Experimental Investigation of Strength Properties of Sunnhemp Fiber Polymer Composite Materials

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ABSTRACT

Some counties are blessed with agricultural diversity and India is one of them Natural-fibers are key by product of taking out-process and they are formed and utilize as reinforcement in composite products. These fibers have prospective to substitute the synthetic fiber composite and conventional material one day moreover natural fibers have low density and light weight. The polymer composite is made by compression moulding process. The percentage of sunnhemp fiber is 10% of resin-weight and size of Sunnhemp fiber is varied from 5mm to 20mm. It was used with 80% of polyester-resin (93P) and 3% of cobalt as accelerator and 9% of methyl ethyl ketone peroxide as catalyst for cured. The polymer composite is made with 8Mpa pressure at room temperature.

The test specimen is cut from 200mmx200m sheet which is made by compression moulding machine. The investigation of mechanical properties using ASTM standard test for plastic materials. After study about the properties with respect to fiber length it concludes that mechanical properties are increases as size increases.

***Key Words**: Sunnhemp Fiber, Polyester Resin, Compression-Moulding, Mechanical Properties.*

I. INTRODUCTION

Composites which composed by natural fiber are one of the eye-catching alternative in providing the contemporary material to overcome the problem of environmental setback which are facing by industries. In the past few decades, researchers and engineers have been functioning on changing from large no. of materials to fiber reinforced polymeric materials [1]. Natural fiber has made to measure properties, is green and environmentally not dangerous.[2]Sunnhemp fibers are found by water decomposing hemp plants-for fourteen days and exclusion of stale pulp by nylon brushes.

Sunnhemp is an nice-looking natural fiber for use as reinforcement in composite because of its less expenditure, reusable nature and much lesser energy requirement for processing. Its physical look comprises of long and glossy vegetable fiber that can be spun into uncouth, physically powerful-threads.[3]The tensile strength of sunnhemp is 200 to 300 Mpa .The properties of the composite lies upon the formation of individual material as resin and fiber have their different properties and it also depends on the method of formation and process parameters[4]

The major-drawback associate with the use of natural fiber is as einforcement in he polymer composite are the poor wet ability and water absorption which is overcome by chemical extraction treatment using alkaline treatment. This will be finished by using polyester resin with sunnhemp fiber in a mould in a compression moulding process at 80Mpa pressure and at room temperature of 30.2°C and they are left for curing for 25 minutes. Then the panel cut by the rules and regulations of the ASTM standards for the testing of mechanical properties of composite. Once the testing is finished then analyzed the mechanical properties as the specimen according to the fiber size.

II. MATERIALS AND METHOD DETAILS

a. **Sunnhemp Fiber: -**Sunnhemp Fiber is purchased from local source and for to extraction of fiber for better mechanical properties is purchased from Astha Fiber and Chemicals MI road Jaipur. Then fiber is chopped in 5mm, 10mm, 15mm, and 20mm size and treated with 10% of NaOH for 1 day then it washed and dry for 3 hours in the sunlight.
b. **Polyester Resin:-** Resin is also purchased from Aastha Fiber and Chemicals and it is of Polyester 93P grade which cured at room temp easily.
c. **Catalyst: -** Methyl Ethyl Ketone Peroxide is applied as catalyst for to control the process and help to cure the material.

d. Accelerator: - Cobalt Naphthalene is used as accelerator which accelerator the rate of chemical process and help to cure.

III. FABRICATION OF POLYMER COMPOSITE

Compression molding is one of its own kind machine and one of the ancient machine which is used for making composite by applying pressure. It has various advantages over other techniques used for composite making like it gives great uniformity and great base.[5]This process gives great mechanism on product width and great uniformity on both upper and lower side.[6]

The mild steel mould is used for the specimen of size 200mmX 200mm X 5mm.The Teflon sheet was placed in the mould for better surface finish and easily removing the sheets of composite. The Teflon sheet is used for both side female and male part of the mould for the surface finish. Sunnhemp fiber after alkaline treatment is used for fabrication of polymer composite with polyester resin and catalyst and-accelerator.

