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Fabrication and Investigation on Basalt Fiber and Jute Fiber Reinforced Hybrid Composites

V. Sivaprasad[1], M. Anusha[2], Y. Srinivasa Reddy[3], V. Venugopal[4], S. Vishwanath[5], M. Selvam[6]

[1,4]Department of Automobile Engineering, Pace Institute of Technology and Sciences (Autonomous), Ongole, Andhra Pradesh, India.
[2,3,5,6]Department of Mechanical Engineering, Pace Institute of Technology and Sciences (Autonomous), Ongole, Andhra Pradesh, India.

ABSTRACT- Composite materials are created by carefully combining two or more components to get a beneficial result. a system of materials made up of two or more physically distinct phases that, when combined, create aggregate properties that are distinct from those of their individual components. The fibre's function is to give the product strength, bind the filaments together into a matrix, and shield the fibres from the elements. On a weight-to-weight ratio, composites are a class of materials that are stronger and more rigid than any other traditional engineering material. We employ in daily life. Other extremely intriguing options for further weight reduction include altering the volume proportion of fibre and resin in the component and aligning the orientation of the fibre along the direction of load. To create the hybrid natural fibre composites, the current experimental investigation intends to. Samples of a variety of jute, basalt, and polyester hybrid natural fibres will be created utilising the hand layup process, where the weight fraction of the fibre matrix is at various percentages and the stacking of the plies is alternated. Composites' void content rises as both the fibre loading and the fibre length increase. Composites with a 25wt% fibre loading demonstrate a better hardness value as far as the influence of fibre loading is concerned. Tensile strength diminishes after 25%, hence tensile modulus is appropriate for average weight percentage of fibre loading, or 25wt%.

KEYWORDS- Basalt Fiber, Jute Fiber, EpoxyResinLY556, HardenerHY591, Tensile test, Handle-up technique, flexural test, Density testing, Impact testing and Flexural testing etc.

I. INTRODUCTION

Similar properties of the materials that make up a composite are also present. As a result, materials' primary function today is to be widely used for everyday applications while also playing a crucial part in the creation of highly complex machines and equipment. Composite materials have a number of advantages over conventional materials, including light weight, simple manufacturing, and low cost. Researchers are working to enhance the properties of composite materials according to application and make them more robust, weightless, and economical.

They discussed the characteristics of hybrid composites reinforced with glass fibre and Palmyra fibre that were combined randomly. The composites' mechanical characteristics, including tensile, impact, shear, and bending properties, were investigated. The hybridization of the fibres employed for reinforcement is found to increase the mechanical properties of the composites. The composites with 50mm fibre reinforcement and a 50% fibre loading were discovered to have the best mechanical characteristics. The inclusion of the glass fibres was found to be boosting the characteristics steadily. Additionally, it was discovered that the insertion of glass fibres significantly reduces the water absorption. Athijayamani et al. (2009) investigated how the mechanical characteristics of a hybrid polyester composite made of sisal and Roselle fibres varied.

Strengths like tensile, flexural, and impact resistance were taken into account. Roselle/Sisal hybrid polyester-based composites were created with various fibre weight percentages. Unsaturated polyester resin had been mixed with Roselle and sisal fibres in a 1:1 ratio at varied fibre lengths. They discovered that the tensile and flexural strength of the composite improved as the fibre content and length of the sisal and Roselle fibres increased. Professor Sandhya and Sanjay Kindo investigated the mechanical behaviour of coir fibre reinforced polymer matrix composites and found that the fibre lengths have a significant impact on the composites' mechanical characteristics, including micro-hardness, tensile strength, flexural strength, impact strength, and others.

II. MATERIALS AND METHODS

In this study, the materials and experimental methods that were taken into consideration for the creation of composites and the methods used to test the characteristics of composites are described in detail. the components used in manufacturing are

A. BasaltFiber,2.Jutefiber,3.EpoxyResin LY556,4.Hardener HY591 and 5.Silicon

Figure 1: Silicon

Figure 2: Raw Material of Basalt Faber

Figure 3: After Making of Basalt Fiber

Figure 4: After making of Jute fiber

Figure 5: Epoxy Resin LY556 Hardener HY591

Figure 6: Basalt fibre Jute fibre Plane jute fibre

B. Handlay-uptechnique

Glass rod was used to combine epoxy and hardener in a basin. Bubble formation was avoided at all costs. Because the air bubbles were trapped in the matrix, the material could fail. The next step in the fabrication process was to cover the surface of the mould with a releasing film. Next, the sheets received a polymer covering. Then one type of fibre ply was added, and correct rolling was carried out. Once more applying resin, a different type of fibre ply was then placed next to it and rolled. Mild steel rod that was cylindrical was used for rolling. Up to eight alternating fibres were placed, this process was repeated. A polymer coating is applied to the top of the final ply to help ensure a good seal.

