Development of Hybrid Reinforced Polymer Composite

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Abstract- *Composites are a mixture of two or more constituent materials where the performance of composites is best that their constituent materials acting alone. The manufacturing of composites provide a means of improving strength, stiffness, resistance to temperature creep of composites whilst at same time offering cost reduction, Natural fibers as reinforcement as they are environmentally friendly, renewable, non-abrasive, eco-friendly, corrosion resistance and biodegradable characteristics. Pineapple is one of the natural fibers having highest cellulosic content nearly 80%. Density of PALF is similar to other natural fibers while Young's modulus is very high, and tensile strength is highest among the related natural fibers. The Borassus fibers are extract the fruit. Low cost natural fiber composites with excellent thermal insulation properties are fabricate from borassus fiber. In this research work fabrication of hybrid composite materials by using PALF & Borassus fruit fibers. These two materials mix with epoxy & Resin, Manufacturing new hybrid composite materials in different ratios. Evaluate of Thermal properties of hybrid reinforced polymer composite materials.*

Keywords- PALF (Pineapple leaf fiber), Borassus fruit fiber, Epoxy and Resin, Thermal properties.

I. INTRODUCTION

Natural fibers have played a very important role in human civilization since prehistoric times. Natural fibers are substances which are prepared from plants and animals that can be converted into filament, thread or rope.The Natural fiber reinforced composite has improved earlier the attention of researchers because they are eco-friendly, light weight, strong, cheap, nonabrasive and excellent mechanical properties.

Low cost natural fiber composite with excellent thermal insulation properties was fabricated from the borassus seed shoot fiber by varying volume fraction using polyester resin. Thermal insulation of the composite increases as fiber content increased The results obtained from this work have significant potential benefits for thermal design of engineering applications like automotive parts , electronic devices, building constructions etc.The tensile property of the fiber was found to increase after alkali treatment due to improve fiber structure and found to be best 8 h alkali treatment. Mechanical properties and thermal properties like tensile strength, impact strength, flexural strength, thermal conductivity and thermal stability of the borassus fiber were found to increase after alkali treatment or water treatment.

Synthetic fibers can be partially substituted with PALF in fabrication of composite products for different applications. It is observed that recent works have reported on chemical modification of PALF, physical and mechanical properties of PALF reinforced polymer composites and its hybrid. Pineapple is one of the natural fibers having highest cellulosic content nearly 80%. Density of PALF is similar to other natural fibers while Young's modulus is very high, and tensile strength is highest among the related natural fibers. PALF is not degraded after long storage in hot and humid local conditions. Flexural and impact properties of PALF-reinforced vinyl ester composites are not affected by the presence of some epidermal tissues on the fibers and by the PALF location in the leaves.

II. METHOD OF MANUFACTURING SPECIMEN

A. Extraction of Borassus fruit fiber

Borassus fruit fiber is a natural fiber (Scientific name is CARYOTA URENS) of Arecaceae family and is used for making strong ropes. The borassus fruit fiber is extracted by a process is known as RETTING PROCESS .The borassus fruits were taken from the tree and immersed in water tank for 2to 3 weeks .After that the fiber were stripped from the stalks by hand. So that fiber will be remain. Washed and dried borassus fruit fiber was taken in separate trays to these trays 10% NaOH solution was added. Then the fiber was soaked in the solution for 10 Hours. After that the fiber were washed thoroughly with water to remove excess of NAOH sticking to the fiber.

Fig. 1 Borassus fruit fiber

Fig. 2 Borassus fruit

B. Extraction of pineapple leaf fiber (PALF)

Extract the pineapple leaf fibers (PALF) from leaves of pineapple. Scrapping Method of Extraction is the machine used for scrapping the pineapple leaf fiber. The machine has the combination of three rollers: feed roller, leaf scratching roller, and serrated roller. Feed roller is used for the feeding of leaves into the machine then leaves go through the second roller that is called scratching roller. It scratches upper layer of leaf and removes the waxy layer. And at last leaves come to the dense attached blade serrated roller, which crushes leaves and makes several breaks for the entry passage for the retting microbes.

Retting of Pineapple Leaves In retting process, small bundles of scratched pineapple leaves are immersed in a water tank which contains substrate: liquor in 1:20 ratio, urea 0.5%, or diammonium phosphate (DAP) for fast retting reactions. Materials in water tank are regularly checked by using finger to ensure fiber are loosened and can extract many chemical constituents like pentosans, lignin, fat and wax, ash content, nitrogenous matter, and pectin. After retting process, fibers are segregated mechanically, through washing in pond water. Extracted fibers are dried in hanging place by air. So that only fibers will be remain. Washed and dried PALF were taken in separate trays to these trays 10% NaOH solution was added. Then the fibers were soaked in the solution for 10 hours. After that the fibers were washed thoroughly with water to remove excess of NaOH sticking to the fibers.

