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# Comparison study of random orientation fibers on mechanical properties of Coconut, Hemp, Munj, Hybrid fiber reinforced polymer composites

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## ABSTRACT

***Natural fibers show many advantages such as low density, low cost, environment-friendly, biodegradable and high specific mechanical performance. This work investigates the flexure and impact strength of hemp and coconut short fiber which is specification aligned in a specific direction. The short fiber of hemp, munj, coconut and hybrid of length 5mm is used for experimental work with epoxy of grade LY556 and hardener HY951. Test results are compared with a randomly oriented fiber sample of the same length with the same epoxy and hardener.***

***Keywords***— *Coconut fiber, Hemp fiber, Munj fiber, Hybrid (coconut, munj, hemp) fiber, Epoxy, Hardener, Tensile strength, Bending strength, Impact strength, Hardness*

## 1. INTRODUCTION

Nowadays scientists and technologists are interesting on natural fibers to replace the synthetic fiber. The important features of natural fibers are low price, low density, high specific properties and low wear of processing machinery [1]. Natural fibers are recyclable, biodegradable and easy disposal at the end of use by the recovery of their calorific value in a furnace [2]. Numbers of investigations have been carried out to assess the potential of natural fibers as reinforcement in polymers. Natural fibers are economic, found in abundance and having higher strength and modulus than plastic [3]. The environment is polluted day by day much so natural fiber is playing a big role in replacing the synthetic fiber. Natural reinforcement polymer composites are suitable for the primary applications, the indoor elements in housing, temporary outdoor application. The insulating properties of natural fiber make it is useful in the automotive door, ceiling panels and transportation [4]. Rashed et. al. [5] investigates the effects of the size of fibers on the mechanical properties. The authors suggested that increasing the size of fiber tensile strength is increased but after a certain size, it is decreasing. Rahman et al. [6] investigated the physico-mechanical properties of jute fiber reinforced polypropylene composites by post-treatment.

Each composites consisting of 30% of fiber and Epoxy resin is of 70%. Epoxy and Hardener ratio is 10:1 [7]. Rajesh et al. [8] investigated the effect of loading and alkali treatment on tensile properties of short jute fiber reinforced polypropylene composites. The authors gave that tensile strength is found maximum for composite with 10% fiber loading and 10% NaOH concentration.

## 2. MATERIALS AND METHODS

### 2.1 Materials

**2.1.1 Resin and hardener:** Epoxy resin is used as a matrix in the composite. The Epoxy resin (LY556) and hardener (HY951) is pursed from local resources. The density and viscosity of epoxy at $25^0$ C are 1.15g/cm$^3$ and 10000 mPa.s respectively

**2.1.2 Fiber:** Coconut, Hemp, Munj, Hybrid were used as reinforcement in the work .biological retting is a process used for removing fibers from stem [9]. Natural fibers are easily grown in eastern parts of India, Bangladesh, Sri Lanka and China. Sri Lanka and India are considered to be major coir fiber producers in the world. Most of the coir fibers produced in China are from the subtropical provinces of Hainan and Guangdong. Natural fibers may be used as the reinforcement material in the composite production [10].

### 2.2 Methods

Samples are prepared by hand layout techniques. Epoxy (LY556) and hardener (HY951) are mixed in the ratio of 10:1.

 

