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Effect of fibers on Hybrid Matrix Composites

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ABSTRACT
Frictional co-efficient, impact quality; dielectric quality and compound resistance examination of bamboo/glass strands strengthened epoxy half breed composites were considered. Two distinctive crossover composites, for example, treated and untreated bamboo filaments were manufactured and impact of soluble base treatment of the bamboo strands on these properties were additionally concentrated on. It was watched that, effect quality and frictional co-proficient properties of the half and half composites increment with expansion in glass fiber content. These properties observed to be higher when salt treated bamboo filaments were utilized as a part of the half breed composites. It is watched that, concoction resistance was fundamentally increments for all chemicals with the exception of carbon tetrachloride. The disposal of nebulous hemi-cellulose with salt treatment prompting higher crystallinity of the bamboo filaments with antacid treatment may in charge of these perceptions. The impact of salt treatment on the holding between glass/bamboo composites was additionally concentrated on. Checking electron magnifying lens (SEM) were additionally directed on the cross segments of broke surfaces with a specific end goal to rate the execution crossover composites were likewise conferred bear natural products.
Keywords: Bamboo fiber, Glass fiber, Hybrid composites, Mechanical properties.

I. INTRODUCTION

In each car and air ship parts producing commercial enterprises, the glass with regular filaments are utilized in view of their flexibility to various circumstances and the relative simplicity of blends with different materials to fill particular need and show craved properties. Phenomenal plastics utilizations are inescapable in nowadays as it is adaptable material that fits numerous employments. The turnaround in support plastic happened not due to shading and strength for family unit items additionally in light of the fact that plastics as an embellishment got to be in vogue and trailblazers. Along these lines this is the day of plastics (composites). Glass fiber fortified composites because of their high particular quality and particular firmness have gotten to be alluring auxiliary materials in weight delicate aviation, car commercial enterprises, as well as in marine, protective layer, railroads, structural building structures, sports merchandise and so forth. Epoxy sap is the most Normally utilized polymer lattice with strengthening strands for cutting edge composites applications. They are being utilized broadly as a lattice to hold the superior fiber fortification together in composite materials, and an auxiliary glue. Among all fortifying filaments, common strands have increased considerable significance as fortifications in polymer lattice composites.

A great deal of work has been finished by numerous exploration hopefuls on these composites in light of these filaments. In any case, little work was investigated about the glass/bamboo half breed strands as these offers a scope of properties that can't be acquired with a solitary sort of support. The glass and the bamboo filaments were joined in the same network to create cross breed composites which confer particular properties that can't be acquired with a solitary sort of support. Consequently creator's principle center is to manufacture propelled composite materials which can good with all conceivable commercial ventures.

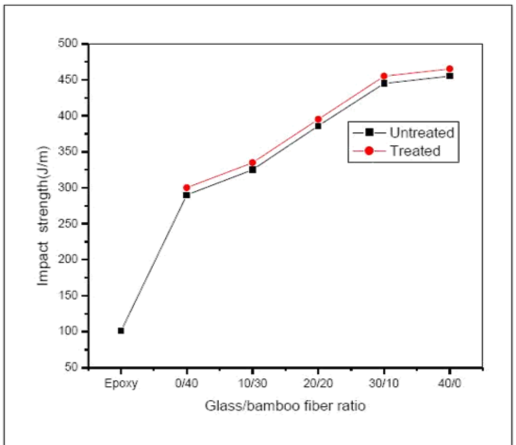

Fig. 1 The variation of impact strength with the ratio of % Glass/bamboo fibers reinforced epoxy composites

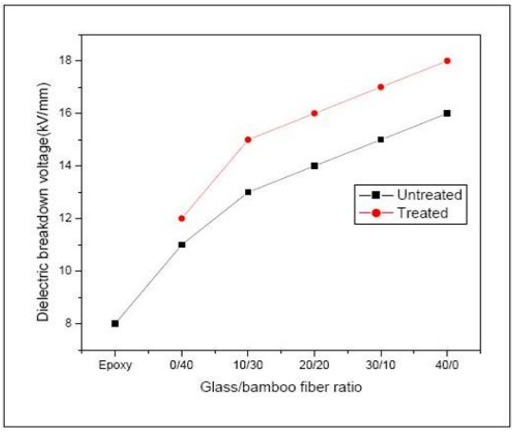

Fig. 2 Variation of the dielectric strength as a function of Glass/bamboo fiber reinforced epoxy composites.

