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TENSILE STRENGTH OF SUGAR CANE FIBER REINFORCED COMPOSITE

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TENSILE STRENGTH OF SUGAR CANE FIBER REINFORCED COMPOSITE

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Thesis is submitted to
Faculty of Engineering, University Malaysia Sarawak
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Dedicated to my beloved parents, Mr. Ariffin bin Derahman and Mdm. Aminah bte Hassan, all my siblings, my supervisor Mr. Noor Hisyam bin Noor Mohamed and all my friends for supporting, help and encourage me through good and hard time

Thank you for your support and encouragement

Amin...

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ABSTRACT

This research is focusing on sugarcane as raw material for fiber reinforcement composite. From the residue a sugar cane, a fiber; bagasse is used to reinforce along with unsaturated polyester resin (UPS). The bagasse fiber reinforced has been fabricated in a random orientation. The specimens are categorized according to its fiber weight fraction (0%, 3% and 6%). A tensile test according to ASTM D3822-01 standard has been carried out in order to determine the tensile strength of the composite. The result showed that increasing of fiber weight fraction will decreased the value of tensile strength of the composite. This result does not agree with the literature and might be due to the sample preparation, high moisture content in the fiber and the lacking of information about the resin used in fabricating the composite.

ABSTRAK

Kajian ini mengfokuskan pokok tebu sebagai salah satu bahan mentah dalam penghasilan bahan komposit berasakan polyester. Berasaskan hampas tebu, terhasil gentian yang dinamakan bagasse, dan bahan inilah yang digunakan untuk penghasilan bahan komposit. Bahan komposit ini dihasilkan di dalam susunan lapis yang rambang. Spesimen-spesimen ini dikategorikan mengikut jumlah berat gentian (0%, 3%, 6%) di dalam bahan komposit. Ujian ketegangan telah dijalankan mengikut piawaian ASTM D3882-01 ke atas semua spesimen untuk mengkaji dan mengetahui ketegangan bahan komposit itu. Keputusan daripada ujian tersebut menunjukkan peningkatan jumlah gentian di dalam bahan komposit akan menyebabkan pengurangan kekuatan tegangan bahan komposit tersebut. Keputusan ini tidak menyamai teori yang mengatakan peningkatan bahan gentian di dalam bahan komposit akan menyebabkan peningkatan nilai kekuatan regangan bahan komposit. Masalah ini berpunca daripada penghasilan sampel, kandungan kelembapan yang tinggi di dalam gentian tersebut dan kualiti matrix yang di gunakan.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Fibre reinforced composite material represent a major change in designing structural material nowadays. Compared to other traditional ways of producing composite, this type of composite is much stronger and stiffer. Composite materials also act as a replacement for material such as metals and cement (they are very heavy, corrosive and less environmental friendly). For the past 30-40 years, fibre reinforced composite has been competing with other material such as steel, aluminium and concrete in cars, aircraft, building and everyday sports goods.

1.1 Scope and Objective

The main objective of this study is to manufacture and testing the sugarcane reinforced composite with 3 set of different fiber weight fraction and random orientation of fibers. The composite will undergo tensile test to determine the mechanical properties of the composite.

In order to achieve the objective of this research, the research will be carried out according to ASTM D3822-01, which is a standard method for tensile properties of polymer matrix composite material. The fibers are dry and treated with Sodium Hydroxide (NaOH). The properties of this treated composite with different weight fraction of fiber can be compared.

1.2 Important of Study

From the test, the mechanical properties of each composite material can be determined according to the result and data being collected. It is important to know the mechanical properties of composite material, in order to verify the properties of the material to which application the material can be applied to, either in normal environment or critical and extreme condition. However, this research will focus only on tensile strength of the composite and the result will be further discussed in chapter 4.

Other properties from the tensile test which are required in design criterion such as young modulus, yield strength, ultimate tensile stress and tensile strain of the product also can be achieved from the test. Therefore, it's necessary to know the effect of each composite material with different filler type for the ease of wide application in future.

1.3 Fibre Composite and Development

Fiber are the dominant constituent of most composite systems and one of the main objectives of any design should be to place the fibers in position and orientations so that they are able to contribute efficiently to load-carrying capability. The most widely available fiber form for advanced structural applications is continuous tows. These produce highly anisotropic materials of very high stiffness and strength in the direction of the reinforcement [3].

Fibers are hold together in a matrix along with resin. The combination of two different phases, can posses extraordinary mechanical properties such as the stiffness and the strength itself. In addition, the long fine form of the fibres, coupled with their mechanical strength, allow natural structures to be preferentially reinforced in areas of greater stress [3]. Compared to other bulk material, composite itself is far fewer defects,

hence a volume composite material given hundreds of times stronger when this fibres making up compared to the same volume of bulk material [4].