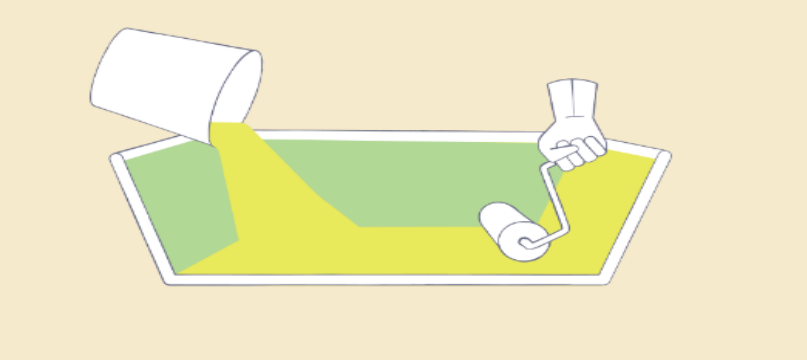

**Fig. 1: Hand layout technique**

### 2.3 Preparation of composite

A wood mold having a dimension of 17 cm*17 cm*0.5 cm is used for composite fabrication. The composite sheet has made the same dimension as a mold. Cello fin sheet and car polish (release gel) are used as a releasing agent from the mold after curing for 24 hours. Each sample is pressed in the press machine for 24 hours before removing from mold under the load of 40 kg.

## 3. MECHANICAL TESTING

Tensile test, Bending test, Hardness test, Impact test on a sample of epoxy and natural fiber composite is carried out. Three separate specimens of Epoxy and natural fiber composites for each Test is tested and the average value is calculated. All tested is done in the Allen house institute of Technology, Kanpur.

### 3.1 Tensile Test

The tensile test is done on the universal testing machine (Presto computerized tensile testing machine). The specimen of the required dimensions is 165*19*5 $mm^3$. Tensile strength ($N/mm^2$) of all fibers are given below table1.

**Table 1: Tensile strength ($N/mm^2$) of coconut, Hemp, Munj, Hybrid fiber**

| Sample | Coconut | Hemp | Munj | Hybrid |
|---|---|---|---|---|
| 1 | 7.902 | 22.467 | 6.623 | 12.647 |
| 2 | 5.567 | 12.091 | 9.697 | 9.192 |
| 3 | 6.432 | 14.318 | 8.432 | 13.787 |
| Average | 6.633 | 16.292 | 8.250 | 11.875 |

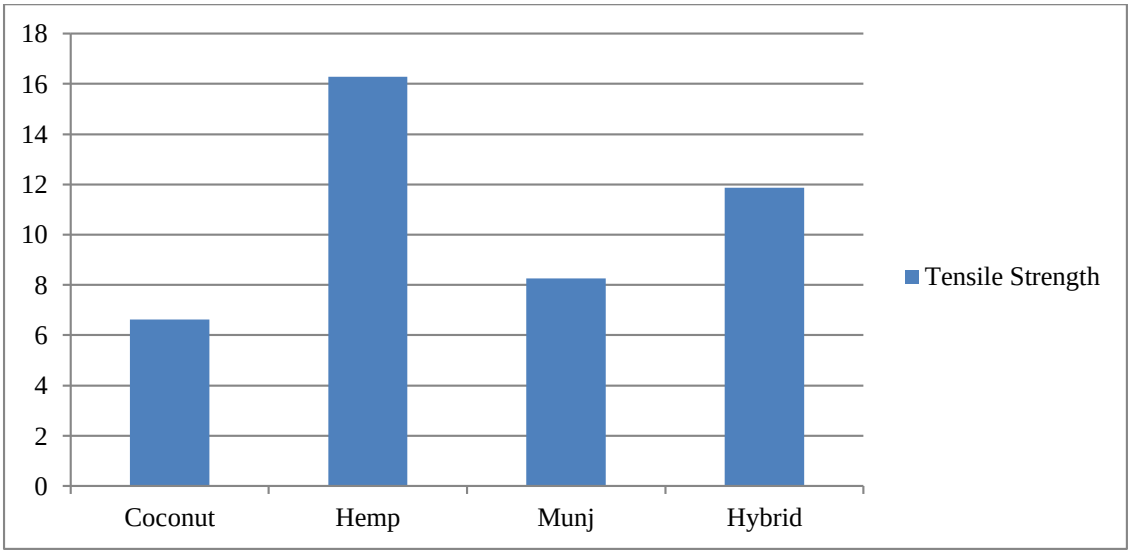


**Fig. 2: Tensile strength ($N/mm^2$) of coconut, Hemp, Munj, Hybrid fiber**

### 3.2 Bending Test

The bending test is composite is the maximum tensile stress that it can withstand during bending before the breaking point. The sample size is 76 mm* 25mm*5 mm as ASTM Standard. This testing is done on the universal testing machine (Presto computerized tensile testing machine). Bending Strength ($N/mm^2$) of coconut, Hemp, Munj, Hybrid fiber are given below in table 2.

