EFFECT OF SHORT PINEAPPLE LEAF FIBER TREATMENT ON THE PROPERTIES OF PINEAPPLE LEAF FIBER- STARCH COMPOSITE

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DECLARATION

I declare that this project report entitled “Effect of Short Pineapple Leaf Fiber Treatment on The Properties of Pineapple Leaf Fiber- Starch Composite” is the result of my own study except as cited in the reference.

Signature : .....
Name of Supervisor: .....
Date : .....

SUPERVISOR'S DECLARATION

I hereby declare that I have read this project report and in my opinion this report is acceptable in term of scope and quality of the award of the degree of Bachelor of Mechanical Engineering (Structure and Material).

Signature : .....
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ABSTRACT

Nowadays, the natural fiber shown the greater performance in developing biodegradable composite to fix and figure out ecological problem. The result from previous study shows that, the usage of natural fiber has gained attention from industries in producing a new composite material as a replacement to use of synthetic fiber such as carbon fiber, glass fiber and carbon fiber. This is because as a reinforcement material due to their excellent in mechanical properties, eco-friendly, and less expensive. Besides, that why the industries looking deeply to it of this potential of fiber reinforcement composite especially form industries in plastic production. Pineapple leaf fiber (PLF) is one of a natural fiber and is the good to replace synthetic fiber. The usage of pineapple plants is limited only on its fruit. So that, the research come out from the leaf that has been wasted with no used. In this study pineapple leaf fiber (PLF) used as the reinforcement materials and starch (SH) used as a matrix material. The composition of PLF/ SH is 50PLF/50SH, 60PLF/40SH, and 70PLF/30SH. The composition that being selected is 60PLF/40SH. Another than that, the fiber has gone through an alkaline treatment to increase the strength and take out the impurities that contained in PLF. Thus, after done the treatment with the several time. This study is used different time of treatment to investigate the properties of PLF/SH composite. Therefore, eight samples that had been treated with this an alkaline treatment with 2 hours until 16 hours of treatment on PLF before it chopped finest and mixed with SH. Based on the result, the samples with long treatment has highest result of flexural stress which is 3.372 (MPa). Lastly, from the result of SEM analysis shows the structure of PLF/SH is perfect melt together and lowest among of void. This is because both of PLF/SH is mixed well and become homogeneous during fabrication process.

ABSTRAK

Pada masa kini, serat semula jadi menunjukkan prestasi yang lebih besar dalam membangun komposit biodegradasi untuk membetulkan dan memikirkan masalah ekologi. Hasil daripada kajian terdahulu menunjukkan bahawa penggunaan serat semula jadi telah mendapat perhatian dari industri dalam menghasilkan bahan komposit baru sebagai pengganti penggunaan serat sintetik seperti serat karbon, gentian kaca dan serat karbon. Ini kerana sebagai bahan pengukuhan dan kerana sifatnya yang sangat baik dalam sifat mekanik, mesra alam, dan lebih murah. Di samping itu, industri-industri juga melihat potensi komposit tetulang serat ini terutamanya industri dalam pengeluaran plastik. Serat daun Nanas (PLF) adalah salah satu serat semula jadi dan sangat baik untuk menggantikan serat sintetik. Penggunaan tumbuhan nanas hanya terhad kepada buahnya. Jadi, penyelidikan itu keluar dari daun yang telah dibazirkan tanpa digunakan. Dalam kajian ini serat daun nenas (PLF) yang digunakan sebagai bahan pengukuhan dan kanji (SH) digunakan sebagai bahan matriks. Komposisi PLF / SH adalah 50PLF / 50SH, 60PLF / 40SH, dan 70PLF / 30SH. Komposisi yang dipilih ialah 60PLF / 40SH. Selain itu, serat telah melalui rawatan alkali untuk meningkatkan kekuatan dan mengeluarkan kekotoran yang terkandung dalam PLF. Oleh itu, selepas melakukan rawatan dengan beberapa kali. Kajian ini menggunakan masa rawatan yang berbeza untuk menyiasat sifat komposit PLF / SH. Oleh itu, lapan sampel yang telah dirawat dengan rawatan alkali iaitu dengan 2 jam sehingga 16 jam rawatan pada PLF sebelum ia dicincang dengan baik dan dicampur dengan SH. Berdasarkan hasilnya, sampel dengan rawatan panjang mempunyai hasil tertinggi tekanan lentur iaitu 3.372 (MPa). Akhir sekali, dari hasil analisis SEM menunjukkan struktur PLF / SH cair dengan sempurna antara satu sama lain. Ini kerana kedua-dua PLF / SH bercampur dengan baik dan menjadi homogen semasa proses fabrikasi.

