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Investigation of Mechanical Behavior of Bagasse (Sugarcane) - Aloevera as Hybrid Natural Fibre Composites

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Abstract: Natural fibres have attracted the researchers for their low cost, ease of availability, high tensile strength, low thermal expansion, high strength to weight ratio and bio-degradability. The present work aims at developing hybrid natural fibres based polymer composite material. The reinforcement used are powdered aleovera and sugarcane bagasse with epoxy resin as a matrix. The specimens were prepared by changing volume fraction and were tested for mechanical properties such as tensile, flextural and impact energy. The composite consisting of 35% vol. of aloevera and sugarcane bagasse has shown the maximum tensile strength (16.412 N/mm^2) as compared with 40% vol. of aloevera and sugarcane bagasse (11.213 N/mm^2), 30% vol. of aloevera and sugarcane bagasse (14.332 N/mm^2) and 25% vol. of aloevera and sugarcane bagasse (15.431 N/mm^2). The flexural strength was found to be higher in case of 25% vol. of aloevera and sugarcane bagasse (38.548 MPa) as compared with 40% vol. of aloevera and sugarcane bagasse (33.524 MPa), 35% vol. of aloevera and sugarcane bagasse (29.76 MPa) and 30% vol. of aloevera and sugarcane bagasse (30.157 MPa). The impact energy in case of 25% vol. of aloevera and sugarcane bagasse (0.35 J) is found to be higher than 35% vol. of aloevera and sugarcane bagasse (0.30 J), 40% vol. of aloevera and sugarcane bagasse (0.25 J) and 30% vol. of aloevera and sugarcane bagasse (0.20 J). The present result would be helpful in developing new natural hybrid composites.

Keywords: Sugarcane bagasse, aloevera, epoxy resin, mechanical properties, natural fiber hybrid composite.

I. INTRODUCTION TO HYBRID COMPOSITE

Hybrid composites are more advanced composites as compared to conventional FRP composites. Hybrids can have more than one reinforcing phase and a single matrix phase or single reinforcing phase with multiple matrix phases or multiple reinforcing and multiple matrix phases. They have better flexibility as compared to other fiber reinforced composites. Normally it contains a high modulus fiber with low modulus fiber. The high-modulus fiber provides the stiffness and load bearing qualities, whereas the low-modulus fiber makes the composite more damage tolerant and keeps the material cost low. The mechanical properties of a hybrid composite can be varied by changing volume ratio and stacking sequence of different plies. Composites are used not only for their structural properties, but also for electrical, thermal, tribological and environmental applications. The production of natural fibers however, can be carried out by manpower and traditional know-how. In those countries, like in South East Asia and Africa where natural fibers can be grown fast and at low cost, the material resource is in own hands. The transfer projects will be more readily financed and local entrepreneurs will be more willing to implement the generated knowledge in the society. In addition, the already existing tendency of clustering will results in a reduction in overhead costs.

II. RAW MATERIAL

A. Sugarcane Bagasse Fiber

The sugar cane bagasse is a residue widely generated in high proportions in the agro-industry. It is a fibrous residue of cane stalks left over after the crushing and extraction of juice from the sugar cane. Bagasse is generally gray-yellow to pale green in colour. It is bulky and quite non uniform in particle size. The sugar cane residue bagasse is an underutilized, renewable agricultural material.

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Fig 1 : Bagasse fiber   Fig 2: Sugarcane raw material

Above fig 1 and 2 shows sugarcane fiber as raw material and the fig 1 shows , after the fiber was crushed.

B. Aloevera

The plants look like giant pineapples, see figure 3 and during harvest the leaves are cut as close to the ground as possible. The soft tissue is scraped from the fibers by hand or machine. The fibers are dried and brushes remove the remaining dirt, resulting in a clean fiber. Aloevera produces sturdy and strong fibers that are very well resistant against moist and heat. It is mainly used for ropes, mats, carpets and cement reinforcement.

 

Fig 3 : Aloevera plant   Fig 4 : Aloevera fiber

The fig 3 and 4 shows aloevera plant and the powdered aloevera plant.

