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Micro structural and Mechanical properties of Agave Americana L. Fiber and Silk Hybrid Fiber Composite Material

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Abstract: ***The fiber reinforced polymer composites are the most used accepted materials; they are useful in the present days as an alternative to the metals. Because of their low cost and high specific strength, low weight and less concerned to the environment, they became more attracted globally. The natural fibers such as Agave Americana with Silk fiber hybrid composites are used in the proportion of 1:1 has been incorporated with unsaturated polyester resin. The effect of fiber at (0, 15, 25, 35 and 45 wt. %) samples are studied. In the project work a hand lay-up method were utilized for preparing the composites. Agave Americana are treat with NaOH fallowed by Hcl acid. And the consequences of alkali behavior on the tensile and compressive properties are going to be studied. Major development of tensile and compressive strengths of the Agave/silk hybrid composites have been observed for various treatments.***

Keywords: Composite materials, Agave Americana L. fiber, Silk hybrid fiber.

I. INTRODUCTION

Fiber based polymer such as reinforced (FRP) is a best composite material prepared by polymer based matrix material reinforced by fibers. The fibers generally are made up of glass, carbon, aramid, or basalt based one. Further fibres based as paper, wood, or asbestos had been used. The polymer is generally such as epoxy, vinylester, or polyester thermosetting plastic, although phenol formaldehyde resins. In earlier period composites made of fiber of coconut or easily available rubber latex are widely used by the automotive industries. Anyhow, during the past decade of eighties centuries, newly created synthetic type of fibers due to better action, had sequently substituted cellulose fibers. In recent year, large interest while using these types of fibers as reinforcement has been grown, in the plastic based factories. The increasing cost of plastics has caused an demand for the natural based renewable and biodegradable materials [2]. Chen and Sun [8] had observed the impact results of composite based laminates using initial stresses by finite model. The Obtained deflections are shown little for normal cases and normal material structural design. While, deflections formed are complex architectures are measured. Finite element is important to calculate the strength of a natural composite. The finite model is used to calculate woven made composites under various loading points [9] failures based under combination of tensile and twisting load are studied. It is observed the failure occurrence is at maximum bending. Several researchers had seen, the strength of the natural composites can be enhanced by treating the fiber suitably. Herrera-Franco and Valadez-Gonzalez [10] has seen, improved properties of the fiber laminates using saline and matrix-resin treatment during which properties are unchanged. The mechanical properties of composites prepared by impregnation and hot curing methods are studied by Dash et al. bleached fibers has shown better mechanical properties for weight showed better for unbleached fibers. Alwar [11] noticed the properties of date palm fiber subjected to different types of treatment processes. For about 1% of NaOH treatment showed betterment in mechanical properties while HCl treatment showed worse properties.

II. EXPERIMENTAL METHOD

A. *Materials*

Agave fibres is an Exotic plant. poised mainly of the plant materials plant fibre. fibres extraction is carried by biological or chemical retting method. The fibers are created to Yellow, and 65.2cm and mean diameter 0.15 mm, The fibre contained quality of about 3.2g/d when dry and 2.8g/d while wet. Commonly fibres are made of hydrophilic in nature for A. Americana fibre . having a moisture recover of 9.99% and wet of 9.20%. Spun based fibres, dyes and samples are prepared. The fiber have seen separated while they subject to acid and alkalis, and were resistant to weak acids and alkalis.

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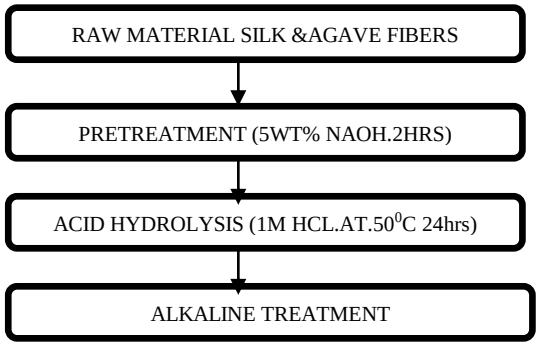

Figure 1: Flow chart for Experimental method.