For the better reinforcement 10% fiber to the weights of the resin is used and accelerator is 2-3% of the resin weight and catalyst is 5-8% of the resin weight is used.

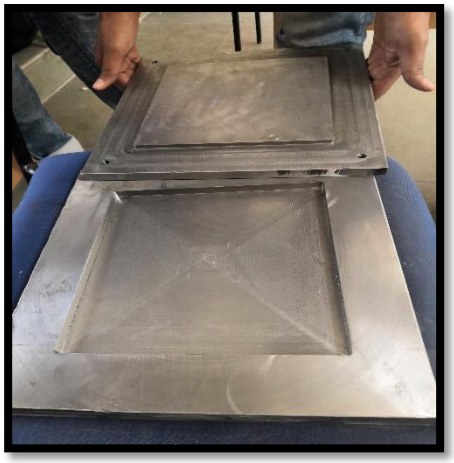

Figure 1. Mild Steel Mould

First the accelerator is mixed with the resin and after that the catalyst and at last add the fiber into the mixture and stir the mixture properly then pour the mixture into the mould and apply the pressure through hydraulic bottle jack and measure the pressure using pressure gauge which was attached with the hydraulic jack and .

For to measure the temperature there is one thermocouple is fixed on the frame as shown in figure 2.Then the sheet is remove from the mould and cure the sheet about 30 minute then it is use for to cut according to the ASTM standards. Simultaneously same process is for other size fiber to fabricate the sheets.

Preparation of Specimen for various Mechanical testing as per ASTM Standards

From the sheet as per mould size of 200mmX 200mm X 5mm and cutting the specimen for tensile, flexural, impact testing.

Fig.2 Experimental Setup

Mechanical Tests

The main objective to determine three important properties of composite materials are following test at room temperature.

Tensile Test: - The tensile strength is determined using ASTM D638 Standard testing machine and the specimen is cut from sheet of size 150mm X 20mm X5mm and gauge length is 50mm.The test is conducted using computerized tensile testing machine and tensile strength was reported in MPa.[7]

Flexural Test: - This test is also conducted at room temp using ASTM D790 Standard through three-point computerized testing machine and the size of specimen cut from the sheet is 115mm X 15mm X5mm. The Flexural Strength is carried out and reported in MPa.[8]

Impact Test: -Izod Impact test is conducted using ASTM D256 Standard by swinging pendulum as similar in the case of metal using sudden applied of load to the specimen and the size of the specimen is 55mmX10mmX5mm.The Impact Strength is carried out and reported in J/m.[9]

Figure 3. Specimen for Testing

IV. EXPERIMENTAL RESULTS AND DISCUSSIONS

Tensile Test

This test is executed to judge the ultimate tensile strength. A specimen of particular shape and customary specification was extracted from the composite piece ready-made. The extracted tensile piece was held in eccentric roller grips with the load applied on the specimen smoothly and the mercury starts rising in the glass pole from zeroscale. As the load rise, befalling of fracture starts in test piece . The load at fracture was written from the measuring device at the time of testing and breaking. The same procedure was repeated for other specimens cut from the same composite plate. Later, the average load at the fracture was putting down and tensile strength was deliberated arranged the foundation of the following formula.[10]

$$\sigma t = \frac{Fc}{Af} (1)$$

$$Af = \frac{m}{\rho L} (2)$$

Here **σt**is equal to tensile strength of the fiber, Fc represents the force at the failure point, m depicts mass of the fiber and **ρ**refers density of the fiber, **Af** is the cross-section area of the specimen, Length of the fiber and weight of fiber is 10% of the resin weight.[11]

Table I. Tensile test result for the polyester composites reinforced with 5-20mm length Sunnhemp fiber.

