Analysis of Impact & Hardness Behavior and Comparison Study of Sisal and Jute Hybrid Composite

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Abstract— Among the various synthetic materials that have been explored as an alternate to iron and steel for the use in automotive, plastics components claim a major share. At present, due to uncertain conditions in the disposal of plastic there is a need to search for its alternate, which is nothing but natural fibers. It is interesting to note that natural fibers such as jute, coir, banana, sisal, etc., are abundantly available in developing countries like India, Srilanka, and some of the African countries. The application of the composite material grown steadily and which occupied the new market. In our daily life, the composite materials are used in different field because of their combinational properties. The main reason for using the composite to reduce the weight of the material and easy. In present investigation natural hybrid composite is developed using Sisal/E-glass (S/G), Jute/E-glass (J/G) and Sisal+Jute/E-Glass (SJ/G) as reinforcing material and Epoxy as a matrix material. To sustain the environmental condition and water absorption, E-Glass is used. The fabrication is done using hand layup technique. The developed hybrid composite will be subjected to different kind of test to determine impact and hardness properties.

Key words: Sisal Hybrid Composite, Jute Hybrid Composite

I. INTRODUCTION

The development of composite materials and their related outline and assembling innovations is a standout amongst the most critical advances ever. A composite material can be defined as a mix of 2 or a bigger number of materials that outcomes in preferable properties over those of the individual segments utilized alone. Composites are the material utilized as a part of different fields having selective mechanical and physical properties and are created for specific application. Composite materials having a scope of focal points over other traditional materials, for example, tensile strength, impact strength, stiffness and fatigue characteristics.

At the point when two or more materials with distinctive properties are joined together, they shape a composite material. Composite material comprises of material which convey more load (called as reinforcement) joined with weaker materials (called as matrix). The crucial components of the matrix are to trade stresses between the fibers and to shield them from mechanical and/or natural harm though the vicinity of fibers in a composite enhances its mechanical properties like tensile strength, compression strength, impact strength and stiffness.

Natural fiber reinforced polymer composites have emerged as a potential ecologically amicable and practical choice to engineered fiber reinforced composites. The accessibility of natural fibers and simplicity of manufacturing have enticed analysts to attempt mainly accessible modest fibers and to study about their attainability of reinforced purposes and to what degree they fulfill the obliged details of good reinforced polymer composite for tribological applications.

II. METHODOLOGY

A. Sisal Fiber

Sisal Fiber is one of the most widely used natural fiber and is very easily cultivated. It is obtain from sisal plant. This plant is referred to formally As Agave sisalana. These plants produce rosettes of sword-shaped leaves which start out toothed, and step by step lose their teeth with development. Every leaf contains various long, straight filaments which can be uprooted in a procedure known as decortication. During decortication, the leaves are beaten to uproot the pulp and plant material, leaving the tough fibers behind. The fibers can be spun into string for twine and material generation, or pulped to make paper items.

Properties	Values
Tensile strength(MPa)	80-840
Young's modulus(Gpa)	9-22
Specific modulus(Gpa)	6-15
Failure strain(%)	2-14
Aspect ratio,I/d	115
Density(Kg/m³)	1300-1500

Table 1: Physical properties of Sisal fiber

B. Jute

Jute, a natural fiber utilized all around, is the bark of a slim plant of tropical and subtropical origin. Jute fiber is 100% bio-degradable and recyclable and subsequently ecologically well disposed. The jute fibers are called as The Golden Fiber because it is a natural fiber with golden and silky shine, It is the least expensive vegetable fiber secured from the bast or skin of the plant's stem, after cotton, it is the second most imperative vegetable fiber, as far as utilization, worldwide utilization, production, and accessibility, It has high rigidity, low extensibility, and ensures better breathability off a brics.

