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Research Article

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ABSTRACT

In the present world, biodegradable polymers and other polymeric composites composed of renewable resources are widely used because of their inherent and intrinsic qualities, including abundance, environmental processing. Due to the improved characteristics and biodegradability, research on hybrid polymer composite has grown in recent years. In order to decrease the use of synthetic fibers without degrading its characteristics, the impact of various stacking sequences containing basalt and pineapple leaf fibers (PALF) has been evaluated in this work. The mechanical properties of various composites produced by the vacuum bagging method are evaluated. The outcomes demonstrated that retaining the pineapple layer in the skin layer increases a number of features. the properties of the produced composites are generally inclined by the adhesion between the matrix and the fiber. To determine the strength of the fiber, various tests such as impact test, tensile test and flexural test are examined. Moreover, a comparative analysis is carried out amid the different fiber composition with the basalt and pineapple leaf fiber, in order to identify the optimal one. In future, the hybridization of basalt and pineapple leaf fiber is used in medical application.

Keywords- Polymeric composites, synthetic fiber, pineapple leaf and basalt fiber, impact test, tensile test and Flexural test.

I. INTRODUCTION

In recent years a tremendous expansion in the analysis and the usage of polymeric composite materials are investigated. Several previous techniques focus on the development and study of high performance reinforcing materials. But the majority of these resources are non-renewable and expensive. The need for developing natural substitutes arises from the erratic supply and pricing of Petroleum- based products. [1]. A fiber reinforced polymer (FRP) is a composite material, which is made of high strength fibers like carbon, glass, aramid and natural fibre, etc, which are embedded in a polymer matrix. The FRPCs are generated by the synthetic fibres compared to Monolithic polymer materials, synthetic FRPCs provide special advantages. However, the synthetic fiber reinforced polymer is expensive and has an adverse effect on the environment. [2]. Material researches have recently focused on the improvement of natural cellulose fiber reinforced polymer composites as alternative replacement to glass, aramid as well as carbon fibers, which are the man-made conventional as well as synthetic materials. Natural fibre reinforced composites are employed as a better replacement for climatically harmful synthetic materials since they are light, cost effective, renewable as well as it required some energy to be produced. But the natural cellulose fibers produce higher moisture absorption, which is the disadvantage of utilizing the natural fiber [3]. Hybrid fiber reinforced polymer composites are suggested by the material researchers as a solution to these problems and to enhance the performance of polymer composites reinforced with the natural cellulose fibers. To create polymer hybrid composites natural fibers are combined with other natural or synthetic fibers. The mechanical as well as thermal properties of polymer hybrid components are enhanced when alternative fillers are combined with natural fibers. Nevertheless, the hybridization of polymer composite generates low durability [4].There are numerous plant fibres which is used as raw materials in industries, including Kenaf, talipot, banana, jute, palmyra, cotton, hemp and flex. Among these, PALF is one of the waste products from the agricultural industry as well as it is commonly grown in both Asia and India. The PALF has excellent mechanical properties as well as it is used in the manufacture of polymer composites reinforced with pineapple fibre. The significant disadvantage of PALF is its hydrophilic nature; it bonds poorly with hydrophobic matrix, especially at high temperatures [5].

In comparison to other combinations like pineapple and banana, basalt fibre (BF) reinforced composite offers better mechanical properties BF is a high- performance inorganic silicate fibre produced by melting and extracting natural basalt rock at high temperatures. It is a type pf green fibre which does not harm the environment. Compared to conventional glass fibre (GF), BF has superior mechanical qualities and it has more corrosion and high temperature resistant.

Basalt fiber has two main disadvantages over E-glass fiber: high density and high cost [6]. The most recognizable and quickly growing grass family member is bamboo. Which is environmentally beneficial, quickly growing, and capable of reabsorbing carbon dioxide from the air. The advantages of bamboo allow for its biodegradability, biodegradable nature, high strength and good stiffness.

These characteristics allow for the traditional use of bamboo in the production of household goods. Based on the precise extraction of the right fiber, bamboo is also be utilized to create reinforced composite materials. However, the bamboo fiber is high expensive and it is harmful to the environment [7]. This work, hybridized approach of pineapple fiber and basalt fiber. To determine the strength of the fiber various tests are carried out like impact test, tensile test, flexure test and flammability test. The comparative analysis carried out with the different fiber compositions to examine the optimal one.

