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# COMPRESSIVE PROPERTIES OF POLYCARBONATE TOUGHENED EPOXY- BAMBOO FIBER COMPOSITES

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## ABSTRACT

Polycarbonate toughened epoxy-bamboo fiber composites are prepared by varying fiber mat content. The blend matrix Epoxy-PC with varying weight percentage (wt%) of PC content in epoxy are prepared. It is observed that the blend matrix epoxy PC containing 10% of weight of PC showed to have minimum compressive strength.

With varying in fiber mat content, toughened epoxy-bamboo fiber composites have been developed and it is evident that the Compressive strength of the composites is increased with the increase in the fiber content from 10% of wt. However, the compressive strength of these reinforced samples is found to be lower than that of un-reinforced matrix.

**KEYWORDS:** Poly Carbonate, Epoxy-PC Blend Matrix, Compressive Strength, and Fiber Mat Content

## INTRODUCTION

In recent years, cellulosic fillers of fibrous nature have been of great interest, as they can yield composites with improved mechanical properties compared to those containing non–fibrous fillers [1]. Though several studies on tensile properties of polymer composites are available [2-4], the information on their compressive properties is meager. Keeping this in view, in the present work the PC toughened epoxy-bamboo fiber composites have been developed and studied their compressive properties by varying the fiber mat content. The effect of polycarbonate content on compressive properties of Epoxy-PC blend matrix is also studied and the results are presented in this paper.

## MATERIALS AND METHODS

### Sample Preparation

A glass mould with 80 mm x 80 mm x 10 mm dimensions is employed for the preparation of compressive test specimens. The mould is coated with a thin layer of aqueous solution of polyvinyl alcohol (PVA) which acted as a good releasing agent. In order to make the blend, the epoxy resin is added with polycarbonate dissolved in dichloromethane. The solvent is removed by degassing in vacuum for about one hour. The blend and the hardener are mixed in the ratio 100:10 parts by weight respectively.

Composites with bamboo fiber mat as reinforcement are prepared using toughened epoxy resin and cured for 24 hrs at room temperature. To ensure complete curing, the composite sheets are post cured at $100^{O}$C for three hours. Then they are cut to required size and shape according to the ASTM standards.

In order to obtain optimum content of polycarbonate in Epoxy-PC blend, the specimens of matrix material are also prepared in similar lines.

### Testing

Compressive test is performed using Instron 3369 Universal Testing Machine. The test specimens with 10 mm x 10 mm x 10 mm dimensions are cut as per ASTM D 3410–695 specifications. The temperature and humidity for this test are maintained at $22^{O}$ C and 50% respectively. In each case five specimens are tested and average value is recorded.

## RESULTS AND DISCUSSIONS

### Effect of Polycarbonate Content on Compressive Properties of Epoxy-PC Blend Matrix

The blend matrices Epoxy-PC with varying weight percentage (wt %) of PC content in epoxy are prepared. They are first subjected to mechanical strength analysis and then the blend matrix that showed the maximum compressive strength among the combinations is chosen to be the matrix for developing composites. From Table 1, it is observed that the blend matrix Epoxy-PC containing 10 wt% of PC showed to have maximum compressive strength. On the basis of the result, this combination is selected as the matrix to prepare composites.

The variation of compressive strength and percentage elongation at break with varying polycarbonate content in Epoxy–PC blend matrix are presented in Figure 1 and Figure 2 respectively. From these figures it is evident that the compressive strength and elongation at break of blend matrix increases gradually with polycarbonate content of upto 10 wt% beyond which decreases moderately. From Table 1, it is further observed that the blend matrix of Epoxy–PC having 10 wt% of PC content showed an increment of about 19.78% in compressive strength over the pure epoxy. It is also observed that the percentage elongation is low in pure epoxy when compared to Epoxy-PC blend matrix, indicates that the percentage elongation increases with addition of polycarbonate, it is due to excellent toughness of PC.

**Table 1: Compressive Properties of Epoxy–PC Blend Matrix**

| Wt % Content of PC in Epoxy–PC Blend | Compression Strength (MPa) | % Elongation at Break |
|---|---|---|
| 0 | 142.23 | 33.27 |
| 2.5 | 155.58 | 36.87 |
| 5 | 162.79 | 37.48 |
| 7.5 | 168.45 | 38.26 |
| 10 | 170.37 | 38.35 |
| 12.5 | 164.19 | 36.44 |
| 15 | 147.34 | 34.78 |

