Tensile & Flexural behaviour of Sugarcane Bagasse Composites

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Abstract: ***Over the past thirty years of composite materials history says that it has been the dominant emerging materials which have proved with their weight to strength ratio, but the present scenario is to do them cost effective. Presently our work is been focused on the development of the composite by the use of sugarcane bagasse fibre in order to study its mechanical properties. Many of the researches are on going towards these natural fibre composites in order to replace few materials like plastic and ceramics. In this work we have focused on the preparation of a polymer matrix composite using sugarcane bagasse fibre which intern helpful to study regarding its mechanical behavior. For this we have adopted the basic hand lying method, which is a easy and reliable methods. The bagasse was successively treated with 14% Toulene solution and then later with 1M Citric acid and was sun-dried. Composites having different percentage weight fraction of 0, 2.5, 5, 7.5 % of sugarcane bagasse fibre for different laminates were made. Later it has cutted or prepared for the tests and the interfacial behaviour of these composites was determined by tensile test and flexural test.***

Keywords: Sugarcane Bagasse, polymer matrix composites, Flexural Test.

I. INTRODUCTION

From the few decades, many of the researchers are trying to bring out few light weight materials which are made from the natural fibre composites. Since these results are attracting the automakers to achieve the weight reduction and to improve the efficiency of the automobiles.This is because of the natural fibres which have many unique properties that are difficult to match with synthetic fibres. Since the experimentation on the natural fibre like bagasse, as alternate to the synthetic fibre in fibrereinforced composites have increased and opened up further industrial possibilities. Natural fibre reinforced composites can be utilized in the plastics, automobile and packaging industries at nominal cost. The fabrication method of a natural fibre composite material enhances themechanical properties and will be strongly related to variables like length offibre and the type of resin used for it. In order to increase the fuel efficiency in the automobiles, they need to focus on the manufacturing of the light weight materials, which are like structural application. For example, dash board, side door panel, front and rear bumpers etc.

Manuscript received on 11 January 2021 | Revised Manuscript received on 29 January 2021 | Manuscript Accepted on 15 February 2021 | Manuscript published on 28 February 2021.

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Thus the usage of the materials of these kinds will ensure the benefits of the automobile manufacturers in the field of green house effect and reduction in carbon dioxide emissions.

II. PREPARATION OF COMPOSITE LAMINATES:

Acrylic mould of Dimensions 150*100*3 mmwas used to fabricate the composite. In the figure 1, showing the pouring the composite into the cavity. The sample used here is preparing for the testing like tensile testing and Flexural testing. The group of samples was manufactured with 0, 1.25, 2.5, 3.75 and 5 Weight fractions of the sugarcane bagasse powder. The common method here we employed is general hand lay-up method. And also a calculated amount of binding materials used such as Epoxy resin (L-12) and the Hardener (K-6) with ratio of 10:1 by weight fraction. Later it was mixed thoroughly in a glass beaker with the help of a glass stirrer in order to remove few air bubbles from it. Initially the application of the OHP sheet was introduced and was spread over the acrylic mould with the application of wax in the inner surface of the mould. Later we poured this mixture safely into the mould (cavity) and allowed it for the natural curing at room temperature for 24hrs. Finally the sample was taken out the cavity and further proceeds with cutting and testing as per the ASTM standards. Raw materials used are Sugarcane bagasse, Epoxy resin (L-12) and Hardener (K-6)

a) Sugarcane Bagasse

It is a fibre like structured, basically belongs to the cane family in which the waste or left over contents after crushing out the juice from the sugarcane from sugarcane mills. Its chemical constituents are lignin, hemi-cellulose, fibre, soluble solids and cellulose. In this present work, the consideration has been made on the weight percentage viz, 0%, 1.25 %, 3.75%, and 5% which acts as a reinforcement in the polymer matrix.

b) Epoxy Resin

For this work we have used the Lapox (L-12) epoxy resin which is a product from Atul limited and which has the general properties like high resistance to chemical attack, very good adhesion to the combining materials, lesser shrinkage, high dimensional stability, tasteless and odourless and have better electrical and mechanical properties.

c) Hardener

The selection has been made on the viscosity which ranges from 10MPa – 20MPa at the room temperature. K-6 was the hardener which we have used.

III. PROCEDURES FOR PREPARATION OF COMPOSITES:

a) Preparation of sugarcane bagasse :

For this work, the collection of the sugarcane bagasse was made from the one of the sugar mills at a reasonable rate. Those bagasses were the left over stalks and completely extracted juice from that. On the next level, the known quantity of the bagasse was cleaned through under high pressurized water for an hour. Where this process removes the waste, sugar residues, few organic materials and few traces of the sand. Later it need to sun dried for 03hrs and was treated with RO water, then it was treated with 14% toluene solution with 1M citric acid and again it was sun dried for 03hrs.

b) Preparation of the composite :

The collected sugarcane bagasse was powdered by using a mixer grinder. The first batch of the samples were manufactured with the following weight percentages (0%, 1.25%, 2.5%, 3.75% and 5%). For each and every sample, the calculated amount of the epoxy resin with hardener was mixed thoroughly in a glass beaker / vessel by using a glass stirrer. Parallelly the air was removed from the mix during stirring process. Later the well mixed paste like content has been poured into the prepared mould or cavity which is a calculated cavity. Further left the mould for 24hrs natural curing and after 24hrs it is further moved to dimension cutting as per the ASTM standards.