C. Epoxy Resin

Epoxy resins are the most commonly used thermosetting plastics in polymer matrix composites. Mechanical properties of epoxy resin are at a density of 1.1 - 1.4kg/m, Elastic modules of 3 - 6GPa, Tensile strength of 35-100MPa, Elongation at break of 1 - 6%.
The Epoxy resin having the following outstanding properties.
Excellent adhesion to different materials
Great strength, toughness resistance, Odorless, & completely non toxic.
Excellent resistance to chemical attack and to moisture
Excellent mechanical and electrical properties.

D. Hardener

In the present work Hardener HY 951 is used. This has a viscosity of 10-20 poise at 250C.

III. FABRICATION OF COMPOSITE FIBER

A. Alkaline Treatment

Alkaline treatment or mercerization is one of the most used chemical treatments of natural fibers when used to reinforce thermoplastics and thermosets. The important modification done by alkaline treatment is the disruption of hydrogen bonding in the network structure, thereby increasing surface roughness. Addition of aqueous sodium hydroxide (NaOH) to natural fiber promotes the ionization of the hydroxyl group to the alkoxide as shown in fig 5.

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Sample No.	Aloevera Fiber (vol)%	Sugarcane bagasse (vol)%	Epoxy resin (vol)%
1	20	20	60
2	17.5	17.5	65
3	15	15	70
4	12.5	12.5	75

Table 1 - concentration of sample preparation

Fig 5: Alkaline treatment of natural fiber

Fiber – OH + NaOH → Fiber – O – Na +H_2O

B. Polymer - Hardener Mixture Preparation

For the making of good composite the measurement of the samples should be accurate and the mixture should be very uniform. We take accurate amount of polymer which we have calculated earlier and 10% of its hardener. Then this mixture is stirred thoroughly till it becomes a bit warm. Bit extra amount of hardener is taken for the wastage in the process. Hardener should taken very minutely because little extra amount of hardener can spoil the composite.

C. Sample Preparation Technique

The composites sheets were fabricated from aloevera and sugarcane bagasse fiber, with resin matrix. The resin used was epoxy resin. The volume fraction of composites was maintained at 25%, 30%, 35%, 40% fiber and 60% resin. After the hybrid composites fabrication cutting of the specimen is done in the desired shape to test the mechanical properties of the natural hybrid composite fiber.

IV. EXPERIMENT PROCEDURES

A. Tensile Test

The tensile strength of a material is the maximum amount of tensile stress that it can take before failure. The commonly used specimen for tensile test is the dog-bone type. During the test a uniaxial load is applied through both the ends of the specimen. The dimension of specimen is (250*25*3) mm as per ASTM from fig - 6, the specimen for the test from fig 8 is mounted on the machine and the fig 9 shows the broken piece after testing. Typical points of interest when testing a material include: ultimate tensile strength (UTS) or peak stress; offset yield strength (OYS) which represents a point just beyond the onset of permanent deformation; and the rupture (R) or fracture point where the specimen separates into pieces by machine as shown in fig - 7.

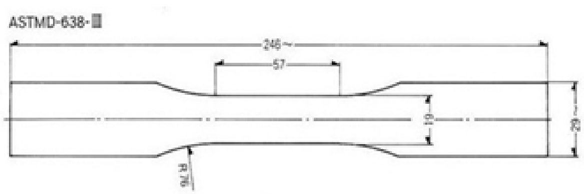

Fig 6 - Dimension of the tensile test specimen

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Fig 7 - UTM machine

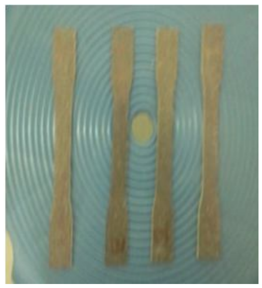

Fig 8 - Tensile test specimen

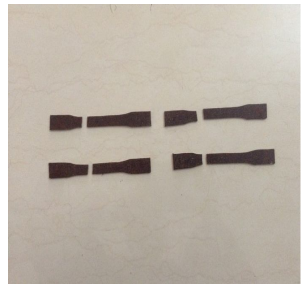

Fig 9 - Tensile test specimen after test

B. Flexural Test

The flexure test method measures behavior of materials subjected to simple beam loading. It is also called a transverse beam test with some materials. Most commonly the specimen lies on a support span and the load is applied to the center by the loading nose producing three point bending at a specified rate. The parameters for this test are the support span, the speed of the loading, and the maximum deflection for the test. These parameters are based on Flexural test specimen was cut into 130*13*3 (ASTM D 790) procedure as shown in fig - 11 & 12. In the fig 10 we can see the flexural test machine.

