Evaluation of Mechanical Behaviour of Banana & Hair fibres composite Material

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Abstract-*In this paper banana fibre and human hair are taken for the development of the composite material. The raw banana fibre is treated by sodium hydroxide to increase the wet ability. The sodium hydroxide treated banana fibres used as reinforcing material for Vinyl ester resin matrix. Human hair is used along with treated banana fibre as a reinforcing material. In this process, the banana fibre is treated with 5% of sodium hydroxide for one hour and the specimen is fabricated by hand moulding process. The mould used for fabricating the composite material is made up of aluminium with a debonding agent applied on the inner side. The banana fibre content is kept constant to 30% of weight fraction of entire composite material. Similarly, human hair content is kept constant to 5% and vinyl ester resin content to 65% of weight fraction of entire composite material. The variation in mechanical properties are studied and analysed. Here, the tensile strength, impact, flexural strength, thickness swelling and water absorption test arrangement of the specimen.*

Keywords-Natural fibers, Mechanical Properties, Thickness Swelling and Water Absorption.

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.

II. METHOD OF MANUFACTURING SPECIMEN

Extraction of Banana Fiber

Banana is a natural fiber of Musaceae family yields a stiff fiber traditionally used in making twine and rope. Banana fiber is extracted by manual process. Where Sheaths are taken from the banana plant and then dipped in the water for 2 to 3 weak. After the decomposition takes place leaves were taken out from the water. Then the leaves are crushed and beaten by a rotating wheel set with blanket knives. So that only fibres will be remain. Washed and dried Banana fiber were taken in separate trays to these trays 10% NaOH solution was added. Then the fibers were soaked in the solution for 1hours. After that the fibers were washed thoroughly with water to remove excess of NaOH stiking to the fibers.

Fig.1 Manual Extraction of banana fiber

Extraction of Human Hair

Fig.2 Human Hair Collected from saloon

The common fiber human hair is taken out from the local sources. It is a fiber which is easily and cheaply available in India. Fibers are generally utilized as a part of cement for the accompanying reasons:

To control breaking because of both plastic shrinkage and drying shrinkage.They additionally decrease the porousness of cement and along these lines diminish draining of water.A few sorts of strands likewise generate more terrific effect, scraped area and smash safety in cement. The fineness of the strands permits them to fortify the mortar division of the cement, postponing split framing and spread. This fineness additionally represses draining in the solid, consequently diminishing porousness and enhancing the surface attributes of the solidified surface. Hair is utilized as a fiber fortifying material in cement for the accompanying reasons: It has a high elasticity which is equivalent to that of a copper wire with comparable width.Hair, a non-degradable matter is making an ecological issue so its utilization as a fiber fortifying material can minimize the issue. It is additionally accessible in wealth and with ease. It fortifies the mortar and keeps it from spalling.

Specimen preparation method

The banana fiber (Figure 3.1) is obtained from banana plant, which has been collected from local sources. The extracted banana fiber were subsequently sun dried for eight hours to remove free water present in the fiber. The dried fiber were subsequently cut into lengths of 15 mm. The vinyl ester resins and catalyst are procured from Shakthi Fibres Ltd. The banana fiber and human hair based vinyl ester composite is fabricated using hand lay-up process. The moulds have been prepared with dimensions of 400×300×10 mm3. . The base plate is fixed inside the frame for fabricate the natural fiber composites of 65% of vinyl ester and remaining natural fibers are used. The mixed resin and catalyst is filled in the pattern. The prepared natural fibers are randomly poured in the resin catalyst mixture without any gap. The roller is rolled in the mould. Again the mould is filled in pattern by next layer and fibers poured randomly. This process is simultaneously done till the required height of the mould. A sliding roller has been used to remove the trapped air from the uncured composite and mould has been closed at temperature 30° C duration 24 hour. The constant load of 50 kg is applied onthe mould in which the mixture of the banana fiber, human hair and vinyl ester has been poured. After curing, the specimen has been taken out from the mould. The composite material has been cut in suitable dimensions with help of zig saw for mechanical tests as per the ASTM standards

Fig.3 Banana fiber and Human hair based Composite material

Fig.4 Specimens as per ASTM standards

III.TESTING OF COMPOSITES

The main objective is to determine material properties of natural fibre reinforced composite material by conducting the following respective tests.

