

# Mechanical Properties of Natural Composite Fibre Prosopis Juliflora

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**ABSTRACT:** Natural Fibres are attractive over man-made fibres due to their advantages low-cost, Bio-degradability, light weight, High Specific strength. One such fibre is Prosopis Juliflora. This fibre which is abundantly available in the nature and having high strength has paved way to its usage as a natural fibre of the fabrication of a composite. This paper spreads alight over the way a Natural Fibre could be used so as to fabricate a Natural composite and this Fabricated Natural composite's Tensile Strength and Flexural Strengths are found using a UTM(Universal Testing Machine).

**KEYWORDS:** Natural Fibre, Composite Material, Mechanical Properties, Epoxy.

## I. INTRODUCTION

A Composite material (also called a composition material or shortened to composite) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The interest in Natural Fibre reinforced polymer Composite materials is rapidly growing. They are renewable, cheap, completely or partially and biodegradable. These fibres are incorporated into a matrix material such as thermosetting plastics. A Fibre Reinforced Composite (FRP) is a composite material consisting of a polymer matrix imbedded with high-strength fibres, such as glass, aramid and carbon. Fabrication of a composite fibre involves the combining of the Natural fibre (Reinforcement) with the Polymer (Matrix), these two are the building blocks of any composite material. The most common procedure used for the fabrication of the natural composite is Hand- Layup process which includes the saturation of Natural fibre (Reinforcement) with the Polymer (Matrix). Layers of the Natural fibre are kept in a mould and resin is poured on each layer such that all layers are coated. Then a roller is used to roll over such that all layers get coated well and extra resin comes out. Left undisturbed till the composite is ready.

## II. FABRICATION OF COMPOSITE MATERIAL

Fabrication is done through Hand- layup technique and four composites are prepared with different fibre compositions. The weight of the fibre is varied in each composite by 5grams.

The first fibre has a composition of 5 grams of Reinforcement (Natural fibre) and the rest is the Resin and Hardner mixture with a total amount of 100ml.

The same way remaining three composites are also fabricated with 10gms, 15gms, and 20gms.

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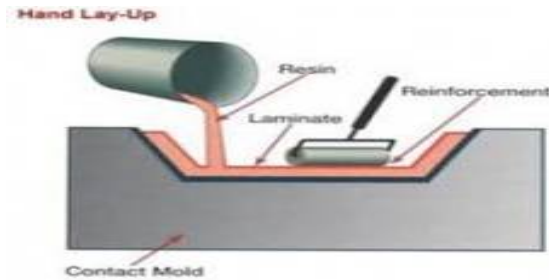


Fig.1. Hand lay-up technique

### III. TESTING OF COMPOSITE MATERIALS

#### Tensile Testing

Testing of the specimens include Tensile testing and Flexural Testing of the composite materials. Firstly composites are cut into the required shape according to the concerned standards. Tensile testing specimen is to be cut into Dumbbell shape as shown in figure. Figure below shows four different dumbbell shaped composites with different compositions of the Natural fibre in them.



Fig.2 Tensile Test Specimens

Tensile testing involves the application of tension at its ends. The specimen is loaded into the UTM (Universal Testing Machine). The two jaws of the machine are relieved and the specimen is loaded and is tightened. Once this is done tension is added onto the ends till the failure happens. The table below shows the tensile strengths of the various specimens with different compositions.

TABLE. 1 Tensile Strengths of composites with different compositions

Composite	Maximum Load(N)	Load at Break (N)	Tensile stress (MPa)	Young's Modulus(MPa)	Tensile Strain at Break
5 grams	293.26	293.26	9.78	1860.43	0.00617
10 grams	609.87	609.87	16.33	2262.73	0.01067
15 grams	967.78	967.78	20.26	2283.48	0.01750
20 grams	686.91	686.91	22.90	2489.42	0.01117

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## Flexural Testing

Firstly composite material is cut into the Rectangular shape according to the standards and then loaded into the UTM where a bending load is added on the the composite material at the centre and it is supported at the extreme two ends. The figure below shows the loading of the specimen into the UTM for Flexural testing of the specimen.



Fig.3 Flexural Test Specimens

The Flexural method measures behaviour of materials subjected to simple beam loading. It is also called as transverse beam test

TABLE.2 Flexural Strengths of composites with different compositions

Specimen	Maximum Load(KN)	Flexural Stress (MPa)	Flex Modulus(MPa)
5 grams	0.05	6.84	3321.31
10 grams	0.12	27.75	5462.67
15 grams	0.06	35.57	6915.40
20 grams	0.12	64.41	11859.83

## Chemical Resistance Testing

The chemical resistance test of the composites was studied as per ASTM D 543-87 Method.

$$W = \frac{w_2 - w_1}{w_1}$$

W = % weight of final sample

W<sub>2</sub> = weight of treated sample

W<sub>1</sub> = weight of untreated sample.

