Tensile Properties of Hybrid Particulate Composite Materials

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Abstract: *In recent past automobile industry is growing enormously. All the manufacturers of automobiles are in the process of supplying them at low cost. The cost of the automobile depends on the materials used in the processes. So, all the researchers are concentrating on new materials which will be strong enough, low cost, less weight, recyclable, high specific strength, non abrasive, eco-friendly, fairly good mechanical properties with biodegradable characteristics. In nature, none of the single material will have all the required properties. Hence much amount of research is intensified on the composite materials.*

In India, large amount of borassus fruit fibre and coconut leaf sheath fibre is available in different states which can be utilized for the preparation of composite materials.. To obtain this new composite material in different ratios, the present experimental work is planned accordingly with the above materials. Physical tests such as tensile test, test will be conducted to evaluate tensile properties of the composites

Keywords - *Borassus fruit fibre, Coconut leaf sheath fibre and Tensile Test*

1. INTRODUCTION:

Natural fibres have played a very important role in human civilization since prehistoric times. The Natural fibre reinforced composite has recently attracted the attention of researchers because they are environmental friendly, being light weight, strong, cheap, nonabrasive, high specific mechanical properties and abundantly available. In present research, we have been characterized the behaviour barassus and coconut sheath fibre . The borassus and coconut leaf sheath fibre are available in nature. It is a genus six species of fan palms, native to tropical regions of Africa, India and Gunea. They are growing upto 30 m high and 2-3 m long. The flower small in densely clustered spikes, followed by large brown, roundish fruits.

Coconut tree is native to coastal areas of Southeast Asia (Malaysia,Indonesia, and Philippines), tropical Pacific islands Melanesia, Polynesia, and Micronesia) and westward to coastal India, Sri Lanka, East Africa, and tropical islands (e.g., Seychelles, Andaman, Mauritius) in the Indian Ocean. Many fibre are available in different parts of the coconut tree (Satyanarayana et al. 1982). The sheath is made up of an inner mat which is sand wiched between two layers of coarse fibre . Only preliminary studies of coconut leaf sheath fibre were reported in the literature (Satyanarayana et al. 1982). Though the fibre from many parts of the coconut trees are put to use, the sheath fibre are left as huge waste. In the present work, we separated the coarse fibre from the outer layers and the fine fibre from the inner mat to study their properties

2. METHOD OF MANUFACTURING SPECIMEN

A. EXTRACTION OF BORASSUS FRUITS FIBRE

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 fibre were stripped from the stalks by hand.So that fibre will be remain.washed and dried borassus fruit fiber was taken in separate trays to these trays 10% NaOH solution was added.Then the fibre were soaked in the solution for 10 Hours.After that the fibre were washed thoroughly with water to remove excess of NAOH sticking to the fibre

Fig. 1 Borassus fruits

Fig.2 Borassus fruits fibre

B. EXTRACTION OF COCONUT SHEATH FIBRES

The Coconut Palm (*Cocos nucifera*) is a member of palm family(Arecaceae). Coconut leaf sheath fibre occur in mat form. The leaf sheaths collected from the trees were dipped in water for one week, thoroughly washed with tap water followed by distilled water, and dried in the sun for a week. Cleaned leaf sheath was separated to inner sheath mat and the outer layer fibre . The fibre of the inner mat and outer layers were separately kept in open to atmosphere temperature for 2 – 3 days to remove the moisture. Some of these fibre were treated with 10% sodium hydroxide (NaOH) solution for 24 hour at room temperature, maintaining a liquor ratio of 25:1 to remove the hemi cellulose and other greasy materials. These fibre were washed with water repeatedly. Finally the fibre were washed with distilled water before drying in atmosphere temperature.

Fig.3 Coconut Leaf Sheath Fibre

C. Epoxy resin and HY951 Hardener

The resin- hardener mixture is used for binding various layers fibre. LY556 epoxy resin and HY951 hardener gives thebest binding property under standard room temperature. Recommended by researchers an optimum mixing ratio of 10:1 between resin and hardener is used.

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 fibre, Coconut leaf sheath fibre and combination of borassus fruit fibre & Coconut sheath fibre. The combination laminate composite is prepared by layer by layer respective fibre. The first layer is Coconut leaf sheath fibre and applied epoxy and resin mixture. After that second layer of borassus fruits fibre placed over the first layer. The specimen prepared per ASTM-D 638 standard.

Fig.4 Specimen of laminate composite

Fig.5 Specimen for Tensile test

3. TESTING OF COMPOSITES

The main objective is to determine material properties of natural fiber laminate composite material by conducting the tensile 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 $165 \times 19 \times 13$ mm^3. This test involves placing the specimen in a machine and subjecting it to the tension according to specific load until it fractures.

Figure 4.1 Experimental set up for tensile test

B. THICKNESS SWELLING (TS) AND 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

$WA_{24} = (39.6-39.6 / 39.6) x100\%$

$WA_{24} = (0.0/39.6) \times 100\%$

$WA_{24} = 0\ \%$

4. RESULTS AND DISCUSSION

Table 4.1 Results for Tensile Test

Specimens	Tensile Test(Mpa)
CLSF1	7
CLSF2	6
CLSF3	7
Avg	6.667
BFF1	4
BFF2	5
BFF3	5
Avg	4.667
C1	10
C2	6
C3	9
Avg	8.333

CLSF: Coconut Leaf Sheath Fibre
BFF: Borasus Fruit Fibre
C: Composite

The variation of tensile strength of the laminate composite materials is shown in the above table. It exhibits the variations of tensile strength with different composite specimens for the peak loads. The specimen composite has high tensile strength of 8.333MPa and the specimen individual has low tensile strength of 4.667MPa for Borassus Fruits Fibre and 6.667 Mpa for Coconut Leaf Sheath Fibre. Thickness Swelling and Water absorption test are tested. But Thickness swelling above materials is not swelling and water absorption is 0%.

5. CONCLUSION

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

- The tensile strength of laminate composite is 8.333MPa greater than individual of borassus Friuts fibre and Coconut Leaf Sheath fibre.
- The above laminate composite materials are not absorbed water.
- The above laminate composite materials are not swelling.

Hence the effect of borassus fruit fibre and Coconut Leaf Sheath fibre based laminate composite exhibit better tensile strength than individual laminate materails. These filled natural fibres composites has a wide range of applications such as in automobile industries as front and rear door liners, parcel shelves, seat backs and sun roof interior shield, valence panels below front and rear bumper, electronic packages, in aircrafts as cabin and cargo hold furnishings, artificial limbs for physically handicapped, in oil industry.

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