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Composite Material for Natural Fiber Reinforced of Disc Brake Pads

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ABSTRACT: Natural fibres are available in abundance in nature and can be used to reinforce polymers to obtain light and strong materials. Natural fibres from plants are beginning to find their way into commercial applications such as automotive industries, household applications. In this project coconut and bamboo fiber is used for reinforcement of the composite. The aim of the project is to determine various mechanical properties such as fatigue strength and shear stress of natural coconut and bamboo fibre reinforced composite. In order to conserve natural resources and economize energy, weight reduction has been the main focus of machine parts manufacturers in the present scenario. Weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes. The coconut and bamboo fibre reinforced coconut and bamboo composite is one of the potential items for weight reduction of about 20% - 30%. The introduction of coconut and bamboo composite materials was made it possible to reduce the weight without any reduction on load carrying capacity, more elastic strain energy storage capacity and high strength to weight ratio as compared with those of steel. The objective of this project is to investigate various mechanical properties such as strength, impact and tensile.

KEYWORDS: Coconut Fibre and Bamboo.

I. INTRODUCTION

The pulped coconut and bamboo fiber composite has good flexural strength. The subject gives a brief look on the suitability of coconut and bamboo composite material and their advantages. Polymeric materials reinforced with synthetic fibres such as glass, carbon, and aramid provide advantages of high stiffness and strength to weight ratio as compared to conventional construction materials, i.e. wood, concrete, and steel. Despite these advantages, the widespread use of synthetic fibre-reinforced polymer composite has a tendency to decline because of their high initial costs, their use in non-efficient structural forms and most importantly their adverse environmental impact. On the other hand, the increase in interest in using natural fibres as reinforcement in plastics to substitute conventional synthetic fibres in some structural applications has become one of the main concerns to study the potential of using natural fibres as reinforcement for polymers. In the light of this, researchers have focused their attention on natural fibre composite (i.e. bio-composites) which are composed of natural or synthetic resins, reinforced with natural fibres. Efforts have been made to reduce the cost of coconut and bamboo composite material to that of steel material. The achievement of weight reduction with adequate improvement of mechanical properties has made coconut and bamboo composite a very replacement material for conventional steel. Material and manufacturing process are selected upon on the cost and strength factor. The design method is selected on the basis of mass production.

From the comparative study, it is seen that the coconut and bamboo composite material are higher and more economical than conventional material.

II. EXPERIMENTAL WORK

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven

their worth as weight-saving materials, the current challenge is to make them cost-effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry. It is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be an integrated effort in design, material, process, tooling, quality assurance, manufacturing, and even program management for composites to become competitive with metals. The composites industry has begun to recognize that the commercial applications of composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of transportation industry. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years. Increasingly enabled by the introduction of newer polymer resin matrix materials and high performance reinforcement fibers of glass, carbon and aramid, the penetration of these advanced materials has witnessed a steady expansion in uses and volume. The increased volume has resulted in an expected reduction in costs. High performance FRP can now be found in such diverse applications as composite armoring designed to resist explosive impacts, fuel cylinders for natural gas vehicles, windmill blades, industrial drive shafts, support beams of highway bridges and even paper making rollers. For certain applications, the use of composites rather than fibers are a class of hair-like materials that are continuous filaments or are in discrete elongated pieces, similar to pieces of thread. They can be spun into filaments, thread, or rope. They can be used as a component of coconut and bamboo composite materials. They can also be matted into sheets to make products such as paper or felt. Fibers are of three types: natural fiber which consists of animal and plant fibers, and man-made fiber which consists of synthetic fibers and regenerated fibers. The earliest evidence for humans using fibers is the discovery of wool and dyed flax fibers found in a prehistoric cave in the Republic of Georgia. Natural fibers are made from plant, animal and mineral sources.

III. METHODOLOGY

- *Extraction of fibre*
- *Mold preparation*
- *Material fabrication*
- *Testing calculation*

Treatment of fiber:

The rough fibres are pre-washed with large amount of distilled water to remove the surface dirt present in the fibers and then put in an oven at 100°C for drying until it gains a constant weight. The mercerisation or alkali treatment is carried out by immersing the washed fiber (200gms) in a 10 % (w/v) sodium hydroxide aqueous solution (2lt) for 3hrs in a temperature of 70°C. It should be stirred occasionally and after that the fibres are taken out and washed in order to remove any absorbed alkali.

Mould Fabrication

The mould used for the fabrication of FRP material should satisfy the following requirements.

- The cavity of the mould should resemble the actual material shape and dimension.
- It should have a continuous positive surface of resolution.
- It should be designed such that it can be rotated about an axis of revolution.

