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Experimental and Investigation of Wheel Hub by using Aluminum and Magnesium Composite Material and Evaluate The Mechanical Properties

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Abstract

The development of composite materials made up of natural fibers is improving in engineering applications such as Automotive, Marine and Aerospace, due to its properties such as high specific strength, renewable, non-abrasive, low cost, bio-degradability. Many researchers have identified different natural fibers used to substitute glass fiber, appears to be favourable material because of its low cost, high strength, high aspect ratio, good insulating, and low thermal conductivity. The goal of this work is to investigate the effects of mechanical and tribological behaviour of hybrid fiber, but the content of composition of matrix and reinforcement fiber is Ratio-1: glass fiber at 15% and bamboo at 15%, Ratio-2: glass fiber at 15% and cotton at 15%, and Ratio-3: glass fiber is 10%, bamboo fiber is 10%, and cotton fiber is 10%. With a constant amount of 70% epoxy resin, after that, a specimen will be prepared and assessed in accordance with ASTM E8 Standard. (Such as tensile, flexural, impact strength)

- The compression moulding technique is used to prepare the composite
- After the preparation of composite material on following testing methods such as tensile, flexural, hardness and wear testing.

Keywords: Wheel Hub, Mechanical Properities.

1. Introduction

In the current quest for improved performance, which may be specified by Numerous criteria comprising less weight, more strength and lower cost, currently used materials frequently reach the limit of their utility. Thus, material researchers, engineers and scientists are always determined to produce either improved traditional materials or completely novel materials. Composites are an example of the second category. Over the last thirty years composite materials, plastics and ceramics have been the prevailing emerging materials. The volume and numbers of applications of composite materials have developed steadily, penetrating and conquering new markets persistently.

Modern composite materials establish a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. Composites have already proven their worth as weight-saving materials; the current challenge is to make them cost effective. The hard work to produce an economically attractive composite component has resulted in several innovative manufacturing techniques currently being used in the composites industry.

2. Types Of Composites

Based on matrix

Broadly, composite materials can be categorized into three groups based on matrix material. They are,

- Metal Matrix Composites (MMCs)
- Ceramic Matrix Composites (CMCs)
- Polymer Matrix Composites (PMCs)
- Metal Matrix Composites (MMCs)

Metal matrix composites, as the name suggests, have a metal matrix. Examples of matrices in such composites comprise aluminium, magnesium, and titanium. The typical fiber contains carbon and silicon carbide. Metals are generally reinforced to suit the requirements of design. For example, the strength of metals and elastic stiffness can be increased, while the thermal and electrical conductivities of metals, large co-efficient of thermal expansion can be reduced by the addition of fibers such as silicon carbide.

2.1. Green Composites

A composite is a material composed of two or more separate phases, having overall properties that are a combination of those of each phase. Natural Fiber (NF) composites, or “green” composites, have attracted much interest over recent years for engineering applications, particularly in the automotive industry, due to their good properties (high specific strength and high specific stiffness), low cost and an increasing focus on the use of renewable materials. Most NF composites are produced by separation of fibers (retting), then incorporation of chopped short fibers into a synthetic polymer matrix using conventional composite manufacturing processes. In this type of composite, natural fibers are used as a substitute for synthetic reinforcements such as glass fibers.

“Truly green” composites may be defined as materials manufactured by incorporation of natural fibers into a “bio-polymer” matrix material derived from natural or renewable resources such as plant oils (Williams and Wool, 2000) or soy flour. The main attraction of truly green composites is environmental: they are considered to have no impact on global warming as, even when incinerated; the volume of CO2 released equals that consumed by the crop before harvesting. Sandwich panels are a class of composite material consisting of two outer faces (or skins) separated by, and adhesively bonded to, a thicker core. This is a quite different construction to that of fibers -reinforced composite materials. Sandwich panels are typically manufactured to provide a combination of relatively high stiffness, strength, or impact resistance in the face material(s) with a low density, thermally insulating or acoustically insulating core material. There is very little in the literature on sandwich panels manufactured from natural materials.

3. Fiber Selection

Fiber type is commonly categorized based on its origin: plant, animal, or mineral. All plant fibers contain cellulose as their major structural component, whereas animal fibers mainly consist of protein. Although mineral-based natural fibers exist within the asbestos group of minerals and were once used extensively in composites, these are now avoided due to associated health issues (carcinogenic through inhalation/ingestion) and are banned in many countries. Generally, much higher strengths and stiffness's are obtainable with the higher performance plant fibers than the readily available animal fibers. An exception to this is silk, which can have very high strength, but is relatively expensive, has lower stiffness and is less readily available.
This makes plant-based fibers the most suitable for use in composites with structural requirements and therefore the focus of this review. Furthermore, plant fiber can suitably be grown in many countries and can be harvested after short periods. Shows properties of some natural fibers and the main type of glass fiber (E-glass). Flax, hemp and ramie fiber are amongst the cellulose-based natural fibers having the highest specific young's moduli and tensile strengths although it should be stated that much variability is seen within the literature.

4. Materials And Methods

4.1. Glass Fiber

FRP plastics use material glass strands; textile fibers are not quite the same as other forms of glass fibers utilized for insulating purposes. Textile glass fibers start as shifting combos of SiO2,

Al_2O_3, B_2O_3, CaO, or MgO in powder structure. These mixtures are then heated through an immediate melt procedure to temperatures around 1300 ○C, after which dies are utilized to extrude fibers of glass fiber in distance across extending from 9 to 17 µm. These fibers are then wound into bigger strings and spun onto bobbins for transportation and further handling. Glass fiber is by long shot the most mainstream intends to strengthen plastic and in this manner appreciates an abundance of generation methodologies, some of which are pertinent to aramid and carbon fibers also owing to their imparted fibrous qualities E-glass (electrical) - lower alkali content and stronger than A glass (soluble base). Great malleable and compressive strength and stiffness, great electrical properties and generally ease, however affect resistance moderately poor.