**Table 2: Bending strength ($N/mm^2$) of coconut, Hemp, Munj, Hybrid fiber**

| Sample | Coconut | Hemp | Munj | Hybrid |
|---|---|---|---|---|
| 1 | 27.525 | 59.517 | 38.614 | 49.522 |
| 2 | 31.811 | 55.554 | 40.931 | 57.383 |
| 3 | 28.665 | 52.145 | 46.840 | 44.674 |
| Average | 29.333 | 55.738 | 42.128 | 50.526 |

 

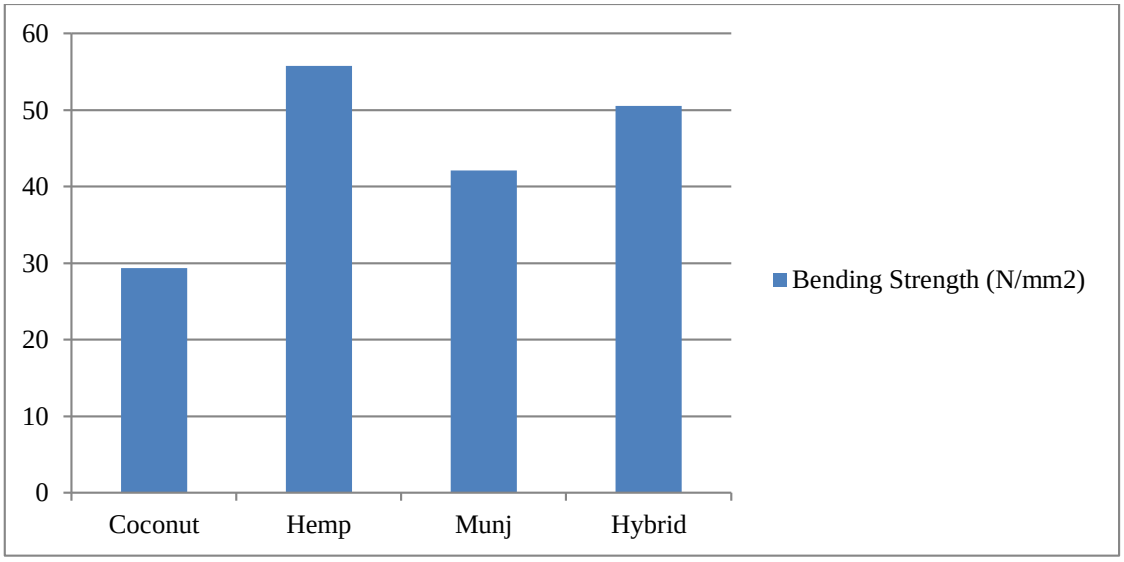


**Fig. 3: Bending strength (N/mm$^2$) of coconut, Hemp, Munj, Hybrid fiber**

### 3.3 Impact test

The impact test is done to understand the toughness of the material. During the test, the specimen is subjected to a large amount of force for a very short period of time. For any material, the higher amount of impact strength shows that it can absorb a large amount of energy before failure. The size of the specimen for impact test is 63.5*12.5*5 mm$^3$. Impact Strength of coconut, Hemp, Munj, Hybrid fiber is given in table 3.