A. Tensile Strength

The tensile test specimen is prepared according to the ASTM D638 standard and the machine specifications are also chosen according to the ASTM D638. According to the ASTM D638standard the dimensions of specimen used are 165 ×19×13 mm3. This test involves placing the specimen in a machine and subjecting it to the tension according to specific load until it fractures.

Sample	Composite	Ultimate Tensile Load in kN	Ultimate Tensile Stress in MPa
S1	Without Hair	0.804	11.82
S2	Without Hair	0.745	11.06
S3	Without Hair	0.568	12.82
Average		0.705	11.9
S4	With Hair	3.18	12
S5	With Hair	3.21	12
S6	With Hair	3.41	13
Average		3.266	12.333

Table .1 Observation values of tensile test

B. Flexural Strength

The flexural specimens are prepared as per the ASTM D790 standard. The 3-point flexure test is the most common flexural test for composite materials. Specimen deflection is measured by the crosshead position. Test results include flexural strength and displacement. The testing process involves placing the test specimen in the universal testing machine and applying force to it until it fractures and breaks. The specimen used for conducting the flexural test. According to the ASTMD790 standard the dimensions of specimen used Table values were calculated by dividing the energy by cross sectional area of the specimen.

S.No.	Specimen	Energy in Joules	
		Without Hair	With Hair
1	S1	1.5	02
2	S2	1.5	02
3	S3	1.5	02
Average		**1.5**	**02**

Table .3 Observation values of impact test

C. Impact Strength

The impact test specimens are prepared according to the required dimension following the ASTM-D256 standard. During the testing process, the specimen must be loaded in the testing machine and allows the pendulum until it fractures or breaks. Using the charpy impact test, the energy needed to break the material can be measured easily and can be used to measure the toughness of the material and the yield stress. The fracture

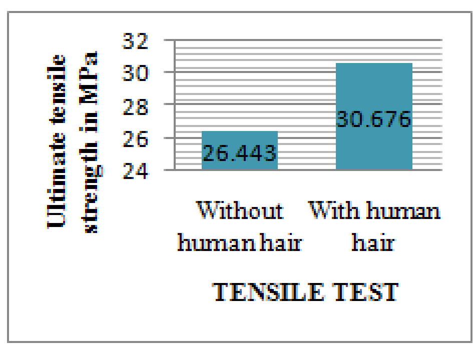
D. Thickness Swelling (TS) & Water Absorption (WA) TEST

Specimens with dimensions are 50 mm 50 mm were prepared for evaluation and thickness swelling. The thickness at middle of each test specimen was measured with micrometer and then soaked in water for 24 hours before for that measurement of the thickness. The thickness swelling rate was determined from the following formula(BSI, 2003).

Thickness Swelling Rate Formula:
$TS_{24}= (t_{24}-t_0 / t_0) \times 100\%$
Where t_{24}= thickness of specimen after soaked in water for 24 hours = 13mm
t_0 = thickness of specimen before soaked in water = 13mm
$TS_{24}= (13-13/13) \times 100\%$
$TS_{24}= 0$
Water Absorption Rate Formula:
$W.A. = (w_{24}-w_0 / w_0) \times 100\%$
Where w_{24}= weight of specimen after soaked in water for 24 hours = 39.83gms
w_0 = weight of specimen before soaked in water = 39.6gms
$WA_{24}= (39.83-39.6 / 39.6) \times 100\%$
$WA_{24}= (0.23/39.6) \times 100\%$
$WA_{24}=0.0058\%$