Figure 1. Glass Fiber

4.2. Significance of Bamboo

Most of the developing countries, a demand for steel is increasing day by day for usage as a reinforcing material. There are circumstances when the manufacturing is not set up sufficient to confront the requirement for steel. Accordingly, it is important to discover elective arrangement which is esteem contrasted with steel. Bamboo accessibility is plentiful and strong. Hence, bamboo can be used as a reinforcing material and become a perfect replacing material for steel.

The bamboo is noticeable as a reinforcing material since it has the tensile strength as the focal prerequisite and equated with other different materials together with steel.

Figure 2. Bamboo tree

As a natural habitat, it has good resistance capacity to withstand the wind forces by its hollow tubular structure. Hence the drawbacks of bamboo can be properly identified and coming with the solution of improvement of bamboo as a structural steel replacing material is a natural substitute.

Cotton fibers are natural hollow fibers; they are soft, cool, known as breathable fibers and absorbent. Cotton fibers can hold water 24–27 times their own weight. They are strong, dye absorbent and can stand up against abrasion wear and high temperature. In one word, cotton is comfortable. Cotton is the most widely produced natural fiber on the planet. Other natural fibers include silk, made from the cocoons of silkworms; wool, made from the fur of sheep or alpacas; and linen, made from fibers in the stems of flax plants.

Cotton fibers come from cotton plants. Cotton is known for its versatility, performance and natural comfort. Cotton's strength and absorbency makes it an ideal fabric to make clothes and homewares, and industrial products like tarpaulins, tents, hotel sheets, army uniforms, and even astronauts' clothing choices when inside a space shuttle.

5. Stack Formation & Mixing Ratio

Table 1. Mixing Ratio

LAMINATES	STACKING SEQUENCE	%	WEIGHT OF MATRIX REINFORCEMENT	SIZE mm
R_1	BF+GF	15+15	BF-45g+ GF -45g+EPOXY -210 gram	150*300*3
R_2	GF+CF	15+ 15	GF-45g+ CF -45g+EPOXY -210 gram	150*300*3
R_3	GF+CF+BF	10+ 10+10	BF-30g+ GF -30g+GF -30 EPOXY -210 gram	150*300*3

5.1. Selection of Epoxy Resin

Polymers generally act as a good binder for fibers as observed from several references. Their carry availability coupled with their lower cost has provoked the selection of polymer as the binder for these fibers. Unsaturated polyester offers the advantage of easy mold ability, better handling, and better flow properties. Easy fabrication and better mixing of polyester provoke their usage. They have a low density of 2.02g/cc adding to our main objective of fabricating a low weight composite.

5.2. Compression Moulding

Compression moulding is a conventional processing technique used to manufacture polymer matrix composites under specific temperatures and pressures. This technique is commonly used in manufacturing due to its simplicity. The process has advantages in terms of low fibre attrition and speed. Many variations of compression moulding have been developed, including a combination of compression with extrusion and sheet moulding compound (SMC) processes in order to reduce the cost by decreasing the cycle time.

5.3 Composite Fiber Specimens' Images

Figure 3. Bamboo fiber, Cotton fiber and glass fiber specimen

6. Weight Of Testing Specimen Before And After

Table 2. Wear rate of the different various composite

RATIO	BEFORE WEIGHT-gm	AFTER WEIGHT-gm	AFTER WEIGHT-gm
BF+GF	0.367	0.365	0.002
GF+CF	0.597	0.591	0.006
GF+CF+BF	0.692	0.688	0.004

Table 3. Specification

LOAD	DURATION	DIA	RPM
20N	600 Sec	30 mm	637

6.1. Conclusion Of Wear Test

During the analysis the wear had been found the minimum wear rate occurred on the Ratio 1 – Glass fiber and Bamboo fiber composite obtained very low wear rate. But the same time glass and cotton fiber shows maximum.

7. Result & Conclusion

Synthetic and natural fiber composites had been successfully developed in this project. The mechanical properties (tensile, impact, flexural) of the composite have been studied and discussed here. This work shows that successful fabrication of natural and synthetic fiber reinforced composites by compression moulding method. Composite samples are suitable for analyse mechanical properties such as tensile. It has given information about the suitability of hybrid fiber as a source of reinforcement in epoxy matrix composites. NFR composites have higher fiber content for equivalent performance which reduces the amount of more polluting base epoxy resin. Now a days many automobiles field used instead of aluminium natural fiber and synthetic fiber for interior components with extraordinary strength charactertics. Finally concluded glass fiber and cotton fiber shows maximum hardness, tensile strength. Flexural strength only maximum obtained at combined fiber ratio.

1. Hardness test shows that the reading of glass fiber and cotton fiber exhibits maximum hardness strength of about 72 HRM.
2. Glass fiber and cotton fiber exhibits maximum tensile strength of about 199.276 N/mm^2
3. Impact test the reading shows of glass, cotton and bamboo fiber exhibits maximum impact load 3.8 joules
4. Flexural strength test result shows glass fiber bamboo fiber and cotton fiber exhibits maximum flexural strength of about 300 N/mm^2

5. The minimum wear rate occurred on the Ratio 1 – Glass fiber and Bamboo fiber composite obtained very low wear rate.

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