S.no	Fiber Length (mm)	Tensile Strength (MPa)
1	5	9.57
2	10	14.83
3	15	20.65
4	20	25.23

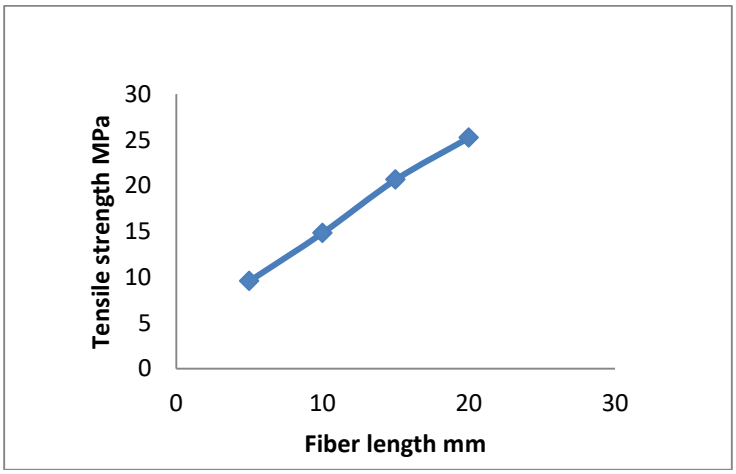

Figure 4. Graph between tensile strength and fiber length.

Flexural Test:

It is principally bending test to calculate its maximum bending strength. It is theoretically called modulus of rigidity and bending is done before it yields. [12]

Table II. Flexural test result for the polyester composites reinforced with 5-20mm length Sunnhemp fiber.

S.No	Fiber Length (mm)	Flexural Strength (MPa)
1.	5	24.8
2.	10	28.9
3.	15	32.7
4.	20	39.1

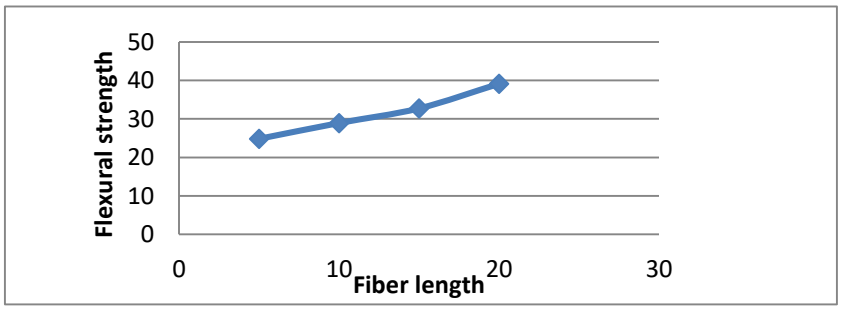

Figure 5. Graph between Impact strength and fiber length

Izod Impact Test:

It is for to determine the impact resistance of the materials. A pendulum with certain load is applied to the specimen releasing from the specific height as per standard. The swings of pendulum is applied impact or sudden load on the specimen and the impact strength is reported in the Joule[13]

Table III. Impact test result for the polyester composites reinforced with 5-20mm length Sunnhemp fiber.

S.no	Fiber Length (mm)	Impact Strength (J/m^2)
1.	5	1.3
2.	10	2.8
3.	15	4.5
4.	20	6.1

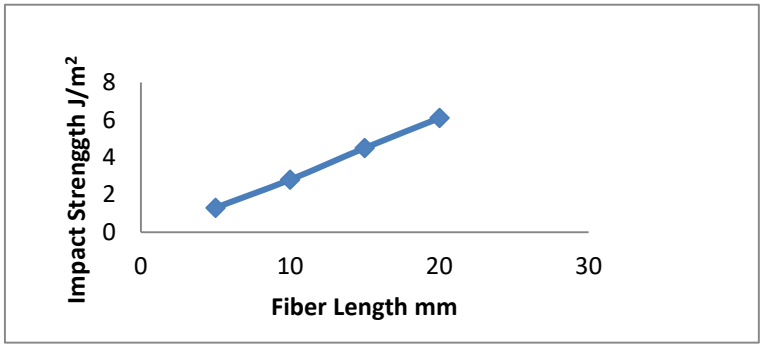

Figure 6. Graph between Impact strength and fiber length

V. CONCLUSION

1. In tensile strength as the increment of fiber length occurs the tensile strength also increases.
2. In flexural strength the strength is directly proportional to fiber length.
3. In Impact test impact strength of composite is increased as the increment in the size of fiber.

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