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Experimental Investigation on Natural Fiber as Composite Material for Vehicle Body Applications

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ABSTRACT: Now-a-days, the natural fibres and fillers from renewable natural resources offer the potential to act as a reinforcing material for polymer composite material alternative to the use of natural fibres and other man-made fibres. Among various natural fibres and fillers like jutefiber, wheat straw, rice husk, wood powder, coconut coir ash, jute, hemp etc. are the most widely used natural fibres and fillers due to its advantages like easy availability, low density, low production cost and reasonable physical and mechanical properties. This research work presents the effects of natural fillers, hybrid composite structure is formed. The result of test depicted that hybrid composite has far better properties than single fibre glass reinforced composite under impact and flexural loads. However it is found that the hybrid composite have better strength as compared to single glass fibre composites.

KEY WORDS: fiber composites, Natural fibers; Automobiles; Green Composites; Material.

I. INTRODUCTION

The growing demand in the world for more adaptable materials suitable for various applications led to the development of polymeric composites with natural fibre as reinforcing agents. Synthetic fibers are not environment friendly because its create environmental pollution so this has shifted the focus on utilizing natural fibers, capitalizing on their advantages of being environment friendly, economical, lower densities, higher filling levels, environment friendly and renewable nature, recyclability. Natural fibers can be used as alternatives of synthetic fibers, e.g. jutefiber, glass, carbon, etc. Natural fibers such as jute, jute, hemp, jutefiber, rice husk, corncob, luffa etc. have satisfactory mechanical properties make them an attractive ecological alternative to synthetic fibers used for the manufacturing of composites. Natural fibers have superior mechanical properties such as flexibility, stiffness and modulus compared to glass fibers. The natural fibers such as banana fiber,coconut coir ashfiber are replacing the glass and other synthetic fibers because it's have easy availability and cost. bananafiber/coconut coir ashfiber composites are environment friendly and user-friendly materials and have very good elastic properties. Banana fiberfiber is the best reinforcement because of low cost, low density, high specific strength, no health hazards and finding applications in making of ropes, mats, carpets, fancy articles etc. Inaddition to this, adding banana fiber, coconut coir ashfiber,jutefiberfiber etc., mechanical properties and water resistance of the hybrid composites. Banana fiberfiber contains 85-90 % organic matter such as cellulose, lignin etc. and rest mineral components such as silica, alkalis and trace elements.

TYPES OF COMPOSITE

POLYMER MATRIX COMPOSITE

Polymers make ideal materials as they can be processed easily, possess lightweight, and desirable mechanical properties. It follows, therefore, that high temperature resins are extensively used in aeronautical applications. Two main kinds of polymers are thermosets and thermoplastics. Thermosets have qualities such as a well-bonded three-dimensional molecular structure after curing. They decompose instead of melting on hardening. Merely changing the basic composition of the resin is enough to alter the conditions suitably for curing and determine its other characteristics. They can be retained in a partially cured condition too over prolonged periods of time, rendering Thermosets very flexible. Thus, they are most suited as matrix bases for advanced conditions fiber reinforced composites. Thermosets find wide ranging applications in the chopped fiber composites form particularly when a premixed or moulding compound with fibers of specific quality and aspect ratio happens to be starting material as in epoxy, polymer and phenolic polyamide resins. Thermoplastics have one- or two-dimensional molecular structure and

they tend to at an elevated temperature and show exaggerated melting point. Another advantage is that the process of softening at elevated temperatures can be reversed to regain its properties during cooling, facilitating applications of conventional compress techniques to mould the compounds. Resins reinforced with thermoplastics now comprise an emerging group of composites. The theme of most experiments in this area is to improve the base properties of the resins and extract the greatest functional advantages from them in new avenues, including attempts to replace metals in die-casting processes. In crystalline thermoplastics, the reinforcement affects the morphology to a considerable extent, prompting the reinforcement to empower nucleation. Whenever crystalline or amorphous, these resins possess the facility to alter their creep over an extensive range of temperature. But this range includes the point at which the usage of resins is constrained, and the reinforcement in such systems can increase the failure load as well as creep resistance.

