[ICAMS-2017: March, 17]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

STUDY ON THE MECHANICAL PROPERTIES OF GLASS FABRIC AND WOVEN JUTE FIBER REINFORCED EPOXY HYBRID COMPOSITES

Ranjith N[*1], Sandeep.B[2] & Dr. Keerthiprasad K. S[3]
[*1]PG Student, Department of Mechanical Engineering, VVIET, Mysuru, Karnataka, India
[2]Faculty, Department of Mechanical Engineering, VVIET, Mysuru, Karnataka, India
[3]Prof, Department of Mechanical Engineering, VVIET, Mysuru, Karnataka, India

ABSTRACT

The investigation was carried out to asses some mechanical properties of glass fabric and jute fiber reinforced epoxy hybrid composites for different fiber orientations - 0˚, 30˚ and 45˚ respectively. These hybrid composites were prepared as per the standards and fabricated by hand lay-up method. Hybrid has always yield with enhancement of the properties in the composites. The study reveals that, impact and hardness properties of the hybrid composites resulted in optimality at 30˚ fiber orientation when compared with others. The presence of glass fabric reinforcement at its extremities in the hybrid has been the main aspect to give enough resistance under impact and scratch conditions and also due to, better adhesion and proper fiber interlocking between the fibers.

Keywords: Glass fiber, Jute, Hybrid, Orientation.

INTRODUCTION

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 equipment’s and even in recreational goods. Very often there might be a need for these materials to operate under high friction and non-lubricated conditions. In terms of structure, materials can be divided into four basic categories: metals, polymers, ceramics, and composite materials. A composite structure is a material composed of two or more phases combined in a macroscopic scale, whose properties are superior constituent materials, acting in an independent manner.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.Composite materials are often used in environments in which they will suffer from impact damage or other conditions also. For example, damage can occur from a hammer being dropped on a composite pipe or from a bullet striking composite armor. Since impact damage resistance is such an important property for composite materials [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. 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 [2].

Unlike metals, fiber reinforced composite materials don’t undergo plastic deformations after the impact. Near the impact area may appear elastic deformations (in the case of a low intensity impact) or deteriorations of the material (the separation of the fibers from the matrix, matrix cracking, and fiber breaking). The absorbed energy consequent to the impact depends, among others parameters, on the fiber – resins link resistance. If this link is strong, a continuous crack may spread along the material. In the case of a weak link, the generated crack may

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

have an irregular form, leading to a rapid separation of the fibers from de matrix and to considerable absorption energy. When designing the composite materials, it is necessary to make sure that the links between the fibers and the matrix aren't too weak, because a low shear resistance also influences in a negative way the impact behavior [2,3]. Many of the experiments on the bi-directional jute fiber epoxy composite under tensile, flexural and shear loading on the fabricated composites by hand layup method and its physical properties was also assed. They have identified that tensile, hardness and impact properties of jute epoxy composite increases in fiber loading. In addition to this flexural and inter laminar shear strength are greatly influenced by the void content of the composite and density was high at 36% of jute fiber in the composite [4 - 6]. Few of the referred literatures says regarding the fundamentals of composites, its uses in certain areas, the behavior of glass or jute fiber reinforced composites or hybrids with thermosetting resin under various mechanical loading conditions. The objective of this work is to study the mechanical properties of glass fabric and jute fiber reinforced epoxy hybrid composite prepared at three different fiber orientation. The hybrid composite was tested for their impact and hardness property which was prepared from hand layup technique.

EXPERIMENTAL DETAILS

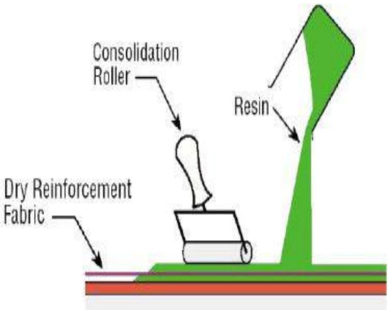

Fig 1: Hand Lay-up Method

E-glass fabric and jute fiber woven mate is used as a reinforcing material in epoxy hybrid composite. K-10 is used as hardener. Dry hand lay-up technique was employed to fabricate the composites. The release film was placed on the lower surface of the mould coated with anti-adhesive gent. E-glass fabric is placed on it, on which a mixture of matrix system (consists of matrix material of epoxy resin plus hardener k-10 was used) is coated with help of a brush.

The stacking procedure was followed: placing of the E-glass fabric one at the bottom followed by jute and at the top again the E-glass fabric thus forming a natural – polymer hybrid composite by coating with the mixture prepared well on it and covering film was again used to complete the stack. To ensure approximate thickness of the sample, a 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 loadswere ensured and then it was allowed to cure for a day at room temperature. Test samples according to ASTM D-256 (ASTM STANDARDS) for Charpy impact test un-notched and Rockwell hardness according to ASTM D-785 were prepared from the cured sheet using cut-off machine.