In the present work, the bamboo & glass fiber reinforced high performance epoxy hybrid composites were developed to identify impact properties with fiber content (with varying ratio of glass/bamboo fibers) were studied. In the present work, the authors fabricated and investigated the interfacial bonding between glass/bamboo reinforced epoxy composites.
The effect of alkali treatment on the bonding between glass / bamboo composites was also studied.

II. METHODOLOGY

2.1. Materials

Superior epoxy pitch LY 556 and the curing operator hardener HY 951 framework were utilized as the grid. Bamboo filaments were secured from Tripura condition of India in the dried structure. Some of these strands were absorbed 1% NaOH answer for 30 min. to evacuate any oily material and hemi cellulose, washed altogether in refined water and dried under the sun for one week. The glass slashed strand mat was utilized as a part of making the cross breed composite rate.

2.2. Preparation of the Composite and the Test Specimens

For making the composite, a trim box was set up with glass with 200 mm 200 mm 3 mm mold cavity. The mold hole was covered with a dainty layer of watery arrangement of poly vinyl liquor (PVA) which goes about as a decent discharging operator. Further a slight covering of hard wax was laid over it lastly another slim layer of PVA was covered. Every coat was permitted to dry for 20 min. at room temperature. A 3 mm thick plate was produced using the epoxy and hardener taken in the proportion of 100 and 10 sections by weight individually. At that point the embellishment box was stacked with the framework blend and drumstick and glass fiber in arbitrary introduction (with changing rate) and was set in vacuum stove which was kept up at 1000C for 3 hours to finish the curing. Subsequent to curing, the plate was expelled from the embellishment box with basic tappering and it was cut into tests for effect test with measurements of. 120 mm x 13mm x 3 mm are cut according to ASTM D 256-88 particulars For examination purpose the example for lattice material were additionally arranged in comparative lines. For Scanning electron magnifying lens examination the cryogenically cooled and broke example surfaces were gold covered and the cracks surface was watched utilizing filtering electron magnifying lens.

2.3. Frictional Co-efficient and Impact Load Measurement

The frictional co-efficient is obtained from friction test (FX-7100) which is performed by sliding a pin on a sample disc at 23ºC and 45% relative humidity. Before each test, the surface of counterpart pin is abraded with No. 1000 abrasive paper and cleaned with alcohol-dipped cotton, followed by drying. This friction test consisted of a rectangular composite pin sliding against composite sheets. Another friction test is also performed at sliding velocity of 0.5 mm/s and the loads are varied from 1, 5 and 10 N during 20 cycles. Thus the friction coefficient is measured. The impact strength is determined using IZOD impact tester. The test specimens with dimensions 120 mm x 13mm x 3 mm are cut as per ASTM D 256-88 specifications. In each case five specimens are tested and average value is recorded.

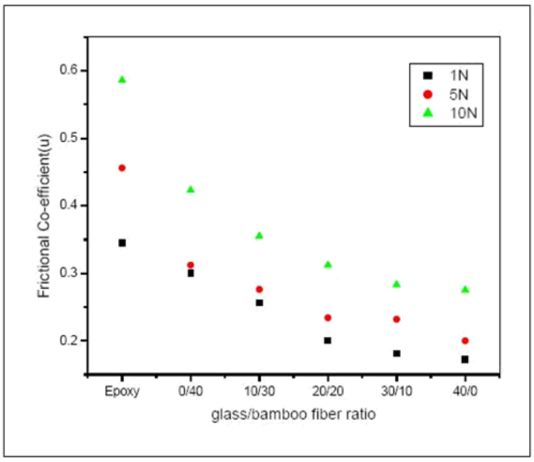

Fig. 3 Variation of frictional co-efficient as a function of glass/bamboo fibre on untreated hybrid composites during 20 cycles.

