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STUDY OF GLASS FABRIC JUTE FIBER REINFORCED POLYESTER HYBRID COMPOSITE UNDER FLEXURAL LOADING WITH AGING

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ABSTRACT
Polyester hybrid composites reinforced with E-glass fabric and jute fiber with three different fiber orientation – 0˚, 30˚ and 45˚, was fabricated by hand lay-up process which form hybrid composite. It is very important to evaluate the mechanical properties of these composite before it is subjected to the real practical application. The samples were prepared as per ASTM standards and were exposed to different aging environment. The flexural test results obtained shows that at 0˚ fiber orientation, the flexural strength of composites has resulted in optimal value with and without aging conditions

Key Words: Glass fabric, hybrid, Jute, flexural strength.

I. INTRODUCTION

The advancement in the material science and manufacturing processes has led to emergence of new materials, one such material is reinforcement based polymer composite. Reinforced polymer composite possesses very high specific stiffness and strength. This has led to their application in many fields such as aerospace, automobile, marine, sports equipments and even in recreational goods. Very often there might be a need for these materials to operate under high friction and non-lubricated conditions. To operate reliably under such severe hostile condition; these materials require very good mechanical property. With several advances made in understanding the behavior of composite materials, many fiber-reinforced polymer composite materials are finding increasing use as primary load-bearing structures and also in a wide range of high technology engineering applications [1].

The ability to tailor composites, in addition to their attributes of high stiffness-to weight and strength-to-weight ratios, fatigue resistance, corrosion resistance, and lower manufacturing costs, makes them very attractive when compared with conventional metals for use in many naval, aerospace, and automotive structural components [2]. High strain rate loading is probable in many of the applications where fiber-reinforced polymer composites find use as candidate materials. It has always been a cause for concern that the mechanical properties of composite materials may be poor at high rates of strain. Hence, study of how the mechanical properties of these composites would change with strain rate is warranted to be able to design structures that would not fail prematurely and unexpectedly at high loading rates [5].Evaluation of mechanical testing being carried out on a scientific basis in the second half of the nineteenth century when metals were the most common engineering material. The use of high performance composite materials, as distinct from 'reinforced plastics', as major load-carrying materials began almost a century later, and it follows that the test methods initially used to test composites were based very closely on 'metallic' techniques. Testing of metals is not a difficult task, being aided by the strain hardening isotropic homogeneous nature of the material [3].

At its simplest, a piece of stock material can be pulled in a testing machine and fail in its mid length: locally reducing the cross-section of the test piece can ensure that failure occurs away from the grips. It is important to understand that, where composite materials are concerned, there the second aim is to determine the properties, or investigate the behavior, of an existing material. This is likely to involve testing material with fibbers lying at a number of angles to the principal loading direction [5]. Polymer composites have become popular due to their ability to modify the mechanical and tribological properties by incorporating the reinforcement fibers.

II. EXPERIMENTAL DETAILS

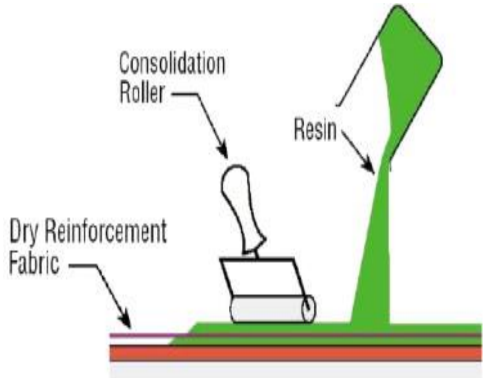

Figure 1: Hand Lay-up Method.

E-glass fabric with jute fiber was used as a reinforcing material in unsaturated polyester composite. The matrix material of unsaturated polyester resin plus Methyl ethyl ketone peroxide (MEKP) as accelerator, plus cobalt as a catalyst and plus graphite as a filler material were used, respectively.