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LIST OFABBERAVATION

PLF	=	Pineapple Leaf Fiber
PP	=	Polypropylene
FRM	=	Fiber Reinforced Plastic
PMC	=	Polymer Matrix Composites
MMC	=	Metal Matrix Composites
NaOH	=	Sodium Hydroxide
CMC	=	Ceramic Matrix Composites
SH	=	Starch
FRP	=	Fiber reinforced Polymer
SEM	=	Scanning Electron Microscope

LIST OF SYMBOLS

MPa	=	Mega Pascal
GPa	=	Giga Pascal
m	=	Meter
kg	=	Kilogram
g	=	Gram
/	=	per
mm	=	Millimeter
µm	=	Micrometer
%	=	Percent
cm	=	Centimeter
°C	=	Degree Celsius

CHAPTER 1

INTRODUCTION

1.0 Background

A composite is a material from two or more material to produce a new material that has a new or improved strength ability from its original individual components. Basically, most of the materials that exist, or we see is made of a composite material. For examples, bones, wood and stone are natural composite items that develop by a natural process. The leaf itself consist of natural fiber and usually use in making a new composite material because of their unique characteristics which have a good mechanical property, stronger, lighter, biodegradable and less expensive compared to the synthetic fiber. Because of that, natural fiber has potential to be an alternative to synthetic fiber such as glass fiber and carbon fiber.

There are a few examples of natural fibers that can be extracted from a plant such as pineapple leaf, banana leaf, palm leaf, hemp, kenaf, bamboo and coconut shell fiber. Furthermore, all natural fiber, Pineapple leaf fiber (PLF) seems to have the highest cellulose content which makes the fibers can produce good mechanical properties. In order to give the unique ability for natural fiber, binder such as the starch composite are added to enhance the existing mechanical properties or and other words called as a reinforcement of the materials.

Reinforcement mean is strengthening the structure or material itself. For example, back in ancient Greek civilization years, clay was reinforced by the straw to build walls. In this case, clay will become the binder holding the straw together thus, make the construction become stronger.

As the previous studies that fiber reinforced plastic (FRP) is a very well-known composite that being used in structure engineering, mostly in the field of aerospace, building and offshore platforms. This is because, there are considered to have more strength, non-corrosive, light in weight and most important is easily moulded or constructed. But the materials or fibers are usually from the glass and carbon combining with the plastic polymer as the binder. While in this study, PLF will be used as the reinforce materials and starch as the binder which may potentially give a good result in mechanical properties, besides it characteristic which is an environmentally friendly, renewable, recyclable and biodegradable. Fibers can be altered by alkaline treatment. In general, alkaline treatment will improves surface roughness and increases the number of celluloses on the surface of fibers. Therefore, Pineapple leaf fibers are conducted with alkaline compound to improve their physical and mechanical properties. In fact, it will exceed mechanical interlocking. Furthermore, in previous studies have collected various trials elaborating with alkaline treatment for natural fiber. Atiqah et al. [4] evaluate the kenaf fiber with 6% sodium hydroxide (NaOH) compound for 3 hours and showed excellent outcome for flexural, tensile and impact strengths. Claudia Merlini et al. [5] experiment alkaline treatment on banana short fibers with 10% NaOH solution for 1 hour.

