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Banana Fibre Reinforced Composites: A Review

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ABSTRACT: Fiber composites are having lot of advantages and applications which are bio degradable, economical and non-toxic. Hence, they are replacing conventional materials in aerospace, automotive, agriculture and construction industries. Natural fibers such as Abaca, sisal, jute, acacia, ramie, hemp, flax, bamboo and banana are preferred in general in industries for making composites using epoxy and polystyrene resin. Normally, hand layup method is preferred for making composites because of its simple procedure and low cost. Sometimes, when requirement is high, compression molding and other machine molding processes are employed. This paper mainly reviews the banana fiber based composites which have wide application in industries. The abundant availability of banana fibers is an added advantage.

I. BANANA FIBRE AND ITS COMPOSITES

Mechanical properties of banana fiber composite are superior than the properties of conventional materials and is utilized as the material of choice for a varied range of structural and non-structural industrial applications. It is a bast fiber , a waste product of banana cultivation and it is a lingo-cellulosic fiber extracted from the pseudo-stem of banana plant with better mechanical properties [1, 2]. Pothan Laly et al. [3] found that the volume fraction of the short banana fiber influences the dynamic mechanical properties of the composites. Benitez et al. [4] found that by treating banana fiber with sodium Hydroxide (NaoH) at saturation pressure, the thermal properties are improved while small improvement in mechanical behavior. Vijaya Ramnath et al. [5] also found that the properties like flexural and impact strength of banana composite are superior to hybrid composite. Ldicula Maries et al. [6] analysed that chemical treatment using NaoH and polystyrene maleic anhydride (PSMA) increases both density and thermal conductivity of banana fiber composite. Also they found that, by this treatment, contact between the fiber and matrix is very high. Cellulose is an abundant and naturally occurring polymer that can be obtained from numerous resources. Also, it offers great opportunities to develop new ecologically adaptable light weight structural composites due to its superior properties such as low density, biodegradability, recyclability, renewability and low cost [7,8]. Oliverira et al. [9] found that banana fiber obtained from the pseudo stem of banana plant is one of the major underutilized raw materials in tropical and sub-tropical regions which are composed by 70% of cellulose in dry weight. Abraham et al. [10] have reported the preparation of nano cellulose from banana fiber by steam explosion. This fractionation treatment allows the modification of physical properties with the breakdown of biomass components by steam heating.

II. PROPERTIES OF BANANA FIBRE

Some of the important properties of banana fiber are furnished in the table 1.

Table.1 Properties of Banana fiber

Fiber	Diameter Range (mm)	Young's modulus (Gpa)	Ultimate stress (Mpa)	Strain (%)
Banana (Untreated)	0.07-0.21	6.6 – 25.6	199-781	1.79-3.27
Banana (Treated)	0.07-0.175	9.73-21.6	148-537	1.38-2.37

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III. APPLICATIONS OF BANANA FIBER

Habibi et al. [11] found that nano- cellulose can be used as an excellent reinforcing agent in biodegradable polymer systems due to its high surface area, unique morphology and mechanical strength. This may be suitable for automotive applications. Banana plant is abundantly grown and these are considered waste after the fruits are ripened. Hence, the banana fiber obtained from the plants can be explored as a potential reinforcement [12]. Kumar et al. [13] analysed that alkaline treatment cleans the fiber surface impurities, modifies the surface structure and increases the fiber surface area. Since, the surface area increases, the cellulose micro fibrils get exposed which in turn improved the wettability and impregnation. Apicella et al. [14] determined while selecting materials for marine applications, the moisture absorption capacity of the fiber composites and its detrimental effect on the mechanical properties must be taken into consideration. Ratna Prasad et al. [15] found that banana fibers provide accountable contributions like good mechanical property, low thermal degradation, swelling and dielectric properties whether the resin may be polyester or epoxy. Sathiyamurthy et al. [16] ,Venkateshwaran et al. [17], Paul et al. [18] studied the mechanical properties such as tensile, flexural and impact properties of coir fiber reinforced polyester composites with the effect of calcium carbonate as filler reinforcement and also effect of alkali treatment with 1% NaoH on strength of banana fibers. They found that treated fibers posses better mechanical properties than untreated fibers. Boopalan et al. [19] evaluated the mechanical and thermal properties of the jute fiber reinforced epoxy composite and concluded that addition of banana fiber upto 50% by weight increases the strength. Venkateshwaran et al. [20] investigated the combination of banana and sisal fiber, and found that fiber length and weight percentages are the major factors in deciding the mechanical properties. Bardiya et al. [21] identified the banana peels containing high organic content are potentially converted to methane through the fermentation process. Methane produced from the anaerotric digestion of banana peel can also be used to generate energy under mesophilic temperature conditions. Srinivasan et al. [22] and Vijaya Ramnath et al. [23] evaluated of mechanical and thermal properties of banana-flax based natural fibre composite and found that hybrid composite has better mechanical properties than mono fiber composites. Sathish et al. [24] investigated the effect of fiber orientation and stacking sequence on mechanical and thermal Characteristics of banana-kenaf Hybrid composite.

IV. CONCLUSION

This paper reviewed some work related to banana fiber based composites and also important properties of banana fiber composites. It also shows the suitability of banana fiber composite for automotive, marine and construction industries.

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