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TABLE. 3 Before weights of the fibre chemical resistance test

Name of the Fibre	Specimen 1 (grams)	Specimen 2 (grams)	Specimen 3 (grams)	Specimen 4 (grams)	Specimen 5 (grams)	Specimen 6 (grams)	Specimen 7 (grams)	Specimen 8 (grams)
Prosopis Juliflora	0.18	0.18	0.21	0.28	0.25	0.20	0.29	0.28

TABLE.4 After weights of the fibre chemical resistance test

Name of the Fibre	Specimen 1 (grams)	Specimen 2 (grams)	Specimen 3 (grams)	Specimen 4 (grams)	Specimen 5 (grams)	Specimen 6 (grams)	Specimen 7 (grams)	Specimen 8 (grams)
Prosopis Juliflora	0.21	0.24	0.28	0.32	0.29	0.24	0.33	0.30

TABLE.5 Values of chemical resistance test

Chemicals	W1	W2	$W = \frac{W2 - W1}{W1}$
40% nitric acid	0.18	0.21	0.1667
10% Hydrochloric acid	0.18	0.24	0.3333
8% Acetic acid	0.21	0.28	0.3333
10% Sodium Hydroxide	0.28	0.32	0.1429
20% Sodium Carbonate	0.25	0.29	0.1600
Benzene	0.20	0.24	0.2000
Carbon Tetrachloride	0.29	0.33	0.1379
Water	0.28	0.30	0.714

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## IV. RESULTS AND DISCUSSIONS

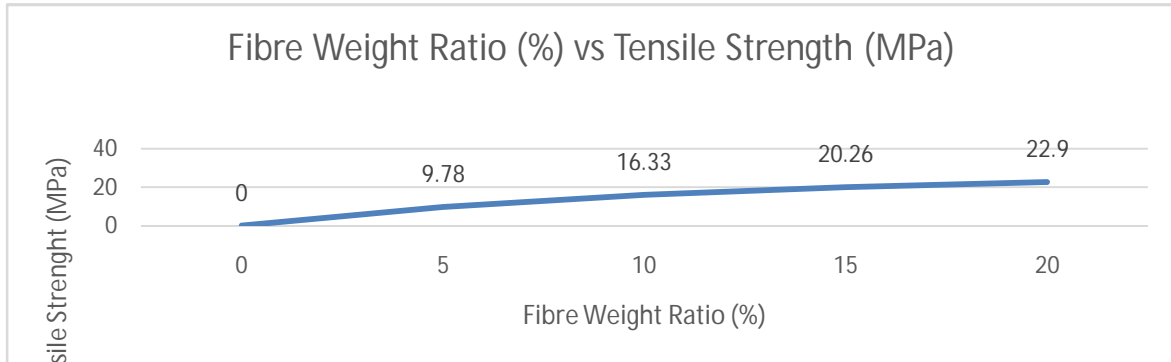


Fig.3 Comparison of weight Ratio (%) & Tensile Strength (MPa)

