ARTICLE IN PRESS

Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Exploration of indispensible properties of textile-grade glass fibers/white caustic treated banana fiber hybrid composite

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ARTICLE INFO

Article history:
Received 15 February 2020
Accepted 18 February 2020
Available online xxxx

Keywords:
Materials
Natural fiber
Artificial fiber
Hybrid composite
Fiber orientation

ABSTRACT

The need of Materials based research always exist due to its demand at all times. But the supply is limited. In particularly, the supply of material is limited for specific applications. Light weight low strength applications are very wide. This investigation focuses the natural fiber hybrid with artificial fiber based hybrid composite preparation. The banana fibers are used to prepare the composite with Textile-Grade Glass Fiber. The banana fiber is here treated with specific concentration of caustic in the distilled water. The composites synthesized with treated and untreated banana fibers. The alternate fashion of horizontal and vertical is followed for fibers' orientation. The bio epoxy is employed as matrix material with mix of hardener. The prepared composite are characterized by water absorbability, tensile properties, flexural properties and shock absorption capacities.
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Selection and peer-review under responsibility of the scientific committee of the International Conference on Nanotechnology: Ideas, Innovation and Industries.

1. Introduction

The application of composite materials is obvious [1]. Day by day the supply of conventional materials supply is diminished [2]. The existing materials sometimes disqualified as it does not meet the particular application [3]. To fulfill the demand the researchers invent new materials. [4] almond shell powder employed to prepare the particulate composite [5]. The powder of skin removed tamarind seeds suggested for fabricating composites. [6] proved that the treated banana fibers will improves the mechanical properties and experimented. [7] preferred to use of banana fibers treated with caustic solution and selected jute fiber for hybrid composite laterally they suggested banana fiber treated by mallic acid with Textile-Grade Glass Fiber [8]. [9] reported a methodology for third axis reinforcement that is prevention of de-lamination by stitching before compression for removing the excess rasin and air gaps and for ensuring predefined uniform thickness. The caustic treated banana fiber and the artificial Textile-Grade Glass Fiber with specific number of layers and pre defined best bonding orientation of fibers are focused in this research [10].

2. Materials and methods

2.1. Composite matrix

The matrix materials are mainly consists of selectively obtained and specially prepared high quality banana fiber, the commercially available high quality Textile-Grade Glass Fiber for reinforcement [11]. The low cost, best match for banana fiber based composite's bonding agents, the cashew nut cell oil is employed as resin and also bought the suitable hardener for the same [12]. the Fiber, its Tensile Strength (MPa), its Density (kg/m^3), its Young's Modulus (MPa) and Flexural Modulus (MPa) are in the order of as follows Banana Fiber, 54, 1350, 3487, 2000–5000, Glass Fiber 2500–3500, 2.5, 70,000, 70,000–73,000, respectively [74–76]. The poly vinyl acetate is employed as releasing agent [71–73]. The high quality banana fiber was prepared from the naturally harvested banana

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https://doi.org/10.1016/j.matpr.2020.02.700
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Selection and peer-review under responsibility of the scientific committee of the International Conference on Nanotechnology: Ideas, Innovation and Industries.

Please cite this article as: A. Raveendra, D. Muruganandam, J. Jayapriya et al., Exploration of indispensible properties of textile-grade glass fibers/white caustic treated banana fiber hybrid composite, Materials Today: Proceedings, https://doi.org/10.1016/j.matpr.2020.02.700

stems by rolling, combing and drying; further the fiber qualities were enhanced by chemical treatment [13].

2.2. Quality addition in banana fiber

The low cost and appreciable enhancement was achieved through caustic treatment [14]. Here it was preferred that 1% of caustic volume fraction with distilled water [15]. The high quality banana fibers soaked in the solution for 240 min followed by drying on open space with normal sunrays (do not being at hot sunrays) [67–70] for 120 min that is dried in the morning 8 AM to 10 AM. After that the fibers cut to 5 cm long [16].

2.3. Synthesis of hybrid composite

The preferred selective sequence of layers and orientation of fibers on each layer are alternate fashion of horizontal and vertical [18,19]. A chromium-plated MS, Square shaped molds (of side 30 cm) are placed in the molding table [20–23]. The parting (Wax) agent applied on the mould which will facilitate release the finished [24–27]. Beadings at the corners of models are maintained the preplanned gap [28,29]. The preplanned length of 50 mm followed for both banana fiber and Textile-Grade Glass Fibers [64–66]. The Textile-Grade Glass Fibers used for extreme layers that top and bottom [30]. In between layers banana but their fashions are alternate orientation of fibers in horizontal and vertical directions [31]. The layers are bonded with just prepared paste of mix of 10 part of resin and one part of hardener [32]. Finally entire composite panel was compressed in CTM and kept in the compressed position for 3 to 4h [17], by which the voids filled up, air bubbles removed and excess resin content also removed [33]. Then panels allow drying in sun light with weight for avoiding bending due to shrinkage while drying [34,35]. Hence the composite samples are prepared by the combination of compression mounding and manual layup technique [36–40].

