

Experimental Investigation of Tensile Strength of Fiber Reinforced Polyester by Using Chicken Feather Fiber

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ABSTRACT

In this experimental study essentially focused to the tensile and yield strength of composites of different percentage of Pure Jute fiber with Chicken feather fiber. The major participation of these compositions is pure Jute and minor variations created by the Chicken feather fiber on the basis of weight. There are two variations created for the investigation one is based on four different (A, B, C & D) percentage variation of fiber used and on that each percentage of Chicken feather fiber variations based on five different length of fiber (2mm, 4mm, 6mm, 8mm & 10mm) used for the composites. For these different conditions of composite produced and tensile and yield strength measured from testing and compared.

Keywords: *chicken feather fiber, pure jute, fiber composite, tensile strength, yield strength*

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1. INTRODUCTION

Composite material growth has been of enormous concentration to researchers and material engineers ever since man revealed that conventional materials could be combined to obtain specific desirable properties hitherto unobtainable [1]. The speed of technological development in the 21st century has led to a constant demand for innovative composite materials which can meet the unique material property requirements of this new age [2]. Composite materials are at the present broadly used in growing number of commercially significant engineering applications, such as in IC engines, components of machine, thermal power stations, packaging of electronic, automobile, train and aircraft structures and mechanical components, such as brakes, drive shafts, flywheels, tanks, and pressure vessels, piping, automobile springs, offshore structures [3].

The common wastes such as egg shell powders can be added to improve the mechanical properties of the composites [4-6]. When the egg shell powders are added to the fiber, the tensile strength of the developed composite was improved by 18 % and the compressive strength has also increased by 30 %. The powder mixed to form the fiber reinforced composite is 100 μ m at 10 % of weight of composite [7-10]. Delamination and void formation was identified beyond 10 % of reinforcement in composites. The orientation of the fibers can be varied from 0⁰ to 90⁰ in order to improve the mechanical properties of composites. Carbon reinforced composites recorded a increase in tensile strength along with appropriate fiber orientation [8]. FEM analysis was used for simulation of mechanical behavior of the composites and was compared with the experimental values in order to create models for predicting the mechanical behavior of new composites [9]. Hybrid epoxy composites mixed with chicken fiber and rubber in appropriate composition has improved the flexural strength, tensile

strength and the compression strength of the material when compared to the base materials [10-15]. The composites reinforced with chicken fiber barbs had improved tensile strength than the composite made with chicken fiber rachis. The flexural strength was also high for chicken fiber reinforced composites [16-19]. The fiber length has also had great impact in improvement of the mechanical properties of the composited. Taguchi's technique can be used for identifying the best combination of the reinforcement material and its orientation angle for better mechanical properties [20-22]. Glass reinforced composites posted higher impact strength and mechanical characteristics under tension and compression. The elongation characteristics can also be improved by proper reinforcement material and parameters.

2. EXPERIMENTAL PROCEDURE

Pure jute fiber and Chicken feather fiber mixed composite created by hand layup method with three different percentage set through epoxy resin. Set A contains 95% of pure jute fiber and 5% Chicken feather fiber also there are five different length of chicken feather fiber such as 2mm, 4mm, 6mm, 8mm & 10mm contributed in the same percentage level of composite. For percentage set A contains 5 specimens (A1, A2, A3, A4 & A5). Similarly Percentage set B contains 90% of pure jute fiber and 10% Chicken feather (B1, B2, B3, B4 & B5), Percentage set C have 85% of pure jute fiber and 15% Chicken feather (C1, C2, C3, C4 & C5) and Percentage set D have 80% of pure jute fiber and 20% Chicken feather (D1, D2, D3, D4 & D5). The clear details and individual name of the specimen were clearly mentioned in the table 1. All the specimens were prepared as per the standards of the tensile and yield strength testing requirement in the ultimate tensile machine with 5 ton capacity connected with sensors connected

setup to the computer for the accurate measurements. Each specimen tested to measure the tensile strength and yield

strength. The experimental results were created as a graphical representation for the investigation.