IV. TESTING AND EVALUATION

Tensile and Flexural behaviour of the sugarcane bagasse composites. These prepared composite samples were further moved to the testing and evaluation sections which are strictly under the standards such as ASTM D-638 and ASTM D-790 by the help of a UTM(Universal Testing Machine). Later the samples were tested on a load of 100KN and the input speed of cross head is 5mm per minute, with the gauge length of 80mm. The tests were carried out at the CMR(Centre for Materials Research) laboratory. The image 1 shows the ASTM Standards for the tests and the image 2 shows the tensile specimen's standard dimensions and in the figure 4 shows the specimens or samples of the composites for testing. For the tensile tests and flexural tests, it has been carried out on the UTM (Universal Testing Machine) of INSTRON 3382 made where the load capacity of 100KN at the temperature of 23 degree centigrade.

V. RESULTS

- It can the inferred that from the above test results, the strength of the sugarcane bagasse composite will increase with the increase of the weight percentage of the contents as the fibre provide the higher binding action for the epoxy used.
- The strength of the composite shows high at the concentration level of 3.75% and later gradually decreases because of the fact that the filler (Sugarcane bagasse fibre) at a specific concentration above that, it does not optimally mix in the matrix.

VI. DISCUSSION AND CONCLUSION

- The results which are obtained from this work are suitable and comparable for the application of few automobile sectors.
- The work proof for the complete utilization of the agricultural waste of the crushed sugarcane bagasse into the suitable products of the high value.
- We found that the best value was with the percentage of 3.75 of weight when compared with the other matrix samples.
- Further works need to be carrying with respect to the chemical treatments, fibre-matrix adhesion, and method of preparation etc. to get few more improvements with the mechanical properties.

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Table 1 : Average Bagasse Composition

ITEM	%
Moisture	49.0
Soluble Solids	2.3
Fiber	48.7
Cellulose	41.8
Hemicelluloses	28
Lignin	21.8

Figure 1 : Fabricating into mold

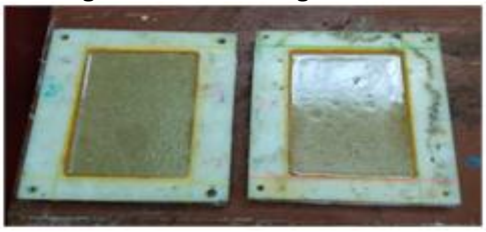

Figure 2 : Prepared mould and curing time

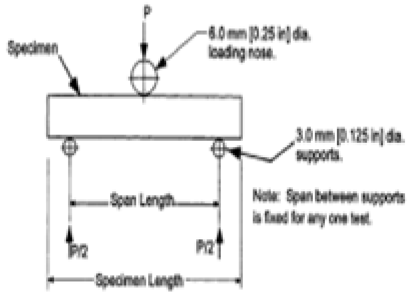

Image 1: ASTM standards

Image 2: Standard Span

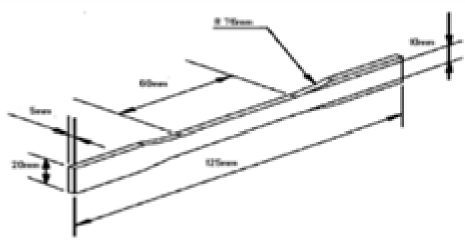

Figure 3 : Specimens for testing

Testing	Machine Used	Working Variables	No of Specimen	Standard Used
Tensile	INSTRON 3382 UTM	Load cell : 100 KN Rate : 5 mm/min	6×5=30	ASTM D638
Flexural	INSTRON 3382 UTM	Load cell : 100 KN Rate : 1.32 mm/min	6×5=30	ASTM D790

Table 2 : variables

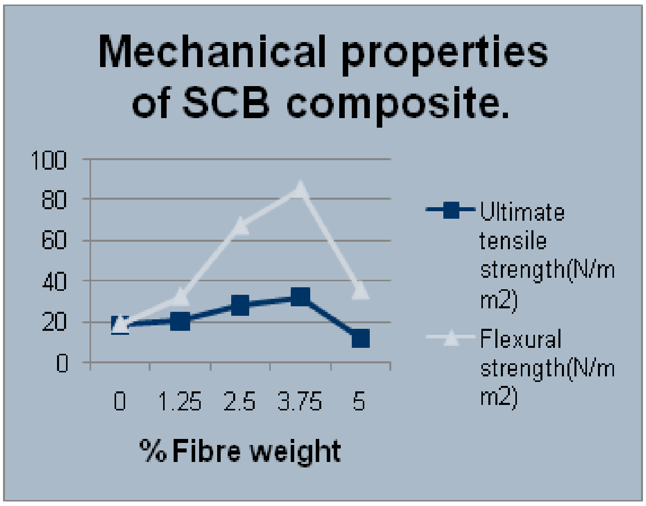

Table 3 : Results

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