1.1 Problem Statement

Nowadays, the usage of natural fibers as an alternative reinforce in composites materials are still in research phase. Some of the problems arise is that synthetic is widely use are hardly to decompose and are not sufficiently eco- friendly. Besides that, by using natural fibers such as pineapple leaf, hemp, kenaf, and jute fibers with certain type of binder to create a composite material seems can be compete with existing synthetic composites which they have a good mechanical property. Just at a certain time, natural fibers have been awakening the industry to substitute their products by using the natural composite. For example, it has been widely used in the automotive industry. Thus, by using the natural fibers they can produce higher strength of automotive interior components such as dashboard, door trim, but cheaper in price. The achievement of natural fiber and fiber reinforce composites. The chemical alteration of natural fiber such as alkaline treatment has acknowledged various levels of success in improving fiber strength in nature fiber composite. An Alkaline treatment of pineapple leaf fiber is commonly method that often used by some researches produce a high-quality fiber for reinforcement materials. The alkaline treatments showed improved behaviour in mechanical properties as compared to untreated fibers. Panyasart et. al [6] attempt test on pineapple leaf fiber (PLF) with 5% NaOH compound and 5 hours engagement period at room temperature. Previous studies by Asim et. al [2] on alkali treatment for pineapple fiber exhibit reinforce in mechanical properties for fibers treated with 6% NaOH. The alkaline treatments showed improved behaviour in mechanical properties as compared to untreated fibers.

In this project, the aim is to study the effect of Short Pineapple Leaf Fibers Treatment on the properties of pineapple leaf fiber (PLF). Starch composite was used as the reinforce material. The various ratio of PLF/SH composite was be selected and the ratio of composition in the PLF/SH composite was fixed at, 70:30, 60:40, 50:50. An alkaline

treatment will be conducted with various hours (2, 12, 24) to extract thin PLF bundles and enhance the PLF properties before the formation process of PLF/SH composite used hot press. The test that will be covered used tensile test, flexure test, hardness test, density measurement and macrostructure analysis. The composite seems to have a good potential that can widely use in industry like for an example for the plastic industries product more benefit to the environment.

1.2 Objectives

The objective of this project is:

1. To determine the effect of Pineapple Leaf Fiber (PLF) treatment on the properties PLF/ Starch (SH) composite.
2. To study the effect of PLF loading on the properties of PLF /SH composite.

1.3 Scope Of Project

This research studied the effect PLF loading on the mechanical properties of PLF/ SH composite had been carrying out. The various ratio of PLF/ SH composite was be selected and the ratio of composition in the PLF/ SH composite was fixed at 70:30, 60:40, and 50:50. An alkaline treatment will be conducted with various hours (2, 12, and 24) to extract thin PLF bundles and enhance the PLF properties before the information process of PLF/ SH composite used hot press. The mechanical properties of PLF/ SH composite will be determined used tensile test, Flexure test, hardness test, density measurement and macrostructure analysis.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Natural fibers composites have gained a reputation in renewal the synthetic fibers such as glass fibers reinforced composites that commonly known to their non eco-friendly to the natural system. There are examples of natural fibers can be from a numerous source such as pineapple leaf, bamboo, banana leaf and kenaf [1].

Biodegradable fiber- reinforced polymer (FRP), is a composite material that produce of a polymer matrix reinforced with fiber. There a lots usage or various of nature fiber. Many industries are interested used in development for their product of natural fiber composites. There are numerous types used to build up of natural fiber composite such as bamboo, coconut, rice husk, wood and pineapple leaf. Biodegradable composite material or Bio composite is a composite material shaped by a grid and support of common fiber. Biocompatibility is linked to the action of biomaterial in various contexts. The capability of a material to act with an appropriate host response in a precise position [29].

The polymer is a macromolecule that composed of many bounding materials. Commonly, an epoxy and polyester thermosetting plastic are the normally favourite choice to used. Biodegradable fiber- reinforced polymer (FRP) is often used in automotive, aerospace, marine and construction industries. There are two type of fiber which is being used for reinforced the composite materials.

i. Synthetic fiber
ii. Natural fiber

Generally, synthetic fiber are using to reinforce plastic due to superior performance of mechanical properties and low cost of production but it very worth it. However, synthetic fiber have big significant as high energy consumption, exposed to damage by hot washing, non- renewability and high density. Furthermore, different side with fiber reinforced polymer composite which is, it earned the world-wide attention due to high specific strength and modulus. In addition, material composite that have great strength fiber such as glass and graphite are commonly used in aerospace, automotive components are highly expensive cost to produce. This condition or standpoint will lead the industry to use of the other option materials composites.