II. CONTRIBUTIONS OF THIS SURVVEY

The polymer composites with various types of fiber have generated different developments as mentioned in the introduction section. Nevertheless, the methods facing several issues for solve the problems about the technique utilized for the polymer composites. Therefore, this research, a review is carried out between the various fibers methods employed in the polymer composites. This work significantly examines the hybridized approach of pineapple leaf and basalt fiber. The main subscriptions of this review are as below,

- To analyze the role of pineapple leaf and the basalt fiber in the polymer composites.
- To identify the strength of the fiber, various tests are carried out.
- The materials and characterization of the fibers are investigated by this study

- The mechanical properties of various composites are generated by the vacuum bagging techniques.
- Furthermore, the future requirementfor enhancing the bond strength of the fibers are also examined.

II. REVIEW OF MATERIALS AND TESTING METHODS FOR BASALT AND PINEAPPLE FIBRE MATERIALS AND METHODS

Materials

In the present study, basalt rock fibers (BRFs) with a length of 13 ± 1 mm and a diameter of 9 μm (De Araújo M. (2011)) are used as reinforcement. Also, Pineapple Leaf Fibers (PLF) with the length of 10 ± 1 mm and the diameter of 340.6 μm (Yusof Y et al. (2016)) are used as reinforcement. The polymer Composites sample materials are given in figure. 1.



Fig 1 Polymer Composites sample materials

Unsaturated polyester resin is used as matrix material. For this resin system, Cobalt Naphthenate (CN) is used as the accelerator and Methyl Ethyl Ketone Peroxide (MEKP) is used as the catalyst. All these materials were procured from M/S Pragathi Industries, Mysore, Karnataka, India. The properties of various fiber materials given in table 1 such as modules of electricity, density, tensile strength, breaking extension, fiber diameter.

Table 1 Properties of fiber materials

Properties	Unit	Basalt Fiber	PALF	EPOXY
Modules of Electricity	GPa	85	34 - 83	2 - 4
Density	g/cm^3	2.18	1.55	1.25
Tensile strength	Mpa	2140	410 -1630	50 - 66
Breaking Extension	%	2.9	1.5 – 3.0	1.2 – 2.6
Fiber Diameter	µm	10 - 17	18 -82	1 - 3

Methods

The thickness of BRF/polyester composite specimens for all fiber volume fractions suchas 15%, 20%, 25%, 30%, 40%, and 45% are maintained as 4.5 mm by using a spacer.

The specimens were fabricated using the compression molding technique. Similarly, the thickness of PLF/ polyester composite specimens is maintained as 4 mm for all fiber volume fractions such as 10%, 15%, 20%,

25%, and 30%. Appropriate bonding between the fiber and matrix was not achieved for the fiber volume fraction of above 30%. Hence, the fabrication of PLF/polyester composite panels was restricted to the fiber volume fraction of 30%. The Samples of PMC MMC and friction surfaced fibers polymer composites sample materials are given in figure 2.



Fig 2 Samples of PMC MMC and friction surfaced Fibers

III. SPECIMEN PREPARATION

Initially, a non-sticky thick plastic sheet has been placed on the bottom base plate of the compression molding machine. Further, spacers with thicknesses of 4.5 mm and 4.0 mm were used for fabricating BRF/polyester and PLF/polyester composites, respectively. The resin, accelerator and catalyst had been mixed well in the volumetric proportions of 50:1:1, respectively to prepare the matrix solution. BRF and PLF fibers were spread inside the spacers uniformly. The resin is then transferred consistently on the fibers. A non-sticky plastic sheet is spread on the top base plate and compressed gently using the hand roller to remove the air bubbles. The compression with heading coil machine is shown in figure 3.