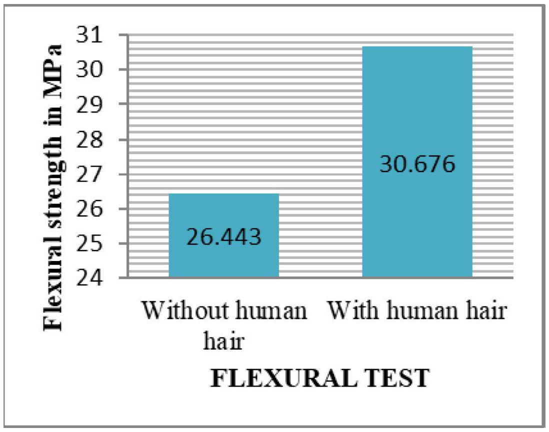
IV. RESULTS AND DISCUSSION

A. Tensile Test



The variation of tensile strength of the composite with and without Human Hair is shown in the above graph. It exhibits the variations of tensile strength with different composite specimens for the peak loads. The specimen with human hair has high tensile strength of 12.333MPa and the specimen without human hair has low tensile strength of 11.9MPa. The tensile strength of composite specimen with human hair is 0.433MPa greater than that of specimen without human hair.

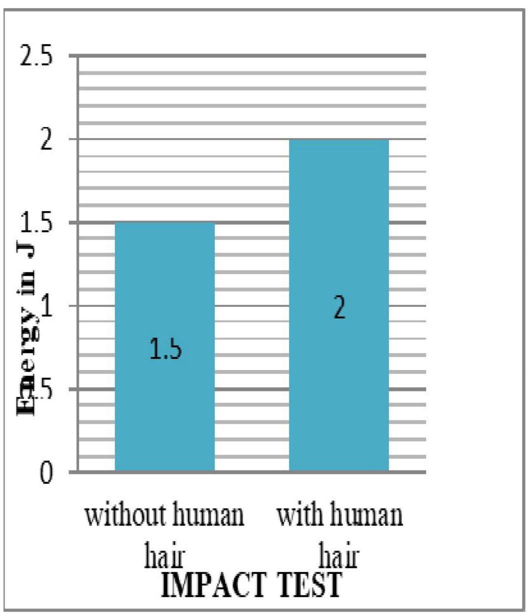
B. Flexural Test



Graph.2 Comparison of Flexural Strength

unication is the fastest growing technologies. In the last two decades, the demand for wireless services and the number of mobile subscribers has been increased. Due to increase in wireless services mobile operators and researches are developing new transmitting technologies, protocols, algorithms and network infrastructure solution to improve the network performance.

C. Impact Test



Graph.3 Comparison of Impact test

The variation of Impact strength of the composite with and without human hair is shown in the above graph. With the results it is concluded that the addition of human hair material increases the Impact strength due to the chemical treatment of the composites of reinforced surface with bonding material, the bonding strength between fibers is improved. Individually the bonding strength of the banana fiber is less. But the improvement of bonding strength with the combination of these two materials is higher. The Impact strength of composite with human hair is higher than the composite without human hair.

V.CONCLUSION

From the experimental results are obtained, the following conclusion are given:

- The tensile strength of composite with human hair is 0.433MPa greater than that of composite without addition of human hair.
- The flexural strength of composite with human hair is 3.557MPa greater than that of composite without NC.
- The impact strength of composite with human hair is 0.5J greater than that of composite without human hair.
- The specimen has corrosion resistance property as well as thermal resistance.
- After the elaborate study of the composite , it is clear that human hair is well accepted choice as a composite fibre in the field of advanced engineering material sciences

Hence the effect of banana fiber and human hair based vinyl ester composite exhibit better mechanical properties than banana fibre based vinyl ester composites. These filled natural fibers composites has a wide range of applications such as in automobile industries as front and rear door liners, parcel shelves, seat backs and sunroof interior shield, valence panels below front and rear bumper, building insulation materials, electronic packages, in flue gas de-sulfurication plant as chimney, in aircrafts as cabin and cargo hold furnishings, artificial limbs for physically handicapped, in oil industry.

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