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Natural Bamboo Fibre Composites, their properties and its Applications - A Review

Roopesh Kumar[a]
roopeshsinha12@gmail.com

B Laxshaman Rao[b]
laxman.mech9@gmail.com

Dr Abhijeet Ganguly[c]
abhijeetganguly@csitdurg.in

Dr. Rajesh Purohit[d]
rpurohit73@gmail.com

[a,b]Research Scholar, Department of Mechanical Engineering, CSIT Durg

[c]Assistant Professor, Department of Mechanical Engineering, CSIT Durg

[d] Professor, Department of Mechanical Engineering, MANIT Bhopal

Abstract: In the present situation, there has been a fast consideration in innovative work in the Bamboo fibre composite field because of its better formability, copious, sustainable, financially etc. Bamboo fibre is a natural fibre that is easily degraded by microbes and potentially becomes an alternative fibre in the future due to its availability, which is abundantly cheap, and grows throughout the year and also isn't affected by the season The application of bamboo fibre is a solution for environmental issues and a business prospect of synthetic fibres that are expected to decrease in line with petroleum. With this work, various values of bamboo have been considered as the basis, mechanical and chemical properties have been given the with major focus. On the basis of these values and qualities, the characteristic and utility of bamboo have been told. The symptoms of use of bamboo have been considered.

Keywords*:* bamboo fibre, composite, mechanical strength, composite fabrication, synthetic fibre

I. INTRODUCTION

There are two rudimentary types of natural fibres: first, the one acquired from the plants are called cellulosic fibres, and second, acquired from animals are called protein fibres. Advantages being: Natural fibres are cheaper, decomposable and have no ill effects on our health. They possess high toughness, low density, and adequate specific strength properties. BFRP (Bamboo Fibre Reinforced Polymer) have great thermal properties, and enhanced energy recovery. In the composites [1].There are so many natural fibre producer resources, especially from plants namely hemp, rice straw, wood, rice husks, wheat, barley, wheat, rye, sugar cane (sugar and bamboo), grass, reeds, kenaf, hemp, oil palm empty fruit, bunches, sisal, coir, water hyacinth, pennywort, cottonwood, mulberry paper, raffia, banana fibre, pineapple leaf fibre and papyrus[2]. Natural fibers is product after chemical reaction obtained from plants and trees, which is called cellulosic fibers. Fiber obtained from animals is called protein fiber. Which is easily available in market with minimum cost [3][4][5]. The advantages are low cost, bio-degradability, low specific gravity, high specific strength, and non-abrasiveness. [6]. The natural fibers are made as reinforcement with polymer matrices classified as thermo sets plastics and thermoplastics which are petroleum based. Research efforts are currently being done carried out in developing a newest class of fully bio-degradable "green" composites by mixing natural/bio fibers with biodegradable resins or matrices [7]. It is a tall grass, quickly developing and regularly woody. Its plant is an unpredictable framework, comprising of two arrangements of comparatively structured vegetative axes: the first is over the ground and the second beneath the ground. Bamboo has a place with the grass family, which includes cellulose

