Tensile Behaviour of BBJS Composite Materials

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Abstract—In the past two decades the usage of composites is increased significantly among all composites natural fiber as reinforcement in polymers is replace many engineering materials. In present work deals making a composite of natural fibers like Banana, Borassus, Jute and Sisal (BBJS) as fibers and give a brief explanation of advances and characterization of new set of natural fiber composites. It has prepared by reinforcing BBJS fibers with epoxy resin and hardener in matrix by using hand layup technique. The reinforcing material may be in the form of fibers, particles or flakes. Reinforcement usually adds rigidity and greatly impedes fracture promulgation. Skinny fibers can have high potency, and provided they are mechanically well attached to the matrix they can greatly improve the composite's overall properties. Fibres are used to carry the load and matrix is used to bind and transmit the load to fibers. The natural fibers were prepared from the raw material by retting and combing process. Composites were prepared as cylindrical shape by using BBJS as fibers of 1:1:1:1, 1:2:2:2, 2:1:2:2, 2:2:1:2 and 2:2:2:1 weight fraction. The tensile properties of composite were estimated after destructive testing the addition of borassus is drastically changes the properties.

Key words: BBJS fibers, epoxy resin, tensile properties,

I INTRODUCTION

Composites consisting two or more chemically distinct constituents, these were on a macro-scale, having a distinct interface separating them. One or more discontinuous phases therefore, are embedded in a continuous phase to form a composite. The discontinuous phase is usually harder and stronger than the continuous phase the reinforcement increases the strength of the matrix. Mix up of short fibers having same length and different diameter offer some advantages over the use of single type of fibers. The natural fibers like jute, sisal, hemp, kenaf, and banana are renewable, non-abrasive and can be destroy for energy recovery. They show excellent mechanical Properties, have low density and are inexpensive.

a) PMC Composites:

Plastics matrix based composite materials constitute more than 95 per cent of composite materials in use today. Both thermo sets as well as thermoplastics are used as matrix materials. As thermo sets mostly exist in liquid state before cross-linking, it is very convenient to combine reinforcements in the required proportion, shape the product and cure it into solid. Thermoplastics, on the other hand, have to be heated and liquefied for adding inserts.

b) MMC Composites:

In Metal matrix composites the reinforcements have high strength fibers in order to improve the strength of the composite and stiffness (Young's modulus). However, it reduces elongation and toughness. Boron reinforced aluminium is very popular for aircraft applications.

c) CMC Composites:

Ceramic, carbon and glass are widely used for this purpose. The introducing of fibers into ceramics improves tensile strength and toughness. Similarly, carbon glass reinforced with carbon fibers has better toughness. The fiber reinforced polymers consist of fibers of high strength and modulus embedded in or bonded to a matrix with a distinct interface between them. In this form, both fibers and matrix retain their physical and chemical identities. In general, fibers are the principal load carrying members, while the matrix keeps them at the desired location and orientation, act as a load transfer medium between them, and protect them from environmental damage [7]

Due to low density, high tensile strength, and low elongation for powder kind of banana fibers, composites based on these fibers have very good potential use in the various sectors like building construction, automotive parts preparation, machinery, etc., Thus we conclude that the systematic and persistent research in the future will increase the scope and better future for banana fiber and its composites. [1-2]

The improvement of tensile and impact properties for treated fibers reinforcement when compared to the raw fiber reinforcement was estimated to 5 to 20% increment. The youngs module of 5 mm alkali treated fiber reinforced composites showed 7% improvement than that of the 5 mm raw fiber reinforced composites.

It is clearly observed that keeping the reinforcement material in NaOH is improves the tensile strength, not the tensile modulus. An improvement in the transverse tensile strength of the single layer fibre composites has been observed through increasing in the case of fibre treatment.
by 1% sodium hydroxide, for four hours treatment. However, at higher alkali concentration (sodium hydroxide 5%), the treatment was decreases the tensile strength of the composites had observed. Therefore Sodium Hydroxide 1 wt%, 4 hours time was selected for treatment of reinforcement and assumed the optimal for the treatment.[3-4]

Mechanical properties of Sisal Fiber (SF) reinforced and urea-formaldehyde resin composites had described earlier[8], the composite with 50 wt% SF shows the high impact strength (Charpy) and it decreases by change with percentage of reinforcement in composite, Whereas the 30 wt% SF has shows the flexural, wear resistance and the no moisture absorption properties are proved excellent in this composite, based on this the parameter was adopted in this work. [5-6]

PREPARATION OF REINFORCEMENT AND COMPOSITE MANUFACTURING METHOD:

Natural fibers were extracted from sisal plants, jute plants, coir, borassus, hemp plants, and banana stems for the preparation of environmental friendly and green composites. Current studies the natural fiber composites offer significant upgrading in materials from renewable sources with enhanced support for global sustainability. These natural fiber composites possess high or moderate strength and thermal stability when they are in usage, or after recycle also. The selected fiber materials are shown below.

A). Banana fiber:

From local area we collected a large amount of banana stems, these collected stems were dried in sunlight. After drying these stems were cleaned by using NaOH solution and removed hard particles from the stem. To get required fibers, the cleaned stems were kept in to NaOH solution for at least seven days time. These were made to required form of powder with required size the cleaned continuous fibers were machined. And graded the above banana fibers powder in to different groups, based on its grain size. The same was followed for all the reinforcement materials. The following groups of powder is 50, 100,150 microns and 200 microns separated by separator.

B). Borassus:

The collected borassus fruits were exposed to sunlight to get dried. After dried the internal and external surface were removed and cleaned for getting net shell of fruit. After cleaning the shell were powdered by machining, to make easy of machining those shells were cut into small pieces.

