Experimental Investigation of Mechanical Properties of Basalt Fiber Reinforced Vinylester Composites

J.Prabakaran, K.Kannan, S.Gopal, S.Palanisamy

Abstract— **In this paper the investigation of Mechanical properties like Tensile strength, Flexural strength, Shear strength and Impact strength of Basalt fiber reinforced vinyl ester composite was carried out experimentally. Composite laminates were prepared by mixing chopped strand basalt fiber and vinylester with proper curing agents. This was placed on the matched plate mould and pressed at 15000 N/cm^2 for 24 hrs at room temperature. The basalt fiber reinforced vinylester composites were manufactured at ratios of 30:70 and 35:65. Tensile and flexural strength of 35:65 ratios showed better results compared with 30:70 ratios. Similarly the impact and shear strength was found good for 35:65 ratio composites.**

Index Terms— **Mechanical properties, Basalt fiber, Vinylester.**

I. INTRODUCTION

Basalt is obtained naturally from earth's crust. It is processed into fibers, twisted into yarn, woven to mat. The application is wide because of its specific Mechanical properties. This basalt fiber reinforced composites are used in Automotive industry, Boat building, Aerospace industry, Sports goods, Turbine blades and Construction Industries. The use of basalt fibers is an alternative to glass fibers as reinforcement in polymer composites [1]. The comparative study between E-glass and basalt fibre reinforced laminates suggests both materials have a similar damage tolerance to impact and also their post-impact residual properties after impact do not differ much, with a slight superiority for basalt fibre reinforced laminates [2]. The friction and sliding wear performance of the carbon–vinyl ester composites are much superior in terms of better wear resistance and lower coefficient of friction as compared to glass–vinyl ester composite and neat vinyl ester [3]. These advantages and superior qualities of Basalt fibers and Vinyl esters have turn our attraction to have a deep investigation.

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II. EXPERIMENTAL INVESTIGATION

Basalt fiber of density 2500-2800kg/m^3 is chopped to 12 mm were used as reinforcing material and vinyl ester of density of 1.42g/cm^3 was used as the matrix material. The various combinational ratios of specimens are prepared with basalt fiber reinforced with vinyl ester are listed in the Table 1.

TABLE 1
COMBINATIONAL RATIOS OF BASALT FIBER REINFORCED VINYLESTER COMPOSITES

Specimen No.	Ratio of fiber & resin	Weight in grams	Resin	Temp in ^{0}C
01	35:65	400	V+P+A+C	100
02	30:70	400	V+P+A+C	100
03	30:70	400	V+A+C	100
04	35:65	400	V+A+C	100

Resin includes vinyl ester (V), Promotor (P), Accelerator (A), and Catalyst(C) respectively. 35:65 and 30:70 are the weight percentage variation. First two specimens are prepared by adding vinyl ester, Promotor, accelerator, catalyst in weight ratio of 10: 0.15: 0.15: 0.15 and the other two specimens are prepared by removing the Promotor with the same weight ratio. In regards to the process the chopped basalt fiber was placed over the vinyl ester matrix system. Compression moulding technique was employed to fabricate the composites. The stacking procedure consists of placing the fibers one above the other with the resin mix well spread between the fibers. The specimen is prepared for a uniform thickness of 3mm. The first and foremost step is the preparation of mould which ensures the exact dimension of the composite to be prepared. The mould is prepared for 30%, 35% of fiber. The mould used for preparing composites is made from two rectangular chromium- plated mild steel sheets having dimensions of 300 mm×300 mm x 3mm. The functions of these plates are to cover, compress the fiber after the vinyl ester is applied, and also to avoid the debris from entering into the composite parts during the curing time. A clean smooth surfaced wooden board is taken and washed thoroughly. The mould plates were coated with release agent

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wax for easy separation of specimen on curing. The whole assembly was kept in a matched plate mould and pressed at 15000N/cm^2 for 24 hrs at room temperature. The weight percentage of basalt fiber in the vinylester composites determined. Then the test specimen is cut for the required dimensions. 25x250x3 mm size for Tensile test [ASTM D3039], 12.7x50.8 x 3 mm size for Flexural test [ASTM D790], 12.8x50 x 3 mm size for Shear test. 13×66×3 mm size for Impact test [ASTM D256]. The prepared specimens are then cured and the edges are trimmed using cut off machine.

III. RESULTS AND DISCUSSION

A. TENSILE TEST

Tensile test specimen is prepared according to ASTM D 3039. The specimen is tested in the electronic tensile testing machine with cross head speed of 5 mm/min and a gauge length of 50 mm. The tensile modulus and elongation at the break of the composites were calculated from the stress strain curve. Four specimens were tested for 4 set of samples and their mean values were reported. The maximum ultimate strength is 33.71N/mm2 for 35:65 ratios. The comparative tensile test results for 35:65 and 30:70 ratios are pictured in figure 1.

