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Experimental Investigations of Ultra Violet Rays, Wear Tests and Mechanical Properties on Jute Reinforced E-Glass Composites

B. Sudhabindu, Abraham Varghese, A.Vinay, K. Maharshi, P. Arvind Kumar

***Abstract:** An attempt has been made to study the influence of wear parameters like UV, wear and percentage of reinforcement on the Jute reinforced E-glass composites. Reinforcement of composite is done based on Taguchi method that was applied for the experiment on UV rays to acquire data in controlled way. An orthogonal array and the analysis of variance were employed to investigate the influence of process parameters on the tensile tests before and after subjected to UV-B rays of composites. The objective is to establish a correlation between the composites. Finally, Opacity, hardness, wear and mechanical tests were conducted and morphology was studied under SEM analysis.*

***Keywords:** UV-B rays, Taguchi, Opacity, wear, Hardness, Tensile.*

I. INTRODUCTION

Composites are able to meet diverse design requirements with significant weight savings as well as high strength-to weight ratio as compared to conventional materials. They are less noisy while in operation and provide lower transmission of vibration than E-glass. Longer life of composites offers excellent fatigue impact, environmental resistance and reduced maintenance. Composites are fire retardant and they exhibit excellent corrosion resistance. The composite parts can eliminate joint/fasteners, providing part simplification and integrated design compared with conventional E-glass parts. The development of the composite leads to the application of natural fibers as reinforcement in order to supersede the synthetic fibers. The reinforced composites using natural fibers have many advantages: Natural finer reinforced composites have good mechanical properties: natural fibers are lower density than the synthetic fiber. Therefore, the composites made of natural fiber are light in weight. Besides, they have a positive environmental impact. Mehtyl Ethyl ketone peroxide is used as catalyst. The temperature at which the resin is to be cured and the rate of curing are controlled by the catalyst.

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*Correspondence Author(s)
B.Sudhabindu, Vidya Jyothi Institute of Technology, Hyderabad (Telangana) 500075, India.
AbrahamVarghese, Vidya Jyothi Institute of Technology, Hyderabad (Telangana) 500075, India.
A.Vinay, Vidya Jyothi Institute of Technology, Hyderabad (Telangana) 500075, India.
K. Maharshi, Vidya Jyothi Institute of Technology, Hyderabad (Telangana) 500075, India.
P. Arvind Kumar, Vidya Jyothi Institute of Technology, Hyderabad (Telangana) 500075, India.

The function of a catalyst is to act ad an initiator for the polymerization process. Curing time can be controlled by varying the catalyst. It does not lead to a full care of ambient temperature by itself.

II. EXPERIMENTATION

The research activities in the field of polymer composite development using natural fibers, the corresponding observations and research gaps and the objectives of this research were reported in the previous chapter. This chapter describes the selection of materials, the experimental setup and the equipment used for testing. Before starting the layup process the mould is prepared. The mould is prepared by cleaning the mould and applying a releasing agent in order to avoid the polymer resin to stick. The mould is prepared by tapping the mould to the table top. After the preparation of mould, the polymer resin and E-Glass fiber hardener are mixed. The proportion of weight by volume is maintained accurately as required. The mixing is performed in the mixing containers with the flat mixing stick slowly.

Next an adequate quantity of mixed polymer resin & E-Glass fiber hardener is deposited in the mold and a brush or roller is used to spread it around all surface. An estimated amount of resin is added to the jute fiber cloth. The first layer of fiber reinforcement is then laid. This layer is wetted with polymer resin and then softly pressing using a roller making the resin that was added in the previous step wick up through the fiberglass cloth. The layer is rolled over properly and made sure that there are no air bubbles present in the layer. The part is cured at elevated temperatures using an oven at room temperature.

Various samples are prepared by this method and tensile and hardness tests are conducted on those samples to find out the optimum composition.

III. RESULTS AND DISCUSSION

The composites were made from jute and E-glass fibers with the binder and the sheets prepared were subjected to mechanical property evaluation for strength and hardness. The source parameters for making the composites were given in the table 4.1 and each of the parameters were kept at two levels.

Uses of statistical techniques in process parametric selections were used to study the effects on properties under consideration. To study the effects with a small number of experiments Taguchi technique was employed with L_8 design matrix.

