Investigation on Impact and Compression Properties of Pineapple Reinforced Polymer Composite

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Investigation on impact and compression Properties of Pineapple Reinforced Polymer Composite

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Abstract

The Natural fiber composites form a combination of plant derived fibers with plastic binders (Polymer matrices). The fibers form the fillers or reinforcements of the composite and the matrix is the continuous phase. In general, fibers are principal load carrying members while the surrounding matrix keeps them in the desired position, acts as a load transfer medium between them. So fibers with good strength and modulus and having good bonding with matrix should be used to a produce a good quality composite material [1-3]. The mechanical efficiency of a fiber composite depends on the adhesion between the matrix and the reinforcement [4-7]. This paper is to evaluate impact and compression properties of pineapple fiber based reinforced composite with epoxy resin as matrix.

1. Introduction

The natural fibers have many advantages. .These fibers are cheaper and environment-friendly, meaning that they are biodegradable, and unlike glass and carbon fibers, the energy consumption to produce them is very small. Through decomposition they can be easily disposed .They possess very good mechanical and acoustic properties and therefore are more suitable for noise attenuation, an increasingly important requirement in interior automotive applications. The usage of such fibers results in weight reduction from 10 to 30%. The density of natural fibers is in the range of 1.25-1.5 g/cm^3 compared with 2.54 g/cm^3 for E-glass fibers and 1.8–2.1 g/cm^3 for carbon fibers. The modulus–weight ratio of some natural fibers is greater than that of E-glass fibers. So they can be very competitive with E-glass fibers in stiffness-critical designs. Vijaya Ramnath et al [6,9] have studied the Abaca-Jute-GFRP composite mechanical properties like tensile, flexural properties and their impact. Composite hybrid fiber with improved properties is obtained with addition of abaca and jute in the glass fiber composite materials.

Vijaya Ramnath et al [6,9] fabricated pineapple fiber reinforced with polymer composite by changing orientation. Three samples were carved from the fabricated material and it is tested for flexural test and the values obtained from the test were concordant to each other. These composites can be used for application demanding superior flexural properties such as automotive door panels and dashboards. Niranjan Raja et al [7] fabricated abaca fiber reinforced with epoxy composite by changing orientation. Three samples were carved from the fabricated material and it is tested for tensile test. They concluded that stress and other parameters do not change significantly for the samples and hence it can be extensively used for automotive and marine applications. Niranjan Raja et al [8] fabricated for woven-roving composite laminate. They conducted tensile test for plain laminate, laminate with circular hole and laminate with rectangular hole. They concluded that strength of plain laminate is higher compared to other two types of composite material and this woven-roving composite laminate is suitable for automotive panel board application**.**

2. Materials used

Pine apple fiber and glass fibers are used as material for the specimen preparation. Pine apple fiber is used when a lightweight, but strong fabric is needed. Glass fibers are the most widely used artificial fibers with superior strength-to-weight ratio. Which have high tensile strength, high chemical resistance, and excellent insulating properties.

3. Fabrication Procedure

Hand-layup method is adapted to prepare the pine apple composite. Firstly, the releasing agent is applied on the mold to provide ease of removal of the manufactured part from the mold. The glass fiber mat (woven roving) is placed on the mold and then the epoxy resin mixed with hardener in the proportion of 10:1 is applied on the mat. The hardener is used to enhance the strength of the composite. A roller is used to exhort the trapped air from the glass fiber mat.. A setup time of 3-4 hours is required for the formation of the base layer of the composite. Now, the pineapple fibers are arranged for the required orientation over the base layer and resin-hardener mixture is applied after each layer. Three such layers of pineapple fibers are formed. These layers are stacked up within the time interval of 15 minutes to avoid drying of epoxy resin. Another layer of glass fiber similar to the base layer is placed on the top. Now, a load of 10-15 kilograms is placed over the composite. This give the required natural composite which can be further cut on the sides to give the required size. The prepared specimen is cut into four samples to conduct the impact test. Figure 1 shows the orientation of the pine apples and glass rovings