Figure 2: composite Specimen sample

Generally Silk is composed of mammal fiber and named as protein based fiber. As silk is one of the natural fiber which is noticed in filament type. Fibroin one of the main chemical constituent of silk. The wet per strength of silk 76-86% is about greater than dry strength. Specific gravity is about 1.25 to 1.34. Silk is unaffected for prolonged period at.140^0 C.

B. *Alkali treatment*

Fibers of weight *15, 25, 35 and 45 %*, are efficiently soaked by 5 wt. % NaOH. Fibers are soaked NaOH solution for about 2hr followed by acid Hydrolysis Hcl at 50°C and washed by distilled water until the pH becomes normal. Fibers are cleaned many times with water to take away unwanted alkali stick over the surface, neutralized with mixed acetic acid and washed again with water. At last dried in an open air

C. *Creation of composites samples*

An wood shaped board of 300 * 300 mm had chosen, with wood based patterns of thickness about 6 mm were mounted on wood shape boards with the help of clamps. The wood patterns were placed so that a gap of 150 mm, 15 mm, and 5 mm were obtained. The composite materials are fabricated by GFRP layers method. GFRP structured by up and down on specimen and consequent midway layers are packed by natural fibers. The specimen moulds of desired dimensions are prepared, wax and hardener is mixed with epoxy and applied over the sides of moulds as to extract easily from mould wall. So matrix solution is prepared. The epoxy and the hardener ratio are maintained at ratio of about 10:1. The required number of fibers are arranged in a way that epoxy mixture completely spreads above the fibers such that first layer of moulded part full with the epoxy resin with hardener mixture. Yet, epoxy mixture is equally distributed over the fiber. A such result, the first and last layers were prepared of epoxy resin. At this type three type of layers of woven roving were inserted one over the another in a series to get top and bottom layers. A curative period time for about 2–5h is chosen for the first and last structures to get superior strength and bounding.

III. MECHANICAL TESTS

Test samples plates to be obtained were cut from the composites as per ASTM standard.

A. *Impact test*

The samples are equipped and tested for impact test according to the ASTM-A370 standard. While testing, the specimen is loaded over the testing machine and make the pendulum to break. While over the impact test, the impact typed force required to crack the sample can be calculated easily to measure the toughness and yield strength. The result and ductility of the sample are studied by means of the impact test.

IV. RESULTS AND DISCUSSION

At the present studies of fibers were prepared and obtained result on tension and, impact properties are evaluated and compared.

Table 1: Results based on Tension testing of Agave fiber and Silk hybrid composite.

Specimen by Weight percentage (Agave fiber + silk hybrid composite)	Maximum Load (KN)	Tensile extension at Maximum Load (mm)	Tensile stress at Maximum Load (MPa)	Modulus (Automatic Youngs) (GPa)
15 % wt	300.00	2.875	12.874	4.253
25 % wt	300.00	1.654	11.985	3.476
35 % wt	300.00	1.262	9.435	2.584
45 % wt	300.00	0.146	7.129	1.985
Mean	300	1.484	10.35	3.074

Table 2: : Results based on Impact testing of Agave fiber and silk hybrid composite.

Sample by Weight percentage (Agave fiber + silk hybrid composite)	Maximum Load (KN)	Tensile extension at Maximum Load (mm)	Tensile stress at Maximum Load (MPa)	Modulus (Automatic Youngs) (GPa)
15 % wt	300.00	1.653	10.244	4.735
25 % wt	300.00	2.984	9.283	3.833
35 % wt	300.00	3.162	7.835	2.162
45 % wt	300.00	4.542	7.523	1.243
Mean	300	3.085	8.721	2.993

V. GRAPHS

A. *Tension properties*

The specimen made to be tested at the UTM and result stress-strain graph is plotted. The graph output form the machine stress -strain are shown in Figure 3

