JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Development of Natural Fiber Composite and Characeristics

Geeta Dwivedi[1], Mr. Manoj Sharma[2], Mr. Vishal Wankhade[3], Dr. Rahul Joshi[4], Dr. Pradeep Kumar Patil [5]

Research Scholar[1], Swami Vivekanand College of Engineering, Indore, India

Assistant Professor[2&3], Swami Vivekanand College of Engineering, Indore, India

Associate Professor[4&5], Swami Vivekanand College of Engineering, Indore, India

Abstract : In past few years, composites are gaining considerable importance by their low cost, lighter weight, easy availability and are also ecofriendly as compared to synthetic fiber. These are the important attractive characteristics of composites that make them useful for almost all fields like engineering, medical etc. In this work naturally obtained FRC materials like sunn hemp and coconut fiber are used. The sunn hemp and coconut fiber are adopted as a natural Fiber and epoxy resin is applied as matrix to make the composite. The hand layup process is used to prepare the samples at normal temperature. The sunn hemp and coconut fiber are reinforced in the matrix at two different fibre percentage 3%and 5%. To avoid voids these samples are kept under pressure for 24 hr. Universal Testing Machine is used for to test the tensile strength and flexural rigidity as per the standard. The composites are analyzed in Hypermesh software. The results are compared with pure epoxy sample and it is analyzed that composite with coir Fiber gives more strength than pure composite. It is evaluated that tensile strength increases with rise in angle of orientation whereas flexural rigidity decreases.

IndexTerms - Sunn hemp, Coconut fiber, Composite, Hand layup, Universal Testing Machine.

I. INTRODUCTION

New material development mutates design and manufacturing processes. The availability of new materials enhances an existing design or process and also revolutionizes it entirely. In the modern society, materials came out as one of the most remarkable areas of research on a global level and in all disciplines. Whether they are a natural resource or a product of artificial substances, all the materials people use have an huge impact on the environment, economy, health, and finally, on the quality of life of people as end users. Some examples of new materials developed or been used in industries are Grapheme in Smartphone, Coatings harder than steel, Mindboggling Recycling and composites.

A material which is contains two or more materials at a microscopic scale and have chemically different phases which is Heterogeneous at a microscopic scale but statically homogeneous at macroscopic scale. The Constituent materials mixed together to form composite have significantly different properties.

One of the constituent reinforcements which provide strength to the matrix and the other is used to embed the reinforcing phase material which is called the matrix. It holds the reinforcements in one place. And this combination of matrix and reinforcements is called as the composite.

The reinforcement's are available in varieties like fibers, particles, or flakes. The reinforcement transfer's the strength to matrix. The matrix is a fluid like epoxy resin used to bind the fibers together. It behaves as a protection from environment. It is responsible for uniform distribution of load in the fibers which results in the development of same quantity of strain in the fiber. Matrix phase is comparatively light-weight and weak than reinforcement.

Tailored characteristics can be developed in the composites which make it useful in almost all areas.

The following conditions are needed to be fulfilled for a material to be a composite:

a) It can be manufactured both by naturally and/or artificially available composites.
b) It is composed phases which are set orderly which may be physical and/or chemical and segregated by a line
c) It has different characteristics from the components used separately.

II. LITERATURE REVIEW

Asim Shahzad et. al. He studies that Hemp fibers have properties that make them a suitable material to replace glass fibers as reinforcements in composite materials. Their main drawback is the uncertainty in their properties. Immeasurable research has been bring off on hemp fiber composites using thermoplastic, thermo sets, and biodegradable polymer matrices. These composites have express mechanical properties which, in some cases, excel even those of glass fiber composites. different fiber surface treatments have been explain to improve the hemp fiber/matrix interfacial bonding, brought improved mechanical properties. Another drawback of sunn hemp fiber composites, their moisture assimilation, can also be overcome by using fiber surface treatment process.

Kiran Rohit et. al. It is a review paper this review has provided a concise summary of the major material attributes of natural fiber composites. These includes: good specific – but different – properties of mechanical, environmental recommendation (renewable, biodegradable, low embodied energy, non-toxic), less cost, high water absorption rate, low durability and bio similarity. After inspect, the current literature present on natural fiber composite the particulate fiber such as coconut coir, Lantana camera, sisal have been already utilized. This developed in growing interest in natural lingo cellulosic materials and composites based on them. addition of wood flour in polyester improved the load bearing capacity (tensile strength) and the ability to withstand bending (flexural strength and modulus) but with the incorporation of met kaolin in wood flour polyester composite adequately decrease the tensile, flexural modulus and strength and increases the water absorption.