Properties	Values
Tensile strength(MPa)	200-450
Young's modulus(Gpa)	20-55
Specific modulus(Gpa)	14-39
Failure strain(%)	2-3
Aspect ratio,I/d	157
Density(Kg/m³)	1300-1500

Table 2: Physical properties of jute fiber

C. E-Glass Fiber

Glass was first made by man in 3000 BC in Asia Minor. Glass fibers as of now contain more than 90% of fibers utilized as a part of polymer composites. There are five major types of glass used to make glass fibers. A glass (high

alkali), C glass (chemical), D glass (low dielectric constant), E glass (electrical) and S glass (high strength), out of which the last two sorts, because of their unrivaled mechanical properties, are most broadly utilized as a part of composite roofing, pressure vessels, containers, tanks, pipes, etc

Properties	Values
GSM	300
Density(kg/m^3)	2550
Tensile strength(MPa)	3450-5000
Young's modulus(Gpa)	70
Elongation at break (%)	2.5

Table 3: Physical properties of E-Glass fiber

D. Fabrication Procedure

- Wight of fabric and quantity of resin is determined in grams.
- Mix the Epoxy resin with hardener in the container.
- At the bottom, the slab of the mould (granite slab) is thoroughly cleaned with acetone and release film is placed on the slab.
- The blend of epoxy resin and hardener arranged by obliged organization in a container, from it, the first coating is done on the release film guaranteeing consistency utilizing a hand roller/brush.
- First layer of fabric is placed over the resin coat.
- Immediately after the first layer of fabric has been applied a compression roller is used to compress the mat and squeeze air bubble.
- Successive layer of laminate are to be applied on one another.
- After the final resin coat is applied, the lay-up is covered by another release film.
- On the top slab approximately weight of 20 kgs is placed which will compresses the lay-up to the desired thickness of 4 mm.
- Allowed to cure for 24 hours in room temperature condition before it is retrieved from the mould.

III. Results and Discussion

In this study natural fibers are added to E-Glass fiber with different orientation and their effect on tensile and flexural properties are evaluated.

A. Impact Test

Impact test is one of the fundamental mechanical tests. The term brittle fracture is used to describe rapid propagation of cracks without any excessive plastic deformation at a stress level below the yield stress of the material.

The Izod test is most economical test and generally used to assess the impact toughness of materials and as being what is indicated is frequently utilized as a part of Quality Control applications.

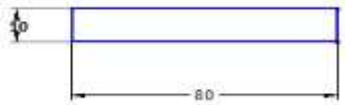

Fig. 1: Dimensions of impact test specimen (All dimensions are in mm)

Impact test is conducted according to the ASTM D-256. Specimens are prepared according to ASTM D-256. Potential energy is kept at maximum valve. Specimen is fixed on the slot. Now the impact load is applied, by releasing the pendulum. When pendulum is released, it hits the specimen in the slot. Load absorbed for breakage is noted down. Procedure is repeated for different trials.

Materials	Orientation	Impact Strength(KJ/m^2)
S/G	0°	73.33
	30°	106.66
	45°	95
J/G	0°	40
	30°	68.33
	45°	60
SJ/G	0°	65
	30°	90
	45°	81.66

Table 1: Impact test results

1) Overall comparison of impact strength with different materials

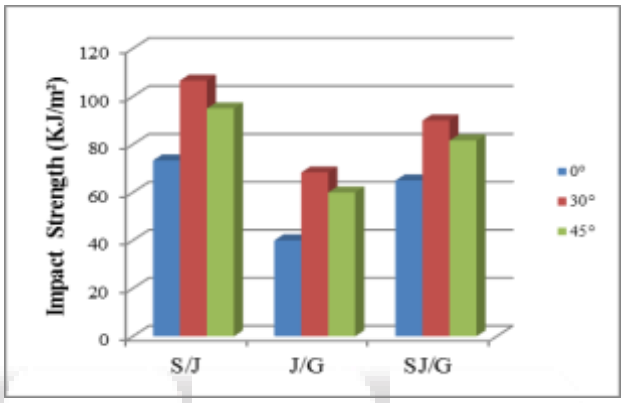

Fig. 2: Overall comparison of impact strength with different materials

Fig: 2 shows the comparison of impact strength of Sisal/E-Glass composite, Jute/E-Glass composite and Sisal+Jute/E-glass composite at different orientation. The impact strength of Sisal/E-glass composite at different orientation is found to be more as compared to Jute/E-Glass composite at different orientation and Sisal+Jute/E-Glass composite at different orientation.