METAL MATRIX COMPOSITE

Metal matrix composites, at present though generating a wide interest in research fraternity, are not as widely in use as their plastic counterparts. High strength, fracture toughness and stiffness are offered by metal matrices than those offered by their polymer counterparts. They can withstand elevated temperature in corrosive environment than polymer composites. Most metals and alloys could be used as matrices and they require reinforcement materials which need to be stable over a range of temperature and non-reactive too. However, the guiding aspect for the choice depends essentially on the matrix material. Light metals form the matrix for temperature application and the reinforcements in addition to the aforementioned reasons are characterized by high moduli. Most metals and alloys make good matrices. However, practically, the choices for low temperature applications are not many. Only light metals are responsive, with their low density proving an advantage. Titanium, Aluminium and magnesium are the popular matrix metals currently in vogue, which are particularly useful for aircraft applications. If metallic matrix materials have to offer high strength, they require high modulus reinforcements. The strength-to-weight ratios of resulting composites can be higher than most alloys.

CERAMIC MATRIX COMPOSITE

Ceramics can be described as solid materials which exhibit very strong ionic bonding in general and in few cases covalent bonding. High melting points, good corrosion resistance, stability at elevated temperatures and high compressive strength, render ceramic-based matrix materials a favourite for applications requiring a structural material that doesn't give way at temperatures. High modulus of elasticity and low tensile strain, which most ceramics possess, have combined to cause the failure of attempts to add reinforcements to obtain strength improvement.

FIBER REINFORCED COMPOSITE

Fibers are the important class of reinforcements, as they satisfy the desired conditions and transfer strength to the matrix constituent influencing and enhancing their properties as desired. Glass fibers are the earliest known fibers used to reinforce materials. Ceramic and metal fibers were subsequently found out and put to extensive use, to render composites stiffer more resistant to heat. Fibers fall short of ideal performance due to several factors. The performance of a fiber composite is judged by its length, shape, orientation, and composition of the fibers and the mechanical properties of the matrix. The orientation of the fiber in the matrix is an indication of the strength of the composite and the strength is greatest along the longitudinal direction of fiber. This doesn't mean the longitudinal fibers can take the same quantum of load irrespective of the direction in which it is applied. Optimum performance from longitudinal fibers can be obtained if the load is applied along its direction.

OBJECTIVE:

The main objective of this addition of pineapple and banana to Epoxy reduces density and significantly increases stiffness; for each weight percent of E-glass added to epoxy (up to 4 wt. %), density and elastic modulus is improved by 3% and 4%, respectively. Designers are able to achieve a weight saving of up to 20 % by using pineapple and banana-Epoxy instead of traditional interior materials in aircraft. Studies of the effect of slip morphology on the monotonic and cyclic ductility of pineapple and banana-Epoxy show that ductility is controlled by strain localization which depends on the extent of work softening on the glide plane. As aging is increased from under aged to peak strength, shear able precipitates localize monotonic strain in intense bands of deformation which produce stress concentrations and reduced ductility.

DESIGN CONSIDERATION

Among the unique characteristics of aerospace grade materials, mechanical properties are most important and play a decisive role while selecting a material. Aircraft designers principally consider properties like weight, strength,

toughness, ductility, hardness, elasticity, fatigue resistance, creep resistance, and corrosion resistance. When designing a new material in aircraft industry, one has to consider multiple factors and these are;

- Raw material's availability and cost
- Required skills and processing technology
- Finished component rejection rates and waste recycling
- Unknown risks while deciding application area
- Uncertainties in performance
- Damage tolerance maintenance frequency & replacement procedures
- Other factors i.e. improvement in profitability and margins.