Impact Testing

Figure 2: Digital Impact Testing Machine

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Digital Impact testing machine which is used which is shown in figure 2. 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 is intended to be used in routine testing and permits the information such as impact energy, and other statistical analysis of the results. It is common to refer to the impact resistance of a material. However, this is an all-embracing term that can refer to many quite different aspects of a materials behavior in a given structure.

Hardness Testing

Rockwell hardness test is commonly used among industrial practices because the Rockwell testing machine offers a quick and practical operation and can also minimize errors arising from the operator. The depth of an indentation determines the hardness values. The hardness testing is carried out to provide a quick assessment and the result can be used as a good indicator for material selections. The Rockwell hardness tester used for test is shown in the figure 3.

Figure 3:*Rockwell Hardness Tester*

RESULTS AND DISCUSSION

Impact Test

Table 1: Charpy Impact strength of different fiber orientation of hybrid composite.

Sl. No	Material Orientation	Charpy Impact Strength(KJ/mts^2)
1	0° Hybrid/Epoxy	20.88
2	30° Hybrid/Epoxy	34.62
3	45° Hybrid/Epoxy	33.27

The values shown in the table 1, when compared gives the better result for the 30˚ fiber orientation of an E-glass fabric and jutereinforced epoxy hybrid composite under impact loading.It is clear from these results obtained that for all the glass fabric and jute fiber epoxy hybrid composite used in this study there are better impact energy is seen at 30˚ fiber orientation. It indicates better impact strength. The lowest values 45˚ and 0˚ fiber orientation of hybrid composite.

Hardness Test

Table 2. Rockwell Hardness Number of different fiber orientation of hybrid composite.

Sl. No	Material Orientation	Rockwell Hardness Number (RHN)
1	0° Hybrid/Epoxy	74
2	30° Hybrid/Epoxy	93
3	45° Hybrid/Epoxy	63

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

The values shown in the table 2, when compared gives the better result for the 30˚ fiber orientation of an E-glass fabric and jutereinforced epoxy hybrid composite under indentation. It is clear from these results obtained that for all the glass fabric and jute fiber epoxy hybrid composite used in this study there are better Rockwell hardness number is seen at 30˚ fiber orientation. It indicates better impact strength. The lowest values 0˚ and 45˚ fiber orientation of hybrid composite.

CONCLUSION

The impact behavior and Rockwell hardness of the samples of glass fabric and jute fiber reinforced epoxy hybrid composites under sudden loading and by indentation were compared and studied for varying fiber orientation in this composite material, the following conclusions are drawn:

- Impact and Rockwell hardness test results with 30˚ fiber orientation of the material has better impact strength and hardness when compared to 45˚ and 0˚ fiber orientation of hybrid composite.
- The hybrid composite was successfully developed by hand layup technique at different fiber orientations.
- For 30˚ fiber orientation of the material, the Charpy impact Strength was 34.62KJ/mts^2.
- For 30˚ fiber orientation of the material, the Rockwell hardness number is 93.
- It can be seen that there is decrease in impact strength as well as hardness when compared with 45˚ and 0˚ fiber orientation of hybrid composite.
- Finally the glass and jute fiber- reinforced polyester hybrid composite with 30˚ fiber orientation is said to be optimal, reason behind this is due to good fiber inter-locking between the fibers and proper adhesion.

ACKNOWLEDGEMENT

We are very grateful to my teacher for providing guidance and support to publish the paper in this journal.

REFERENCES

[1] P Reed, 'Mechanical properties and mechanical testing of polymers', Handbooks of Polymer Science, Ed G M Swallowe, Chapman and Hall, 1997
[2] ASTM Hand Book for testing of advanced composite materials.
[3] S V Potti and C T Sun, 'Prediction of impact induced penetration and delamination in thick composite laminates', International Journal of Impact Engineering, 1997 19 31–48.
[4] Vivek Mishra, Sandhyarani Biswas, "Physical and Mechanical Properties of Bidirectional Jute Fiber epoxy Composites", Procedia Engineering 51 (2013) 561 - 566.
[5] M. R. Sanjay, B. Yogesha,"Studies on Mechanical Properties of Jute/E-Glass Fiber Reinforced Epoxy Hybrid Composites", Journal of Minerals and Materials Characterization and Engineering, 2016, 4, 15-25.
[6] A.F. Avila et al., International Journal of Impact Engineering 34 40, 2007, pp. 28–41.