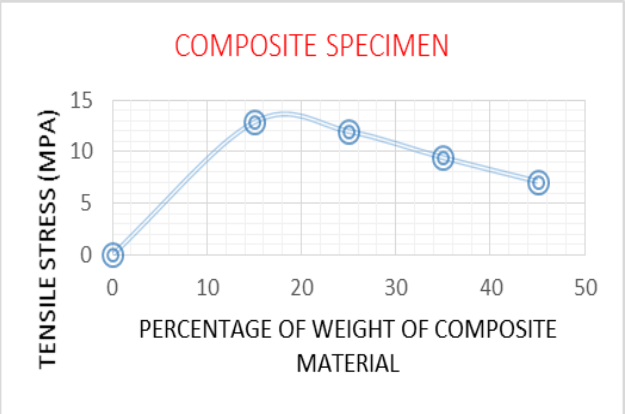

Figure 3: Results of Tensile stress for Agave fiber and Silk fiber

B. *Impact properties*

The impact properties of specimen samples are carried out. The impact test is done by Izod impact machine.

The impact force on Agave and silk composites shown crack at the starting and results bigger into the breakage, and fiber pullout as shown in fig 4.

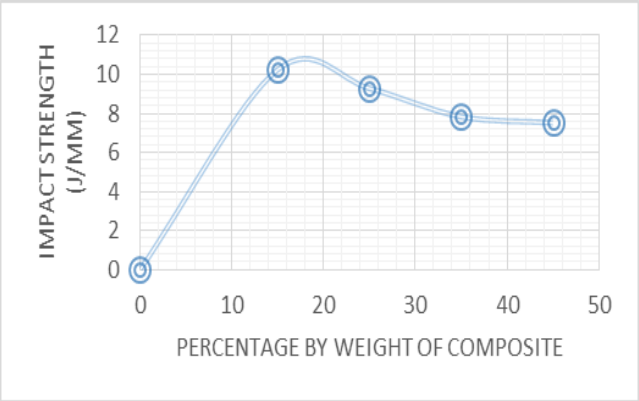

Figure 4: Results based by Impact stress for Agave fiber and Silk fiber

VI. SCANNING ELECTRON MICROSCOPY ANALYSIS

The SEM of composites prepared by Agave and silk sample is well studied using SEM. The SEM picture of the samples is presented in Fig 5 to 9. The origin of fracture takes place over the sample by the adding of load. The under figures shows the fiber fracture of the specimen.