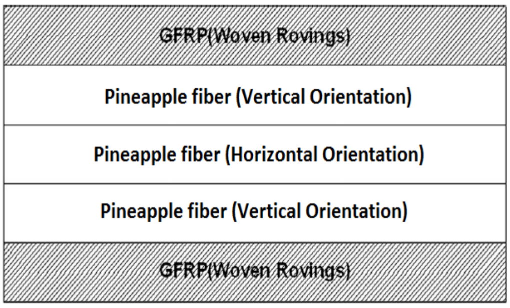

Figure 1: Orientation of fibers

Figure 2 ASTM D: 256- impact test sample

5 Impact testing of the composite samples:

To analyze the capability of the four samples impact test is conducted on a Charpy impact test machine and loss in energy is found. It is done as per ASTM D: 256 standards .The schematic diagram of tested sample is shown in the figure 2. Stacking sequence of the fibers is more important than composition is determining impact toughness.

6 Compression testing of composite samples

A compression test determines behavior of materials under crushing loads and carried out in Universal testing machine. The specimen is compressed and deformation at various loads is recorded. The test is conducted as per ASTM: D 695 standards

Table 1 Energy absorbed in impact and compressive test values for the samples:

Sample No	Energy absorbed in Joules	Ultimate load F_{max} (KN)	Compressive Strength		Compressive modulus	
			KN/mm^2	MPa	KN/mm^2	MPa
1	3.9	7.26	0.06238	62.38	0.484	484
2	4.0	7.54	0.06534	65.34	0.491	491
3	3.8	7.12	0.06120	61.20	0.479	479
4	4.3	7.69	0.06870	68.70	0.491	491

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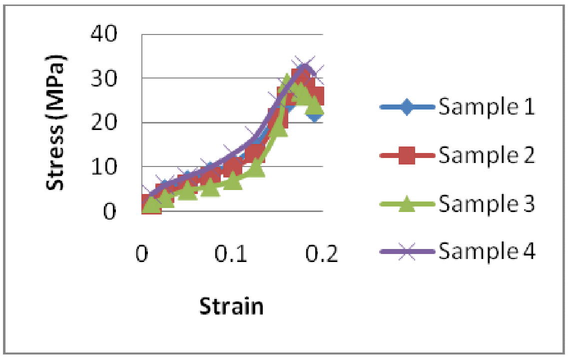

Figure 3 Stress Vs Strain

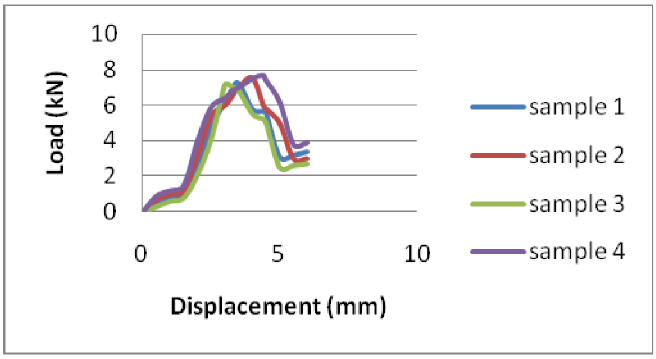

Figure 4 Load Vs Displacement

6. Results and Discussions:

In impact test each sample is impacted by a heavy blow and during this Period energy absorbed by each sample is given in table 1. Table 1 also shows the ultimate load and the corresponding compressive strength. The figure 3 shows the stress Vs Strain and figure 4 shows variation of load Vs displacement during compression test of composite samples

7. Conclusion:

Based on the results of the impact tests, it is seen that there is no appreciable variation in the impact properties of the four samples and the average energy absorbed is 4 J. Also from the compression test, it is seen that average ultimate load is 7.4 KN and average compressive strength is 64.4 MPa. This signifies that there is a uniform distribution of the reinforcement fibers and that the fiber-matrix adhesion is uniform at all places.

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