Table 1
Toughness of dry and wet hybrid composites.

Characterization criteria	Treated	Untreated
Observed Energy in joules	12.48	7.95

Fig. 1. Sample specimen of hybrid composite for characterizing properties under impact load.

3. Characterization

3.1. Toughness based Characterization of hybrid composite

The Toughness of the materials is usually characterized by Impact Test Method [28–35]. Charpy Test setup is employed in this investigation [41–44]. The specimen prepared under the standard of ASTM D256 to the dimensions of 2½ × ½ × 1/8 Cubic Inches [45–54]. The energy observed by the specimen is observed. And tabulate in Table 1 [61–63]. The specimen is shown in Fig. 1 [58–60]. The investigation ambient conditions are room temperature and 50% the average RH [55–57].

4. Results and discussions

4.1. Shock absorbability

The impact load or shock load based test namely charpy is employed for this investigation. The results reveal that impact strength of the treated banana fiber based hybrid composites got improved (Refer Fig. 2). That is treated fiber based composite is stronger in withstanding shock load than untreated fiber based hybrid composite (Refer Fig. 2).

5. Conclusion

The exploration of indispensible property of textile-grade glass fibers/white caustic treated banana fiber hybrid composite is dis-

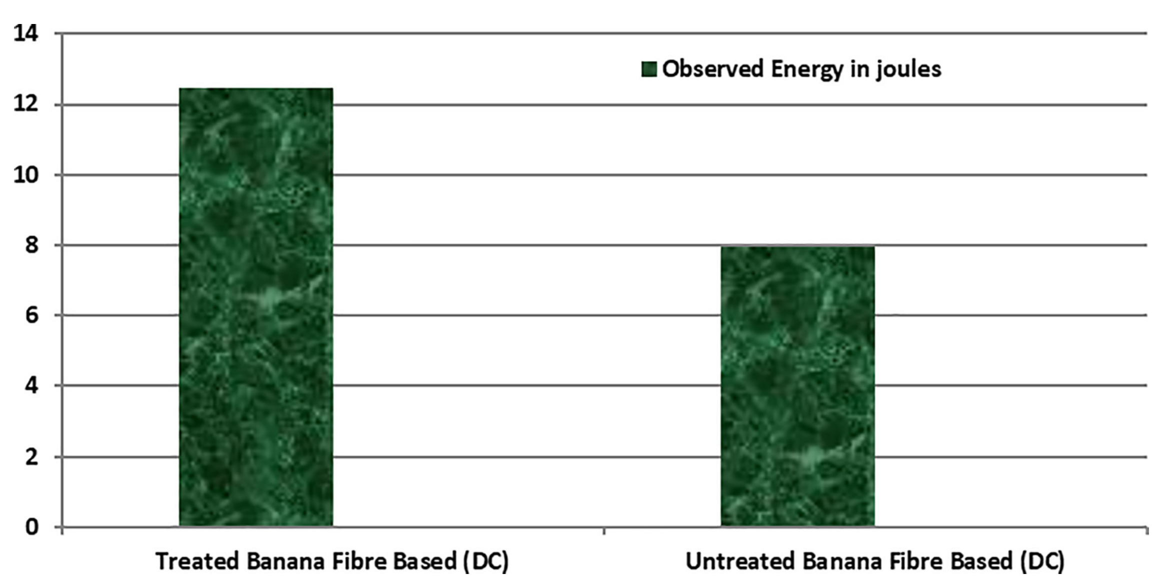

Fig. 2. Impact strength of treated and untreated banana fiber based hybrid composite.

cussed in this paper. The natural abundant Banana fiber and one of the artificially strong Textile-Grade Glass Fibers were hybrid here with bio resin and hardener matrix to form the hybrid composite panels. In which the banana fiber is selectively processed and specially treated for enriching the proposed composite strength. It was experimentally proved that the proposed treated banana fiber based composite performed well and also it was tested in the wet condition and found that the composite increases its strength by absorbed moistures.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Please cite this article as: A. Raveendra, D. Muruganandam, J. Jayapriya et al., Exploration of indispensible properties of textile-grade glass fibers/white caustic treated banana fiber hybrid composite, Materials Today: Proceedings, https://doi.org/10.1016/j.matpr.2020.02.700