Table 1. Complete detail of specimen compositions for the investigation

| Batch | Percentage of Pure Jute | Percentage of Chicken Feather Fiber | Fiber Length In Mm | Specimen Name |
|-------|-------------------------|-------------------------------------|--------------------|---------------|
| A | 95 % | 5 % | 2 | A1 |
| | | | 4 | A2 |
| | | | 6 | A3 |
| | | | 8 | A4 |
| | | | 10 | A5 |
| B | 90% | 10% | 2 | B1 |
| | | | 4 | B2 |
| | | | 6 | B3 |
| | | | 8 | B4 |
| | | | 10 | B5 |
| C | 85% | 15% | 2 | C1 |
| | | | 4 | C2 |
| | | | 6 | C3 |
| | | | 8 | C4 |
| | | | 10 | C5 |
| D | 80% | 20% | 2 | D1 |
| | | | 4 | D2 |
| | | | 6 | D3 |
| | | | 8 | D4 |
| | | | 10 | D5 |

3. RESULTS AND DISCUSSION

Table 2 and Figure 1(a) elaborates the yield strength and tensile strength of the composites that was made with 95 % of pure Jute and 5 % of the fiber. The length of the chicken fiber was varied from 2 mm to 10 mm and the stresses were recorded for 5 samples. The yield stress has increased linearly with the increase in length of chicken fiber. It has proved that longer the length of the fiber, the yield stress increases. As such, the tensile strength of the developed composites also increased with the increase in fiber length. It is noted that, the tensile stress decreased for sample 5 which had the chicken fiber length of 10 mm. The maximum tensile stress was recorded with sample 4 which had 95 % of jute fiber and 5 % of chicken fiber with length 8 mm.

Table 2. Stress behavior of Set A Composites

| Fiber length in mm | Specimen name | Yield strength (MPa) | Tensile strength (MPa) |
|--------------------|---------------|----------------------|------------------------|
| 2 | A1 | 6.7 | 12 |
| 4 | A2 | 8.7 | 13.9 |
| 6 | A3 | 10.25 | 16.25 |
| 8 | A4 | 11.5 | 17.9 |
| 10 | A5 | 12.8 | 15.8 |

Table 3 and Figure 1 (b) represent the stresses generated upon application of load on the composites made of Jute fiber and chicken fibers of varying lengths. It is evident that the average yield and tensile stress of the composites has reduced with the increase in chicken fiber.

It can be seen that there is an increase in yield stress with the increase in fiber length utilized for making the composite upto 6 mm and the remains constant till 8mm fiber length. A sudden increase is observed when the fiber length is further increased. With regard to tensile strength, an increase is observed in linear form up to 4 mm fiber length and increases exponentially beyond that.

Table 4 and Figure 1 (c) shows the tensile behavior of composite made with 85% jute fiber and 15 % of chicken fiber. The stresses induced in the composites have decreased with the increase in chicken fiber fraction. Also, it is noted that with the increase in the fiber length has increased the stress of yielding and tensile. The stress tends to be increasing linearly up to 4 mm fiber length and remains constant for the composites with the chicken fiber length of 6 mm. Beyond 6 mm and till 10 mm fiber length, the stresses tends to increase.

Table 3. Stress behavior of Set B Composites

| Fiber length in mm | Specimen name | Yield strength (MPa) | Tensile strength (MPa) |
|--------------------|---------------|----------------------|------------------------|
| 2 | B1 | 5.8 | 8.9 |
| 4 | B2 | 7.4 | 11.3 |
| 6 | B3 | 8.2 | 12.45 |
| 8 | B4 | 8.4 | 14.1 |
| 10 | B5 | 10.3 | 15 |

Table 4. Stress behavior of Set C Composites

| Fiber length in mm | Specimen name | Yield strength (MPa) | Tensile strength (MPa) |
|--------------------|---------------|----------------------|------------------------|
| 2 | C1 | 3.6 | 5.8 |
| 4 | C2 | 6.1 | 8.7 |
| 6 | C3 | 6.45 | 8.65 |
| 8 | C4 | 7.7 | 10.3 |
| 10 | C5 | 12 | 14.2 |

Table 5. Stress behavior of Set D Composites

| Fiber length in mm | Specimen name | Yield strength (MPa) | Tensile strength (MPa) |
|--------------------|---------------|----------------------|------------------------|
| 2 | D1 | 1.5 | 3.7 |
| 4 | D2 | 3.5 | 6.1 |
| 6 | D3 | 2.65 | 4.85 |
| 8 | D4 | 3.9 | 6.5 |
| 10 | D5 | 11.2 | 13.4 |

The maximum yield strength and tensile stress was obtained with the composite having the maximum fiber length. This is due to the variation in load distribution on the developed composites.