Fig 10 - Flexural test machine

Fig 11 - Flexural test specimen

Fig 12 - Flexural test specimen after test

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C. Impact Test

The impact test is a method for evaluating the toughness and notch sensitivity of engineering materials. It is usually used to test the toughness of metals, but similar tests are used for polymers, ceramics and composites. Izod Impact test specimen is machined to a square or round section, with either one, two or three notches. The Impact test specimen was cut into: izod 66*13*3(ASTM D 256), which is clamped vertically on the anvil with the notch facing the Hammer.

Fig 13 - Impact test machine

Fig 14 - Impact test specimen

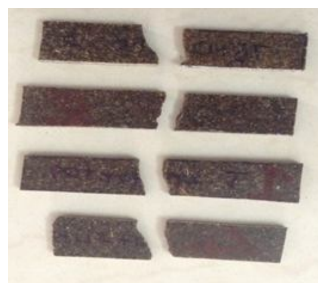

Fig 15 - Impact test specimen after test

V. RESULT AND CONCLUSION

A. Tensile Test Result

Tensile test was also carried out on UTM machine in accordance with ASTM D638 II standard. All the specimens were of dog bone shape of dimension (250x25x3.2) mm. The results were tabulated in the table 2.

Sample No.	Cs Area mm^2	Peak load N/mm^2	Elongation %	UTS N/mm^2
1	39.00	437.370	1.520	11.213
2	39.00	640.201	2.360	16.412
3	39.00	558.974	1.960	14.332
4	39.00	601.824	1.780	15.431

Table.2 - Tensile test results

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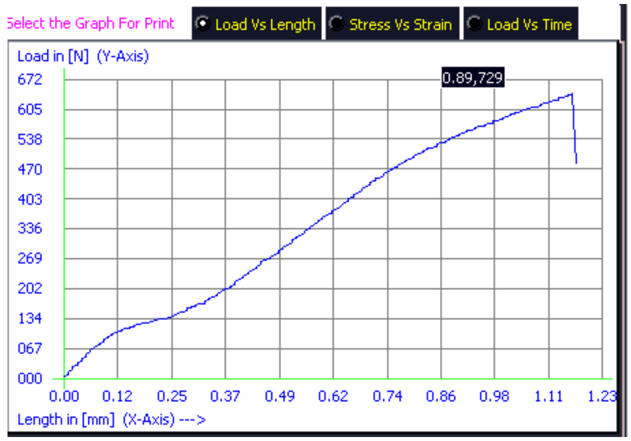


Graph 1 - Tensile test results

From graph - 1, sample 02 , is considerable increase of tensile strength as the percentage of fiber increases to a maximum of 40% and then the strength decreases. The maximum Tensile strength of 2.36MPa is obtained for 35% fiber reinforcement.

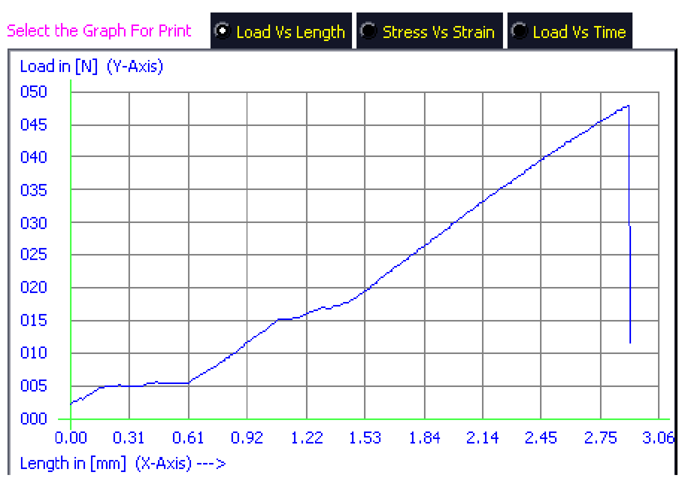
B. Flexural Test Result

Flexural test was also carried out on UTM machine in accordance with ASTM D790 standard. All the specimens were cut into (130x13x3.2) mm. The results were tabulated in the table 3.

