

Analysis of Mechanical Properties of Mudar/Coir Hybrid Vinylester Composite Materials

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ABSTRACT: In this paper the investigation of Mechanical properties like Tensile strength, Flexural strength, Impact strength and water absorption test of Mudar/Coir fiber reinforced vinyl ester composite was carried out experimentally. Composite laminates were prepared by mixing chopped strand Mudar/Coir and vinylester with proper curing agents. This was placed on the matched plate mould and pressed at 15000 N/cm² for 24 hrs at room temperature. The Mudar/Coir reinforced vinylester composites were manufactured at ratios of 30:70, 40:60 and 50:50. Tensile and flexural strength of 30:70 ratios showed better results compared with 30:70 ratios. Similarly the impact and water absorption test was found good for 30:70 ratio composites.

KEYWORDS: Mechanical properties, Mudar/Coir fiber, Vinylester.

I. INTRODUCTION

Mudar/Coir fiber 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 Mudar/Coir fiber reinforced composites are used in Automotive industry, Light Weight Materials, Boat building, Aerospace industry, Sports goods, Turbine blades and Construction Industries. The use of Mudar/Coir fiber is an alternative to glass fibers as reinforcement in polymer composites [1]. The comparative study between E-glass and Mudar/Coir fiber 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 Mudar/Coir fiber 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 Mudar/Coir fiber and Vinyl esters have turn our attraction to have a deep investigation.

The reinforcements, which are stronger and stiffer, are dispersed in a comparatively less strong and stiff matrix material. The reinforcements share the major load and in some cases, especially when a composite consists of fibre reinforcements dispersed in a weak matrix (e.g., carbon/vinyl ester composite), the fibres carry almost all the load. The strength and stiffness of such composites are, therefore, controlled by the strength and stiffness of constituent fibres. The matrix also shares the load when there is not much difference between the strength and stiffness properties of reinforcements and matrices (e.g., SiC/Titanium composite). However, the primary task of a matrix is to act as a medium of load transfer between one reinforcement to the other. It also holds the reinforcements together. In that regard, the matrix plays a very vital role. Besides, the matrix may considerably influence the hygral, thermal, electrical, magnetic and several other properties of a composite.

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II. EXPERIMENTAL INVESTIGATION

Mudar/Coir fiber of density $2500\text{--}2800\text{kg/m}^3$ 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 Mudar/Coir fiber reinforced with vinyl ester are listed in the Table 1.

TABLE 1
COMBINATIONAL RATIOS OF MUDAR/COIR FIBER REINFORCED VINYLESTER COMPOSITES

Specimen No.	Ratio of fiber & resin	Weight in grams	Resin	Temp in $^{\circ}\text{C}$
01	30:70	400	V+P+A+C	100
02	40:60	400	V+P+A+C	100
03	50:50	400	V+P+A+C	100

Resin includes vinyl ester (V), Promotor (P), Accelerator (A), and Catalyst (C) respectively. 30:70, 40:60 and 50:50 are the weight percentage variation. First three specimens are prepared by adding vinyl ester, Promotor, accelerator, catalyst in weight ratio of 10: 0.15: 0.15: 0.15 and same weight ratio. In regards to the process the chopped Mudar/Coir 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%, 40% 50% of fiber. The mould used for preparing composites is made from two rectangular chromium-plated mild steel sheets having dimensions of $300\text{ mm} \times 300\text{ mm} \times 3\text{ mm}$. 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 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 Mudar/Coir fiber in the vinylester composites determined. Then the test specimen is cut for the required dimensions. $25 \times 250 \times 3\text{ mm}$ size for Tensile test [ASTM D3039], $12.7 \times 50.8 \times 3\text{ mm}$ size for Flexural test [ASTM D790], $13 \times 66 \times 3\text{ mm}$ size for Impact test [ASTM D256] and $20 \times 20 \times 3\text{ mm}$ Water absorption test. The prepared specimens are then cured and the edges are trimmed using cut off machine.

III. EXPERIMENTAL SETUP

1. Tensile test



Fig 1 Tensile testing machine

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The tensile tests were conducted according to ASTM D 3039 standard on a computerized Universal Testing Machine. Fabricated composite was cut to get the desired dimension of specimen for mechanical testing. For the tensile test, the specimen size was 150 mm gauge length and thickness was 3 mm. Tensile strength was tested in Instron machine. The specimen with desired dimension was fixed in the grips of the Instron machine with 7 mm gauge length. The experimental set up for tensile test is shown in Figure 1.

