiber was then washed with distilled water until it becomes neutral state. When the fiber has become neutral state, then the fiber was dry under the sunlight until it is completely dried. The fiber was crushed using crusher machine and sieved the size of fiber to 1.0μm. The mixture of resin, fiber and hardener was poured into the mold and cure in the oven at 100℃. Five different samples were produced using hand lay-up molding technique by varying the composition of fiber between 0.2% and 1.0% weight composition. A few of testing were carried out to investigate the effect of fiber composition on their mechanical and physical properties such as tensile test, hardness test, density test and microstructure. The tensile strength, mean hardness, mean density, modulus, % elongation and yield strength of the composite were analyzed. The results showed that the tensile strength, modulus and yield strength had their highest values of 38.83 MPa, 1.22GPa and 15MPa respectively at 0.2% of composition .As a conclusion, composition of fiber will give an effect to the mechanical and physical properties of composites if the composition is in the range of 0.8% to 1.0% of weight composition.

Keywords: Lalang, Epoxy resin

ABSTRAK

Kesan komposisi serat lalang pada sifat-sifat fizikal dan mekanikal Epoksi Lalang Komposit telah dikaji. Gentian lalang dipilih dalam penyediaan polimer komposit kerana kosnya yang rendah, mesra alam, tersedia dalam kuantiti yang banyak, boleh diperbaharui dan boleh terhurai secara biologi. Pada langkah yang pertama dalam penyediaan serat, daun lalang telah direndamkan di dalam larutan 5% natrium hidroksida (NaOH). Selepas itu, serat tersebut kemudiannya dibasuh dengan air suling sehingga menjadi keadaan yang neutral. Apabila serat berada dalam keadaan neutral, kemudian serat tersebut dikeringkan di bawah sinaran cahaya matahari sehingga ia kering sepenuhnya. Serat kemudian dihancurkan dengan menggunakan mesin penghancur dan diayak kepada serat yang berukuran 1.0μm. Campuran resin, pengeras dan serat kemudian dituang di dalam acuan dan di keraskan di dalam oven dengan kadar suhu 100℃. Lima jenis sampel yang berbeza telah dihasilkan dengan menggunakan kaedah "hand lay-up molding technique" dengan mengubah komposisi serat antara 0.2% hingga 1.0%. Beberapa ujikaji telah dijalankan untuk mengkaji kesan komposisi serat terhadap ciri-ciri mekanikal dan fizikal seperti ujian tegangan, ujian kekerasan, ujian kepadatan dan mikrostruktur. Kekuatan tegangan, purata kekuatan dan kepadatan, modulus, % pemanjangan, dan kekuatan alah bahan komposit tersebut telah dianalisa.. Keputusan menunjukkan kekuatan tegangan, modulus dan kekuatan alah mempunyai nilai tertinggi iaitu 38.83 MPa, 1.22GPa and 15MPa untuk komposisi 0.2%. Secara kesimpulannya, komposisi gentian akan memberi kesan kepada ciri-ciri mekanikal dan fizikal bahan komposit apabila komposisi tersebut adalah antara 0.8% hingga 1.0%.

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CHAPTER I

INTRODUCTION

1.0 INTRODUCTION

Most of the products we seen every day are made from composite materials. Composite materials can be defined as combination of two or more materials to produces better properties than those of the originally materials [1,2]. However, most composites are made up of just two materials which consist of two constituents such as the reinforcement and a matrix.

The role of reinforcement in a composite material is to increase the mechanical properties of materials. The different fiber characteristics that used in composites have different properties, so it may affect the properties of the composite in different ways. In general, there is four factors that govern the fiber's contribution such as the basic mechanical properties of fiber itself, the surface interaction of fiber and resin, the amount and orientation of fiber in composite [6,7].

On the other hand, the function of the matrix in a composite material is to bind the reinforcement together and to keep the reinforcement correctly positioned in order to obtain optimal utilization of the mechanical properties. So, the type of matrix will give

an effect to the properties of composite. For example, Epoxy Lalang Composite is the polymer composites that can be used in a variety of applications like automotive and construction in industries area [6,7].

Epoxy is one of the most important classes of thermosetting polymers containing epoxide group which are usually used as matrices for fiber-reinforced materials. Besides that, the reinforcing phase will provide the strength and stiffness to the composites. Usually, the reinforcements are harder, stronger, and stiffer from the matrix. In this investigation, natural fiber of lalang grass has been used as reinforcement for Epoxy Lalang Composites fabrications [4,8].

