UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ANALYSIS ON EFFECT OF COCONUT FIBRE TOWARDS IMPACT CHARACTERISTICS

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Mechanical Engineering Technology (Maintenance Technology) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Mechanical Engineering Technology (Maintenance Technology) with Honours. The member of the supervisory is as follow:

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ABSTRACT

Fibre is the one of the elements with matrix combination phase to become a new material structure that called composites. These combinations of the two types giving specific function where the fibre as the reinforcement in the composite are to provide the strength to the overall of the composite. In the production of composite resource at present, a combination of elements used must have towards more technology-friendly environment, where it can affect low rate pollution for the long term durations. Among the selected type of fibre access feature that required more environmentally friendly is a natural fibre. The scope of this study is to produce a composite of natural fibre where using coconut fibre source in which the impact test was done and the results is analysed. In industrial of creating new composite, it must give low effect emissions to the environment, in other side, the total cost in composite productions must be decreased so natural fibre is an alternative for the problem solving. Scope of this study includes the production of a composite consisting of coconut fibre and polyester resin by running the impact test and also reviewing the element properties to produce this composite. The result shows the value of impact properties which are giving effect by the total of fibre content. The pattern of the result whereby the increasing of the rate of percentage coconut fibre in the sample increased the value of the resilience and energy absorb. However the values given are directly proportional between percentage of coconut fibre, when 60% of coconut fibre content giving the maximum value of impact properties. Overall of this research output shows that the elements that affected towards increasing of the result is the good bonded between fibre, proper strength distributions and absorption of value of impact energy and also increment of fibre plasticity by the lignin of the fibre.

ABSTRAK

Gentian adalah salah satu elemen-elemen dengan matriks gabungan fasa menjadi struktur bahan yang baru,yang dipanggil komposit.Kedua-dua jenis gabungan ini memberikan fungsi yang tertentu di mana gentian sebagai tetulang di dalam komposit tersebut akan memberi kekuatan kepada keseluruhan komposit tersebut.Dalam penghasilan komposit sumber pada masa ini, gabungan elemen-elemen yang digunakan mestilah ke arah lebih teknologi mesra alam sekitar, di mana ia boleh menjejaskan kadar rendah pencemaran bagi tempoh jangka panjang. Antara jenis yang dipilih mempunyai akses gentian yang lebih mesra alam adalah gentian semulajadi. Tujuan kajian ini adalah menghasilkan komposit khususnya gentian semulajadi iaitu kelapa serabut di mana ujian kesan dilakukan dan keputusannya akan di analisis.Dalam industri untuk mewujudkan komposit baru, ia mesti memberi kesan pencemaran yang rendah ke alam sekitar,di sisi lain,jumlah kos dalam pengeluaran komposit mesti menurun,oleh yang demikian gentian semula jadi adalah alternatif bagi menyelesaikan masalah.Skop kajian ini meliputi sumber yang terdiri serabut kelapa dan resin poliyester dengan menjalankan ujian impak dan kajian setiap unsur untuk menghasilkan composit ini. Keputusan menunjukkan bahawa nilai hentaman bergantung dengan jumlah peratusan kandungan serat dalam sampel. Corak hasil di mana peningkatan kadar peratusan gentian kelapa dalam sampel akan meningkatkan nilai daya tahan dan serapan tenaga. Walau bagaimanapun nilai yang diberi adalah berkadar langsung antara peratusan gentian kelapa, apabila 60% daripada gentian kelapa kandungan memberi nilai maksimum terhadap nilai hentaman. Elemen-elemen yang terlibat ke arah meningkatkan hasil adalah ikatan antara gentian, pengagihan kekuatan yang sempurna dan penyerapan nilai kesan tenaga dan juga kenaikan daripada nilai plastik serabut oleh lignin di dalam serabut.

DEDICATIONS

To my beloved mother Mrs Hamizah Binti Rashid and my beloved father Mr Amir Fizal bin Hj Mosman.