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fibers in the lignin matrix [8]. Bamboo is used as a part of development and as a material for manufacturing tools for everyday life because of its good quality. Ratio of weight and strength, flexural strength of Flax and Abaca Epoxy Hybrid Composite made by hand layup method and found that hybrid composite has very good mechanical behavior than mono fiber composite. Bamboo is a subfamily (Bambusoideae) of flowering perennial ever-green plants in the grass family. Some varieties of bamboo species are Ci bamboo, Moso bamboo, Lv bamboo, Dan bamboo, Ma bamboo [9] [10]. Though bamboo is having many characteristics similar to those of hardwood, it is not wood and belongs to the family of grass that is much denser, stronger and fast-grower making it an easier replenish able one. It grows 3 times as fast as Eucalyptus Bamboo has a very long history with human kind. Bamboo is also one of the oldest building materials. It takes about 4years before it can be used in construction. However, it can be used for various purposes, at various stages of its life. Bamboo is a hollow tube, sometimes with thin walls, and consequently it is more difficult to join bamboo than pieces of wood. In bamboo, this has no rays, which give bamboo a far more evenly distributed stresses throughout its length. The bamboo fiber is formed from the starchy pulp of bamboo plants. In fact, bamboo fiber may be regenerated cellulose fiber, which is produced from bamboo pulp processed from bamboo culms. It looks like cotton in its un-spun form. The particular gravity of bamboo varies in 0.40 to 0.80 depending mainly on the bodily structure. The moisture content of bamboo varies vertically from the under-side to the highest portions and other (horizontally) from the outer layer to the inner layers. Bamboo possesses very high moisture content. Wet ability is the ability of a liquid to form a coherent film on a surface, owing to the dominance of molecular attraction between the liquid and the surface over the cohesive force of the liquid itself. Wet ability of bamboo has a significant influence on adhesion and other related properties. Bamboo fibre contains 26.0% to 43.0 % of Cellulose and 21.0% to 31.0% Lignin, the mean diameter of bamboo like is 0.014 mm and the mean length of the same is 2.7 mm. The figure1 shows the scanning electron microscope images of bamboo fibre [10].

II. Methodology

Methodology is a framework for thinking related to input-process-output and their characteristics based on standard requirements. Methodology of mapping journal review will be carried out as shown in Figure 2.

A. Bamboo Fiber Processing Method

Bamboo fiber processing methods can be carried out through three methods. Those are chemical processing methods, mechanical processing, and combination of chemical and mechanical processing methods. Chemical extraction methods such as Chemical Retting and Alkaline or Acid Retting are used to remove or reduce the lignin element from the fibers. This chemical extraction method also affects other elements contained in fiber such as pectin and hemicelluloses [20]. The investigated waste lignocelluloses material is clearly distinguishable by their chemical composition, and different mechanical behavior can therefore be expected. High –density polyethylene was filled with different mixtures of bagasse fibres and nano-SiO2 to produce fibre reinforced composites. Physical and mechanical properties of the produced composites.

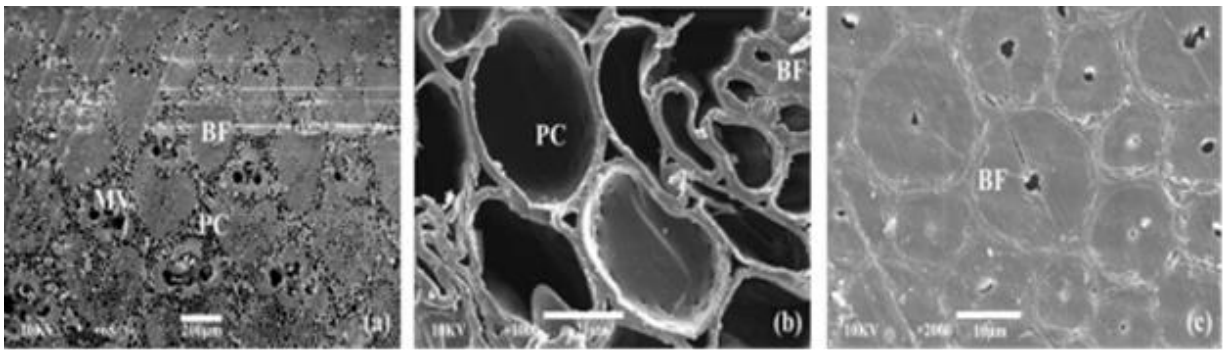

Figure 1. scanning electron microscope images of Ci bamboo fiber (a)cross section of raw bamboo (b)Parenchyma cells (c)bamboo fiber [10]

