SUPERVISOR DECLARATION

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

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Date : ....1/7/2015....................

THE EFFECT OF FIBRE TYPE, SIZE, AND FIBRE ARCHITECTURE ON THE MECHANICAL PROPERTIES OF BIO 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."

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Special dedication to my beloved family especially to my parents, Ayub Bin Lazim, Juliah Binti Ramlan, Siti Nur Azween Binti Ayub and also to my lovely husband and son, Ahmad Akmanizam Bin Haji Yusuf and Ahmad Akmal Ariff Bin Ahmad Akmanizam.

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ABSTRACT

In recent years natural fibre appears to be outstanding material which comes as the viable and abundant substitute for the expensive and nonrenewable synthetic fibre. Natural fibre like sisal, banana, jute, oil palm, kenaf and pineapple leaf have been used as reinforcement in thermoplastic for application in furniture, low cost housing, and civil structures. This research is focus on natural fibre reinforced composite that have received increasing attention in variety industry. Pineapple leaf fibre is one of natural fibre that has also good potential as reinforcement in thermoplastic composites. The treated pineapple leaf fibre reinforced PLA have been used in the fabrication process of the biocomposites by using the compression molding via hot press machine to form a thin film. Following this, a series of mechanical series which are tensile (ASTM D3039), flexural (ASTM D790) and impact (ASTM D6110) were conducted. Scanning electron microscope (SEM) analysis was done to scrutinize the topology and morphology of the PALF/PLA composite. Overall, the experimental work suggest than alkaline treatment PALF fibre with continuous long fibre reinforced PLA biocomposites exhibit superior mechanical properties in comparison to that of the plain polymer and data from literature review when subjected to tensile , flexural and impact test,with wt 30% of fibre loading.

ABSTRAK

Dalam tahun-tahun kebelakangan ini serat semula jadi kelihatan bahan yang luar biasa yang datang sebagai pengganti yang berdaya maju dan banyak untuk serat sintetik yang mahal dan tidak boleh diperbaharui. Gentian semula jadi seperti sisal, pisang, jut, kelapa sawit, kenaf dan daun nanas telah digunakan sebagai tetulang dalam termoplastik untuk aplikasi dalam perabot, perumahan kos rendah, dan struktur awam. Kajian ini memberi tumpuan kepada gentian semulajadi bertetulang komposit yang telah menerima perhatian yang semakin meningkat dalam pelbagai industri. Gentian daun nanas adalah salah satu daripada gentian semula jadi yang berpotensi juga baik sebagai tetulang dalam komposit termoplastik. Gentian daun nanas yang dirawat bertetulang PLA telah digunakan dalam proses fabrikasi daripada biocomposites dengan menggunakan acuan mampatan melalui mesin akhbar panas untuk membentuk sebuah filem nipis. Berikutan itu, satu siri siri mekanikal iaitu tegangan (ASTM D3039), lenturan (ASTM D790) dan hentaman (ASTM D6110) telah dijalankan. Mikroskop elektron imbasan (SEM) analisis dilakukan untuk meneliti topologi dan morfologi komposit PALF / PLA. Secara keseluruhan, kerja eksperimen mencadangkan daripada alkali serat rawatan PALF dengan serat panjang berterusan bertetulang biocomposites PLA mempamerkan sifat mekanik unggul dibandingkan dengan polimer yang nyata dan data daripada kajian literatur apabila dikenakan tegangan, lenturan dan ujian kesan, dengan berat 30% daripada loading serat.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Nowadays, the agriculture or bio-material resources become very important in human life due to their advantages. The advantages of using the bio-resources are, they are multifunctional, flexibility in characteristics, biodegradability and wide distribution all over the world [1]. This is because, most of the industry, generates large amounts of waste due to widespread use of glass fiber reinforced polyester composites [2]. By usage and disposal of these materials, they have been becoming critical because of their non-biodegradability in light of increasing environmental consciousness and demands of legislative authorities related to their recycling [3]. Besides that, the limitations that often arise when the desire to fulfill the needs for improving the performance of these materials is also one of the problems. To solve these problems, the development of bio-composites is the alternatives to improve the process technology and economic factors [1] and to produce new and better material.