As regards to the processing, on large granite stone a release film was placed first and it was coated with anti adhesive gent. On it Glass fiber woven mat is placed on it, on which a mixture of matrix system (consists of matrix material of unsaturated polyester resin plus Methyl ethyl ketone peroxide (MEKP) as accelerator, plus cobalt as a catalyst and plus graphite as a filler material) is coated with help of a hand brush. Dry hand lay up technique was employed to fabricate the composites as shown in figure 1. The stacking procedure was followed: placing of the glass fabric with jute fiber woven mat one above the other at different fiber orientations, with the mixture prepared well on it and covering film was again used to complete the stack. To ensure approximate thickness of the sample, spacer was used. At the last again release film coated with anti adhesive agent was kept and on it another large granite stone was again placed over it to apply enough load on it was also coated with anti adhesive agent in order to aid the ease of separation on curing. Enough load was ensured and then it was allowed to cure for a day at room temperature. Test samples according to ASTM D-790 (ASTM STANDARDS) were prepared from the cured sheet using cut-off machine and some samples were exposed in sea water for aging to take place.

Flexural Test

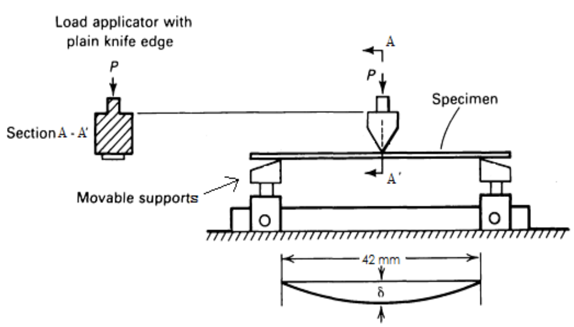

Figure 2: Schematic diagram of three point Bending.

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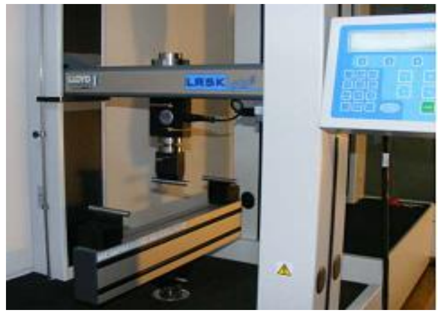

Figure 3: Computerized Universal testing machine.

Computerized Universal testing machine as shown in figure 3 with sketch of three point bending in figure 2, which uses modern software for material test and analysis is used. A sophisticated data gathering algorithm might be expected to adjust the rate of data collection in conjunction with varying rates of change in load or strain, and so on. Most testing machine software is intended to be used in routine testing and permits automatic calculation of information such as Rigidity modulus, and statistical analysis of the results. Stress and strain data are to be taken by the computer software called Nexygen Plus Material test and analysis, from a printed graph.

III. RESULTS AND DISCUSSION

The tables from 1 to 3 and the figures from 4 to 5, shows the better performance for the 0˚ fiber orientation of hybrid composite, then the remaining samples with varying percentage of 30˚ and 45˚. It is clear from these graphs and the results obtained that for the entire hybrid composite used in this study there are better flexural properties seen at0˚ fiber orientation of hybrid composite. It indicates better flexural strength, rigidity modulus and stiffness. Graphs of stress-strain generated by the computer for different fiber orientation of hybrid composite are shown for with and without aging conditions.

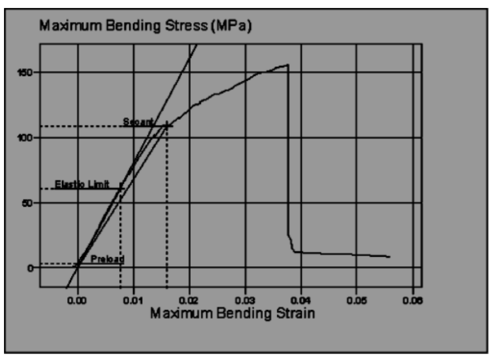

Figure 5. Stress-strain for 0° Hybrid/Polyester With aging for I month.