B. Hardness Test

Hardness is one of the properties of a material that empowers it to oppose plastic deformation, usually by penetration. Be that as it may, the term hardness might likewise resistance to scratching, bending and abrasion or cutting.

Rockwell hardness test is regularly utilized among modern practices in light of the fact that the Rockwell testing machine offers a quick and practical operation and can likewise minimize lapses emerging from the administrator. The depth of a space decides the hardness values. There are two sorts of indenters, brale and steel ball indenters.

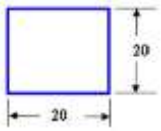

Fig. 3: Dimensions of hardness test specimen (All dimensions are in mm)

Hardness test is conducted according to ASTM D-785. Specimen is cut into ASTM D-785. A standard specimen isp laced on the surface of the Rockwell hardness tester, minor load is applied and the gauge is set to zero, the major load is applied by tripping a lever. After 15seconds

the major load is removed. The specimen is allowed for 15 seconds and then the hardness is noted down. The procedure is repeated for different trials.

Materials	Orientation	Rockwell Hardness Number
S/G	0°	87
	30°	89
	45°	84
J/G	0°	71
	30°	73
	45°	67
SJ/G	0°	81
	30°	82
	45°	78

Table 2: Hardness test results

1) Overall comparison of hardness with different materials

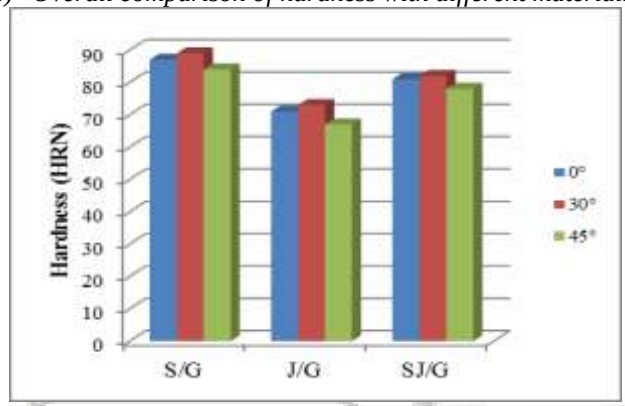

Fig. 4: Overall comparison of hardness with different materials

Fig 4 shows overall comparison of Rockwell hardness number of Sisal/E-Glass, Jute/E-Glass and Sisal+ jute/E-Glass composite at different orientation. The hardness value is depends on the position where the indenter is placed over the material. The hardness value will be more if the indenter is placed on the fiber and the hardness value will be less if the indenter is placed between the fibers. Hence the hardness value does not depend on the orientations of the fibers.

IV. Conclusion

The natural hybrid composite is developed by using hand layup technique. The effect of combination of fibers is investigated. The experiments are carried out to understand tensile and flexural behavior for different orientations. From the discussion of the results obtained the following may be concluded. The impact strength is more at Sisal/E-Glass hybrid composite as compared to Jute/E-Glass hybrid composite and Sisal+Jute/E-Glass hybrid composite. The hardness is more at Sisal/E-Glass hybrid composite as compared to Jute/E-Glass hybrid composite and Sisal+Jute/E-Glass hybrid composite. The hardness of the natural hybrid composites is not depending on the orientations. Overall comparison between the properties of all composites tested revealed that the Sisal+jute/E-Glass composite show the less mechanical properties as compared to Sisal/E-Glass composite and Jute/E-Glass composite.

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