In the past decade, many of research work have been conducted on the natural fiber reinforced composite materials in any applications. So, we can conclude that natural fibers can be used to reinforced composite materials to obtain strong and light materials. Moreover, natural fibers have its own characteristics such as it is renewable, biodegradable, low cost, low density, high specific strength and stiffness, low energy consumption and low wear on machinery [2,3].

There are two types of fibers includes natural fiber which consists of animal and plant fibers and manmade fiber which consists of synthetic fibers and regenerated fibers. However, they have different between natural fiber and synthetic fiber based on its characteristics and function. For example, all of the natural fibers are derived from plants and animals, whereas synthetic fibers are almost made from synthesized polymer. In addition, fabrics that made up from natural fibers are generally more comfortable than synthetic fibers. Not only that but natural fiber is more expensive, biodegradable and limited usage compared to synthetic fibers. In natural fibers, it is naturally made whereas in synthetic fibers, spinnerets are used to produce the filaments [5,8,10].

1.1 BACKGROUND

There is a lot example of composite materials that is fabricated in different ways. In this investigation, composite materials will be fabricated from lalang fiber which is namely as Epoxy Lalang Composite. Epoxy Lalang composite can be categorized as fiber-reinforced composite [4,5]. On the other hand, a number of investigations will be conducted to evaluate the mechanical and physical properties of Epoxy Lalang Composite. Firstly, the sample of Epoxy Lalang Composite will be fabricated in different weight composition. This is because the composition of fiber is known to give significant effect on the properties of composite [5,8].

In order to obtain optimal result, four tests have been conducted such as tensile test, hardness test, and density test and microstructure test. So, we might be to investigate the mechanical properties of materials through this four testing. Other than that, the tensile test is carried out in order to obtain experimental data. In addition, all the experimental data will be analyze in order to obtain optimal level and performance.

1.2 OBJECTIVE

a. To produce the sample of Epoxy Lalang Composites with different weight composition using lay-up moulding technique.
b. To investigate the mechanical properties of composites using tensile test.
c. To evaluate the experimental data using analyzing method to obtain optimal level and performance.
d. To verify the result from experimental data on the mechanical properties of Epoxy Lalang Composites.

1.3 SCOPE

a. Produce samples for Epoxy Lalang Composites using lay-up molding technique with five different weight compositions.
b. Carried out tensile test in order to obtain experimental data for analyzing method.
c. To use all the experimental data for analyzing method in order to obtain optimal level and performance of composites.
d. Verifying results from experimental data in the mechanical and physical properties of Epoxy Lalang Composites using tensile test, hardness test, density test and microstructure test.

1.4 PROBLEM STATEMENT

One example of composite materials is Epoxy Lalang Composite which is categorized as fiber-reinforced composite. The usage of natural fibers is growingly gaining its attention due to environmental concern as well as for its economical value such as cost savings and a reduction in density when compared to glass fiber. Recent interests in car manufacturers to incorporate natural fiber composites into both exterior and interior part imposed a necessity to find suitable candidates that will achieve certain properties and characteristics such as its strength and weight. The composition of fibers is known to have significant effect on the properties of the composite [1, 2, 3]. This study will investigate the effect of fiber composition to the Epoxy Lalang Composites using analyzing method in order to obtain optimal result that will be verified experimentally for its mechanical properties.

CHAPTER II

LITERATURE REVIEW

2.0 INTRODUCTION

The use of composite materials is not something new in engineering industry, but it has been in used since long time ago. Composite materials are defined as combination of two or more materials with different properties to produce new materials where the properties that couldn't be achieved by single material on its own. This material is made up of groups of fibers and polymer matrix in the form of materials which called as "Fiber Reinforced Polymer". Fiber Reinforced Polymer can be divided into three groups which are Fiberglass Reinforced Polymer, Carbon Reinforced Polymer and Aramid Reinforced Polymer [12].

The Fiber-Reinforced Polymer properties shows resulting strength will be different at certain cases or level, which is influenced by fiber length, loading, orientation and weight composition of fiber. Fiber can be divided into two categories such as natural fiber and synthetic fiber. A number of experiments have been conducted on natural fibers to test its characteristics and performance [11,12].

The examples of mechanical testing in order to test the properties of composite materials are impact test, flexural test, tensile test and compressive test. Besides that, the

use of natural fibers for different application has been increase every year due to its advantages. Advantages of using natural fiber include low density, low cost, renewable, environmental friendly, lightweight and high specific mechanical performance.[1,2,3]

In addition, there are a few of advantages in using natural fibers such as it may reduce usage of metals, reduce wastage, reduce weight and increase the recycle materials. At the same time, the use of natural fiber can save our environment from contaminated by wasted materials [12,13].