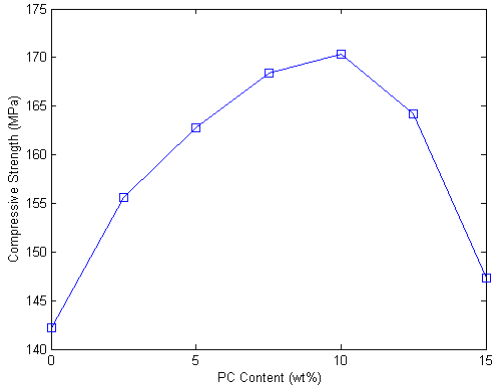


**Figure 1: Variation of Compressive Strength with PC Content in Epoxy–PC Blend Matrix**

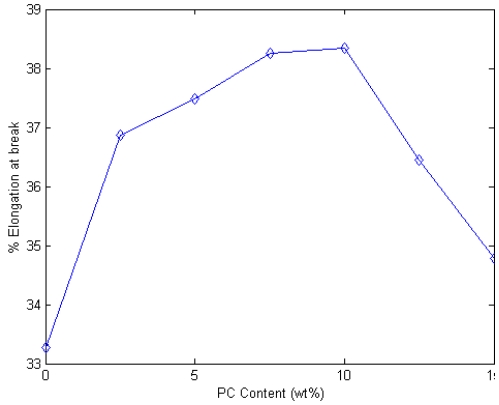


**Figure 2: Variation of Percentage Elongation at Break with PC Content in Epoxy-PC Blend Matrix**

**Effect of Fiber Mat Content on Compressive Properties of the Composite**

The compressive strength and percentage elongation at break of longitudinally oriented PC toughened epoxy-bamboo fiber composites with different fiber mat content are presented in Table 2. For comparison, these values for the matrix are also presented in the same table. The variation of compressive strength and percentage elongation at break of the composites with fiber mat content are presented in Figure 3 and Figure 4 respectively. From these figures, it is observed that the compressive strength and percentage elongation values are increasing with mat content. However, the compressive strength of these reinforced samples is found to be lower than that of un-reinforced matrix. This could be due to the presence of voids at the resin–fiber interface.

The composites under consideration are inferior to that of Epoxy–PC blend matrix material. Thus, the developed composites may not suitable materials for applications where higher compressive strength is required.

**Table 2: Variation of Compressive Properties of Longitudinally Oriented PC Toughened Epoxy-Bamboo Fiber Composites with Fiber Mat Content**

| Fiber Mat Content (Wt%) | Compressive Strength (MPa) | % Elongation at Break |
|---|---|---|
| 10 | 96.65 | 32.52 |
| 20 | 102.93 | 36.81 |
| 30 | 122.13 | 38.26 |
| 40 | 143.09 | 38.93 |
| **Matrix** | **170.37** | **38.35** |

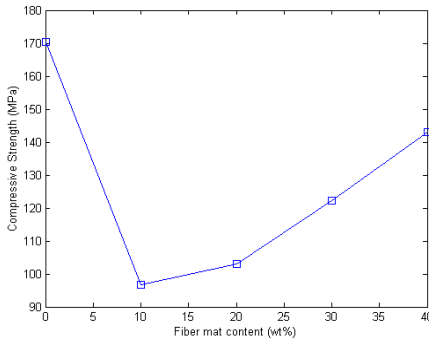


**Figure 3: Variation of Compressive Strength of Longitudinally Oriented PC Toughened Epoxy-Bamboo Fiber Composites with Fiber Mat Content**

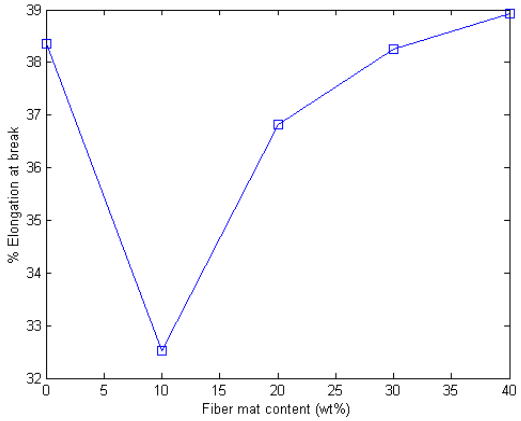


**Figure 4: Variation of Percentage Elongation of Longitudinally Oriented PC Toughened Epoxy-Bamboo Fiber Composites with Fiber Mat Content**

## CONCLUSIONS

The critical study of results and discussion presented in this paper yields noteworthy conclusions. The conclusions are identified and listed below.

- The blend matrix Epoxy–PC containing 10 wt% of PC showed to have minimum compressive strength. On the basis of the result, this combination is selected as the matrix to prepare composites.
- The compressive strength of longitudinally composites increases with increase in fiber content. However, the compressive strength of these reinforced samples is found to be lower than that of un-reinforced matrix. This could be due to the presence of voids at the resin-fiber interface.
- The developed composites are inferior to that of Epoxy-PC blend matrix. Hence, the developed composites may not be suitable for materials higher compressive strength is required.

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