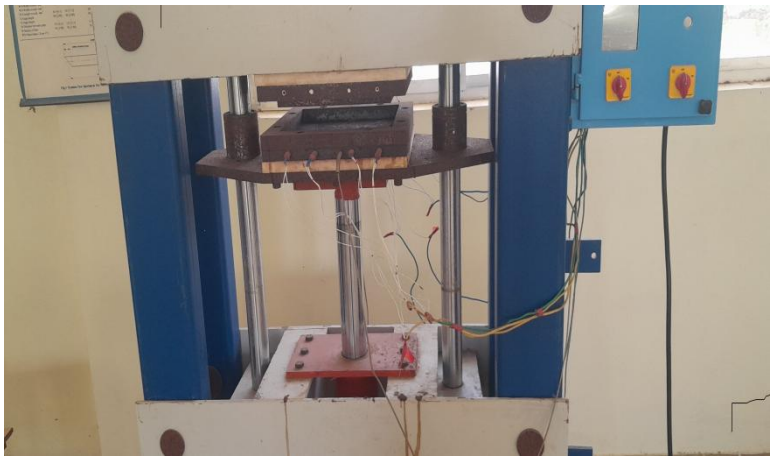


Fig 3 Compression Machine with heating Coil

After that, the pressure of 3 bars and temperature of 80°C were applied, and these are maintained it for 20 minutes. Besides, the composite specimen is removed from the mold and allowed it for curing at room temperature for 24 h. The compression with heading coil machine is shown in figure 3.



Fig 4 Metal matrix composites Allminium alloy 6063

The stepwise procedure for the extraction of BRF from the basalt rocks is given in Figure. 5.

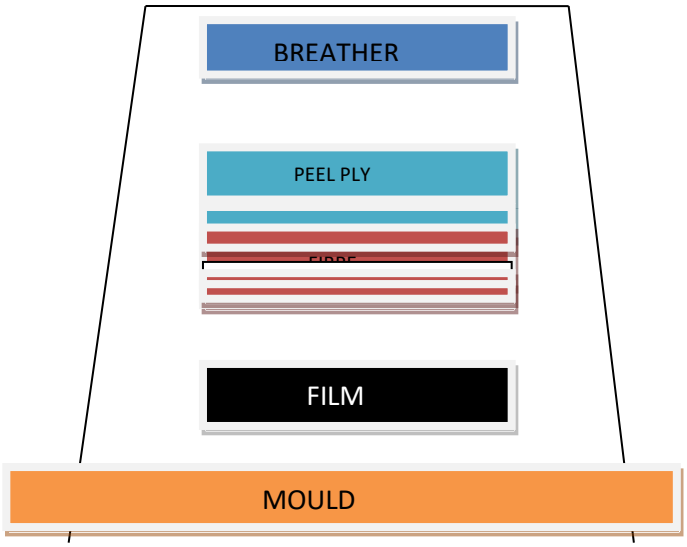


Fig 5 Vacuum begging method

V. CHARACTERIZATION OF COMPOSITES MECHANICAL CHARACTERIZATION

Tensile andflexural tests were conducted as per ASTM-D-3039(2017) and ASTM-D-7264(2011), respectively. The specimen dimensions used for the tensile test were 250 mm in length and 25 mm in width. The length and width of the specimen used for the flexural test were 160 mm and 13 mm, respectively. These tests were conducted on a computer- controlled universal testing machine with a load cell capacity of 50 KN. All tests were conducted at the crosshead speed of 2 mm/min. Comparative analysis is carried out for different technique in pineapple leaf and basalt fiber as well as other technique is utilized for better bonding strength. The figure 6 shows that the comparison of various composite materials tensile strength. The figure 7 shows that the Impat esing machine.