2.1 COMPOSITE MATERIAL

Composite material is a material created through the combination of two or more physically and chemically distinct components which combined together will produce a new material. In general, the composite materials are made up of a selected reinforcing agent and a compatible matrix binder in order to obtain better properties and characteristics[8,9]. However, there are three main categories in classification of composite materials which are polymer matrix composites, metal matrix composites and ceramic matrix composites. Figure 2.1 shows the classification of composites.

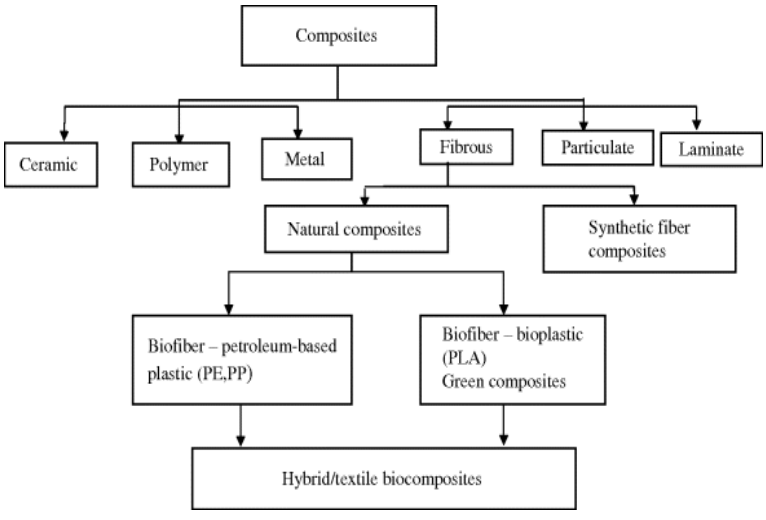

Figure 2.1 Classification of composites [4]

2.1.1 Polymer Matrix Composite

Polymer Matrix Composites is commonly known as Fiber Reinforced Polymer. Fiber-Reinforced Polymer is the composite material which is produced with combination of fiber and matrix resin [13]. The combination of these two materials has produced one other material which is much better in terms of strength and original material. These materials usually use a polymer-based resin as the matrix and a few of fiber such as glass, carbon, aramid and natural fiber as the reinforcement[12] .The reinforcement in a Polymer Matrix Composite will allocate the high strength and stiffness to the composite while the function of the matrix in Polymer Matrix Composites is to bond the fibers together. Generally, polymer can be classified into two classes which are thermoplastic and thermosetting. Fiber-Reinforced Polymer is commonly used in the few areas like aerospace, automotive, marine, and construction industries [15,17,19].

Besides that, Polymer Matrix Composites are frequently used and very popular compared to other composites due to their low cost and simple fabrication methods. However, non-reinforced polymers are limited use in structure materials because of the low level of its mechanical properties. By using epoxy resin as the matrix, so it will give good tensile strength to the composite which epoxy resin are the strongest polymers composite. Furthermore, there is some disadvantages of Polymer Matrix Composites which is low thermal resistance and high coefficient of thermal expansion. In addition, there are two types of polymers will be used as matrix materials for fabrication of composites such as thermosetting and thermoplastics [14,15,16]. Table 2.1 shows the types of polymer which is thermosetting and thermoplastics.

Table 2.1 Types of Polymer [5]

Thermosetting	Thermoplastics
Epoxies	Low Density Polyethylene
Phenolics	High Density Polyethylene
	Polypropylene
	Nylon
	Acrylics

There is different way that reinforcing fibers may be arranged in term of unidirectional fibers, rovings, veil mat (thin pile of randomly orientated and looped continuous fibers), chopped strands (thin pile of randomly orientated and looped short fibers) and woven fabric[12]. In terms of properties of Polymer Matrix Composites, a few of aspects are determined such as the properties of the fiber, orientation of the fibers, concentration of the fibers and properties of the matrix. Fiber-Reinforced Polymer can be divided into three main types:

2.1.1.1 Fiberglass-Reinforced Polymer

Fiberglass is one of fiber material made from delicate glass. It is used as a strengthening agent in polymer products which produce composite materials. Polymers such as fiber-reinforced polymer or glass-reinforced plastic are usually known as fiberglass. Fiberglass is widely used to produce mats, thermal insulation, strengthening for various materials, sound absorber, car body and boat body. Fiberglass-Reinforced Polymer is the composite material which combines resin and fiberglass to obtain a useful material for a variety of uses. If polymer material is not treated, it will have a few of