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Table 3.1: Process parameters and their levels

S. No.	Source	Notations	Low level (1)	Medium level (2)	High level (3)
1	Binder (Catalyst: Resin)	X_1	1:2	1:8	1:10
3	E-Glass (Surface Finish)	X_2	4	7	10

The results of the composite materials tested for their strength and their hardness have been compiled in table 4.2. It was found that highest strength of the composite is obtained when the binder is 1:10 ratio, and E-glass at 4nm roughness. And the tensile strength after UV test was found to be highest with the combination of 1:10, and 4nm respectively. The data have been subjected to analysis of variance (ANOVA) and the computations are compiled in tables 4.2 and 4.4 for strength and hardness respectively.

Taguchi Array: $L_9(3^2)$

Factors: 2

Runs: 9

Table 3.2: L_9Orthogonal Array

Run	X1	X2
1	1	1
2	1	2
3	1	3
4	2	1
5	2	2
6	2	3
7	3	1
8	3	2
9	3	3

Table 3.3: Strength Parameters

Runs	X1	X2	Strength before U.V	Strength after U.V
1	1:10	4	95.2	93.1
2	1:10	7	94.3	92.1
3	1:10	10	93.8	91.1
4	1:8	4	94.7	90.8
5	1:8	7	93.5	89.6
6	1:8	10	92.8	89.5
7	1:2	4	94.6	90
8	1:2	7	93.1	89.2
9	1:2	10	92.5	88.8

Table 3.4:Anova Table before UV

	S.S	DOF	MS	F	% of Contribution
X1	1.723	7	1.726	86.15	25
X2	5.04	1	5.04	253.5	72.8
Error	0.157	7	0.02		2.2
Total	6.92	9	0.786		

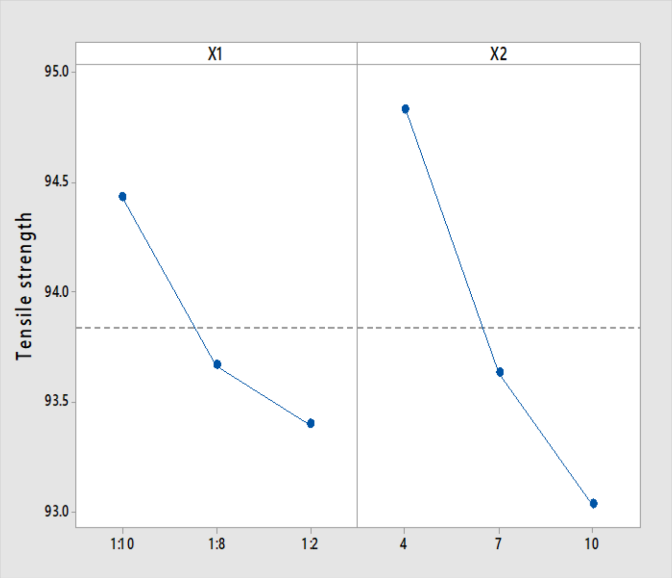

Figure 1. Analysis of Tensile strength before UV

The E-glass was contributing to the extent of 72.8% while achieving the strength of the composite while the binder was affecting the least to the tune of 25% only.

Table 3.5: Anova table after UV

	S.S	DOF	MS	F	% of Contributio n

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X1	12.93	1	12.93	26.94	77.26
X2	3.466	1	3.466	7.23	20.7
Error	0.34	7	0.48		2.04
Total	16.73	9	1.85		

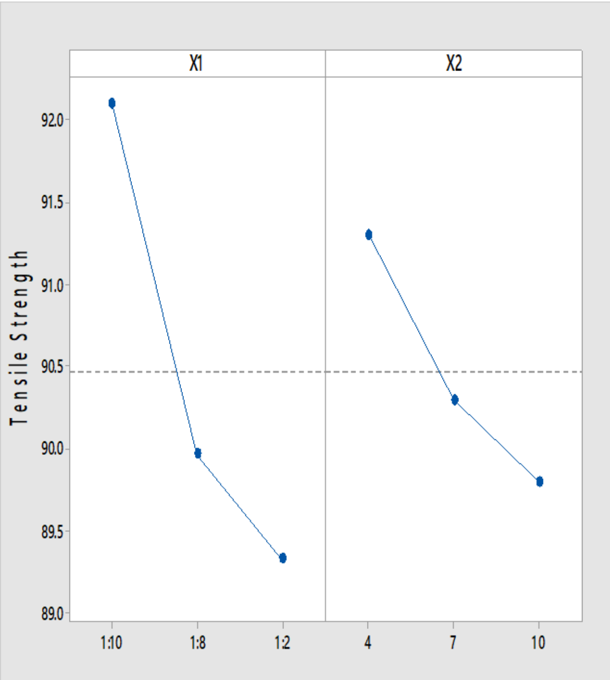

Figure 2: Analysis of Tensile strength after UV

The Binder was contributing to the extent of 77.26% while achieving the strength of the composite while the E-glass was affecting the least to the tune of 20.7% only. The overall optimal parameters were chosen depending upon the requirement of the property. However in most of the applications, the strength would be taken as criteria and hence the optimal parameters was fixed with binder at 1:10 and E-glass roughness at 4nm.