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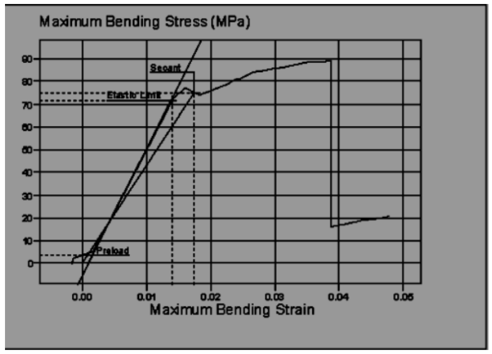

Figure 6. Stress-strain for 0° Hybrid/Polyester With aging for II month.

Table 1. Flexural properties of Hybrid Composite without aging

Sl No.	Material	Load in N	Flexural Strength (MPa)
1	0°Hybrid/Polyester	130	180
2	30°Hybrid/Polyester	208	154
3	45°Hybrid/Polyester	180	109

Table 2. Flexural properties of Hybrid Composite with aging for I month.

Sl No.	Material	Load in N	Flexural Strength (MPa)
1	0°Hybrid/Polyester	244	156
2	30°Hybrid/Polyester	150	116
3	45°Hybrid/Polyester	148	94

Table 3. Flexural properties of Hybrid Composite with aging for II months

Sl No.	Material	Load in N	Flexural Strength (MPa)
1	0°Hybrid/Polyester	160	89
2	30°Hybrid/Polyester	120	80
3	45°Hybrid/Polyester	110	48

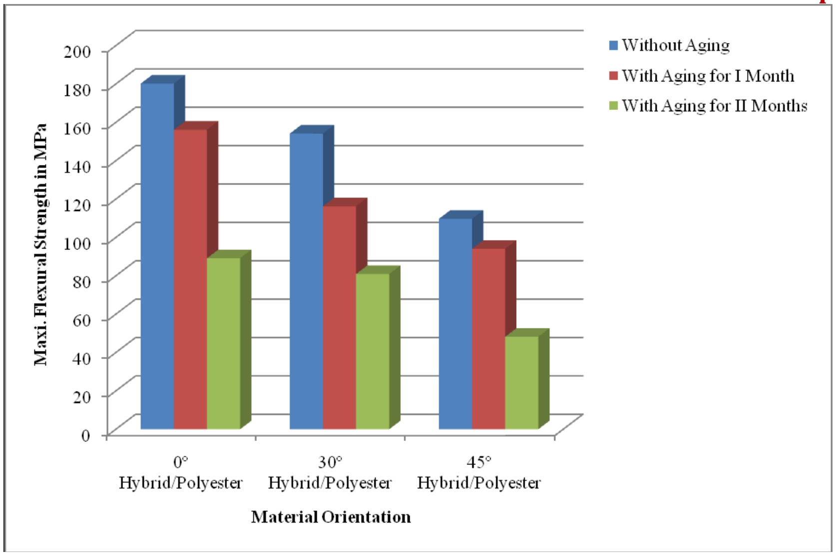

Figure 7. Comparison of flexural strength of Hybrid/Polyester composite with and without aging.

IV. CONCLUSION

From the Flexural test, behavior of the samples of hybrid composite under 3 point loading were studied for varying fiber orientation in this composite material with or without aging, the following conclusions are drawn:

- Flexural test results with 0˚ fiber orientation of the material have better flexural strength when compared to 45˚ and 30˚ fiber orientation of hybrid composite without and with varying aging conditions.
- The hybrid composite was successfully developed by hand layup technique at different fiber orientations.
- From the figure 7, for 0˚ fiber orientation of the material, the flexural Strength was 180 MPa without aging, 156 MPa with an aging for I month and 89 MPa for II months of aging.
- It can be seen that there is decrease in flexural strength when compared with 45˚ and 30˚ fiber orientation of hybrid composite.

Finally the glass and jute fiber- reinforced polyester hybrid composite with 0˚ fiber orientation is said to be optimal, with and without aging conditions reason behind this is may be due to proper adhesion, curing and glass fabrics present at its extremities in composites.

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