USE OF COMPOSITE IN AEROSPACE STRUCTURE

It is to be realized that in order to meet the demands in feature of aerospace structure, it is necessary to have materials with a peculiar property-set. The use of composites has been motivated largely by such considerations. The composites--in particular, the advanced fibre reinforced composites using carbon or aramid fibres in polymer matrices--offer several of these features as given below

- Light-weight due to high specific strength and stiffness
- Fatigue-resistance and corrosion resistance
- Capability for high-degree of optimization: tailoring the directional strength and stiffness
- Capability to mould large complex shapes in small cycle time reducing part count and assembly times. Good for thin-walled or generously curved construction
- Capability to maintain dimensional and alignment stability in space environment
- Possibility of low dielectric loss in radar transparency
- Possibility of achieving low radar cross section. These composite materials also have some inherent weaknesses
- Laminated structure with weak interfaces: poor resistance to out-of-plane tensile loads
- Susceptibility to impact-damage and strong possibility of internal damage going unnoticed

USE OF COMPOSITE IN AUTOMOTIVE INDUSTRY

The automotive industry has two very distinct parts: the large-volume sector and the specialist area producing modified or complete vehicles in small numbers. The challenges of each are different and this is reflected in the way car manufacturers approach the use of composites.

- In the large-volume sector, a large percentage of the cost is in the capital plant needed for manufacture and so once the required equipment has been procured and commissioned it is very costly to change the design of a component. This naturally makes the industry very conservative, and encourages extensive prototype testing in both real and simulated environments of any new system before the investment is made.
- In small-volume production, however, the manufacturing operations are much less capital intensive and so the resistance to change in material is somewhat less.

SCOPE OF THE PROJECT

The scope of the project is to develop high strength and increase in elongation of composite material with mixture of pineapple and banana with epoxy resin. To reduce the density of composite material used in aerospace industry and also to reduce the weight of the material used in interior parts of the aircrafts.

II. LITERATURE REVIEW

1. Influence of rice husk fillers on mechanical properties of banana/epoxy natural fiber hybrid composites **S. Deepan, R. Jeyakumar , V. Mohankumar , A. Manojkumar**

Increasing environmental pollution, climate change, and the use of non-biodegradable or renewable resources have become major concerns for researchers in the modern industrialized world. It is believed that if we are to build a sustainable future, we must address these issues while also protecting the capabilities of the forthcoming generations to achieve their own requirements. Compared to synthetic reinforcing fiber natural fiber has different advantages such as harmlessness, low densities, lower processing costs, and similar comparable strength. In this experiment banana fiber reinforced with the epoxy and rice husk bio filler hybrid composites were made and the Mechanical properties of for these hybrid composites were characterized. Different volume fractions of fiber with various composite samples were made by using the traditional hand layup method and pressure applied at moderate temperature. All the hybrid samples

were tested under tensile, flexural, and impact loading, the interfaces of fiber matrix were evaluated and the fractured surface structures were analyzed using a Scanning electron microscope (SEM). From the results, it was observed that the composite samples with 30 % banana fibers and 10 % rice husk exhibited better mechanical properties when compared with the other composite compositions.

2. Banana Fiber-Reinforced Epoxy Composites: Mechanical Properties

Tuan Anh Nguyen and Thi Huong Nguyen

Currently, the growing field of technology has paved the way for using environmental friendly resources; in particular, plant origin

holds ecological concern and renewable aspects. Currently, natural fiber composites have widening attention, thanks to their ecofriendly

properties. In the present work, the composite material is reinforced with natural fibers from the bark of banana trees (banana fibers), a material available in Vietnam. Banana fibers are extracted from banana peels, pretreated with NaOH 5%, and then cut to an average length of 30 mm. Banana fiber is reinforced for epoxy resin Epikote 240 with mass percents: 10 wt.%, 15 wt.%, 20 wt.%, and 25 wt.%. The results were evaluated through structural morphology (SEM), mechanical properties, fire resistance, and thermal properties. Experimental results show that the tensile, compressive, and impact strengths of biosynthetic

materials up to 20% by weight have increased compared to epoxy neat. Flame retardant and thermal properties are kept stable; 20 wt.% banana fiber gives a limiting oxygen index of 20.8% and satisfactory thermal stability.