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LIST OF SYMBOLS AND ABBREVIATIONS

Gpa	=	Gigapascal
Mpa	=	Megapascal
g/cc	=	Gram/cubic centimetre
Pt-Rh	=	Platinum-Rhodium Alloy
PAN	=	Polycarylonitrile
PAMC	=	Particulate Aluminium Matrix Composite
ASTM	=	American Society for Testing and Materials
J	=	Joule
KJ/m²	=	Kilojoule per meter square

CHAPTER 1
INTRODUCTION

1.1 Fibre

Fibre is the one of the elements with matrix combination phase to become a new material structure that called composites. These combinations of the two types giving specific function where the fibre as the reinforcement in the composite are to provide the strength to the overall of the composite, and the matrix phase provide the composite to against buckling for the compression force (Mahajan, G.,V.S.Aher, 2012). The fibre matter in the filament phase have extraordinary mechanical features in term part of strength and stiffness properties (A R Bunsell,J Renard, 2005) where fibre in the element composite structure provide strength more to the same materials in the bulk form, it commonly used for enhance the mechanical performance properties such as ceramics, metal, polymer and the other types classifications of fibre. It show from the experimental proving that increasing carbon fibre in composite content will increase the strength and toughening to prevent of the damage factor (Tiesong Lin et al., 2009), another example such as fibre glass ,the structure of the fibre can be an hundred much time stronger than bulk phase because the fibre structure inside the composite giving the parallel strength are with axes of the fibre, it can be obviously for the strength that can be negligible if right angle of the bundle being pulled with the fibre assembly in high anisotropic.

Composite technology are widely popular for industrial applications because it can adapt in different situations and easy to combine with another material part to become a various structure and exhibit desirable properties such as in the applications for use in manufacture industrial especially in making a wing plane technologies, where the fibre becomes an part to be more light, resist to corrosions and fatigue (Mouritz, 2006). In the production of composite resource at present, a

combination of elements used must have towards more technology-friendly environment, where it can affect low rate pollution for the long term durations.

Among the selected type of fibre access feature that required more environmentally friendly is a natural fibre, it gives the rates of lower environmental impacts compared to another productions such as glass fibre (S.V. Joshia et al.,2003).Example of natural fibre classification material is coconut fibre, and it identify become as the reinforcement strength element to making a new composites.

In this study case using coconut fibre by mixing polyester resin with different volume fractions and strength test of each sample by using Pendulum Impact Test Machine. All the data result will be record as a guide by producing a new of the composite sample.

1.2 Problem Statement

In an industrial production field that focused in producing composite recently using a fibre material that giving bad effect when dispose, in another way it also an alternative to the synthetic materials, where are now become an attractive in automotive industrial, because of low density and decrease the total cost (S.V. Joshia et al.,2003).In industrial of creating a new composite it must give low effect emissions to the environment so natural fibre is an alternative to solve this problem. In other side, the total cost in composite productions must be decreased by using natural fibre sources compare with another fibre material reinforced usage (Lucintel, 2011), and replacing the coconut fibre as a recycle material part to build the composite structure.

1.3 Objective

1. Create a new composition by using coconut fibre as a natural material.
2. Analyse impact effect to the composite properties of coconut fibre as a reinforcement in polyester resin.
3. Study about coconut fibre material and polyester resin.

1.4 Work Scopes

1. Creating the new composite by using the coconut fibre as reinforced material with polyester resin.
2. Analysing the impact effect of composite sample by using Pendulum Impact Test Machine.
3. Studying the element of the composite combination that is coconut as fibre as reinforcement and polyester resin as a matrix.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This literature review chapter will describe the composite structure and types of reinforcement fibre. Reference options are guided from the journal, previous thesis, reference book and article from the internet. This chapter includes overview properties of coconut fibre as a reinforcement phase with polyester resin as a matrix for combinations of composites, polyester resin material and also standard options to do testing methods.