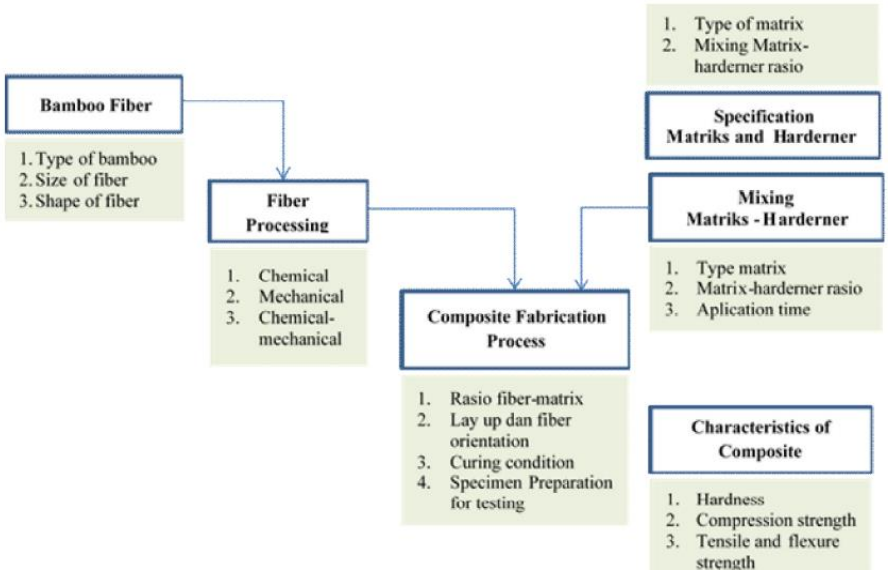

Figure 2: Methodology of The Mapping of Journal Review of the Bamboo Fiber-Reinforced Composite Materials

B. Bamboo Treatment

The hydrophilic (oil do not mix with water) nature of bamboo strands is due to its fabricated components, for example, lignin that can diminish bond with the hydrophobic framework materials. Numerous scientists have adopted concoction treatment-based strategies, for example alkalization. Bamboo fibre is a natural organic product. the main chemical component are cellulose, hemicelluloses and lignin [11].

a. Alkaline treatment

The most commonly used chemical treatment of natural fibers is alkaline treatment, whenever the manufacture is of thermoplastics and thermo sets. Alkaline treatment has two effects on the fibers. One has the potential to increase the roughness on the outer surface by successively increasing mechanical interlocking and the other has the potential to increase the number of cellulose exposures on the fiber surface. The excessive lignin, wax and oil present on the outer surface of the fiber cell are removed by alkaline treatment. Ionization of a chemical group by NaOH treatment.

b. Silane Treatment

Silane treatment is most prominent in the presence of moisture and can also reduce the number of cellulose hydroxyl groups; moisture combined with a hydrolyzable alkoxy group leads to the formation of silanol, causing it to react with the hydroxyl group of the fiber, forming a becomes covalent. bond with the wall.

C. Properties

Natural varieties are an inexhaustible raw material and their reach is almost limitless. When common fiber reinforcing plastics are subjected to an ignition process or landfill, at the end of their life cycle, the CO2 discharge measurement of the filaments is unbiased with respect to the amount absorbed between their developments, since regular strands are biodegradable. Natural filaments are for the foremost more cost effective than glass strands. The grating nature of characteristic filaments is far lower contrasted with glass trends, which prompts favorable circumstances on specialized and material re-using, or the procedure of composite materials as a rule.

III. Results & Discussion

Based on the testing, it was obtained the status of the research and development of the type and parameters of the extraction process and the characteristics of the mechanical properties of bamboo fiber. The type of matrix used for the fabrication of bamboo fiber composites and its mechanical and physical properties. The results of this testing will be used as a reference. As table 1[8].

