

Mechanical Behavior of Aloe Vera, Tailor Waste and Jute Fiber Reinforced Polymer Matrix Hybrid Composites

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Abstract - The new era beginning by changing the existing traditional materials with hybrid composite materials due to its excellent characteristics like more strength to weight ratio, high tensile strength, low thermal expansion. The new-fangled materials are being developed and are their usages increasing rapidly now days. Hybrid polymer composites become additional impressive due to their high specific strength, lightweight and biodegradability. Integration of Aloe Vera, Tailor Waste and Natural Jute fiber is suitable for various industrial, domestic applications at present. To meet the demand of industry it is necessary to develop or fabricate such materials. In this connection in our study we would like to evaluate the mechanical properties like tensile strength, and flexural strength. The results obtained from the adaptation of Aloe Vera, Tailor Waste and Natural Jute got better properties and this material can be used as an alternative material for Polymer composites.

Key Words: Hybrid composites, Polymer–matrix composites (PMCs), Mechanical properties, Aloe Vera, Tailor Waste and Natural Jute.

1. INTRODUCTION

Utilization of Engineering Materials for various application in both Industry as well as domestic purpose is increasing rapidly with respect to durability, strength to weight ratio, along with enhanced properties in an economic manner. The use of natural fibers is upgraded strangely due to the fact that the field of application is amended day by day particularly in automotive industries. Ashok kumar et al developed sisal-glass fibers into epoxy matrix for fabricating epoxy based hybrid composites(1). Ramesh et al focused on sis-ju-glass fiber in polyester composite and evaluated the mechanical properties along with inside cracks and inside structure of fracture surface using SEM (2). Ishak et al states that Kenaf fibre has more stable to be used for composite material which is made up of an central woody core and an outer stringy bark surrounding the core. (3). Pereira et al reviewed that the vegetable fibres are to be developed which are growing to lessen the impact on environment in order to get sustainability.(4). Herrera et al reviews the fragmentation and microdebond/micro-indentation in composite materials (5)Materials and Methods.

1.1 Reinforcement Material

Raw materials used in this experimental work are:

- Aloevera
- Tailor waste
- Natural Jute fiber

Aloe Vera

Aloe Vera, from Liliaceae family, Aloe Vera Fibers are in less in weight, sturdy, and healthy material used in various industries due to their splendid properties. Nowadays, due to its medical importance, this plant, which is native to south and eastern coasts of Africa, is being cultivated in several countries throughout the world.

Tailor Waste

The mode and extent of damages inflicted upon cotton fibers by mechanical actions during cotton ginning and the subsequent textile manufacturing processes have long been speculated but have not been carefully studied in the past. Investigations on this important issue is unsuccessful due to lack of means for testing the tensile properties of cotton fibers before and after each stage of process.



Fig. 1. a) Raw form of Aloe Vera (b) Extraction of Aloe Vera (c) Tailor waste (d) Jute fiber

Three Sample specimens fabricated by considering the following percentage of fibers

Table 1. shows composition of materials

S no	Aloevera (gm)	Tailor waste (gm)	Jute (gm)	Resin (ml)	Hardener (ml)
1	10	11	9	60	10
2	15	6	9	60	10
3	20	5	5	60	10

2. EXPERIMENTAL TESTING

Authors followed the basic manufacturing process of composites of Hand layup Method as fabrication of hybrid composites by preparing three specimens of varying in composition of constituents of reinforced material boded with matrix material using glass mould .These specimens are tested experimentally to identify the properties of each specimen having size of 100x20x3 mm with respect to tensile, flexural strengths on Universal Testing Machine. The impact response in Aloe vera, Tailor Waste and Natural jute composites reflects a failure process involving crack initiation and growth in the resin matrix, fiber breakage.