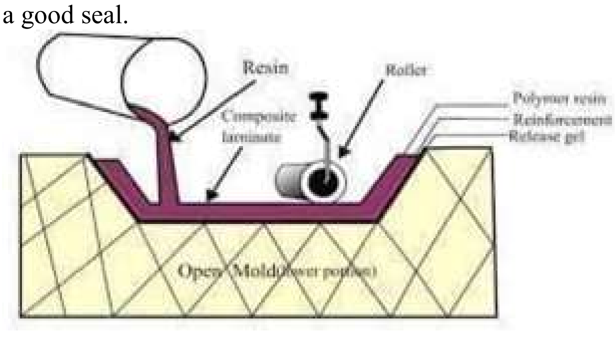

Figure 7: Hand Lay-uptechnique

C. Mould Preparation

To begin with, the composite mould is ready. To create the necessary composite, we must build a mould with the following dimensions: 300 x 300 x 6 mm. A clean, smooth-surfaced piece of mild steel is taken and cut to the specified size.

Figure 8: Mould used for fabrication of the composite

Table 1: Designation of Composites

Slabs	Proportions(wt%)	Fiber(wt%)	Epoxyresin(wt.%)	Hardeners
Slab-1	20:80	20%(250gm)	80%(1000gm)	60gm
Slab-2	25:75	25%(333gm)	75%(1000gm)	90gm
Slab-3	35:65	35%(430gm)	65%(800gm)	64gm

Figure 9: Tensile test samples

Figure 10: (b) Loading Arrangement of Tensile Test

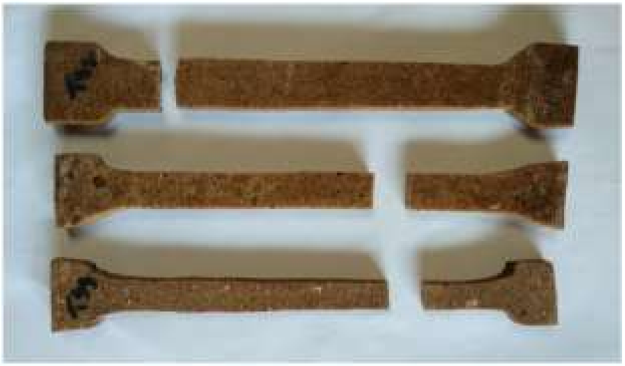

Figure 11: (c) After Tensile Test

Figure 12: (a) Flexural Test Samples

Figure 13: (c)Loading Arrangement For Flexural Test

Figure 14: (d)After Flexural test

Figure 15: (a)Impact Test Samples

Figure 16: (b)Impact Testing Machine.

Figure 17: (c)After Testing

Figure 18: Hardness Testing Machine Hardness Testing Samples Density Testing

III. RESULTS AND DISCUSSION

For the purpose of this inquiry, natural fibre particle reinforced polymer composite materials' mechanical properties are shown below. The previous chapter provided specifics on how these composites were processed and the tests that were performed on them. Here, the findings of several characterisation experiments are provided. Tensile strength, flexural strength, impact strength, and shear strength evaluation have all been researched and debated. Additionally, included are the results' interpretation and a comparison of several composite samples.

Physical and Mechanical Behavior of Composites

Effect of particle content on tensile strength of reinforced polymer composites

The use of rice husk particle reinforced polymer composites was found to improve the composites' tensile strength. This is due to the fact that silicon is present in rice husk particulate in a higher proportion, and at the same time, it was discovered that the tensile strength decreased as the silicon proportion in the particulates increased. Tensile strength testing revealed that slab-2 can withstand the greatest load.

Table 2: Tensile strength of composites

Sample Name	Length mm	Breadth mm	Thickness mm	Extension mm	Maxload N
SLAB-1	153	12.5	4-6	0.9	550
BSLAB-2	153	12.5	4-6	1.0	740
SLAB-3	153	12.5	4-6	0.7	310

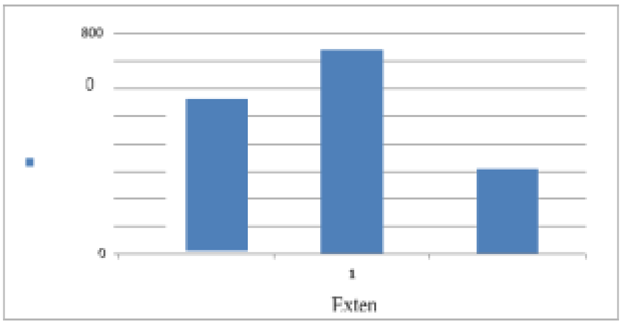

Figure 19: Effect of particle content on tensile strength of rein for copolymer composites