The composite sheet is prepared by the obtained optimum parameters taking Jute as 1mm thickness and the samples were subjected to different tests like opacity test, wear test and mechanical properties.

3.1. Opacity Test

Samples were subjected to opacity test to know the light emission when samples were subjected before and after UV-B lamp and degradation was calculated by percentage.

Table 3.6: Percentage degradation of Opacity

S. No	Properties	% of Opacity
1	Before UV	18.2
2	After UV at 20 hrs	18.2
3	After UV at 40 hrs	18.1
4	After UV at 60 hrs	18.1
5	After UV at 75 hrs	18.1
6	After UV at 100 hrs	18

3.2. Hardness Test

After subjected to UV accelerated weathering at 8 hours UVB simulation at 60°C followed by 4 h of condensation at 50°C, the samples were subjected to hardness under Vickers hardness test ASTM E-384. The results were tabulated in the table:

Table 3.7: Change in hardness of the composite sheet

S. No.	Properties	Hardness
1	Before subjected to UV	80
2	After UV at 20 hrs	78.8
3	After UV at 40 hrs	78
4	After UV at 60 hrs	77.3
5	After UV at 75 hrs	76.4
6	After UV at 100 hrs	75

3.3. Wear Test

The samples were placed under ASTM G65 at an angle of 15° and particles of 75μ at a rate of 10gms/min with various angles of 30°,45°,60°,75° and 90° and changes were observed in their tensile strength.

Table 3.8: Change in the tensile strength and hardness when subjected to different angles

S. No	Angles	Minutes	Tensile strength	Ultimate tensile strength	Hardness	Hardness after wear
1	30	60	84	84	80	79
2	45	60	84	84	80	78.2
3	60	60	84	83.2	80	77.8
4	75	60	84	82.5	80	75.3
5	90	60	84	82.4	80	75

3.4. SEM analysis:

The tested samples are subjected to various tests like UV rays and wear tests are analyzed by using SEM. The figure3 of a) represents the sample before subjected to UV rays and wear test, b) represents the sample after subjected to UV rays upto 100 hours, c) represents the sample subjected to wear test at an angle of 75.

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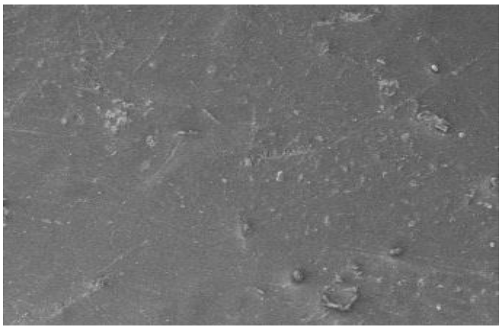
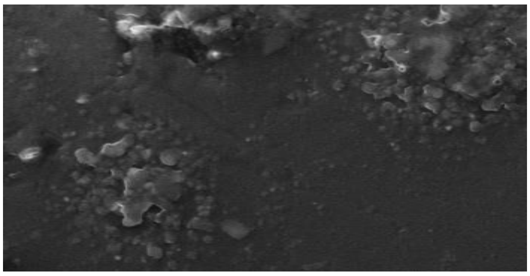
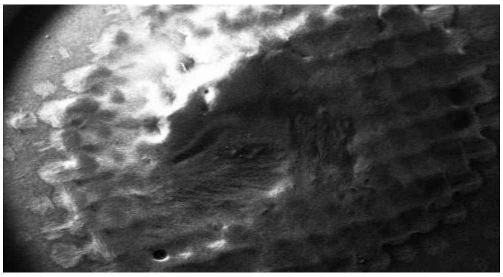


Figure 3: a) Before test



b) After UV at 100 hrs



c) After wear at 75^0

IV. CONCLUSION

Composite sheet with E-glass as 4nm, Binder with a ration of 1:10 as MEKP catalyst, Isothalic resin and constant Jute fiber with 1mm of thickness is prepared by using Taguchi method that were tested based on their tensile tests when subjected before and after UV-B rays. When opacity test and hardness tests are conducted after subjected to UV-B rays, It was found that the loss is minimum. When tensile and hardness tests are conducted, the major loss was observed at and angles of 75 and90.

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