Sample No.	Cs Area mm²	Peak load N/mm²	Flexural strength MPa	Flexural modulus GPa
1	39.00	41.506	33.524	2749.805
2	39.00	38.846	29.760	2426.204
3	39.00	37.337	30.157	2316.319
4	39.00	47.726	38.548	1576.504

Table 3 - Flexural test result

In the graph 2, we can clearly see that 25% volume ratio aloevera fiber with sugarcane and Epoxy resin flexural strength value is high (38.548 Mpa) when compared to other volume ratios.



Graph 2 - Flexural test results

C. Impact Test Result

Impact test was also carried out on impact testing machine in accordance with ASTM D256 standard. All the specimen was cut into: izod 66*13*3mm. The results were tabulated in the table 4.

Sample No.	Fiber %	Impact Value (j)
1	40	0.25
2	35	0.30
3	30	0.20
4	25	0.35

Table 4 - Impact test result

we can clearly understand that fiber with 12.5%sugarcane and 12.5% aloevera has more impact value when compared with other volume ratios. The 25% fiber has a maximum impact value of 0.35J.

REFERENCES

[1] A.K. Rana, A. Mandal, B.C. Mitra, R. Jacobson, R. Rowell, A. N.Banerjee(1998)"ShortJute Fiber - Reinforced Polypropylene Composites: Effect of Compatibilizer" Journal of Applied Polymer Science, Vol. 69, 329-338 .

[2] A. N. Shah and S. C. Lakkad(1981), Mechanical Properties of Jute-Reinforced Plastics, Fiber Science and Technology 15, 41, 46.

[3] BC Ray Loading Rate Sensitivity of Glass Fiber-epoxy Composite at Ambient and Sub-ambient Temperatures Department of Metallurgical and Materials Engineering, National Institute of Technology, Rourkela

[4] Berghezan,A.Nucleus(1966)8(5) ,(Nucleus A Editeur,1,rhe,Chalgrin,Paris, 16(e).

[5] D. Ray, B.K. Sarkara, A.K. Rana, N.R. Bose (2001) "The mechanical properties of vinylester resin matrix composites reinforced with alkali-treated jute fibers" Part A 32 119–127

[6] Hassan M.L., Rowell R.M., Fadl N.A., Yacoub S.F. and Chrisainsen A.W. (2000) "Thermo plasticization of Bagasse. I.Preparation and Characterization of Esterified Bagasse Fibers." Journal of applied polymer science, Volume 76, p. 561- 574.

[7] Jartiz (1965) A.E., Design, p.18.

[8] Kelly (1967) A. Sci. American 217, (B), p. 161.

[9] Mohd Suhairil Meon, Muhamad Fauzi Othman. (2012) "Improving tensile properties of kenaf fibers treated with sodium hydroxide".Elsevier,