Fibre can be divided into 3 groups that are natural fibre, regenerated fibre and synthetic fibre [3]. Natural fibre consists of vegetables fibre, mineral fibre and animal fibre. This natural fibres all share the common traits of possessing molecular structures which themselves are arranged in a febrile manner [3]. Regenerated fibre is a fibre from natural fibre structural which is processed to form continuous filaments [3]. Synthetic fibres have the long molecular structure and are made from relatively simple molecules. Glass and carbon fibre are the example of synthetic fibre. Composite can be classified into roughly three or four type according to the filler types:

- Particulate or granulate
- Short fiber
- Long fiber
- Laminate

The short and long fibers are typically employed in compression moulding and sheet moulding operations. These come in the form of flakes, chips and random mate who can also can be made from continuous fibers laid in random until the desired thickness of the ply or laminate is achieved.

1.4 Characteristic of Composite Material

There are 3 characteristic that make the composite unique and useful:-

1.4.1 Strength

- They are high in rigidity and strength provides the required strength for all structures that they are used for buildings together with light weight properties.
- High capability to bear stresses (tensile strength), it's about four or six times greater than steel and aluminium's [10].
- 30% to 40% lighter than similar made of aluminium [10], it is obvious why the aircraft component made by this composite material.
- Besides their mechanical properties (high rigidity and high strength) help to prolong the cycle life of some equipment.

1.4.2 Stiffness

- Another characteristic of composite material is their stiffness to density ratio. This stiffness helps in building various structures.
- The stiffness can be set depends on application needed, it's also depends on type of fibre used, for example synthetic fibre is stiffer than natural fibre [10].

1.4.3 Expenses

- A lot of composite manufactured at a lower cost compared to other material such as steel or concrete. As for the fibre composite, they may be competitive at initial cost that includes manufacturing cost, less expensive in term of installation cost and far less costly to maintain [10].

1.5 Application of Composite Material

The use of the composite material is expanding and extensive. Applications include aerospace, building and civil engineering, marine, sporting goods and many more. For instant:-

1.6.1 Aerospace and Military

- Example of aerospace application includes the horizontal and vertical tail planes on the Boeing 777 that are made of carbon/epoxy because fibre composite is easier to shape according to aerodynamic rule.
- In military aircraft, weight is the most significant for performance, for example helicopters have used fibreglass reinforced rotor blades for improved fatigues resistance.

1.6.2 Sporting Goods

- Tennis racquets and golf shaft are the example of sports equipment that using composite material (carbon) to be made. There are lighter, better and stronger than wooden racquets. This also can help to prolong life times for the equipment [10].

1.6.3 Marine

- Before the composite were available the boats and ship made from the wood [10]. Therefore they were very costly, hard to shape a lot of maintenance problems. When the composite material is available, fibre composite boats were very famous because of their properties such as, very light in weight, easy to shape and less costly.

1.6.4 Building and Civil Engineering

- The main building material in civil engineering, concrete, fibre reinforcement is used. Fibre is used to hinder the crack propagation in the cement.

Composite materials has a wide range of application due to its possibility to combine high strength and stiffness with low weight and non-corrosive and is considered to be less expensive in cost when compared to other material in some cases.

They are also cheaper because of the reducing in cost over the product life time as they also has very low on maintenance cost [10].

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This section will focuses on several important features about the research of the composite material respect to the two type of fiber, which is composite material reinforcement of natural fibre as filler. This section also will discuss the definition of the natural fibre, wood fibre, aluminium filler, resin and tensile testing operation in order to further and support the research going to be conducted

2.1 Natural Fibres

Natural fiber are derived from a renewable resource, do not have a large energy requirement to process, and biodegradable. They are complex, three dimensional, polymer composites made up primarily of cellulose, hemicelluloses, pectins and lignin.

In composite industry, it usually refers to wood and agrobased bast, leaf, seed and stem fibers. These fibers often contribute greatly to the structural performance of the plant and when used in plastic composites, can provide significant reinforcement [2].

Fiber reinforced plastic composite have played a dominant role for a long time in a variety of application for their specific strength and modulus. The manufacture use and confiscation of traditional fiber reinforced plastic, usually made of glass, carbon or aramid fiber reinforced thermoplastic and thermosetting resins are considered critically because of environmental problems. Recently, there has been an increasing interest in the biodegradable plastic composite using natural fiber reinforcement.

One of the largest areas of growth in natural fiber plastic composite is the automotive industry, particularly in Europe. Most of the composite currently made with natural fibers are press mould. Natural fiber typically combined with polypropylene, polyester or polyurethane to produce such components as door and trunk liners, parcel shelves, seat back, interior sunroof shields and headrest [10].

The advantage of natural fibres includes low price, low density, unlimited source and abundance, sustainable availability, low abrasive wear of processing machinery. If the low density of the natural fiber taken into consideration, then its specific stiffness and strength are comparable to the respective quantities of glass fibers. Further, natural