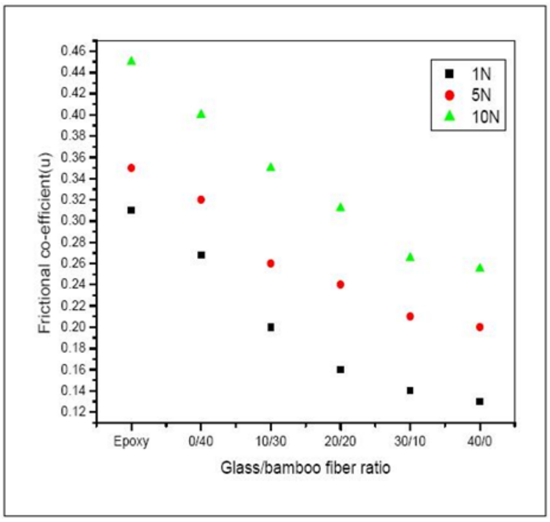

Fig. 4 Variation of frictional co-efficient as a function of glass/bamboo fibre on treated hybrid composites during 20 cycles.

2.4. Dielectric Strength

The composite examples were made according to the ASTM D 149 to gauge the dielectric quality. The examples having measurements of 120mm x 120mm x 3mm are fortified with filaments in a solitary course along 120mm length. The dielectric separate voltage is resolved at five focuses for every example, and normal quality was considered for examination. The focuses chose are sufficiently inaccessible so that there
is no flashover. The test is carried out at 50Hz frequency and room temperature. Digital micrometer of 0.001mm least count is used to find the thickness of the specimen at break down point and the test was repeated for all specimens fabricated from different kinds of fibres.

2.5. Chemical Resistance Test

To ponder the synthetic resistance of the composites, the test strategy ASTM D 543-87 [9] was utilized. Three acids, three salts and four solvents were utilized for this reason. Acidic corrosive, nitric corrosive, hydrochloric corrosive, ammonium hydroxide, fluid sodium carbonate, watery sodium hydroxide, carbon tetrachloride, benzene, toluene, and refined water were utilized after cleansing. For every situation, the examples (5x5x3) mm3 were pre-said something an exactness electrical adjust and plunged in the individual synthetic reagents for 24 hrs. They were then evacuated and instantly washed in refined water and dried by squeezing them on both sides with a channel paper at room temperature as portrayed somewhere else [7]. The treated samples were then re-weighed and the percentage loss/gain was determined using the equation:

$$\% \text{ weight loss or gain of the sample} = \frac{\text{Original weight - Final weight}}{\text{Original weight}} X100$$

2.6. Scanning Electron Microscopy Analysis

A Jeol JSM-6400 Japan scanning electron microscope (SEM) at 15 kV accelerating voltage equipped with energy dispersive spectroscopy (EDS) to identify the clay particles in the nanocomposites. The fractured surfaces were gold coated with a thin film to increase the conductance for SEM for analysis.

III. RESULTS AND DISCUSSION

3.1. Impact Strength Tests

The variety of effect quality with the proportion of rate glass/bamboo fiber in these composites is displayed in Figure 1. For this situation additionally the half breed composites are found to have great effect properties. On account of most extreme quality, the qualities change between 36 to 430 MPa. The effect quality of these composites was observed to be upgraded when antacid treated bamboo filaments were utilized as a part of the cross breed composites. Comparative perception was made by Varada Rajulu et al [2 – 9] and Srinivasulu et al [10] on account of some bamboo composites and polymer covered bamboo filaments.