III. OBJECTIVE

The objective of this research work is to determine a better option in the field of reinforcement material.

The first objective is to utilize the natural waste in the form reinforcing material; therefore coir fiber is taken. The second objective is to develop the composite material by using the coir rope which has been achieved successfully. The third objective is to use of fiber content variation to find out the better result in composite and also use a mixed fiber for compare all the result. After the manufacturing of composites mechanical properties like tensile strength and flexural rigidity were evaluated.

IV. METHODOLOGY

Fig 1 Methodology Flow Chart

V. MATERIAL SELECTION

Matrix phase: Epoxy resin is nominated as a matrix. It is a polymer matrix that is commonly used is having a thermal conductivity of 0.363W/mK .These resins have low molecular weight and available in viscous liquid form. Epoxy resin and hardener (Haksons clear coat epoxy resin and hardener). We have used this epoxy resin as matrix phase material because it is easily available, corrosive resistant, it has good strength and ability to transfer stress to reinforcement material without failure. As a result, various epoxy adhesives have been manufactured to satisfy.

Various demands based on the applications.Theyaresuitableforanyproductrequiringahighstrengthadhesiveandcan be used on a variety of materials. The density of this epoxy is 1.1gm/cc3 and the density of hardener is 0.98gm/cc^3.

Fig 2 Epoxy Resin used in matrix phase

Properties of Epoxy Adhesives

As used as a binding material, the epoxy material needs to withstand warmth, water, and it should be chemical resistant. It also needs to have a high level of adhesion on a variety of substance sand to be adaptable enough to be formed into various shapes. All these properties can be achieved by handling the situations by which the adhesives are being created. Epoxies are additionally sturdy and can withstand substantial burdens, making them astonishing basic glues. Epoxies come in possibly one-part or two-segment frameworks. The primary contrast between the frameworks is the distinction in relieving temperatures.

Properties of Hardener

- A hardener is a segment of particular sorts of blends. In certain blends a hardener is utilized basically to build the flexibility of the blend once it sets. In different blends a hardener is utilized as a curing agent. Hardener in various forms such as reactant or in the form of catalyst that occurs in the reaction during the process of mixing.
- Hardeners are quite often important to make an epoxy resin helpful for its planned reason. Without a hardener, epoxies don't accomplish anyplace close the noteworthy mechanical and chemical properties that they would be with the hardener. The right type of hardener must be chosen to guarantee the epoxy blend will meet the necessities of the application. Research ought to consistently be done on both the resin and the hardener to ensure the last epoxy blend will perform agreeably.
- Hardeners are utilized to fix epoxy resins. In any case, basically adding a hardener to an epoxy gum may not make the epoxy blend fix rapidly enough. If so an alternate hardener might be required. Additionally, hardeners with specific added substances can be utilized. This hardener added substances fill in as catalysts that accelerate the restoring procedure.

Reinforcement phase:

They can be particles, flakes, whiskers or sheets. Here we have used coir rope as reinforcement in the matrix material. Composites are fabricated by the means of coir rope at three different orientation angles namely 0°, 45° and 90°. Coir fiber rope strands are used for making of composites by arranging the strands of ropeside by side with no gap between them.Coir ropes are used as because they are light weight and their fibers possess fairly good strength.

Materials Used:

Coconut fiber

Coir is the naturally obtained fiber which is taken from the outer covering that is called as the coconut shell husk. These are non uni-cellular, hard & rigid array of natural fruit fiber. They are renewable and biodegradable in addition to that it has several properties such as good amount of strength, sufficient length, moisture regain capacity and high durability against solar radiations, salty water, microbes etc. They are modified into coir ropes .The thermal conductivity of coir rope is about 0.1036 W/mK and its density is 0.75 gm/cc^3. The specimen samples are prepared from this coir rope. Now here this coir rope strands are the main load carrying constituents which are acting as a reinforcing material for the composites.