3. Experimental Study of The Mechanical Properties of Banana Fiber and Groundnut Shell Ash Reinforced Epoxy Hybrid Composite

A. Lakshumu Naidu, S. Kona

Effect of addition of filler material to the natural fiber composite was experimentally investigated. Composites are manufactured by the conventional hand-layup method. All composites are made with a fixed banana fiber with 15% weight fraction addition of different weight fraction of (0, 3, 5, 7.5%) groundnut shell ash is added to the composite. Tensile, hardness, impact and compressive strength are conducted to find the mechanical behaviour of the composites. Preparation and testing were conducted according to ASTM standards. Results illustrate that mechanical properties are improved by the addition of groundnut shell ash to the epoxy based banana fiber composite. Natural fiber composites are predominantly used in automobile (Door panels, interior parts and cabin linings), aerospace and packing material. Natural fibers have more advantages like low cost, biodegradable and low density than the inorganic materials, the environmental impact of the natural fibers are less compared to synthetic fibers.

4. Utilization of Banana Fiber-Reinforced Hybrid Composites in the Sports Industry

Al Rashid, Muhammad Yasir Khalid, Ramsha Imran, Umair Ali,

The sports industry is an ever-growing sector worldwide. With technological advancements in information technologies, the sports industry has merged with the entertainment industry, reaching and influencing billions of people globally. However, to ensure and advance the safety, security, and sustainability of the sports industry, technological innovations are always needed in several manufacturing and materials processes to achieve cost-effectiveness, efficiency, durability, reusability, and recyclability of products used in this industry. For example, 90% of the field hockey equipment produced in the world comes from Sialkot, Pakistan. Most export quality field hockey equipment is currently produced via reinforcement of glass/carbon fibers in epoxy resin. The current study aimed to introduce new materials for field hockey equipment to reduce manufacturing costs and the environmental impact of synthetic materials, without comprising the quality of the final product. Our literature review on natural fibers revealed that they offer excellent and compatible mechanical properties. Based on extensive experimental studies, we concluded that banana fiber reinforced hybrid composites could be an alternative to pure glass fiber reinforced composites, with comparable and even higher load withstanding capabilities. Using banana fiber reinforced hybrid composites for the fabrication of hockey products would cut costs and lower the environmental impact stemming from the uses of biodegradable organic materials. It will also lead to the development of a domestic economy based on domestic resources.

5. Experimental Investigation of Mechanical Properties of Banana and Glass Fiber Reinforced Epoxy Based Hybrid Composites with Filler Materials

P. Divya Vani, P. Prasanna

Natural fibers are fibers obtained from plants, animals and geological processes. These are of low cost and light in weight because of which, they are used in various engineering applications. Hybridization is a process of incorporating synthetic fiber with natural fiber to get the better material properties. Filler materials are those materials which on addition improve the properties of composite. An investigation is carried out to find the effect of filler materials on mechanical properties of hybrid composites by changing the content of filler. Experiments are carried out as per ASTM standards to find the mechanical properties. The effect of fiber length and % of filler on tensile strength, flexural strength, Impact strength and hardness of composites is studied.

III. MATERIALS SELECTION

1. Banana fiber
2. pine apple fiber
3. epoxy resin
4. 4.hardner HY915

EXPERIMENTAL DETAILS

BANANA FIBER:



The banana is not a tree but a high herb that can attain up to 15 feet of height. It is a perennial plant that replaces itself. Bananas do not grow from a seed but from a bulb or rhizome. The time between planting a banana plant and the harvest of the banana bunch goes from 9 to 12 months. The flower appears in the sixth or seventh month. Bananas are available all year long. Bananas are grown in tropical regions where the average temperature is 80° F (27° C) and the yearly rainfall is 78-98 inches (200-250 centimetres). They require moist soil with good drainage. In fact, most bananas exported are grown within 30 degrees either side of the equator. Banana growing is, in general, labour intensive because banana plants require intensive, individual care in order to obtain the required quality fruit: clearing away of jungle growth, propping to counter bending from the weight of the growing fruit and irrigation during the dry season.

EXTRACTION OF BANANA FIBRE

Banana fibre is extracted, not on a commercial worthwhile scale anywhere in the country. For extraction of fibres from the pseudostem, the most common method followed in Indian villages is hand scrapping, i.e. to scrap the stem with blunt metal edge. The drawback of hand scrapping is that the fibre output is very low. The essentially hand driven process of extracting banana fiber is now set to change with the invention of the Banana Fiber Separator Machine. An

easier and quicker way of extracting fibres is to use a machine extractor, called Raspador, Banana Fiber is extracted from Banana pseudostem sheaths. Some efforts to extract the fibre by conventional methods like Hand extraction are being made in state of Kerala but the quantity of fibre produced is quite small.