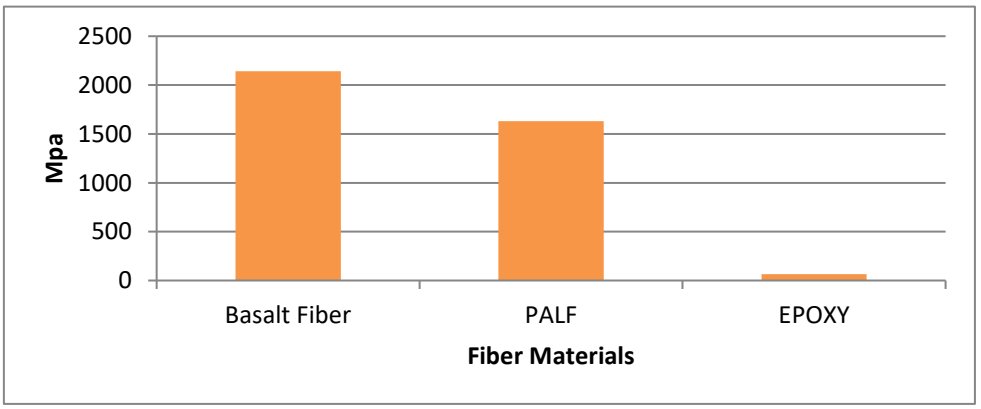


Fig 6 Comparison of Tensile strength

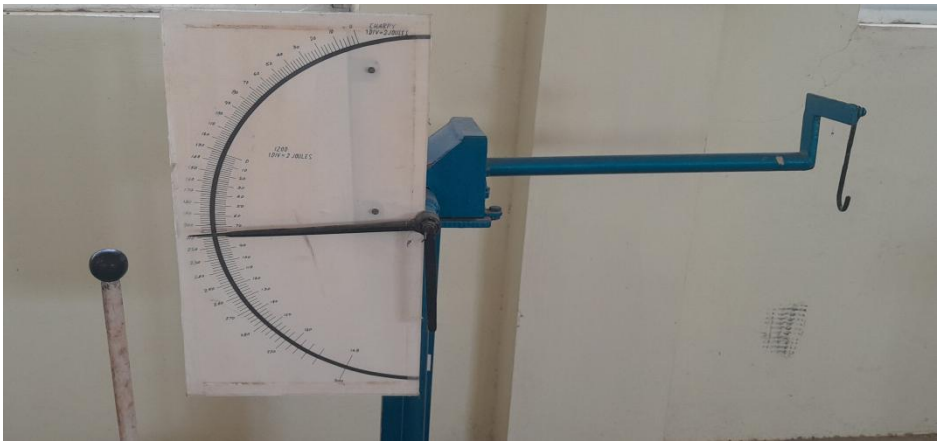


Fig 7 Impact Testing Machine

The figure 8 shows that the comparison of various composite material's dimension parameter

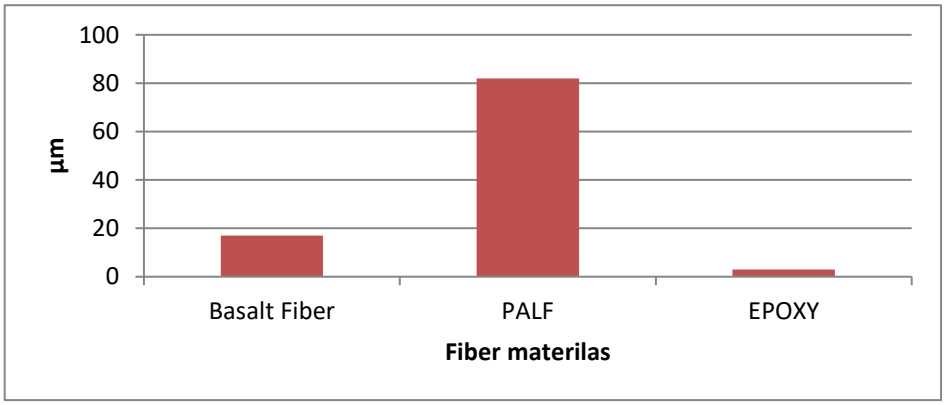


Fig 8 Comparison of fiber diameter

VI. CONCLUSION

In order to decrease the use of synthetic fibers without degrading its characteristics, the impact of various stacking sequences containing pineapple leaf and basalt fiber have been evaluated in this work,the basalt have been evaluated in this work, the basalt and pineapple composites are generated by using the vaccum bagging method the mechanical properties as well as the chemical composition of different composites are analyzed in this study. This work mainly focus on the use of pineapple leaf and basalt fiber in polymer composites the chemical properties of jute, coir, banana, sugar balm fiber are analyzed from this canalization, it is observed that the pineapple and basalt fiber to determine the optimal one. From the graph the pineapple and basalt fiber achieves good tensile strength in future the hybridization of basalt and pineapple leaf fibers are used in medical application, which gives the best result for the treatment of limbs and knee bones.

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STATEMENT AND DECLARATIONS

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Conflict of interest statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethics statements

Studies involving animal subjects

No animal studies are presented in this manuscript.

Studies involving human subjects

No human studies are presented in the manuscript.

Inclusion of identifiable human data

No potentially identifiable images or data are presented in this study.

Availability of data and materials

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation can be directed to the corresponding author.

Generative AI disclosure

No generative AI was used in the preparation of this manuscript.

Figures and Tables Creation

All figures and tables were created by own and included in this research article.

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