**Table 3: Impact strength (J/m) of coconut, Hemp, Munj, Hybrid fiber**

| Sample | Coconut | Hemp | Munj | Hybrid |
|---|---|---|---|---|
| 1 | 243.41 | 213.2 | 373.02 | 228.2 |
| 2 | 169.8 | 190.32 | 313.5 | 208.32 |
| 3 | 229.8 | 184.32 | 340.32 | 215.32 |
| Average | 214.33 | 195.94 | 342.28 | 217.28 |

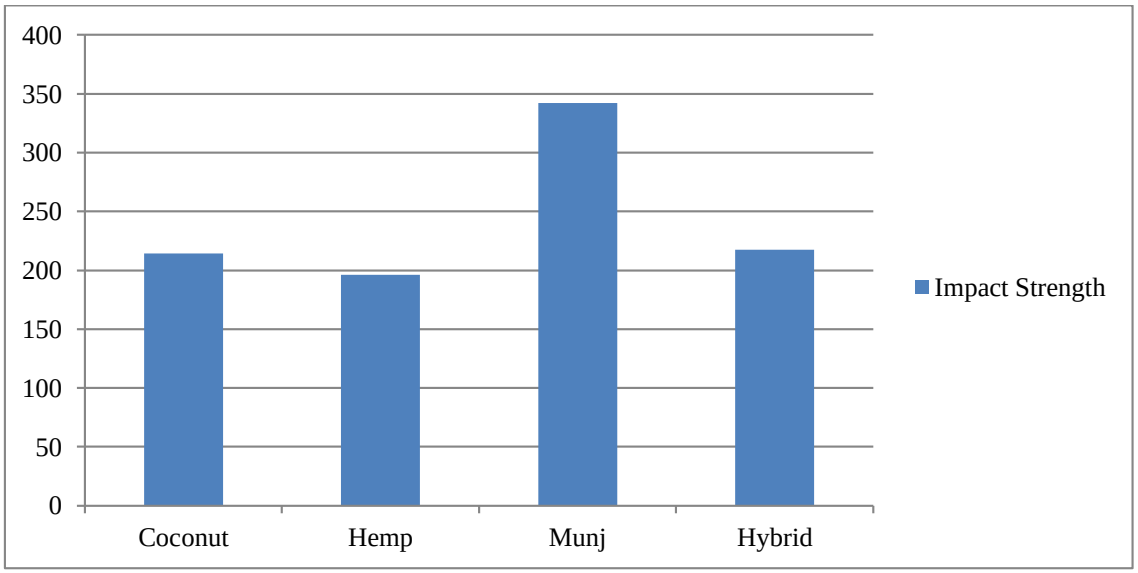


**Fig. 4: Impact strength (J/m) of coconut, Hemp, Munj, Hybrid fiber**

### 3.4 Hardness test

The durometer hardness test is a measure of the resistance of a material to penetration of spring loaded needle like indenter. The hardness of polymers (rubbers, plastics) is usually measured by shore scales. Hardness is tested by an instrument called as Durometer on the Shore D scale. Durometer utilizes an indenter loaded by a calibrated springs. Fixed size of the sample is not required for the test. The reading obtained on the Shore D Scale by durometer is given below in Table 4.

**Table 4. Hardness of coconut, Hemp, Munj, Hybrid fiber**

| Sample | Coconut | Hemp | Munj | Hybrid |
|---|---|---|---|---|
| 1 | 46.8 | 78.1 | 69.3 | 64.5 |
| 2 | 46.7 | 76.2 | 73.2 | 65.3 |
| 3 | 45.2 | 75.4 | 73.7 | 65.7 |
| Average | 46.233 | 76.56 | 72.066 | 65.166 |

 