2.2 Composites

Composites material as figure 2.1 shows the structure by the combination of two or more material compositions with different properties. In other side the term of composite is could mean almost anything if taken at face value, where all materials are composed of different subunits if examined details (Roylance, 2000). The details structure is a mixture of two or more of the element of materials present as a percentage of reasonable and have different properties in each other so that the composite is a become a new substance by producing a new properties of mechanical behaviour and also new structure for applicable usage in other side the combinations to be a new composites by different of the constituents ,they will retain their originality properties even it mixing properly and it can be identified by physically appear by proving with the laboratory test. Some of the composites that combine with heterogeneous structures by require the specific of desired design and functions are usually built by the limit in referring the desired classifications of field

scopes, however the research are made and it will produce the innovated types of the composites can be more upgrade compared with previous of the composites structure that exist.

The other material such as plastic it not similar with composites because plastic it is compound where the two materials of the chemical element are bond and combined together by a fixed proportions in term of the mass and overall of the substance can be split to convert into a substance with a simpler phase. Other materials such as alloy also are in different classifications even the concept are combination more element because it is homogenous mixture where the constituents will be in different phase in term of properties after in a mixing phase. (K.Srinivasan, 2009)

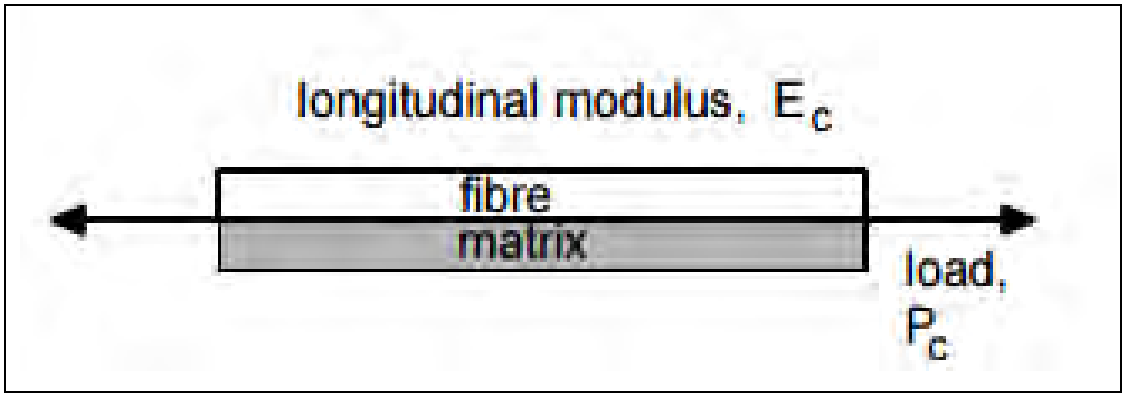

Figure 2.1 Composite Material (Harris, 1999)

The main base of the composites are divided at least the two types different chemical materials by different phase properties components there is a reinforcement and matrix. The functions of matrix in the composites is combines the fibres together where align well in force of stress directions, where the loads is applied and transfer to the fibres so it can enable to holding shear forces compressions as value of tensile loads (Harris, 1999).Reinforcement usually are from fibre material that to provide a total of the strength bonding and also physically in term rigid where the can hold to avoid to be deforms when force applied (Marston, 2007).Most common the types of the fibre for reinforcement is in term of fibres, sheets or particles and the common name for matrices is polymer, metal or ceramic.

The technology of the composites applications widely used as a part in aircraft such as development part of the aeroplane (Nayak, Nikhil V, 2014),in

research for the applications of the aerospace applications such as carbon Nano tube composites material part (Mark D. Taczak,2006),marine equipment such as body boats that lighten the overall of weight (Dr. S. Selvaraju, S.Ilaiyavel, 2011).

2.3 Reinforcements Classifications

There are several types of reinforcement used in the industry and each reinforcements display distinctive characteristics. Example types of reinforcements are metallic, polymeric, aramid, polyethylene, graphite, glass, carbon, alumina, silicon carbide, and basalt.