TABLE 1

COMPARISON OF MECHANICAL PROPERTIES OF BAMBOO FIBER COMPOSITE AND GLASS FIBER[8]

No	Fiber	Volume Fraction (vf: %)	Tensile strength (MPa)	Tensile Modulus (GPa)	Elongation (%)	Flexural strength (MPa)	Flexural modulus (GPa)	Density (g/cm3)	Ref
1	BF		500-575	27-40	1.9-3.2	100-150	10-13	1.2-1.5	[4]
2	BF+EPOXY	65	87-165	3-15	1.7-2.2	107-140	10-12	1.16-1.25	[14]

IV. APPLICATIONS

Bamboo is one of the oldest materials used by humans from hunting to housing, from containers to food. The potential and importance of bamboo in reducing deforestation and global warming is remarkable. The stalk of bamboo is hollow inside and the outer wall is circular. The outer wall consists of pulp and membrane. The thin outer green layer is high-density silicone that produces a hardness equivalent to hardwood and the smooth surface of a wax-like material. The thick layer inside the yellow layer is loose and delicate. The stem is a source of fiber. It is strong and has natural anti-bacterial properties. It is light in weight and flexible. It can also withstand seismic effects. China, India and Japan are the major producers in this order. But unlike China, India, despite being the second largest producer of bamboo in the world, makes little use of this wonderful grass. China has the advantage of having the monopodium (upright) variety of bamboo which is easy to grow and process while India is home to the Symposia (strange) variety which is tougher. About 136 species of bamboo are found in India. The world is using bamboo in many ways. Chinese company Daiso is known worldwide for its bamboo-based products. [12-15].

Figure 3 Typical applications of Bamboo fiber [17]

A. Automotive Applications

The Characteristic filaments have encountered quick development in car advertise, particularly in European countries also, South-eastern Asian countries. Bio composite established development expanding every twelve months with the worldwide explore field since it guarantees a wise cost and execution contrasted with contending advances. The most expansion of Industries brought a Revolution prior to transportation with the making of vapour (steam)-controlled boats and air ship motors. In nineteen thirty, an instant modern insurgency may be a vital period within the produce of auto slot utilizing filament as an alternate option to current materials. Renowned vehicle creator, Henry Ford likewise underpins the use of materials from characteristic filaments begin to induce advance the time of car development. Global organization and therefore the Asian countries additionally upheld by granting rules in worldwide car fabricating industries. An investigation demonstrates that minimal effort regular bamboo fiber materials which are very probable to be utilized as a component of car [17][18].

Fig. 4. Phoenix Bamboo Concept Car

V. CONCLUSION

Bamboo fiber is discussed in the results of a journal review, from bamboo that grows in Asia, especially China, India and Indonesia. Bamboo fiber is one of the natural fibers that can be used as raw material for natural fibers, considered from the advantages of bamboo fiber compared to glass fiber that has allow cost aspect, abundant raw materials, environmentally friendly, light specific gravity, high growth rate, good strength and stiffness value. Bamboo fiber consists of cellulose, hemicelluloses and lignin. The level of cellulose and hemicelluloses in the form of holocellulose can be more than50%. Fiber processing methods can be carried out chemically, mechanically and combination of both. Fiber processing carried out by an alkaline process will have a positive impact on the strength of the bamboo fiber composite material. The characteristics of bamboo fiber composite materials(mechanical and physical properties) will be affected by the parameters of composite materials production process, namely the choice of fiber type, matrix type, fiber orientation, fiber volume fraction, fiber size, fiber orientation, rivers cape, and composite fabrication parameters (types of process, temperature, pressure, time).During this time, the benefits bamboo have been used since long time ago for household purposes such as containers, chopsticks, woven mats, fishing rods, handicrafts, and furniture. This review study presented the concerns associated with the environment have broadened within the last two decades. Previously attention was on the problem associated with the energy sources but the same has been shifted to the more technical issues like wise because the former one. Further, it provided a summary of need of natural composites especially bamboo fiber reinforced plastics.

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