MECHANICAL CHARACTERIZATION OF PALMFRUIT (HYBRID) FIBRE REINFORCED COMPOSITE

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ABSTRACT:

This paper describes the research work carried out with natural composites of Jute-Palm fruit-jute (J-P-J) and Sisal-Sisal-Sisal (S-S-S) fibers at different orientation are prepared with polymer resin. Natural fibers are collected from local farmers and extracted to our required size also cleaned, treated as per our requirement. Specimens were prepared with ASTM Standards and are tested to evaluate tensile strength, Flexural strength and Impact strength. Woven mat technique and Hand lay-up technique is followed at room temperature to mould the specimen. The weight fractions of fibers are equal 50:50% for all the fibers used in the experimental analysis. Flexural, tensile and Impact properties of hybrid composites were analyzed. The result shows the energy absorbed by the jute-palm-jute composite is more than the other for equal weight fractions.

Key words: Jute, Palmyara, Sisal, polymer resin, Hardener, Woven mat, tensile strength, Flexural strength and Impact strength.J-Jute,S-Sisal,P-Palm.

1. INTRODUCTION

Increasing demand and interest in using natural fibers from different area has throwing the research in the field to innovate for the application of more kind. Natural fiber has more advantages to use in engineering applications. Automotive sector plays major role to adopt green materials in its different parts. Zero-emission norms, scarcity of raw material and environmental friendly status emphasis the use of natural fibers. However, recently, deforestation scarcity in agriculture field we need to renew the future. Natural fiber composites have many applications because of their ease of fabrication, low prize, and high mechanical properties and environment friendly as compared with metal and plastic materials.

Studies on the mechanical properties of natural fiber reinforced polymer resin have shown that fiber length distribution, orientation, type of resin, curing time/method and use of hybrid composites plays major role in determining the mechanical properties. Present study investigates whether the palmyara and its hybrid fibers with polymer binder can be effectively used to replace the plastics. Sisal-Sisal-Sisal mat and Jute-palmyara-jute is prepared by woven and hand layup technique and the results were compared.

The purpose of this work is to develop the material with biodegradability, high strength and excellent mechanical properties of palmyara fibers at different configuration and hybridization. Palmyara fruit fiber is reinforced between the woven jute mats and is molded with vinyl Easter by hand layup technique. Sisal woven plates of three layers are laminated and are molded with vinyl ester. Use of natural fibers with polyester, FRP, Glass and carbon fibers receiving attention because of biodegradability, renewability, less weight, and low cost etc., Continuing research have investigated the development of natural fiber composites such as banana (Ganeshan et al., 2016). The Banana fiber reinforced polymer composites (Ashok Kumar et al., 2016). The Mechanical and water absorption properties of woven jute/ banana hybrid composites (Kandeepan et al., 2016). The Mechanical properties of Natural fiber (Banana,Coir,Sisal) the effect of epoxy coated kenaf fiber. Flexural properties of long Bamboo fiber/PLA composite. Pulping and Paper properties of palmyara palm fruit –Mechanical properties of Glass/Palmyara fiber waste sandwich composites (Thamilarasan et al., 2016), Mechanical characterization of palmyara fruit fiber Reinforced Epoxy composites were discussed.

2. MATERIALS AND METHODS

2.1. Materials: In this research, fiber bundles of 100 to 300 μm and length of 100 mm were used. Following figure shows the macroscopic photograph of fibers used for this work. Stem explosion method is used to take out the fibers. Stem explosion is the method of applying temperature and pressure on it to evaporate water and to extract fiber (Gupta et al., 2015).

2.1.1. Extraction of fiber: After the afore mentioned process sisal leaves are soaked in the normal water for 14 days. After two weeks the leaves are taken out from the water and dried under sun light for another two weeks. Then the dried leaves are soaked in to water for two days. Now the fiber is easily extracted from the processed leaves by hand (Yoganandam et al., 2016).

Figure 1: Extraction of fiber

2.1.3. Weaving of fibers: Fibers are combined together to form a thread which makes it very stronger compared to individual fibers. These threads are forming a mat by weaving them. Dimensions of the mat are 400 × 400 × 0.8mm^3 (l×b×t).Plain weaving method is used in our project, in plain weaving method each warp fiber passes alternately under and over each weft fiber. The fabric is symmetrical, with good stability and reasonable porosity (Warenyou et al., 2005). With large fibers this weave style gives excessive crimp and therefore it tends not to be used for very heavy fabrics. It gives nice grip to individual threads (Hafsatsaliu et al., 2015).

3. RESULTS AND DISCUSSION

After removing the material from the mould it is cut to the required dimensions to carry Tensile, Flexural and Impact tests (Vinoth et al., 2016). The specimens are cut as per the ASTM standard. For the flexural Test specimen were cut as per the dimension of 200×25×3 mm^3, Tensile Test specimen 250×25×3 mm^3 and impact test specimen are cut to the dimension of 75×25×3 mm^3

Table 1: Mechanical Properties of the composite specimen.

Impact test (Charpy)	
Test Parameter	**Value**
Length of the specimen	75mm
Breadth of the specimen	10mm
Thickness of the specimen	3mm
Test temperature	24ºC
Absorbed energy	2 J/cm

Flexural Test	
Test Parameter	**Value**
Gauge width	23.40 mm
Gauge Thickness	3.09 mm
Original cross-Sectional area	72.31 mm^2
Flexural Load	0.160 KN
Flexural strength	85.93 Mpa
Displacement of specimen	10.7 mm

Tensile Test	
Test Parameter	**Value**
Gauge width	22.06 mm
Gauge Thickness	3.01 mm
Original cross Sectional area	66.40 mm^2
Ultimate tensile Load	2.42 KN
Ultimate tensile strength	36 MPa
Displacement of specimen	2.05 mm

The following table shows the loads (Flexural, Tensile and Impact) on sisal-sisal-sisal composite with Jute-palmyara-Jute composite (Velmurugan et al., 2016).

Flexural Test	
Test Parameter	**Value**
Gauge width	32.67 mm
Gauge Thickness	9.57 mm
Original cross Sectional area	312.65 mm^2
Flexural Load	1.67 KN
Flexural strength	61.10 Mpa

Tensile Test	
Test Parameter	**Value**
Ultimate tensile Load	6.79 KN
Ultimate tensile strength	22 MPa
Impact test(Charpy)	
Test Parameter	**Value**
Test temperature	24ºC
Absorbed energy	20 J/cm

Thus, the results of jute –palm fruit –jute composite is compared with sisal –sisal-sisal woven mats.

4. CONCLUSION

The mechanical properties of woven mat of S-S-S fiber and J-P-J fiber were studied, and the tested values are tabulated. High strength bio degradable composite properties such as flexural, tensile and impact strengths of S-S-S woven plate molded with vinyl ester is tested and the results were compared with the JPJ fiber reinforced with vinyl ester, the second one posse's high toughness. The comparative table shows results of JPJ and SSS composies.JPJ composite absorbs more energy when compared to S-S-S woven fiber composite (20 joules as mentioned above). Optimum strength is achieved when 50:50 % of

weight of fiber with vinyl ester. Above graphs shows the flexural, tensile and impact loads of JPJ composite is higher than SSS composite. Comparative graph shows the flexural, Tensile and impact strengths of JPJ composite is quite high.

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