2. Flexural test



Fig 2 Flexural testing machine

The use of flexural tests to determine the mechanical properties of polymeric composites is widely prevalent because of the relative simplicity of the test method, instrumentation and testing equipment required. The flexural strengths of the specimens were determined for specimens using the three-point bending test as per ASTM D790. The specimens of dimensions 80 mm x 15 mm x 3 mm tested with a span length of 63 mm. The 3-point flexural test is the most common flexural test and used in this experiment for checking the bending strength of the composite materials. The testing process involves placing the test specimen in the UTM and applying force to it until it fractures and breaks. Three point bend test method was used for finding the flexural strength using Universal Testing Machine Instron 1195. The loading arrangement for flexural strength is shown in Figure 2.

3. Impact test



Fig 3 Impact testing machine

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The impact test specimens are prepared according to the required dimension following the ASTM D 256 standard. During the testing process, the specimen must be loaded in the testing machine and allows the pendulum until it fractures or breaks. Using the impact test, the energy needed to break the material can be measured easily and can be used to measure the toughness of the material and the yield strength. The effect of strain rate on fracture and ductility of the material can be analyzed by using the impact test. Specimen dimension for impact test was 65 mm × 13 mm and 3mm. Impact testing was conducted in impact testing machine.

4. Water absorption test



Fig 4 Water absorption testing machine

Water absorption is used to determine the amount of water absorbed under specified conditions. Factors affecting include :types of plastic, additives used ,temperature and length of exposure the data sheds light on the performance of the materials in water or humid environments. Specimen dimension for water absorption test was 20 mm × 20 mm and 3mm. Water absorption testing was conducted in water absorption testing machine.

IV.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 15,289N/mm² for 30:70 ratios. The comparative tensile test results for 30:70, 40:60 and 50:50 ratios are pictured in figure 1.

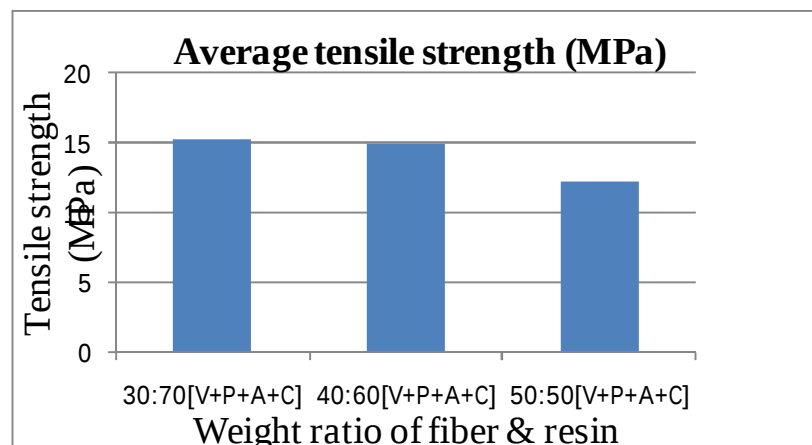


Fig.5 Tensile Test result for Mudar/Coir fiber Reinforced Vinylester Composites

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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 30:70, 40:60 and 50:50 ratios are pictured in figure 2.