The use of natural fibers as a reinforcement in fiber-reinforced plastic (FRP) is a good choice because of their advantages. The natural fibre may be obtained either from plants or animals [4]. Plants based fibre consists of kenaf, hemp, flax, bamboo, pineapple and sisal. While for animal, the fibre obtained from silk and wool. Natural fibers have many application in the automotive industry, aerospace, marine and infrastructure primarily in non structure parts. The advantages of using the natural fiber than the other reinforcing materials are their low cost, low density, high mechanical strength, high toughness, size ability, flame retardancy and corrosion resistance, non abrasive, non-toxic, acceptable specific strength properties enhanced energy recovery, and biodegradability [2].

There are many different polymers of renewable materials such as polylactic acid polymers (PLA), cellulose esters, poly hydroxyl butyrates, starch and lignin based plastic. Among these polymers, polylactide has been introduced commercially for product where biodegradability is wanted. Polylactide acid (PLA) is a versatile polymer and it‟s made from renewable agriculture raw materials where is then fermented to lactic acid. Polylactide polymers have good stiffness and brittle materials and it is necessary to used plasticizers to improve the elongation and impact properties. The polylactide (PLA) is full biodegradable [5].

Biocomposites are the combination of natural fiber and polymers matrices. Biofibers offers of a numbers of advantages like renewability, recyclability, biodegradability, low specific gravity, and high specific strength [7]. The research study aims to investigate the effect of fiber type, size and architecture on the mechanical properties of biocomposites. The research work is focus on kenaf and pineapple leaf in combination with other polymeric material.

1.2 OBJECTIVE

The objectives of this project are listed below:

i. To produce biocomposites with good mechanical and physical properties.
ii. To study the effect of chemical treatment on the bonding mechanism present in the polymer composites.
iii. To access the tensile and impact properties of the polymer composites.

1.3 SCOPE

The scopes of this project are listed as below:

i. Selection of fibre material and chemical treatment process in producing biocomposites.
ii. To fabricate the biocomposites test panel.
iii. To conduct a series of mechanical testing to identify the mechanical properties of the biocomposite.
iv. To conduct a physical testing.
v. To obtain the surface morphology of biopolymer.

1.4 PROBLEM STATEMENTS

With growing production and mass volume use, the disposal of non-biodegradable composites after their intended useful life has become an important and expensive issue [4]. Besides that, composites cannot be easily recycled and reused because the combine with two dissimilar materials and the released gases might also bring new pollution [4]. The advantages of using the fossil resources not only difficult to recycling, it also induces the problem of waste plastic and petroleum products and can cause an increased in carbon dioxide linking to global warming because of the incineration. This phenomenon also leads to greenhouse effect and world climatic changes [2].

Fibre provides strength and stiffness and act as reinforcement in fibre-reinforced composite materials [7]. Natural fibre reinforce composites are finding increasing use in spectrum of applications. Natural fibre can be obtained from plant and animal. Natural fibre that consist of plant have gained commercial success in automotive applications , while natural fibre from animal are also used as reinforcing agents [4]. To date, limited studies have focused on understanding the effect of fibre type, size and architecture on the mechanical properties of polymer biocomposites. One of the important aspects to enhance the mechanical properties of these materials is by improving the adhesion between the matrix and the fibre, at the interface.

Hence this research work aims to contribute in the understanding of the fibre reinforcement type, size and architecture in enhancing the mechanical properties of such biocomposites through an experiment work. Besides that, the aim of this study is to investigate the effect of processing methods, fibre length, fibre orientation, fibre-volume fraction, and fibre surface treatment on the fibre matrix adhesion and mechanical properties, of such natural fibre-reinforced PLA based composites [4]

1.5 PLANNING AND EXECUTION

Table 1.1: Gantt chart for PSM 1

NO	ACTIVITIES	WEEK OF PROGRESS													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Selection of PSM title							S							
2	Literature review							E M							
3	Design of experiment							E							
4	Draft of PSM 1 poster							S							
5	Submission of poster							T E							
6	Characterization of raw material							R							
7	Preliminary data analysis							B							
8	PSM 1 report writing							R							
9	Submission of PSM 1 report							E A							
10	PSM 1 seminar							K							

The Gantt chart (Table 1.1) shows the planning for Final Year Project 1 research work, which commence in September 2014. The research activities include selection of research title and approval by the respective lecturer, literature review that is continuous throughout the studies, conceptual design or design of experiment, as well as establishing the methodology. This is followed by poster preparation and submission, also characterization of raw material and gets a preliminary data analysis. Draft report preparation and submission and the last but not least, Final Year Project 1 seminar.