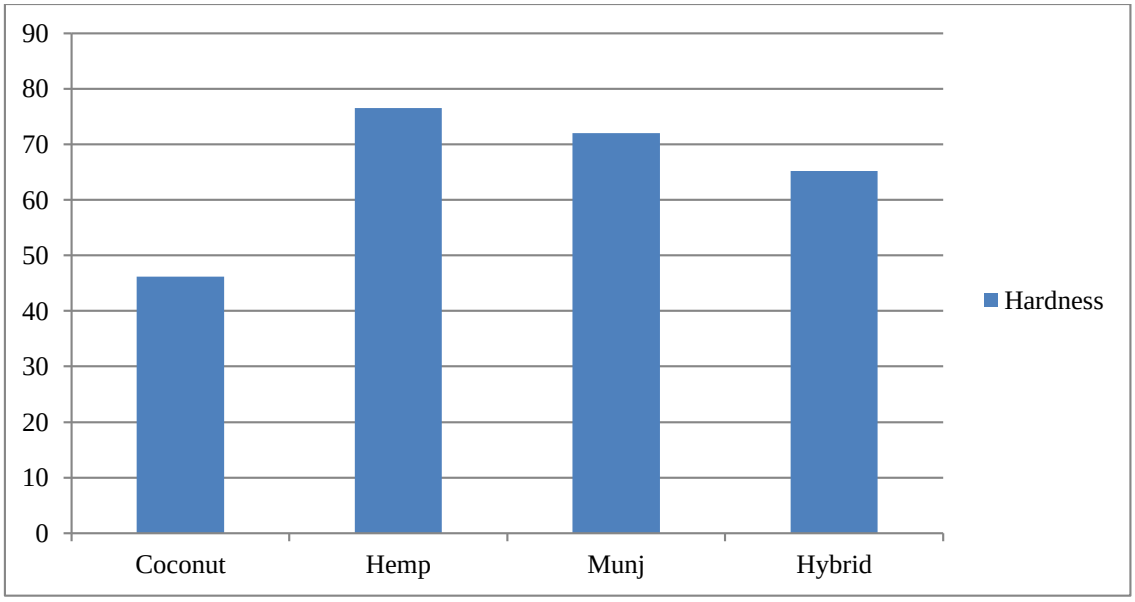


**Fig. 5: Hardness of Coconut, Hemp, Munj, Hybrid fiber**

## 4. RESULT AND DISCUSSIONS

Hemp fiber are have found more bending, tensile strength and hardness more than the coconut, munj, hybrid fiber because hemp fiber and epoxy resin have found strong adhesion causes the proper transfer of load from the matrix to fiber, munj have found more impact strength than hemp, coconut, Hybrid fiber. Mechanical properties of Coconut, Hemp, Munj, Hybrid fiber are given in table 5 and plotted in figure 6.

**Table 5: Average of mechanical properties of Coconut, Hemp, Munj, and Hybrid fiber**

| | Tensile Strength ($N/mm^2$) | Bending Strength ($N/mm^2$) | Impact Strength (J/m) | Hardness on the shore D scale |
|---|---|---|---|---|
| Coconut | 6.633 | 29.333 | 214.33 | 46.233 |
| Hemp | 16.292 | 55.738 | 195.28 | 76.56 |
| Munj | 8.250 | 42.128 | 342.28 | 72.066 |
| Hybrid | 11.875 | 50.526 | 217.28 | 65.166 |