3. RESULTS AND DISCUSSION

3.1 Tensile Test specimens:

In this the outcomes of the experiments performed for the evaluation of respective tests are given bellow



Fig. 2. Shows Dog bone shape Specimens for tensile

Table 2. composition of specimens and results of tensile test

S.NO	Specimen	Tensile test (Mpa)
1	a-10,j-9,t-11 (Specimen-1)	22.6
2	a-15,j-9,t-6 (Specimen-2)	32.95
3	a-20,j-5,t-5 (Specimen-3)	28.28



Fig. 3. Tensile Stress of 3 Specimens

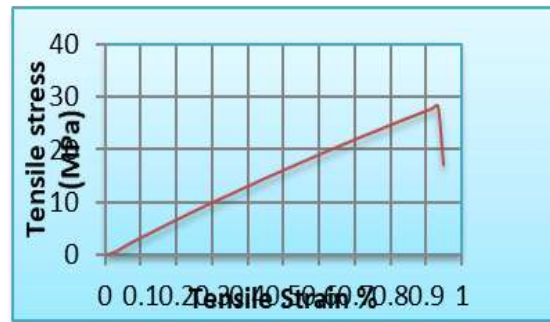


Fig. 4. stress strain diagram for Specimen 1

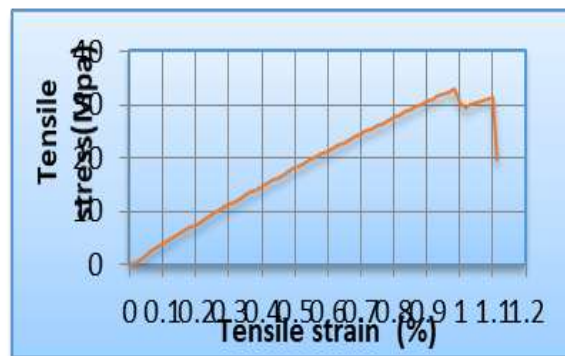


Fig 5: stress strain diagram for Specimen 2

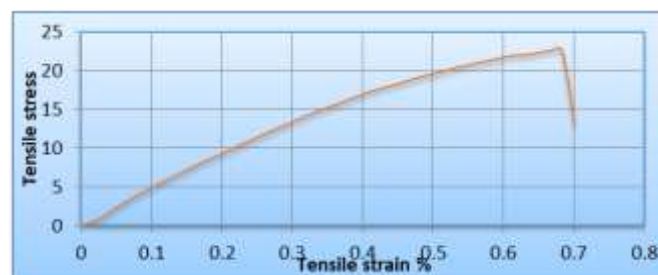


Fig. 6: stress strain diagram for Specimen no -3

Inference: From the above graph between tensile stress and tensile strain as it shows that tensile stress is increased with increase of tensile strain and maximum tensile stress at 28.28 Mpa and tensile strain at 0.93 %. The deformation starts at 0.91% for specimen 1 and tensile stress is increased with increase of tensile strain and maximum tensile stress at 32.95 Mpa and tensile strain at 1.1 %. The deformation starts at 0.983% for specimen 2 and also found that tensile stress is increased with increase of tensile strain and maximum tensile stress at 32.95 Mpa and tensile strain at 0.71 %. The deformation starts at 0.683% for specimen 3

3.2 Flexural Test specimens



Fig. 5. Flexural Stress of 3 Specimens

Table 3. composition of specimens of Flexural test

S.NO	Specimen	Flexural test (Mpa)
1	a-10,j-9,t-11 (Specimen-1)	71.97
2	a-15, j-9, t-6 (Specimen-2)	51
3	a-20, j-5, t-5(Specimen-3)	78.311