In this composite, the yielding capacity and the tensile behavior were very much similar for different fiber length. As in set 3, the behavior of the composite with 80 % Jute fiber and 20 % chicken fiber was similar in nature with regard to tensile and yield stress. The maximum stresses were recorded for the composite with maximum fiber length. But in set 4, the stresses increased with increase in fiber length upto 4 mm. Further, the stress levels reduced for the composite with 6 mm fiber length and starts increasing beyond that. This may be due uneven distribution of chicken fiber over the composite. Figure 1 (d) and table 5 has recorded the stresses for various fiber lengths. It is evident from Figure 2 that, the tensile stress of developed composites reduces with the increase in chicken fiber content. Set 1 defines shows the tensile strength of the composites with 2 mm fiber length for all compositions. Similarly, the tensile behavior of the composites for all other sets also similar. The maximum average tensile strength was

recorded for 10 mm chicken fiber length added composites. Figure 3 shows that, the yielding stress of developed composites reduces with the increase in chicken fiber content for up to chicken fiber length of 8 mm.

The yield stress behavior of composite with 10 mm fiber length predominantly decreases up to 10 % of chicken fiber addition. But, the yielding capacity of the composite with 15 % addition has increased in comparison with 10 % added composite and again reduces thereafter with the increase in chicken fiber fraction. Again, the average yielding stress is maximum for the composite with 10 mm fiber length. In each and every plot produce the variations of the corresponding values of the experimental results of the testing in different composition condition. For set A maximum the tensile and the yield strength reached for 8 mm length of fiber used, similarly set B, set C and set D reached the maximum tensile and the yield strength obtained for the fiber with 10 mm length. But depended upon the percentage of fiber used preposition the maximum tensile and yield strength obtained for the 90 % of pure Jute fiber with 10% of Chicken feather fiber used composites.