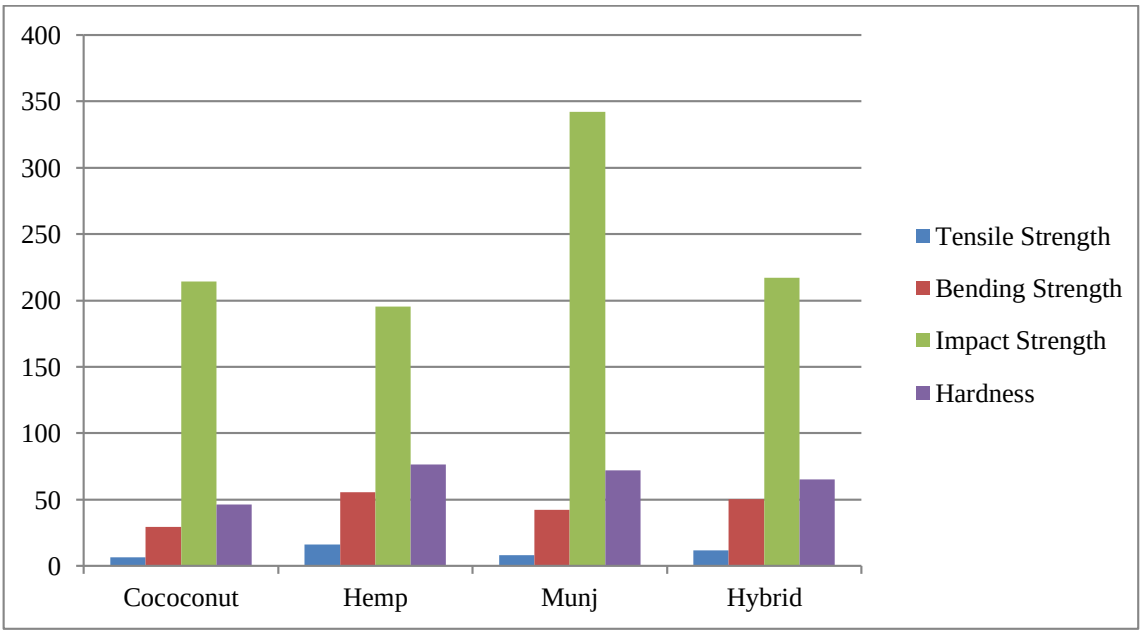


**Fig. 6: Average of mechanical properties of Coconut, Hemp, Munj, Hybrid fiber**

## 5. CONCLUSIONS

The mechanical properties of fabricated hemp/coconut/munj/hybrid fiber reinforced composites are evaluated. The fallowing conclusions have been derived from the experimental investigation

- The successful fabrication of hemp/coconut /munj/hybride Fiber Reinforced Composites with different percentage of Fiber loading can be achieved by a compression molding method.
- Hemp fiber composite ( 55.738 N/mm2 ) have found more bending strength than munj fiber composite( 42.128 N/mm2), hybrid ( 50.526 N/mm2) and coconut composite (29.333 N/mm2 )

 

- Hemp fiber composite (16.292 N/mm2) have found more tensile strength than coconut fiber composite (6.73N /mm2), munj fiber composite (8.16 N/mm2) and hybrid composite (11.875 N/mm2).
- Munj fiber has found more impact strength than hemp, coconut and hybrid composite.
- Hemp fiber composite has found more hardness than Coconut, Hybrid, Munj.

## 6. ACKNOWLEDGEMENTS

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## 7. REFERENCES

[1] Saheb DN, Jog JP. Natural Fiber Polymer Composites: A Review. Advances in Polymer Technology 1999; 18:351-363
[2] Kumar R, Kumar K, Sahoo P, Bhowmik S. Study of Mechanical Properties of Wood Dust Reinforced Epoxy composite. Procedia Material Science 2014; 6: 551-556
[3] Gowda TM, Naidua ACB, Rajput C. Some Mechanical Properties of Untreated Jute Fabric-Reinforced Polyester Composites: Part A 1999; 30: 277 -284
[4] Mishra V, Biswas S. Physical and Mechanical Properties of Bi-directional Jute Fiber Epoxy composite. Procedia Engineering 2013; 51: 561-566
[5] Rashed HMMA, Islam MA, Rizvi FB. Effects of Process Parameters of Tensile Strength of Jute Fiber Reinforced Thermoplastic Composites. Journal of Naval Architecture and Marine Engineering 2006; 3: 1-6
[6] Rahman MR, Huque MM, Hasan M. Improvement of Physico-Mechanical Properties of Jute Fiber Reinforced Polypropylene composites by post treatment. Composites: Part A 2008; 39:1739-1747
[7] Sandhyarani Biswas, Sanjay Kindo, Amar Patnaik. Effect of Fiber Length on Mechanical Behavior of Coir Fiber Reinforced Epoxy Composites. Procedia Material science 2011; 12: 73-78
[8] Rajesh G, Prasad AVR. Effect of Fiber Loading and Successive Alkali Treatments on Tensile Properties of Short jute fiber Reinforced Polypropylene Composites. Advanced Materials Manufacturing and Characterization 2013; 3: 528-532
[9] Khan JA, Khan MA. The use of jute fibers as reinforcements and in composites 2015; 10.1533/9781782421276.1.3
[10] Sapuam SM, Faiz M, Mohd Zaki AR. Plant Based fiber reinforced composites. Ci Technol Mater 2001; 13: 37-40

 