The mould is designed as per the design of the constant cross-section material and above the requirements. After deciding the dimensions of the mould, it is manufactured using wood as the pattern material. Adding small wooden pieces along its boundaries create the coconut and bamboo composite material.

Fabrication of composite :

For the fabrication of the randomly oriented raw coir fiber-reinforced epoxy composite (RCFREC) and alkali coir fiber-reinforced epoxy composite (ACFREC) a handmade wooden mold is designed. First, a releasing plastic sheet is spread over the wooden mold. Heavy duty silicon spray is applied to the plastic sheet for easy removal of the composite plate. The fibers are cut into 30 mm length and distributed uniformly at the bottom of the mold which is prepared before. Fifteen volume percentage of the fiber is used for the fabrication of the composite. Then a heavy load is applied on the mold containing the fibers for compression for around 24 hours. Then epoxy and hardener are mixed

together on a weight percentage of 10:1 to form a matrix. The matrix is poured over the fibers in an evenly manner. Another releasing plastic sheet is spread over and then pressed and pushed down with an iron roller to avoid and eliminate any air bubble. Finally, load is given to it to remove excess matrix and left for curing at room temperature for 24 h. After that the desired composite plate can be obtained.



Conventional Brake Pad



Unconventional Brake Pad

IV. TECHNIQUE USED FOR TESTING

Hardness Test

All Brinell tests use a carbide ball indenter. The test procedure is as follows: The indenter is pressed into the sample by an accurately controlled test force. The force is maintained for a specific dwell time, normally 10 - 15 seconds. After the dwell time is complete, the indenter is removed leaving a round indent in the sample. The size of the indent is determined optically by measuring two diagonals of the round indent using either a portable microscope or one that is integrated with the load application device. The Brinell hardness number is a function of the test force divided by the curved surface area of the indent. The indentation is considered to be spherical with a radius equal to half the diameter of the ball. The average of the two diagonals is used in the following formula to calculate the Brinell hardness.

Result

Brinell hardness number = 24

Impact Testing

The impact test, also known as the V-notch test, is a standardized high strain-rate test which determines the amount of energy absorbed by a material during fracture. This absorbed energy is a measure of a given material's notch toughness and acts as a tool to study temperature-dependent ductile-brittle transition. It is widely applied in industry, since it is easy to prepare and conduct and results can be obtained quickly and cheaply.

Impact test value is 30 N.m

Wear Testing

Several standard test methods exist for different types of wear to determine the amount of material removal during a specified time period under well-defined conditions. ASTM International Committee G-2 standardizes wear testing for specific applications, which are periodically updated. The Society for Tribology and Lubrication Engineers (STLE) has documented a large number of frictional, wear and lubrication tests. Standardized wear tests are used to create comparative material rankings for a specific set of test parameter as stipulated in the test description. To obtain more accurate predictions of wear in industrial applications it is necessary to conduct wear testing under conditions simulating the exact wear process. An attrition test is a test that is carried out to measure the resistance of a granular material to wear.

Result

Wear rate = 0.25m²/N

Tensile Strength

The tensile test of the composites is performed as per the ASTM D3039 standards. The test will be complete using a universal testing machine. A universal testing machine (UTM), also known as a universal tester, materials testing machine or materials test frame, is used to test the tensile stress and compressive strength of materials. It is named after the fact that it can perform many standard tensile and compression tests on materials, components, and structures

Observation:

Dimension of the specimen in mm = 250x25x2.5

Area of the specimen = 62.5 mm²

Tensile strength = Load / Area

Strength	Load kg			Tensile Strength (N/mm ²)		
	A	B	C	A	B	C
Elastic	50	48	52	7.85	6.87	8.161
Yield	58	58	61	9.10	9.10	9.57
Plastic	72	73	75	11.30	11.45	11.77
Ultimate	80	84	84	12.56	13.18	13.18
Breaking	94	94	96	14.75	14.75	15.06

Mean Tensile strength = 14.85 N/mm²**V. CONCLUSION**

This study explains the various characteristics and properties of the coconut and bamboo fiber. By means the literature survey it is well clear that the coconut and bamboo and bamboo fiber is best suitable for its properties. This work will shows that successful fabrication of a coconut and bamboo and bamboo fiber reinforced epoxy composites by simple hand lay-up technique. Solid particle erosion characteristics of these composites can be successfully analyzed using x ray test. This approach not only needs engineering judgment but also requires a rigorous mathematical model to obtain optimal process settings. The results indicate that impact velocity, erodent size and fiber loading are the significant factors in a declining sequence affecting the erosion wear rate. In our project having different composition of specimen (Epoxy Resin, Natural Fiber) Coconut fiber, bamboo fiber. Mechanical properties tests (Tensile, Impact and Hardness and wear test) are conducted on the specimen and analyze the result.

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