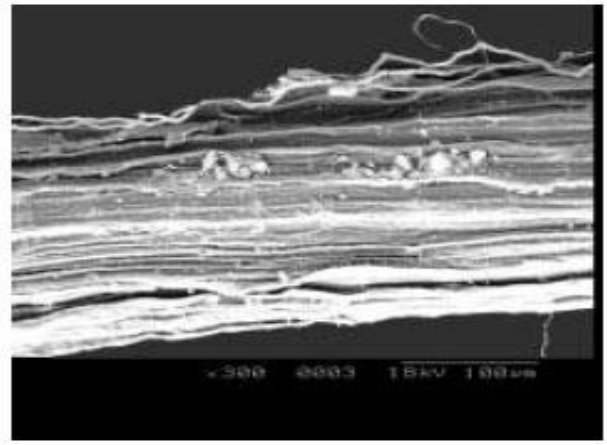

Figure 5: SEM image of fiber composite before tests

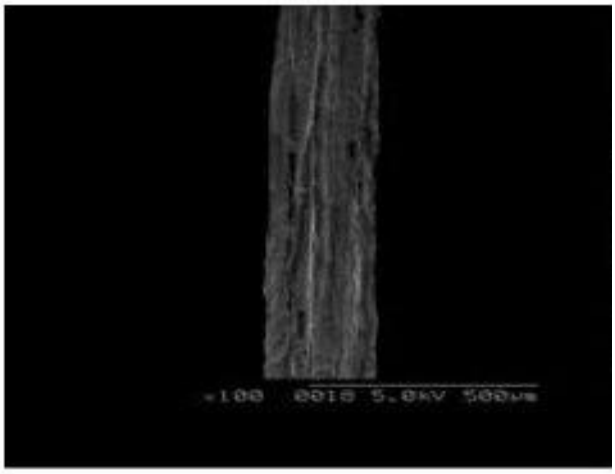

Figure 6: Result from SEM image of about 15 % wt of fiber composite after tests

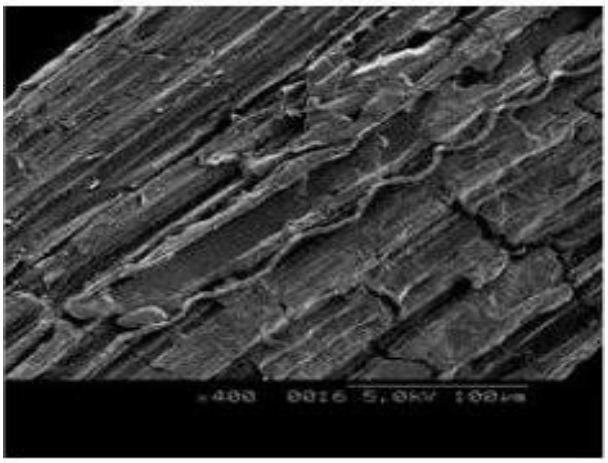

Figure 7: Result from SEM of about 25 % wt of fiber composite after tests

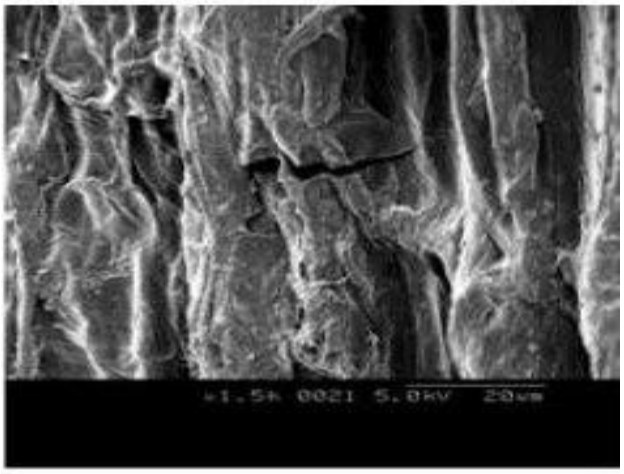

Figure 8: Result from SEM of about 35 % wt of fiber composite after tests

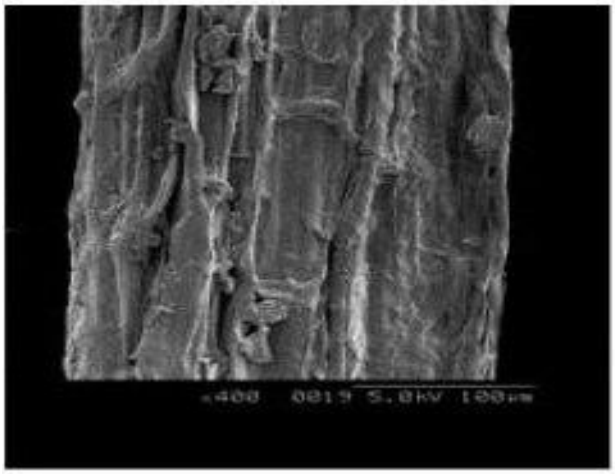

Figure 9: Result from SEM of about 45 % wt of fiber composite after tests

VII. RESULTS AND DISCUSSIONS

The Agave and Silk hybrid fiber reinforced epoxy composites are handmade and arranged according to GRPF layer one horizontal and then longitudinal upon each other and then compacted using mold apparatus. The specimen composites are subjected to mechanical testing. Depending on the outcome, they are derived as below.

1. The outcome obtained from Composite FRP materials had shown maximum strength at tension and can withstand the maximum strength of about 10.35 MPa at an average of all weight by percentage fibers.
2. The composite fiber reinforced epoxy show an Average of Tensile strength under Impact test strength as 8.72 Mpa.
3. The morphology at different weight percentage of composite show a unique effect at each test.
4. The tensile test at 45% of weight percentage of composite shown in Fig 9 shows less damage. Compared to other composite. This shows that the as the weight percentage increases there will good against tensile and compressive force.

VIII. CONCLUSION

The Agave and Silk hybrid fiber reinforced epoxy composites, has shown better Mechanical properties against tension up to maximum strength of 10.35Mpa.The SEM showed better Mechanical properties of composite material for up to 45% of loading.

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