Analysis of Composite Material (Fiber Glass)

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ABSTRACT - Today’s world is using metals which are heavily weighted and possess good mechanical properties as the main element for engineering and structural purposes. Our concern is to replace the metals with the composite materials which are light in weight and have similar properties as that of metals. Composite used in the present investigation is made up of fibre glass. Fibre glass also called glass reinforced plastic is a polymer made of plastic matrix reinforced by fine fibres of glass.

Four different composites are prepared using hand lay-up operation. Composites were made by fibre glass, wheat husk, rice husk and wood straw using resin and hardener at 50°C, pressing them in a mould made by two plates of cast iron (8 x 10 inches). To analyze the properties of each composite, tensometer for tensile test and vicker’s hardness test for hardness were used. Stress - Strain and Load - Displacement curve were drawn by tensometer at a particular applied load to check the fracture point.

At last comparison between the mechanical properties (Young’s modulus and Poisson’s ratio) of the prepared composites were concluded.

Keywords – Hardness, tensometer, fracture, reinforced plastic, composite, fiberglass etc.

I. INTRODUCTION

Composites are artificially made or naturally occurring, made up of two or more constituent material with dissimilar properties which remain separate and distinct at the macro or microscopic scale within the finished structure. Disc brake pads are the best example made up of composites which consist of hard ceramic particles embedded in soft metal matrix. Fiberglass is very strong and robust material with a good advantage of weight which is very light. In comparison to metals, its bulk strength and weight properties are also very favorable. Common applications of fibre glass are boats, automobile, water tank etc.

Fibre glass is strong in tension and compression while it is weak in shear. Hence fibres collectively can be arranged permanently in a preferred or suitable direction within a material. During the era of Second World War, fiberglass was developed in United Kingdom as a replacement for molded plywood. First commercial use of fiberglass was in building of boats, where it was publically accepted by people in 1950’s. Certain applications of fibre glass are found in telecom industries also. Manufacturing of composites in industries is done with the help of moulding process.

II. LITERATURE REVIEW

Gassan et al. [1] improved the tensile, flexural strength and stiffness of Jute-Epoxy composites by treating the fibres with silane. Tripathy et al. [2] found that delignification by bleaching produces better interfacial bond between jute fibre and polyester matrix and hence better mechanical properties of the composites.

Luo et al. [3] found an increase in the mechanical properties of “green” composites prepared from pineapple leaf fibres and polyresin(hydroxybutyrate-co-valerate, a biodegradable polymer [4]) with the fibres in the longitudinal direction. However, the researchers report a negative effect of the fibres on the properties in the transverse direction.

Gauthier et al. [5] report that adhesion may be improved by using coupling agents like maleic anhydride to incorporate hydroxyl groups on the matrix through hydrophilization and consequently enhancing the wetting effect of the resin on the fibres.

III. EXPERIMENTAL SETUP/ DESIGN/ FABRICATION

Hand layup operation is used to prepare the fiberglass layers connected by resin and hardener. Resin is mixed with catalyst or hardener if working with epoxy else it will not cure (harden) for days/weeks. Correct ratio of catalyst to resin must be used to ensure the correct curing time. 1% catalyst is a slow cure, 2% is the
recommended ratio and 3% is a fast cure. Adding more than 4% may result in resin failing to cure.

Firstly a mould is prepared of size 8 x 10 inches made up of cast iron in which fibre layers are jointed. Three specimen were prepared of fibre glass with in-between layer of wheat husk, rice husk and wood straw. An improvement in the tensile strength and hardness of the specimen were noticed by these three husk. All the specimen were having fiber glass plate on top and bottom and in between wheat husk, rice husk and wood straw were jointed with resin and hardener. Specimens were heated at the temperature of 50 °C one by one. Above specimen were now tested for tensile test on tensometer, hardness test on vicker’s hardness tester.

IV. RESULTS AND DISCUSSION

The tensile tests of the glass fibre reinforced polymeris conducted in the tensometer. The stress-strain curve and load displacement curve for the same are plotted as shown below:

A. Stress-Strain Curve

Graph 1: Stress strain curve for Rice husk fibre glass

Graph 2: Stress strain curve for Wheat husk fibre glass

B. Load-Displacement Curve

Graph 3: Load displacement curve for rice husk
Further hardness test results were calculated by using Vicker’s hardness tester which gave up the following results as shown in the graphs below:

Graph 4: Load displacement curve for wheat husk

Graph 5: Load displacement curve for Wood straw

Graph 6: Vicker’s hardness report
V. CONCLUSION

<table>
<thead>
<tr>
<th>S.N</th>
<th>Material</th>
<th>Lateral Strain</th>
<th>Longitudinal Strain</th>
<th>Poisson Ratio</th>
<th>Young Modulus (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wheat Husk</td>
<td>0.015</td>
<td>0.037</td>
<td>0.39</td>
<td>471.5</td>
</tr>
<tr>
<td>2</td>
<td>Rice Husk</td>
<td>0.018</td>
<td>0.051</td>
<td>0.35</td>
<td>644.5</td>
</tr>
<tr>
<td>3</td>
<td>Wood Straw</td>
<td>0.019</td>
<td>0.064</td>
<td>0.29</td>
<td>1381.08</td>
</tr>
</tbody>
</table>

Table 1: Properties calculated by tensometer

Metals can be replaced by the fibre glass as its properties are same as that of metals and they are light in weight too. Composites offer endless design options. Fibre glass has same mechanical properties as aluminium, steel so it can replace these metals.

REFERENCES