CHARACTERISTICS OF BANANA FIBER

In most part of India, these banana trunks are thrown as agricultural waste because most of the people are ignorant about the extraction of the fibre and its utilization except Kerala where this fibre is partly used for manufacturing household articles. This present portion of article gives an evaluation of yield, structure and properties of banana fibres gathered from a few commercially cultivated varieties. Results indicate that variation exists in both structure and properties of fibres from different regions along the length and across the thickness of the trunk. Banana fiber is a natural leaf fiber. It has its own physical and chemical characteristics and many other properties that make it a fine quality fiber.

SPECIFICATION OF BANANA FIBRES

| Linear Density (D) | Average Strength (cN/tex) | Strength Unevenness (%) | Average Elongation at Break (%) | Elongation Unevenness (%) | Break Strength (cN/tex) |
|--------------------|---------------------------|-------------------------|---------------------------------|---------------------------|-------------------------|
| 4.03 | 39.3 | 34.3 | 5.4 | 19.7 | 2.3 |

USES/ APPLICATIONS

Banana is cultivated in about 2, 30,000 hectares of land and the fibre yield is around 8.7 lakh toned. Though fibre extraction is not done on any large scale at present, banana fibres are reported to have been spun on the jute spinning machinery and used hand bags and other fancy articles. Most of the Banana fibers produced today is used for ropes and cordage. The resistance of the fibre to the sea-water and its natural buoyancy has created a ready market for it in the manufacture of shipping cables. It is also widely used for making power transmission ropes and cordage, wall drilling cables, fishing nets, lines and other types of cordage.