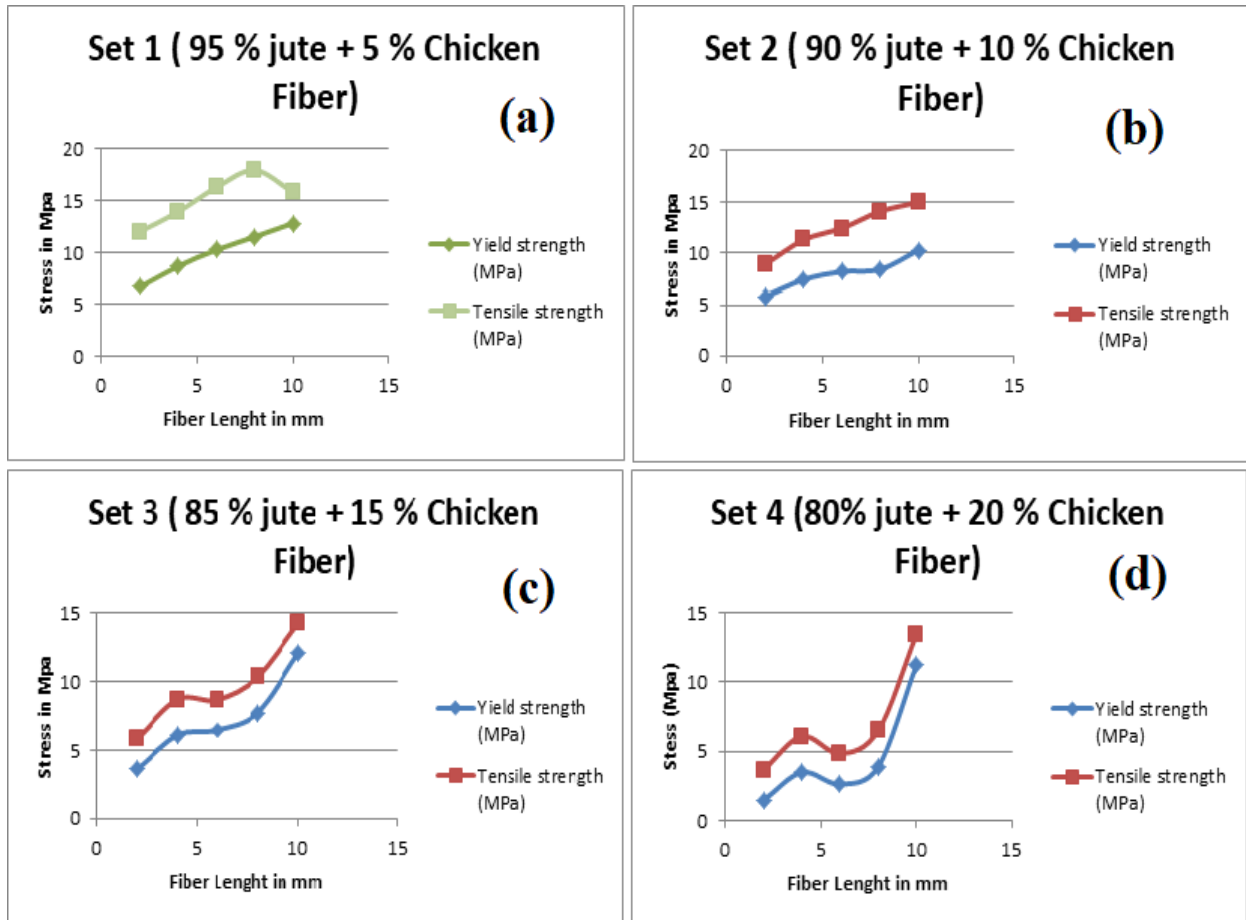


Figure 1. Tensile strength and Yielding capacity of developed composites with varying chicken fiber length

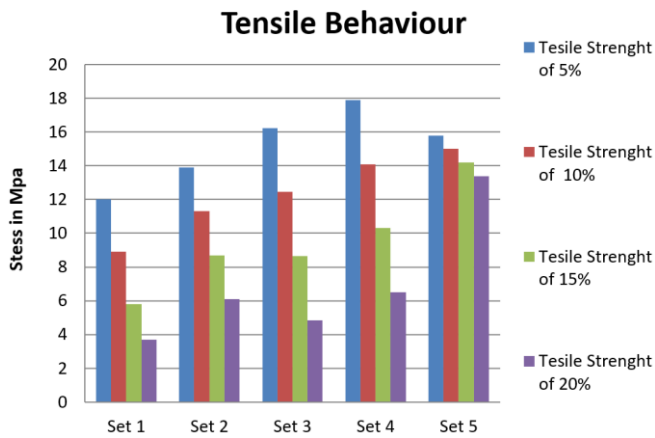


Figure 2. Tensile Behaviour

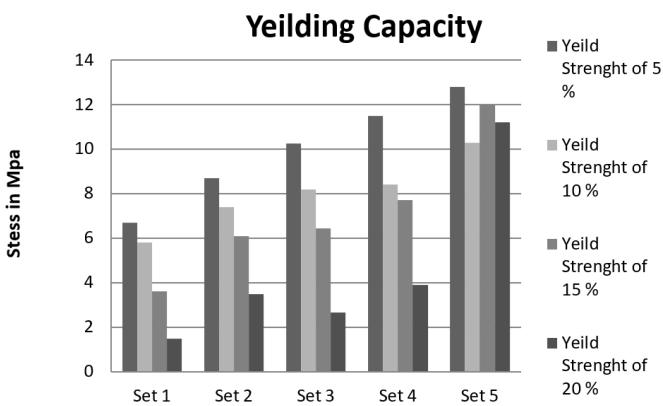


Figure 3. Yielding Capacity

4. CONCLUSION

From this experimental study of the tensile and the yield strength analysis on composites of pure jute fiber with Chicken feather fiber, the following conclusions are given:

(1) Percentage variations of Chicken feather fiber produce considerable impact on the tensile strength as well as the yield strength.

(2) In Set A compositions meet the maximum tensile and yield strength for 8 mm length of chicken feather fiber used in jute fiber.

(3) Chicken feather fiber with length of 10 mm produce the upper most tensile strength and yield strength for the set B, set C and set D when compared to other lengths.

(4) Among these four set of percentage variation composites greatest tensile strength reached for Set A which contains 95 % of pure Jute fiber and 5 % of Chicken feather fiber.

(5) Between these four set of percentage dissimilarity composites, Set A which contains 95 % of pure Jute fiber and 5 % of Chicken feather fiber accomplished the furthestmost yield strength.

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