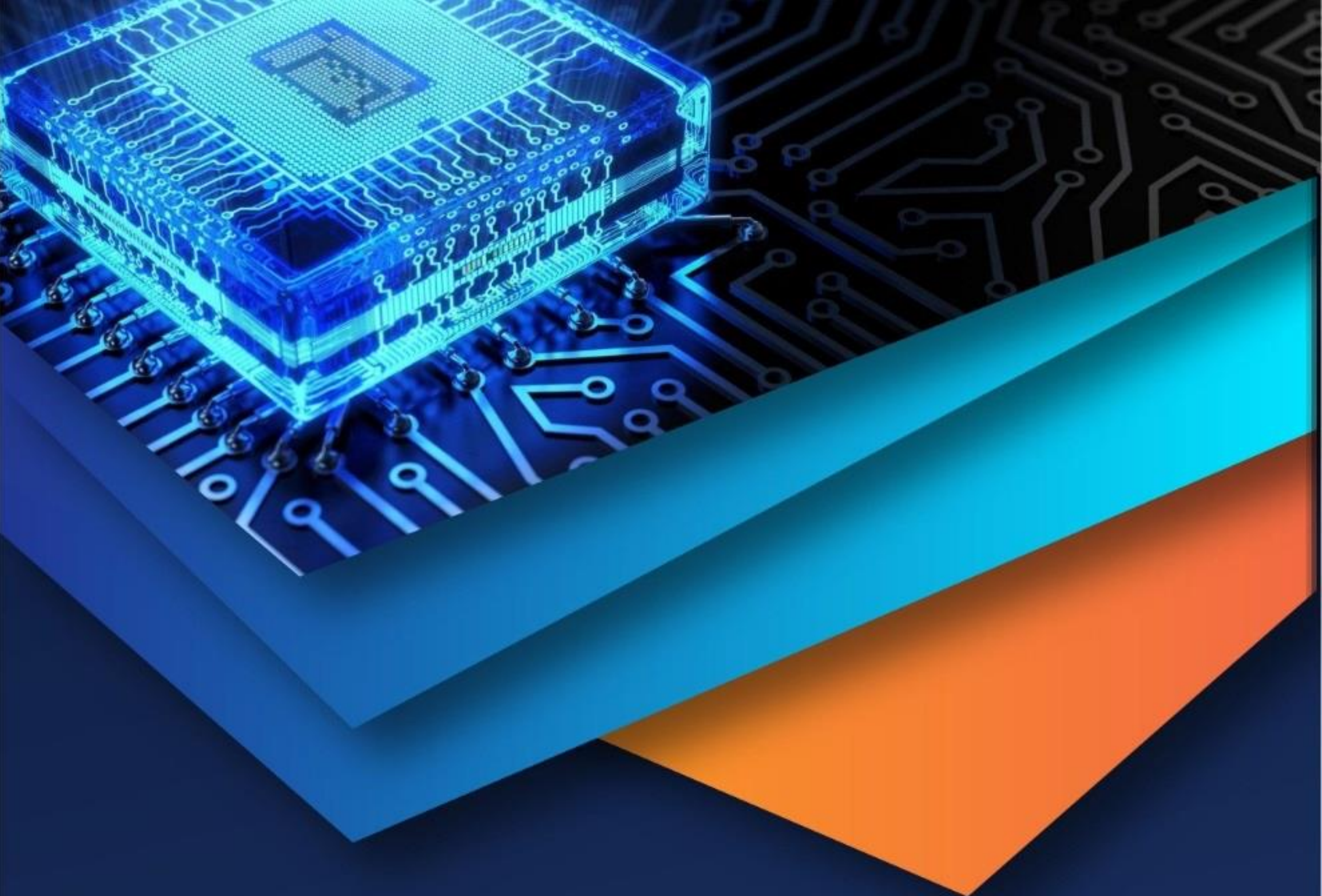
[10] Monteiro S.N.; Rodriquez R.J.S.; De Souza M.V., D'Almeida J.R.M. (December 1998) "Sugar Cane Bagasse Waste as Reinforcement in Low Cost Composites" Advanced performance Material, Volume 5, No.3, p. 183-191.

[11] N.Venkateshwaran, A. Elayaperumal,G.K. Sathiya. Aug2011 "Prediction of tensile properties of hybrid-natural fiber composites"Elsevier,

[12] Suchetclan Van, Philips Res. Repts. (1972) Volume 27, p. 28

[13] S.V.Joshi,L.T.Drzal,A.K.Mohanty,S.Arora (2001) "The mechanical properties of vinylester resin matrix composites reinforced with alkali-treated jute fibers" Part A 32 119–127.

[14] Yan Li , Chunjing Hu, Yehong Yu (2008) "Interfacial studies of sisal fiber reinforced high density polyethylene (HDPE) composites" Part A 39 570–578.



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