CHAPTER 2

LITERATURE REVIEW

2.1 COMPOSITES

A composite is a structural material that consists of two or more combined constituents that are combined at a macroscopic level and are not soluble in each other. When there are combine together result in a material with entirely different properties from those of the individual components [7]. In other words, a composites material is made by combination with two or more material when the two materials work together, it can give a better and unique properties of composites than those of the individual components used alone. However, within the composites, it can easily shows the different materials apart as they do not dissolve or blend into each other. In contrast to metallic alloys, each material retains its separate physical, chemical and mechanical properties. The two constituents are reinforcement and a matrix [8]. Material of biological origin is generally composites for example bone. The bone in body becomes from a hard but brittle material that is called hydroxyapatite which is mainly calcium phosphate and a soft and flexible material called collagen which is a protein [9]. Collagen also has in hair and finger nails. When it combines with hydroxyapatite it can give bone the properties that needed to support the body [9].

Natural composites exist in both animal and plants. Wood for instance, which is made from long cellulose fibre. Cellulose is also found in cotton, but when it does not bind it together with lignin, it become much weaker. When the two weak substances lignin and cellulose combine together, it will become a much stronger one [9]. For many thousands of years, people have been making a composite. Exodus speaks of using straw to reinforce mud in brick making, without which the bricks would have no strength [10]. Mud can be dried out to make a brick shape to give a building material. It has a good compressive strength but it will break easily if apply a bending force because it has a poor tensile strength. For the ancient society to imitating the nature, they will use this approach as well by mixing mud ad straw together it is possible to make bricks that are resistant to both squeezing and tearing and make excellent building blocks [9, 10].

Most composites are made just to two materials. One is the matrix or binder. It surrounds and binds together fibre or fragments of the other material, which is called the reinforcement [9]. The main advantages of the composites materials are their high strength, toughness and stiffness, and its combine with low density, low cost, size ability, flame retardancy and corrosion resistance, non abrasive, non-toxic, acceptable specific properties ad they are recyclable and biodegradable when compared with bulk materials, allowing for a weight reduction in the finished part [2,8]. As show in table 1, the fibre that has been used in modern composites has strength and stiffness than used of traditional bulk materials. The high strengths of the glass fibre cause from the processing that avoids the internal or surface flaws. There is normally have a weaken glass, and the strength and stiffness of the polymeric aramid fiber is a consequence of the nearly perfect alignment of the molecular chains with the fibre axis [10].

Table 2.1: Advantages and Disadvantages of Commercial Composite [8].

ADVANTAGES	DISADVANTAGES
• Lighter weight.	• High raw material cost and usually high fabrication and assembly cost.
• The ability to tailor the layup for optimum strength and stiffness.	• Adverse effects of both temperature and moisture.
• Improve fatigue life.	• Poor strength in the out of plane direction where the matrix carries the primary load.
• Corrosion resistance.	• Susceptibility to impact damage and delaminating or ply separations.
• Good design practice.	• Greater difficulty in repairing them compared to metallic structure.
• Reduced assembly costs due to fewer details part and fasteners.	• Matrix degrades.

The biggest benefits of modern composites materials are they are light and strong. A new material can be made that exactly from the requirements of a particular application, when choosing the right and appropriate combination of matrix and reinforcement material. Besides that, composites also can provide the flexibility design because many of them can be molded into complex shapes. Although the resulting product is more sufficient, the raw materials are often expensive.

The first modern composites material was fiberglass. It is still widely used today for boat hulls, sport equipment, building panels and many car bodies. The matrix is a plastic and the reinforcement is glass that has been made into fine threads and often woven into a sort cloth. On its own, the glass is very strong but brittle and it will break if