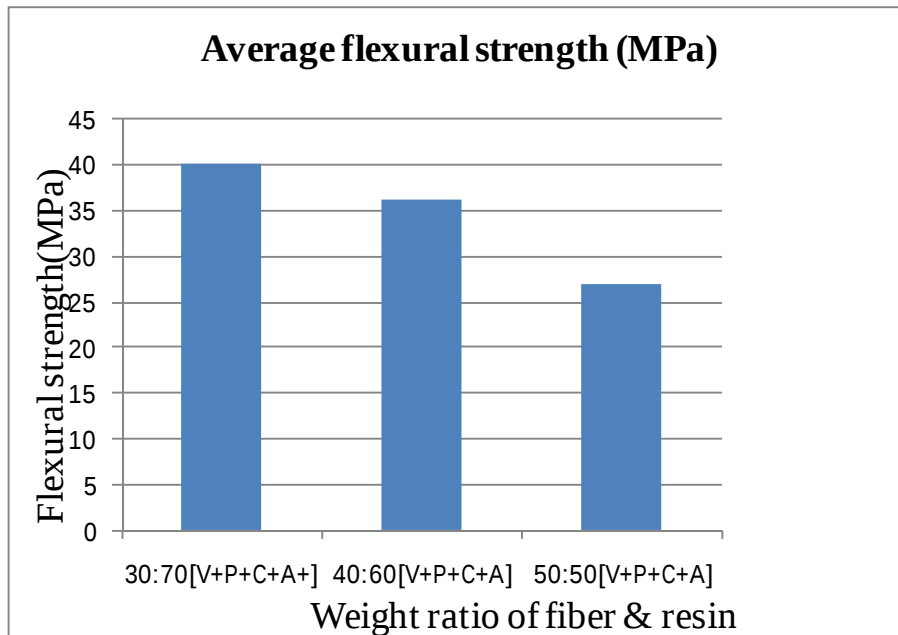


Fig.6 Flexural Test result for Mudar/Coir fiber Reinforced Vinylester Composites

C.IMPACT SRTENGTH

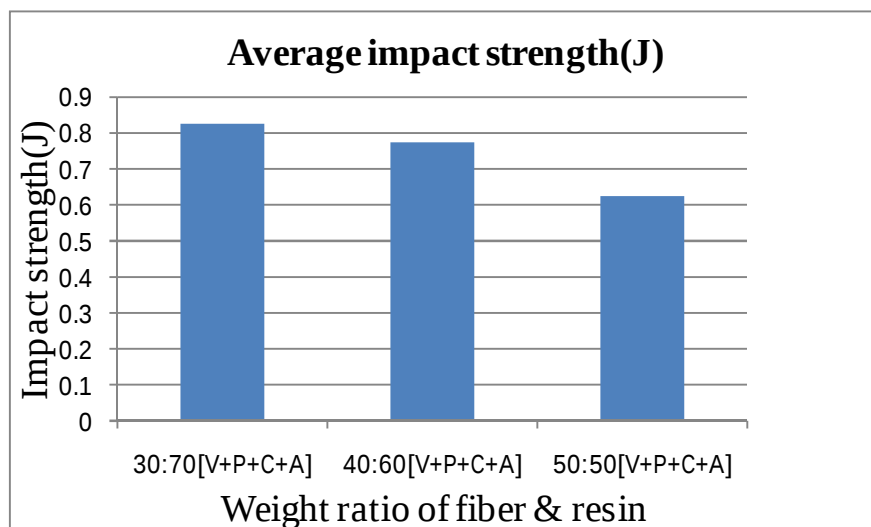


Fig.7 Impact Test result for Mudar/Coir fiber Reinforced Vinylester Composites

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Impact is a single point test that measures a materials resistance to impact from a swinging pendulum. 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 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 30:70, 40:60 and 50:50 ratios are pictured in figure 3.

D.WATER ABSORPTION TEST

Analyzing the water carrying capacity of the Mudar&coirfiber reinforced composite samples an impact test is carried out. The water absorption test was performed according to ASTM D 570. The specimen dumped into the glass of water, the absorption test doing in 48 hrs .The tested results are given below.



Before testing



After testing

Table 2 Water absorption test of various specimens

Samples	Weight before test in gms	Weight after test in gms(48 hrs)	% of water absorption
30:70	1.25	1.5	20.0
30:70	1.31	1.67	27.5
40:60	1.34	1.7	26.9
40:60	1.1	1.47	33.6
50:50	1.14	1.54	35.1
50:50	0.96	1.29	34

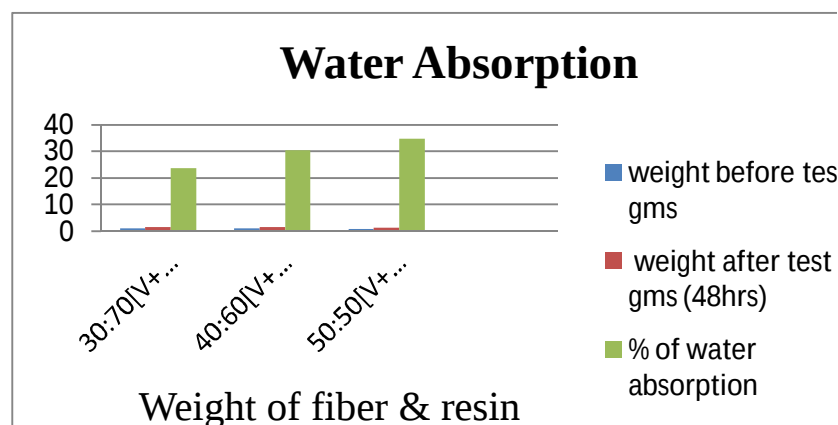


Fig.8 Water Absorption result for Mudar/Coir fiber Reinforced Vinylester Composites

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V.CONCLUSION

The mechanical behaviour of Mudar/Coir fiber reinforced vinylester composites was studied. From the results it is observed that the fiber & resin ratio 30:70 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.

VI.ACKNOWLEDGEMENT

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