Effect of Particle Content on Flexural Strength of Reinforced Polymer Composites Flexural test performed with TENSOMETER in accordance with ASTM D790. The test speed was 2 mm/min, and the span length was 50 mm. When compared to the other two hybrid composites labs, the basalt fibre and jute fibre hybrid composite has the maximum flexural strength (14.9 MPa in wet and 14.5 MPa in dry state) because its strength increases with increase in interfacial adhesion as shown below.(absorbed 18.3 J in dry state) is found to be less effective in impact testing than the composite made of basalt fibre and jute (absorbed 20.9 J in dry condition), as shown below.

Table 3: Impact Strength of Composites

SampleName	Length in mm	Breadth in mm	Thickness inmm	MaxEnergy inJoules
J-BGR	67.5	10	4-6	1.2
J-BGR	67.5	10	4-6	2.7
J-BGR	67.5	10	4-6	1.2

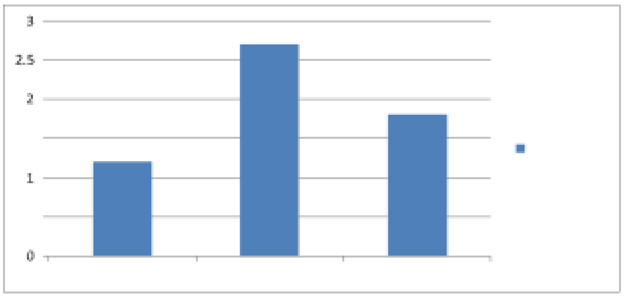

Figure 20: Effect of particle content on Impact strength of rain forced polymer composites

Effect of particle content on Hardness of rain forced polymer composites
The surface hardness of composites is considered as one of the most important factors that govern the wear resistance of composites. Figure 19, 20, and 21 shows the effect of particulate loading and length on the hardness of composites. The test results show that with the increase of particle content, the micro-hardness of particulate epoxy composites is improved. The increase in hardness value is probably due to the incorporation of particles in the epoxy resin.

Table 4: Hardness of Composites

SampleName	Length in mm	Breadth inmm	Thickness in mm	Hardness Hv
SLAB-1	30	30	4-6	11.3
SLAB-2	30	30	4-6	12.3
SLAB-3	30	30	4-6	13.1

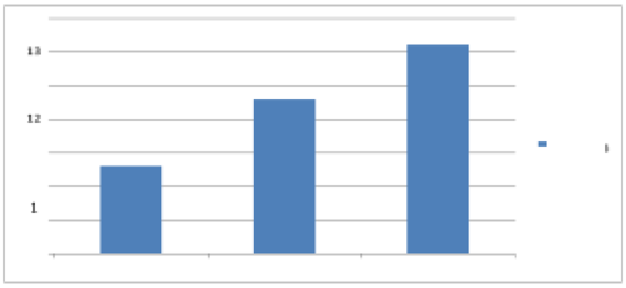

Figure 21: Effect of Particle Content on Hardness of Reinforced Polymer Composites

Effect of Particle Content on Density Test of Reinforced Polymer Composites The mechanical and physical properties of composites are dramatically decreased when void content is present. All of the composite specimens' theoretical density, experimental density, and related void content are shown in Table 4. The table shows that as the amount of particles in a composite material grows, so does its void content. Previous researchers have already noted a correlation between an increase in particle content and a corresponding trend in void content.

Table 5: Void Fraction of Hybrid Composites

Composites	Theoretical Density(gm /cc)	Experimental density(gm/cc)	Void fraction in %
SLAB-1	1.81	1.40	0.22
SLAB-2	2.11	1.33	0.36
SLAB-3	2.50	1.50	0.40

IV. CONCLUSION

The results of the experimental study on "BASALT FIBRE AND JUTE FIBRE REINFORCED HYBRIDE COMPOSITES" are shown below. Hybrid particle reinforced epoxy composites can be successfully made using a straightforward hand lay-up method. It has been shown that the fibre loading has a significant impact on the different properties of composites. Composites' void content rises as both the fibre loading and the fibre length increase. According to the tests that were done, composites with a 25 weight percent fibre loading had better hardness values. With 25% weight percent of fibre, the maximum tensile strength may be shown. Tensile strength diminishes after 25%, hence tensile modulus is appropriate for average weight percentage of fibre loading, or 25wt%.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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