INEAPPLE FIBER



EPOXY RESIN



PREPARATION OF MOULD



EPOXY, Hardner & Remover



Weighting Machine



Hand layer Moulding Preparation



compression Moulding Preparation



Surface Finishing Of Moulding



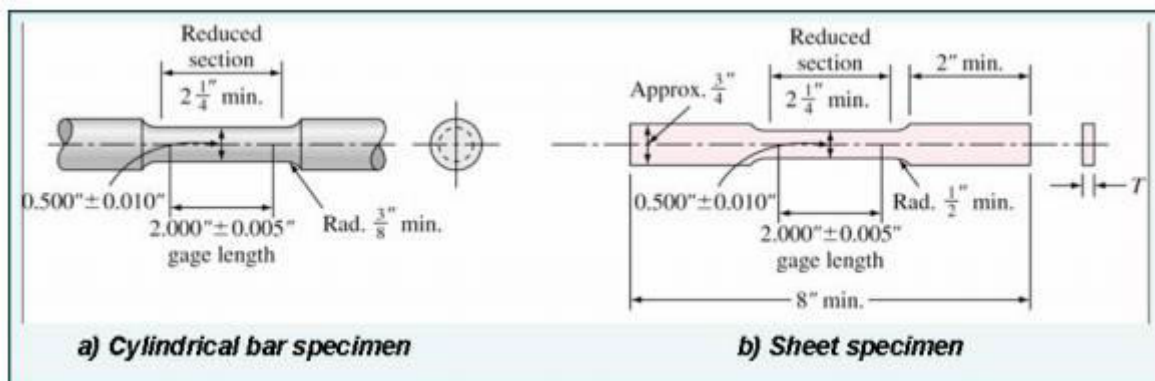
Fabricated composite material

TENSILE TEST



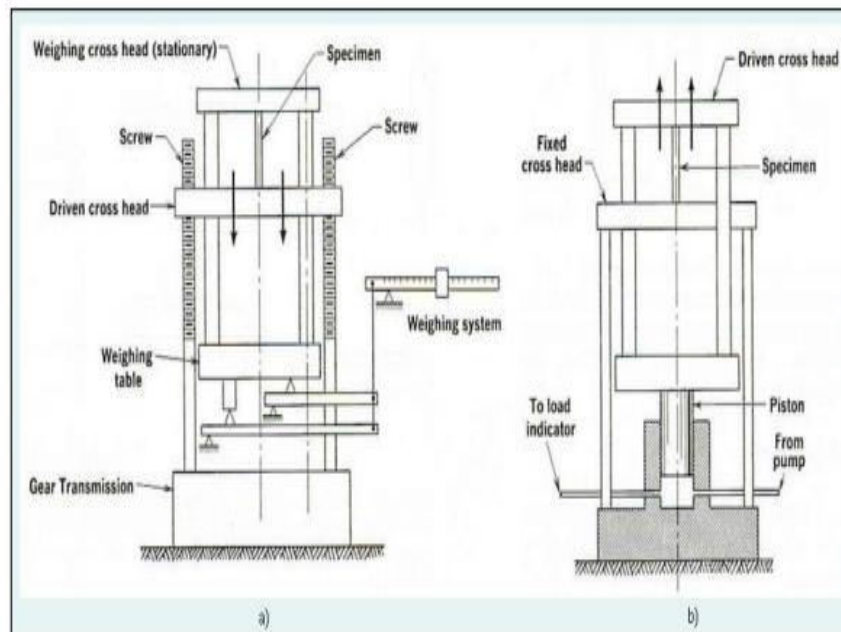
UNIAXIAL TENSILE TESTING:

Uniaxial tensile test is known as a basic and universal engineering test to achieve material parameters such as ultimate strength, yield strength, % elongation, % area of reduction and Young's modulus. These important parameters obtained from the standard tensile testing are useful for the selection of engineering materials for any applications required. The tensile testing is carried out by applying longitudinal or axial load at a specific extension rate to a standard tensile specimen with known dimensions (gauge length and cross sectional area perpendicular to the load direction) till failure. The applied tensile load and extension are recorded during the test for the calculation of stress and strain. A range of universal standards provided by Professional societies such as American Society of Testing and Materials (ASTM), British standard, JIS standard and DIN standard provides testing are selected based on preferential uses. Each standard may contain a variety of test standards suitable for different materials, dimensions and fabrication history.



STANDARD TENSILE SPECIMENS

The equipment used for tensile testing ranges from simple devices to complicated controlled systems. The so-called universal testing machines are commonly used, which are driven by mechanical screw or hydraulic systems. The below figure illustrates a relatively simple screw-driven machine using large two screws to apply the load whereas next figure shows a hydraulic testing machine using the pressure of oil in a piston for load supply. These types of machines can be used not only for tension, but also for compression, bending and torsion tests. A more modernized closed-loop servo-hydraulic machine provides variations of load, strain, or testing machine motion (stroke) using a combination of actuator rod and piston. Most of the machines used nowadays are linked to a computer-controlled system in which the load and extension data can be graphically displayed together with the calculations of stress and strain. General techniques utilized for measuring loads and displacements employs sensors providing electrical signals. Load cells are used for measuring the load applied while strain gauges are used for strain measurement. A Change in a linear dimension is proportional to the change in electrical voltage of the strain gauge attached on to the specimen.



a) a Lead screw driven machine

b) a hydraulic testing machine

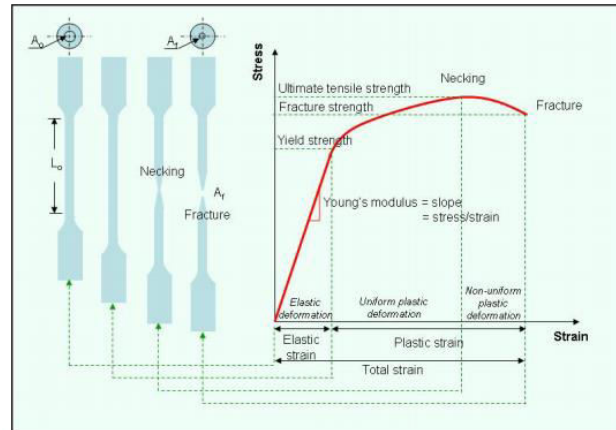
STRESS AND STRAIN RELATIONSHIP

When a specimen is subjected to an external tensile loading, the metal will undergo elastic and plastic deformation. Initially, the metal will elastically deform giving a linear relationship of load and extension. These two parameters are then used for the calculation of the engineering stress and engineering strain to give a relationship as illustrated in figure 3 using equations 1 and 2 as follows