3.2. Dielectric Strength Test

It is also worth noticing that the dielectric strength of hybrid fibre composites (**Figure 2**) increases with increase in volume fraction of fibre in the composite in the present study. This is a very rare phenomenon which is not observed in many of the natural fibre composites. Dielectric strength of hybrid fibre composites investigated in the present research

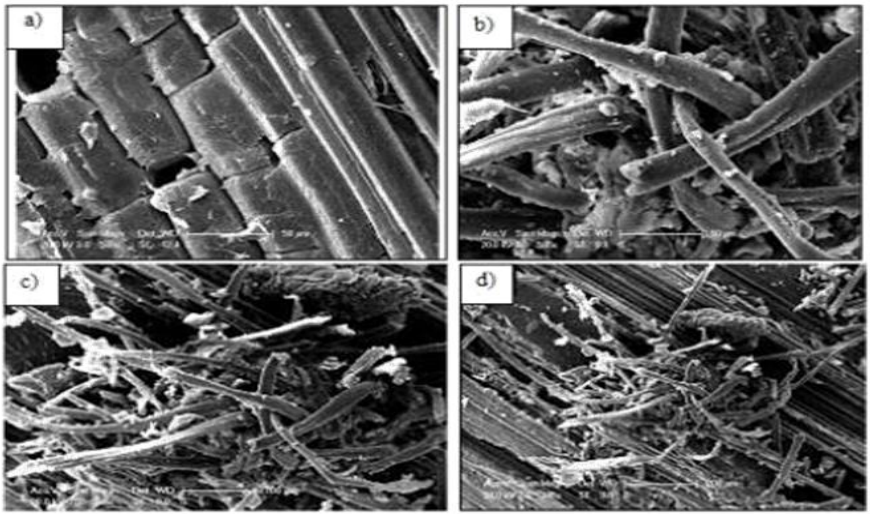

Fig. 5 SEM of untreated bamboo fiber (a) and (b) at two regions 100x magnification and (c) and (d) at two regions 200x magnification

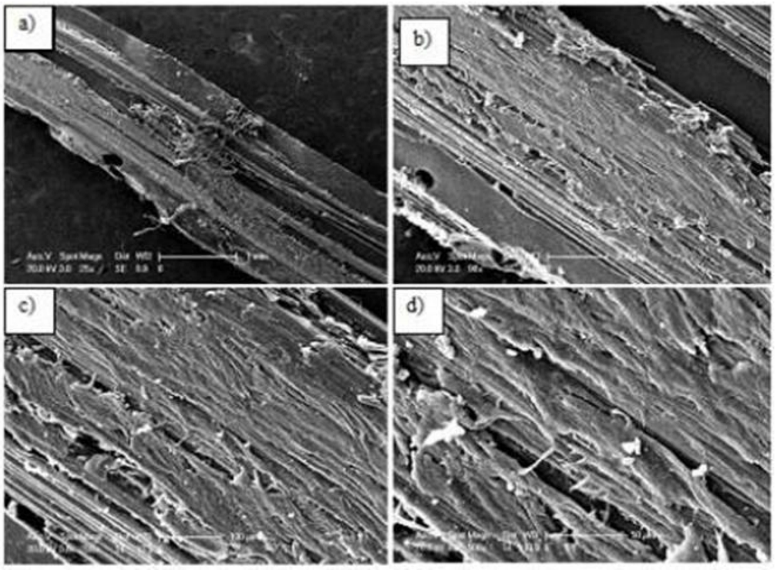

Fig. 6 SEM of treated bamboo fiber (a) and (b) at two regions 100x magnification and (c) and (d) at two regions 200x magnification

Table 1 Effect of chemicals on neat epoxy matrix and hybrid composites at % change in weight after dipping for 24hr.