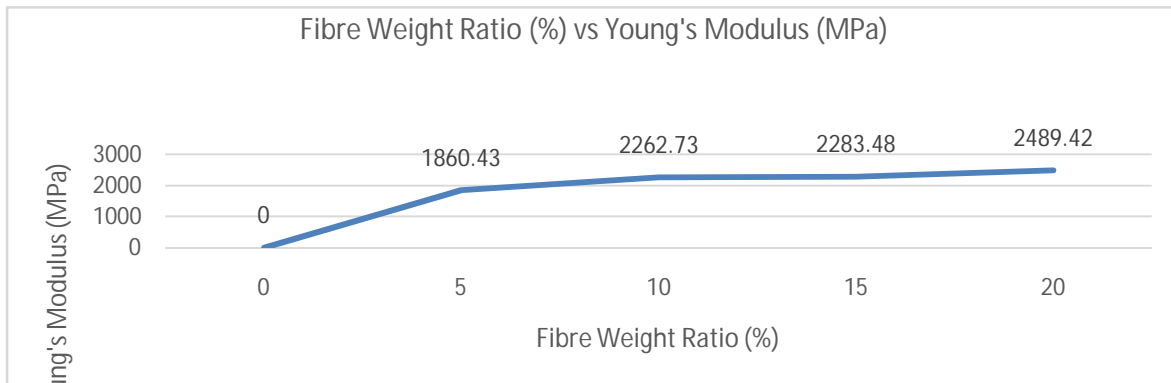


Fig.4 Comparison of Weight Ratio (%) and Young's Modulus

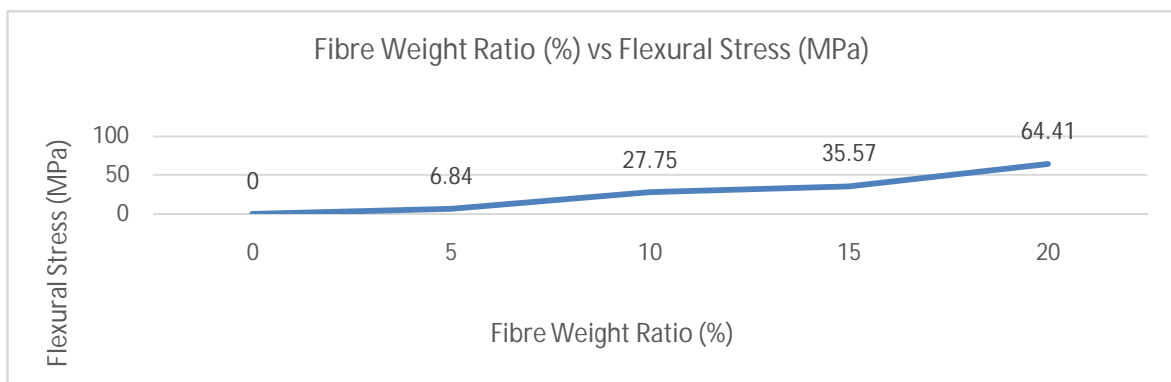


Fig.5 Comparison Weight Ratio (%) and Flexural Stress (MPa)

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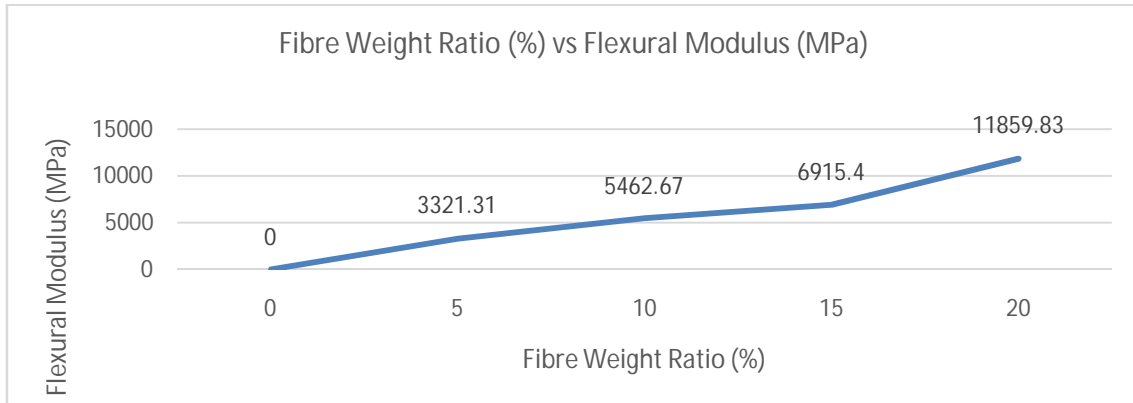


Fig.6 Comparison of Weight Ratio (%) Flexural Modulus (MPa)

## V. CONCLUSION

The fibre reinforced natural composites are fabricated by the simple hand lay-up technique in the laboratory condition. The proposed composites are subjected to the mechanical characterization, such as tensile strength, flexural strength, and chemical resistance test etc. The following conclusions have been driven out from the experimental results.

1. Based on the experimental investigations, micro mechanics assessment and static analysis the strength determining factors such as ultimate breaking load, ultimate stress, displacement at maximum force, Tensile strength, and Flexural strength.
2. The Prosopis Juliflorafibre reinforced composites have more Tensile properties obtained at 20 gms of fibre, and Maximum Flexural Strength is obtained at 20 gms weight of the fibre.
3. Results indicate that the fibre improves the properties and can be considered as great potential to increase with varying the fibre weight ratio.
4. The effects of Chemical Resistance test were studied. After conducting test the fibre weights increase. This indicates the weight-density also increases that resembles better strength of the fibres.
5. In future, there is tremendous investments on natural fibres, to bring a great impact on manufacturing sectors.

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