YOUNG'S MODULUS, E:

During elastic deformation, the engineering stress-strain relationship follows the Hook's Law and the slope of the curve indicates the Young's modulus (E)

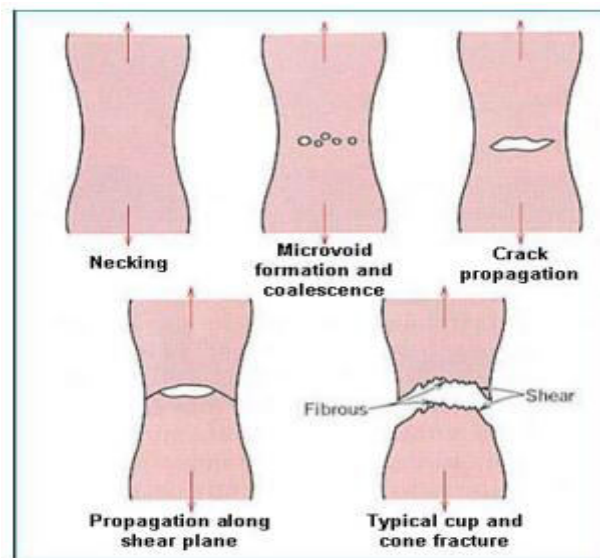
Young's modulus is of importance where deflection of materials is critical for the required engineering applications. This is for examples: deflection in structural beams is considered to be crucial for the design in engineering components or structures such as bridges, building, ships, etc. The applications of tennis racket and golf club also require specific values of spring constants or Young's modulus values.



Stress-strain relationship under uniaxial tensile loading

FRACTURE CHARACTERISTICS OF THE TESTED SPECIMENS

Metals with good ductility normally exhibit a so-called cup and cone fracture characteristic observed on either halves of a broken specimen as illustrated in figure 8. Necking starts when the stress-strain curve has passed the maximum point where plastic deformation is no longer uniform. Across the necking area within the specimen gauge length (normally located in the middle), microvoids are formed, enlarged and then merged to each other as the load is increased. This creates a crack having a plane perpendicular to the applied tensile stress. Just before the specimen breaks, the shear plane of approximately 45° to the tensile axis is formed along the peripheral of the specimen. This shear plane then joins with the former crack to generate the cup and cone fracture as demonstrated in figure 8. The rough or fibrous fracture surfaces appear in grey by naked eyes. Under SEM, copious amounts of micro voids are observed as depicted in figure 9. This type of fracture surface signifies high energy absorption during the fracture process due to large amount of plastic deformation taking place, also indicating good tensile ductility. Metals such as aluminium and copper normally exhibit ductile fracture behaviour due to a high number of slip systems available for plastic deformation. For brittle metals or metals that failed at relatively low temperatures, the fracture surfaces usually appear bright and consist of flat areas of brittle facets when examined under SEM as illustrated in figure 10. In some cases, clusters of these brittle facets are visible when the grain size of the metal is sufficiently large. The energy absorption is quite small in this case which indicates relatively low tensile ductility due to limited amount of plastic deformation prior to failure.



In summary, tensile properties should be considered as important design parameters for the selection of engineering materials for their desired application. Engineers have played a significant role in that they should be able to analyse and understand material behaviour and properties through these mechanical testing parameters.