Natural fiber has create a huge ability to replace for example glass fiber in composite due to more economical characteristic and good mechanical properties compare to synthetic fiber [30].

A composite material is a constituent material that made from two or more micro or macro material with different chemical and physical properties. Natural fibers can help to develop the mechanical properties of a product since it has profit to environment. In addition, the comparison price between the natural fibers are more economical compared to synthetic fiber such as glass fiber and carbon fiber that have been extensively used in the industries.

In this literature review, pineapple leave fiber starch (PLF/ SH) composite is used with the various ratio was be selected fixed at 70:30, 60:40, and 50:50 and with an alkaline treatment will be conducted with various hour (2, 12 and 24).

2.1.1 Types Of Composite

There are there types of composite depend on their matrix type. These are known by their natural behaviour and the properties. These consist of Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC) and Polymer Matrix Composites (PMC).

2.1.1.1 Metal Matrix Composites

Metal matrix composites are commonly used in the production of chamber nozzle for aircraft applications, tubing, cables, heat exchangers, space shuttle, automotive industries and structural members. This is due to the properties of the metal matrices that have higher strength, fracture toughness and stiffness. Besides, metal also have the qualities that can withstand high temperature in corrosive environment compared to the polymer composites [12].

2.1.1.2 Polymer Matrix Composites (PMC)

Generally, the strength and stiffness of a polymer is low compared to the metal and ceramic, but these complications had been overcome by reinforcing them with other materials. However, the process for producing the composites much simple and cheaper compared to other types of composites. This make the polymer matrix composites gained it demand in the industries [12].

2.1.1.3 Ceramic Matrix Composites (CMC)

The primary goals in producing the ceramic matrix composites is to increase strength or toughness of a materials. Normally it is found that there is a good outcome in the improvement in strength and stiffness of a material by using ceramic matrix composites [12].

2.2 Reinforcement

Reinforcement produce strength and rigidity, helping to support structural load [23]. Based on a journal, fiber-reinforced polymeric composites have gained so much acclaim because of their great mechanical properties like high specific strength and modulus [20]. Nowadays, natural fiber is used as a good restoration of synthetic fibers as reinforcement in plastic to reduce cost, increase the productivity of material and to improve mechanical properties of a product. The famous examples of the natural fibers such as rice straw, wood, bamboo, hemp and others [21].

2.2.1 Natural Fiber

Natural fiber-reinforced polymer composites have gained an excellent reputation among the engineers and material scientists in these days because of the ability of the composites to produce great mechanical properties, dielectric properties and giving many advantages to the environment such as it is renewability and biodegradability. Besides that, by using these natural fibers, many environmental problems can be solved. These composites are also can be well used as a wood replacement in the construction industry. Furthermore, natural fibers have raised an attention due to various disadvantages of the conventional petroleum-based plastic,

glass or carbon fiber that not an eco-friendly, very expensive and must use high progressing technologies. There numerous natural fibers that are used as reinforcement of polymer composite such as the pineapple leaf, bamboo, jute, banana, and coir [22].

There are few types of natural fibers, for example is the lignocellulosic fiber. The fibers are held by binder agents called “lignin” and “hemicellulose” in the fiber cell. The fiber also can be found on the outer layer of the fiber bundles and leaves. The fiber cells are structured in different layers, formed typically by groups of Nano-scale cellulose chains extending helically along the axis of the fiber cells and interconnected by amorphous regions composed of lignin and hemicellulose [25]. On the other hands, for vegetable fibers which are considering to be more complex because they are construe by the wide variety of organic compound in the fiber such as the lignin, hemicellulose, fatty acids, fats, waxes and many more [24].

Moreover, natural fiber as widely spread in many industries such as the building industry. This is because of the characteristics of natural fiber that is good in thermal insulation. The purpose why the natural fiber is used because of it is an environmentally friendly, energy saving and giving a long term of favour to the aspects of financial as it is low cost and does not requires skilled labour and not harmful to the human health compared to commercial thermal buildings insulators that mostly made from minerals wools, glass foam, and rock wools [26].

2.2.1.1 Pineapple Leaf fiber

Nowadays, natural fibers have got many intentions among the researchers as it has high potentials in replacing the synthetic fibers in fiber-reinforced plastics. The