C). Jute fiber:

Jute plants were collected and bundled, that were kept in to water for Retting process, is help to separate the jute fiber from plants, the separated jute was washed to remove dust if any present. The dried fiber were converted into powder by using Jute mills, and converted into required size of powder form.

D). Sisal fibers:

These extracted from the leaf of sisal plants, the extraction of the sisal fibers were follow the same procedure as jute fiber. A bunch of fibers were clamped on a stick to facilitate segregation and separated, and grouped accordingly as its fiber size. The separation and knotting is repeated until we get required amount of fibers. This Sisal fiber can be used for making variety of composite products.

III. THE SELECTION OF AMOUNT OF FIBER MATERIAL TO PREPARE COMPOSITE(S):

The weight of the matrix was calculated by multiplying density of the matrix and the volume of the mould. The weight of the fiber material is also calculated with corresponding specified weight percentage of fibers. For hybrid combination the corresponding weight of fiber is calculated by sharing the obtained weight of fiber into four fiber materials.

IV. MOULD PREPARATION AND FABRICATION:

For this work the PVC pipe of 400 mm length & 23 mm diameter was used to prepare samples. For quick and easy removal of the composite oil was applied to the mould. The weight presents of banana, borassus, jute and sisal (i.e. 10, 20, 20 and 20 weight %) in the ratio 1:2:2:2, was mixed with the matrix material consisting of epoxy resin and hardener in the ratio of 5:4 these mixture mixed thoroughly then poured into the mould. Care was taken to avoid formation of air bubbles at the time of pouring and mixing, was allowed to cure at room temperature for 24 hours. The above procedure was adopted to prepare different composite rods with different percentages of reinforcements.

V. RESULTS AND DISCUSSIONS OF TENSILE TEST:

The microstructure of composite was clearly shows the clean bond between fibers and matrix is same as all the natural composite material.

The three sets of each combination were prepared and tensile test were conducted as per the ASTM standard. Table 1 shows, the various combinations of tested specimen. C1 to C5 combinations were shown the BBJS wt% fibre.

The result of tensile properties was shown in the table 2 among all combinations the C3 specimen has shows the lower strength compare to all specimens in specimen C3.
the borassus was 1 wt% remaining 2 wt% , in all combinations C1 shows the tensile strength of 12.72MPa at peak load of 4.96 KN.

Compare to strength of C1 and C3, the increases of other fiber (wt%) is shows the less tensile properties. No one combination of composite were didn’t gives the best tensile result of all the possible incremental of (wt%) fiber. And also the two specimens of tested combinations was shown approximately similar tensile properties these are C2 and C5, in these combinations Borassus and Jute are same wt% and other fiber materials banana and sisal only changed. Got the same tensile properties nearly 12.7 MPa for C1 and C4, in both the Jute wt% is same remain was increased two times in C4. The equal wt% of reinforcement material presence in the composite material has shows the best result and incremental of the fiber remain decreases the result.

Is clearly shows the bar graph of the tensile properties, among that the sample 1 and sample 4 have the same tensile strength nearly 12 KPa, and the sample 2 and sample 5 shows the nearly the same strength 11 KPa. the sample 3 shows the least strength 9 KPa. The transfer of load is compared to continuous fiber. And also the hybridization of natural fibers has provided considerable improvement of tensile strength when compared to individual reinforcement; and also the increment of fiber wt% in the composite is decrease the tensile strength. The tensile strength increased by 65% (maximum)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Sample designation</th>
<th>Combination wt% (B:B:J:S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C1</td>
<td>1:1:1:1</td>
</tr>
<tr>
<td>2</td>
<td>C2</td>
<td>1:2:2:2</td>
</tr>
<tr>
<td>3</td>
<td>C3</td>
<td>2:1:2:2</td>
</tr>
<tr>
<td>4</td>
<td>C4</td>
<td>2:2:1:2</td>
</tr>
<tr>
<td>5</td>
<td>C5</td>
<td>2:2:2:1</td>
</tr>
</tbody>
</table>

Table: specimen preparation and designation

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Average Peak Load (KN)</th>
<th>Average Tensile strength (MPa)</th>
<th>Average young’s modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>4.96</td>
<td>12.72</td>
<td>182.00</td>
</tr>
<tr>
<td>C2</td>
<td>4.53</td>
<td>11.57</td>
<td>154.94</td>
</tr>
<tr>
<td>C3</td>
<td>3.91</td>
<td>9.04</td>
<td>88.75</td>
</tr>
<tr>
<td>C4</td>
<td>4.56</td>
<td>12.41</td>
<td>211.89</td>
</tr>
<tr>
<td>C5</td>
<td>4.70</td>
<td>11.50</td>
<td>126.63</td>
</tr>
</tbody>
</table>

Table: Tensile properties of the tested samples.

VI. CONCLUSION:

Successfully prepared the BBJS Composite of various wt% of reinforced and tensile properties, of BBJS fiber reinforced composites was observed. It is found that polymer banana and other reinforced natural composites are the best natural composites among the various combination.

The mechanical behavior of the BBJS composite material has been estimated in the present work. The materials of BBJS composite had taken in different ratios are mixed with resin and hardener and made into geometrical shapes. These have been tested experimentally for impact, compression and tensile tests. The results found high tensile strength for C1 composition, because equal amount of powders are added. All the material having good tensile properties except borassus.

The tensile result shows the equal wt% of reinforcement material presence in the composite material has shows the best result and incremental of the fiber remain decreases the tensile result.

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REFERENCES:

thermal analysis of vinylester-resin-matrix composites reinforced with untreated and alkali-treated jute fibres.” Comp Sci and Tech 2002, 62, 911-917