MATERIALS AND EQUIPMENT

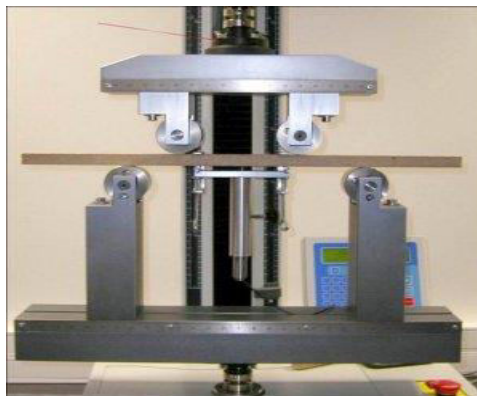
1. Tensile specimens
2. Micrometer or vernier callipers
3. Universal testing machine
4. Stereoscope

EXPERIMENTAL PROCEDURE

1. The specimens provided are made of composite materials. Measure and record specimen dimensions (diameter and gauge length) in a table provided for the calculation of the engineering stress and engineering strain. Marking the location of the gauge length along the parallel length of each specimen for subsequent observation of necking and strain measurement.
2. Fit the specimen on to the universal Testing Machine (UTM) and carry on testing. Record load and extension for the construction of stress-strain curve of each tested specimen.
3. Calculate Young's modulus, yield strength, ultimate tensile strength, fracture strain, % elongation and % area of reduction of each specimen and record on the provided table.
4. Analyse the fracture surfaces of broken specimens using stereoscope, sketch and describe the results.
5. Discuss the experimental results and give conclusions.

FLEXURAL TEST

Method for measuring behaviour of materials subjected to simple beam loading. It is also called a transverse beam test with some materials. Specimen is supported on two knife edges as a simple beam and load is applied at its midpoint. Maximum fibre stress and maximum strain are calculated for increments of load. Results are plotted in a stress-strain diagram, and maximum fibre stress at failure is flexural strength. Flexural yield strength is reported for materials that do not crack. Standard test procedures are given in ASTM D-790 (plastics) and ASTM C-674 (fired white ware). ASTM D-797 (elastomers), ASTM A-438 (cast iron) and ASTM D-86 (glass).



Flexure tests are generally used to determine the flexural modulus or flexural strength of a material. A flexure test is more affordable than a tensile test and test results are slightly different. The material is laid horizontally over two points of contact (lower support span) and then a force is applied to the top of the material through either one or two points of contact (upper loading span) until the sample fails. The maximum recorded force is the flexural strength of that particular sample. Unlike a compression test or tensile test, a flexure test does not measure fundamental material properties. When a specimen is placed under flexural loading all three fundamental stresses are present: tensile, compressive and shear and so the flexural properties of a specimen are the result of the combined effect of all three stresses as well as (though to a lesser extent) the geometry of the specimen and the rate the load is applied.

PROCEDURE

- Prepare the test specimen
- Clean the bearing surfaces of the supporting and loading rollers, and remove any loose sand or other material from the surfaces of the specimen where they are to make contact with the rollers.
- Circular rollers manufactured out of steel having cross section with diameter 38 mm will be used for providing support and loading points to the specimens. The length of the rollers shall be at least 10 mm more than the width of the test specimen. A total of four rollers shall be used, three out of which shall be capable of rotating along their own axes. The distance between the outer rollers (i.e. span) shall be $3d$ and the distance between the inner rollers shall be d . The inner rollers shall be equally spaced between the outer rollers, such that the entire system is systematic.
- The test specimen shall be placed in the machine correctly centred with the longitudinal axis of the specimen at right angles to the rollers. For moulded specimens, the mould filling direction shall be normal to the direction of loading.
- The load shall be applied at a rate of loading of 400 kg/min for the 15.0 cm specimens and at a rate of 180 kg/min for the 10.0 cm specimens.

COMPRESSION TEST

Compression tests are used to determine how a product or material reacts when it is compressed, squashed, crushed or flattened by measuring fundamental parameters that determine the specimen behavior under a compressive load. These include the elastic limit, which for "Hookean" materials is approximately equal to the proportional limit, and also known as yield point or yield strength, Young's Modulus (these, although mostly associated with tensile testing, may have compressive analogs) and compressive strength.

IV. CONCLUSION

The experimental study on the hybrid composite with natural fillers on physical, tensile, compression and flexural test and mechanical behavior test leads to the following conclusions On the upcoming study the natural fillers are added with the prescribed weight ratio to the banana and pineapple fiber its mechanical characteristics are analyzed by the same testing procedure and by comparing the obtained results, the better material composition is finalized.

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