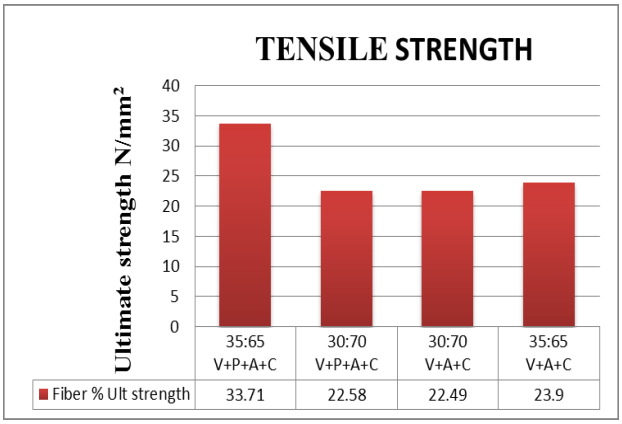

Fig.1 Tensile Test result for Basalt Fiber Reinforced Vinylester Composites

B. FLEXURAL TEST

The flexural test was performed by the three points bending method according to ASTM D 790, and cross head speed is 1 mm/min. Four sets of specimens were tested, and their mean values were reported. The specimen was freely supported as a beam, the maximum load was applied in the middle of the specimen, and the flexural modulus is calculated from the slope of the initial portion of the load deflection curve. The comparative flexural test results for 35:65 and 30:70 ratios are pictured in figure 2.

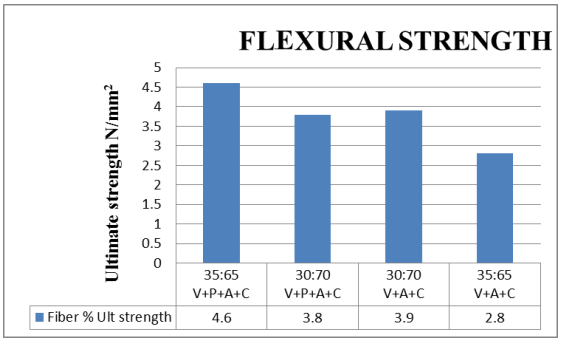

Fig.2 Flexural Test result for Basalt Fiber Reinforced Vinylester Composites

C. SHEAR STRENGTH

The Shear test was performed by shear attachment in the universal testing machine with a cross head speed of 1 mm/min. The size of the specimen is 12.8x50 x 3 mm. Four sets of specimens were tested, and their mean values were reported. The comparative shear test results for 35:65 and 30:70 ratios are pictured in figure 3.

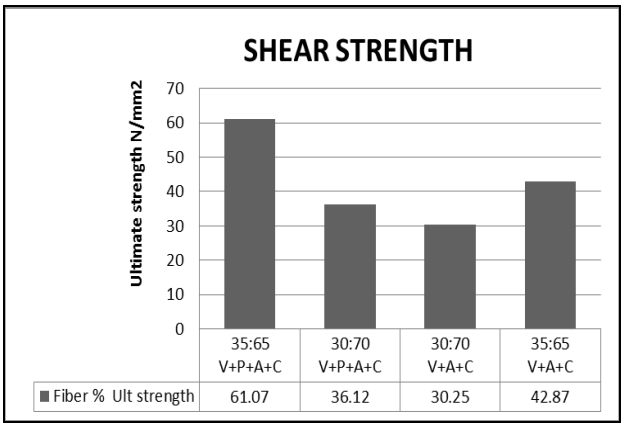

Fig.3 Shear Test result for Basalt Fiber Reinforced Vinylester Composites

D. IMPACT SRTENGTH

Impact is a single point test that measures a materials resistance to impact from a swinging pendulum.

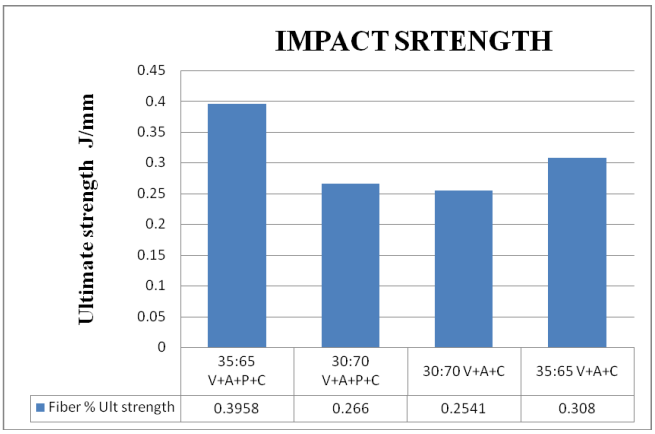

Fig.4 Impact Test result for Basalt Fiber Reinforced Vinylester Composites

Impact is defined as the kinetic energy needed to initiate fracture and continue the fracture until the specimen broken. The Impact test was performed in Izod machine. The

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specimen is prepared according to ASTM D256 [13×66×3 mm]. Four sets of specimens were tested, and their mean values were reported. The comparative impact test results for 35:65 and 30:70 ratios are pictured in figure 4.

IV. CONCLUSION

The mechanical behaviour of basalt fiber reinforced vinylester composites was studied. From the results it is observed that the fiber & resin ratio 35:65 of vinylester, Promotor, accelerator, catalyst, and CHOPPED BASALT fibers showed better Mechanical properties. It is concluded that shortest fibers have good adhesion with the vinylester resin for tensile properties.

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