2.3.1 Metallic Fibre

Physical types of this composite such as in wire where in diameter size of 100μm construct made from Ti(Titanium),Ta(Tantalum),Mo (Molybdenum) or steel are classification of conventional drawing wire, for taylor process the specific wire size is 10μm or less. In some process for the large wire metal that melts in the glass sheets where reach in certain temperature, the main of the core metal wire combining in the melts conditions while the sheets become softer. The sheath decrease and the diameter become small where all the combination in stretching process. The improving by bonding of the fibre reinforced and the layer of the metallic in the surface treatment process in the aspect of the material decompositions, preparations and process of the cure where it cause residual stress of reserving stretching post (Tamer Sinmazçelik et al.,2011).

The properties types such as melting points, strength modulus are must be considered when selecting as reinforcement materials. The metal types such as Steel, Beryllium, molybdenum are good in strength, refractoriness and modulus in the term of the combination phase, all these material types have the high density except to the certain types such as Beryllium have a modulus where are (-300Gpa) with a low density (1,8 g /cc).The usage cost of the types of the Beryllium fibre are expensive

and also very dangerous because it can effect by toxicity from this material (K.Srinivasan, 2009).

2.3.2 Aramid Fibre

Make from the structure of nylon by benzene extra rings for the backbone that are increasing the properties of stiffness. The properties element is fatigue in the strength and poor due to the compression force but in the other advance is high tensile strength, high tensile in the modulus phase, low value of the break when the elongation have been done and also can resist to the chemical reactions (M Jassal,S Ghosh, 2002) Usually the names of these aramid called as Kevlar and the certain applications are used for reinforce in tyre structures. To produce this fibres is in low temperature by using sulphuric acid and then it extruded in freezing bath to remove the solvent. The strength of this fibre are low where is 850Mpa and Modulus of young is 5 Gpa. The density are in 1.45g/cc. Modulus and the strength are increases up or can be reach above to 2750 Mpa and 75Gpa by stretching and cold drawn as a structure align. (K.Srinivasan, 2009)

The improvement of the reinforcement value in term of the mechanical properties while use these types fibre such as increase in compressive strength, flexural strength and the main of the reinforce value (Abed Noor Jame et al., 2012)

2.3.3 Polyethylene

Identified as a lowest density compared to the other fibres where the value of the elastic modulus is 175Gpa, the melting point value is low that is 135 degree Celsius and the phase of the available use are over 100 degree Celsius. For the properties to produce in ultra-strong characteristics ,it can be made in gel spinning of the Ultra High Molecular Weight Polyethylene for producing of extraordinary types, and the phase will be as high of the strength of tensile and the density are light, for the other way of the physical such as axial and the compressions of the transverse are

low where the value with the other material properties such as fibreglass and carbon fibre are contra of high difference (Marissen, 2011)

The types in ribbond conditions where the combination of fibre band are strong, thin, easy to react with composite resin, and the applications of the composites are usually use in the dentistry for the many types of usage (Agrawal, 2014)

2.3.4 Glass Fibre

They have many varieties types of these fibre such as E-glass(electrical glass),S-glass(the stiffness are high),C-glass(Resistant to the chemical reactions),E-CR-glass(which are can resist to the element of the corrosions and electrical) and AR-glass(resistant to the alkaline chemical).In manufacturing of the glass fibre productions where the raw materials will be melted in hopper and glass of molten and gravity attractions by the Pt-Rh(Platinum-Rhodium Alloy) bushing by containing with the available of many holes. The polymer have been coated to the overall of the fibre before entering the drum process. (K.Srinivasan, 2009)

The size of diameter depends the bushing that used in the molten glass viscosity and total heat that used in the hopper, usually it produced the diameter 10μm in overall process. In the process such as Melt spinning glass are from melt of strong silicate viscous most glass fibre forming process with the multitude process such as novel plasma glass melting and fibre technology of modelling which including E-glass boron silicate, free-boron, Glass of E,D,S,ECR, insulation bio component, AR and Chinese C Glass types (Wallenberger, 2010) Certainly the fibre not to be great as a reinforcement functions and the factor of these functions depending with the environment conditions such as temperature ,moisture and field of stress in way the material have been exposed (Mariana Etcheverry,Silvia E. Barbosa, 2012).