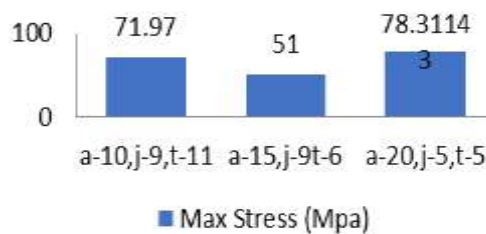


Fig. 6. Shows flat shape specimens

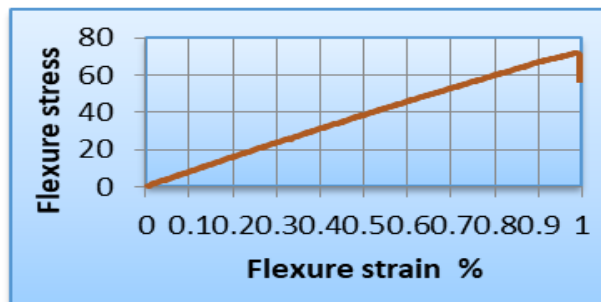


Fig. 7. stress strain diagram for Specimen 1



Fig 8:- stress strain diagram for Specimen 2

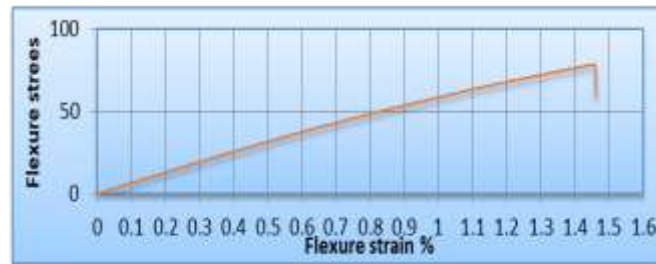


Fig. 9. stress strain diagram for Specimen no -3

Inference: From the above graph between flexure stress and flexure strain as it shows that flexure stress is increased with increase of flexure strain and maximum flexure stress at 71.97 and flexure strain at 0.99%. The deformation starts at 0.98%. for specimen 1 and flexure stress is increase with increase of flexure strain and maximum flexure stress at 51 and flexure strain at 0.96%. The deformation starts at 0.93%.for specimen 2 and also found that flexure stress is increase with increase of flexure strain and maximum flexure stress at 78.31 and flexure strain at 1.46%. The deformation starts at 1.45%.

4. CONCLUSION

The experimental investigation of hybrid composites consisting of Aloe Vera, jute and tailor waste reinforced polyester was done according to ASTM standards. Tensile, Impact test and flexural tests were conducted on three specimens.

4.1 CONSOLIDATED RESULT TABLE FOR ALL 3 SPECIMENS

Table 4. composition of specimens and results of 3 specimens

S.NO	Specimen	Tensile test (Mpa)	Flexural test (Mpa)
1	a-10, j-9, t -11 (Specimen-1)	22.6	71.97
2	a-10, j-9, t -11 (Specimen-2)	32.95	51
3	a-20, j-5, t -5 (Specimen-3)	28.28	78.311

The following explanations were made:

- ❖ The strength of the composites increased as fiber volume percentage increased for all the specimens.
- ❖ Maximum tensile strength is 32.95MPa.
- ❖ Maximum flexural strength is 78.311Mpa.
- ❖ Maximum flexural modulus is 7967.59Mpa
- ❖ As per the above maximum values the combination of percentage of aloevera (10g) and jute (9g) fiber and tailor waste (11g) i.e. Specimen-I is best suitable.

REFERENCES

[1] Ashok Kumar, M., Ramachandra Reddy, G., Siva Bharathi, Y., Venkata Naidu, S., & Naga Prasad Naidu, V. (2010). Frictional coefficient, hardness, impact strength, and chemical resistance of reinforced sisal-glass fiber epoxy hybrid composites. Journal of Composite Materials. <https://doi.org/10.1177/0021998310371551>

- [2] Ramesh, M., Palanikumar, K., & Reddy, K. H. (2013). Composites Part B: Engineering. <https://doi.org/10.1016/j.compositesb.2012.12.004>
- [3] Ishak, M. R., Leman, Z., Sapuan, S. M., Edeerozey, A. M. M., & Othman, I. S. (2010). IOP Conference Series: Materials Science and Engineering. <https://doi.org/10.1088/1757-899X/11/1/012006>
- [4] Pereira, P. H. F., Rosa, M. de F., Cioffi, M. O. H., Benini, K. C. C. de C., Milanese, A. C., Voorwald, H. J. C., ... Mulinari, D. R. (2015). Vegetal Polímeros. <https://doi.org/10.1590/0104-1428.1722>
- [5] Herrera-Franco, P. J., & Drzal, L. T. (1992). Composites. [https://doi.org/10.1016/0010-4361\(92\)90282-Y](https://doi.org/10.1016/0010-4361(92)90282-Y)

BIOGRAPHIES



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