Fig. 3 Pineapple leaves

Fig. 4 Pineapple leaf fibers

C. Epoxy resin and Hardener

The resin and hardener mixture is used for binding various layers fiber. LY556 epoxy resin and HY951 hardener gives the better binding property under standard room temperature then other resin. An optimum mixing ratio of 10:1 between resin and hardener is used to follow by researchers suggestions.

D. Specimen preparation method

In this study, Manual hand layup method is used for preparing composite laminates. We have taken two plane glasses and fax is applied on top and bottom surface of glass. The LY556 epoxy resin and HY951 hardener mixture is completely applied. The specimens are manufactured borassus fruit fiber, pineapple leaf fiber and combination of borassus fruit fiber&Pineapple leaf fiber. The combination laminate composites are prepared by layer by layer up to three layers respective fibers. The first layer is Pineapple leaf fiber and applied epoxy and resin mixture. After that second layer of borassus fruit fiber is placed over the first layer. Then followed same way third layer of Pineapple leaf fiber is placed over the second layer. The specimen prepared as per ASTM-D 638 standard. Such as we have prepared four sheets these are 1.Three layer Borassus fruit fiber, 2.Three Pineapple leaf fiber, 3.Two Borassus fruit fiber and one layer pineapple leaf fiber, 4.Two layer Pineapple leaf fiber and one layer Borassus fruit fiber.

Fig. 5 Specimen laminated composites

Fig. 6 Specimens for testing

III. TESTING OF COMPOSITES

Thermal Conductivity test

Thermal conductivity of a material depends on the nature of material, the area of cross section normal to the direction of heat flow and the temperature gradient between the hotter part and colder part of the material. The guarded heat flow meter test method is used to determine the thermal conductivity of the samples at different temperature using instruments in accordance with ASTM.A sample of the material is placed under a uniform compressible load between two polished surfaces, each controlled at different temperature. The lower surface is part of a calibrated thermometer. The heat flows from the upper surface through the sample to the lower surface establishing an axial temperature gradient stack. To calculate the thermal conductivity by using these values are specimen dimensions, heat input and temperature difference from source to sink. When it reaches thermal equilibrium condition of the temperature difference across the specimen is measured along with the output from the thermometer.

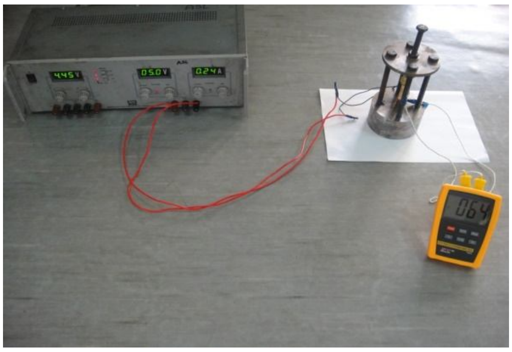

Fig. 7 thermal conductivity test

IV. RESULTS AND DISCUSIONS

Table.4 Results for Thermal conductivity (W/m-K) Test

Name of the Materials	Sample 1	Sample 2	Sample 3	Average K (W/m-K)
B	0.278	0.278	0.278	**0.278**
P	0.307	0.307	0.307	**0.307**
H	0.294	0.294	0.294	**0.294**
C	0.297	0.300	0.304	**0.300**

B: Three layer borassus fruit fiber
P: Three layer pineapple leaf fiber
H: Two layer borassus fruit fiber and one layer pineapple leaf fiber (Hybrid composite H)
C: Two layer pineapple leaf fiber and one layer borassus fruit fiber (Hybrid composite C)

From the above table, it shows the variation of thermal conductivity of different composite sample**B**, **H**, **C** and **P**. It exhibits the variation of thermal conductivity is increasing from **B** to **P**. The thermal conductivity of composite material **P** isgreater than the composite material **B**.

V. CONCLUSION

From the experimental results are obtained, the following conclusion are given. The borassus fruit fiber composite **'B'** has very low thermal conductivity is 0.278W/m-K compare to other composite materials. For the thermal conductivity of hybrid composite is decreasing when comparing pineapple leaf fiber composite.

Thermal insulation properties improved for the hybrid composites **C** and **H.**

The results obtained from this work have potential benefits for thermal design of engineering applications like electronic devices, building constructions and etc.

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