Chemical	Neat epoxy	GF/Bamboo Hybrid composite
Hydrochloric acid	+1.207	+0.873
Acetic acid	+1.262	+0.241
Nitric acid	+2.459	+1.678
Sodium hydroxide	+1.124	+0.568
Sodium Carbonate	+0.295	+0.245
Ammonium Hydroxide	+0.989	+0.767
Benzene	+2.330	+10.426
Toluene	+2.459	+4.810
Carbon tetrachloride	-2.921	-2.145
Distilled water	+1.634	+1.023

work of the hybrid composite can certainly be considered for electrical insulation applications.

3.3. Frictional Co-efficient Test

For the perfect epoxy, the frictional coefficient is expanded with an expanding of burden power. The frictional coefficients of the composites are unmistakably diminished, particularly at a higher power. The bringing down of the grating, i.e., better tribological property, is fundamentally distinguished at 40/0 wt% of glass fiber/bamboo content. The contact coefficients for untreated are higher when contrasted and treated for the same filler content. Variety of frictional co-effective after 20 cycles of GF/bamboo fiber filled epoxy under a sliding pace of 0.5 mm/s and changing heaps of 1N, 5N and 10N, as an element of half and half fiber are introduced in Figure 3 and 4. It is seen that the rubbing coefficients significantly diminished with expansion in fiber stacking at the chose sliding rate. It is further seen that frictional co-productive qualities enhanced astoundingly at low load power furthermore increment with burden power.

3.4. Chemical Resistance Test

Chemical resistance of neat epoxy and hybrid composites are tabulated in the **Table 1**. It is evident that weight is increased for matrix after immersion. This is understandable as the matrix is well cross linked and as a result swelling takes place instead of dissolution. These composites proved to be good resistance to attack on chemicals except carbon tetrachloride.

3.5. Morphology Test on Cross Sections of Fractured Surfaces

To probe the bonding between the reinforcement and matrix, the scanning electron micrograms of fractured surfaces of glass/bamboo reinforced epoxy hybrid composites were recorded. These micrograms were recorded at different magnifications and regions. The analysis of the micrograms of the composites prepared under different conditions is presented in the following paragraphs.

3.5.1. Untreated bamboo fiber

The micrograms of broke surfaces of untreated bamboo fiber are displayed in Fig. 2 (a)-(d). Figures (an) and (b) speaks to the fractograms at two districts with an amplification of 100X. Figure 2 (c) and (d) are the fractograms at these locales at amplification of 200X. From every one of these micrograms, it is obvious that fiber pullout is watched, demonstrating a poor holding between the filaments. At the point when the interfacial holding is poor, the mechanical properties of the composites will be second rate. All the mechanical properties of the glass/bamboo fiber composites concentrated on show that these properties are the minimum for these composites with untreated bamboo strands. Poor people attachment is demonstrated in Fig 2 underpins this perception.

3.5.2. Treated bamboo fiber

The fractograms of alkali treated bamboo fiber composites are presented in figures 3 (a), (b), (c) and (d). These fractograms were recorded at two different regions and 100X and 200 X magnifications. From these micrograms it is clearly evident that the surface of the fibers becomes rough on alkali treatment. The elimination of hemi-cellulose from the surface of the bamboo fiber may be responsible for the roughening of the surface. Here, though the bonding is improved, fiber pullout is reduced. Thus the alkali treatment improved the bonding. This is in accordance with the mechanical properties of these composites.

IV. CONCLUSION

The cross breed composites of glass/bamboo fiber strengthened epoxy were made keeping in mind the end goal to assess frictional and sway properties, dielectric quality, concoction resistance and SEM investigation contemplated. The impact of antacid treatment of the bamboo strands on these properties was examined. The half and half composites with salt treated bamboo strands were found to have higher effect properties. Treated composites likewise demonstrated that they have great dielectric properties at 40/0 bamboo/glass fiber weight proportion. These treated mixture composites were improved great mechanical properties at glass/bamboo: 40/0. Synthetic resistance enhanced essentially for every one of the chemicals with the exception of carbon tetrachloride. The disposal of shapeless powerless hemi cellulose parts from the bamboo strands on salt treatment might be in charge of this conduct.

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