2.3.5 Carbon Fibre

Carbon fibre are the sixth rank in the term of the light element, the bonding of the carbon covalent are strongest compared to the other fibre where the value of bonding is 4000 kJ/mole. These material can be produced from the process of polycarylonitrile (PAN) or pitch .The pitch types are more cheaper for usually used in the beginning process of manufacturing with the process of the fiberisation, stabilizations, carbonizations and also graphitisation (K.Srinivasan, 2009).

The structure of the atomic in carbon fibre characterized is similar to the graphite where include of layers of the carbon atom layers (graphene sheets) by arranged in hexagonal of the pattern. It depends by the precursors and in the process of the manufacturing, the planes layer will be as microstructure of PAN. The coating of the Carbon Fibre to facilitate is easy for handling for adhesion factor with matrix material. (K.Srinivasan, 2009).The microstructure of PAN form it depends on the condition of processing and precursors as the figure 2.2

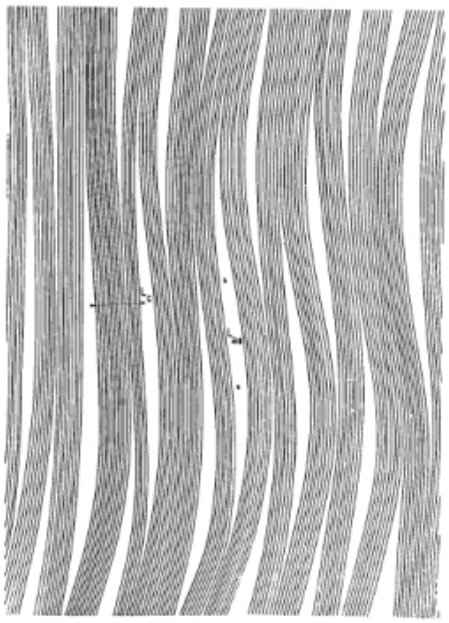

Figure 2.2 Microstructure of PAN carbon fibre ((Huang, 2009)

2.3.6 Alumina Fibre

The types of the materials can be produced from the technique of sol-gel processing (process material become in solid phase from small molecules). Firstly the concentrate of the Sol is prepared from viscous gel form. The gel is obtain to spun, the precursor fibre and to get the oxide fibre the final process called calcined (K.Srinivasan, 2009).In the reinforced for alumina reinforced process the mechanical properties are giving great element of the properties where it affected by parameters of sintering and also combination of interface between fibre and matrix. The lower of the temperature, giving lower to the strength maximum reach and gives resulting in ductile fracture (P.Y Lee et al.,2003).

2.3.7 Silicon Carbide

This types of fibre are can be produce by controlled pyrolysis of the polymeric precursor. The result are very thin size compared to the result of producing by Chemical Vapour Depositions (K.Srinivasan, 2009).

With reinforced by using purity of silicon carbide fibres the elastic and proportional stress of limit are increase, the tensile properties in plane are insensitive from the research by a carbon interphase thickness for a range between 30 and 230nm and it was found in composites strength that have multilayers on silicon carbide and bundles fibre bundles that is superior in the composites by a carbon alone. Silicon carbide have a phase of non-oxide ceramic which are used in industrial applications .The main properties of silicon carbide are high of hardness and strength, thermal and chemical stable, high of the melting point reach, and also the erosion resistance (Houyem Abderrazak,Emna Selmane Bel Hadj Hmida, 2011).

The mechanical behaviour giving a good properties with the value of the big thermal stability and resistance to oxidations, it can establish that Particulate Aluminium Matrix Composite (PAMC) with silicon carbide giving a good result of mechanical properties in the temperature consist. The strength of the Ultimate Tensile for yield strength, hardness and ductility gives a stability and improvement