Fig 3 Coconut Coir Fiber used in reinforcement phase

Sunn hemp

Sunn, (Crotalaria juncea), also called sunn hemp or Indian hemp, annual plant of the pea family (Fabaceae) and its fiber, one of the bast fiber group. The fiber is made into cordage, fishing nets, sacking fabrics, canvas, and rug yarns and is used to manufacture such paper products as cigarette and tissue papers. These Fibers are being procured for use as the composite Fiber due to its mechanical properties it possesses which are discussed herewith. It has a Fiber diameter of 48 µm, its apparent Density is 1.34 g/cm^3 , Its Ultimate tensile strength is 200-300 MPa, its Modulus is 2.68 GPa, and its Extension at breakage is 2.5-3.5% (Details Procured from Central research institute for jute and allied Fibers(ICAR), West Bengal.) all the sunn hemp long fiber arranged in a straight line and then cut them into small flakes about 1 cm. They are used for making samples of composite.

Fig. 4 Sunn Hemp Fibre used in reinforcement phase

Specimen Preparation

Specimens are made and have the following dimensions:

TEST	SCHEMATIC FIGURE
Tensile strength	29 cm 2.5 cm

JETIR

Fig. 5 Specimen prepared with different combination of reinforcement and matrix material

Table 1 – Nomenclature of Specimen Prepared

Abbreviations Used	Details
3% SHFE	3% Of sunn hemp fiber epoxy composite
5% SHFE	5% Of sunn hemp fiber epoxy composite
3% CFE	3% Of coconut fiber epoxy composite
5% CFE	5% Of coconut fiber epoxy composite
3% SH-CFE	3% Of sunn hemp + coconut fiber epoxy composite
5% SH-CFE	5% Of sunn hemp+coconut fiber epoxy composite

Tensile test:

This test is one kind of mechanical test. It is also referred as tension testing. It's a basic material science check during which a specimen is put down in tension till failure occurs. By tensile test we determine the ultimate tensile strength value of the material, in this test a sample is typically pulled to its breaking point. A tensile test is used to knowhow a material will behave and also to find out the elongation within the material. Tensile tests are normally performed on UTM.

In this test, test piece ends are hold into the grips and are linked to a device that measures the load. If small load is applied, the deformation will be entirely elastic. However, when the value of the load increased further, the material is permanently deteriorated. Usually, this test is performed at normal temperature and the load is applied gradually.

Effect of Different fiber used in composite

The tensile strength represents the maximum stress which it can bear prior to its failure. UTM TUE-C-200 of load capacity 200 kN is used to test specimens as per ASTM D3039 standards.
It was found that the tensile strength value of the fiber epoxy composite is increased for all samples of fiber epoxy as compare to plain epoxy. The value of the tensile strength varies with the change of composite fiber and increases with the increase of fiber content.

The tensile strength for 5% CFE samples was found to be maximum.

Observation table of tensile strength of composite fiber at different % fiber contribution as shown in figure below:

Table 2 Observation Table of Tensile Strength for Different Fibre Composite

S.NO	NAME OF SPECIMEN	TENSILE STRENGTH
1.	3% SHFE	6.374 Mpa
2.	5% SHFE	19.005 Mpa
3.	3% CFE	18.906 Mpa
4.	5% CFE	21.536 Mpa
5.	3% SH-CFE(Hybrid)	9.292 Mpa
6.	5% SH-CFE(Hybrid)	18.833 Mpa

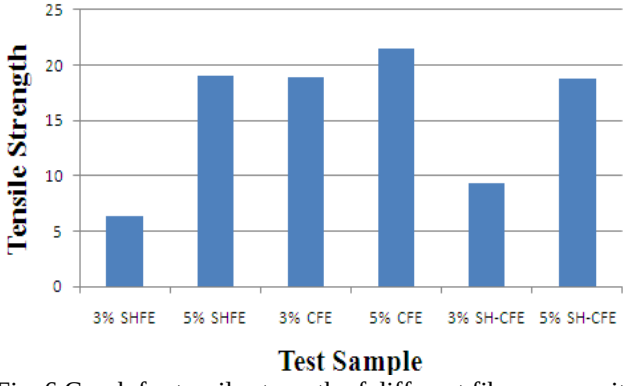


Fig. 6 Graph for tensile strength of different fiber composite

Graphical representation of Tensile Testing results of different composite fiber material on UTM Machine

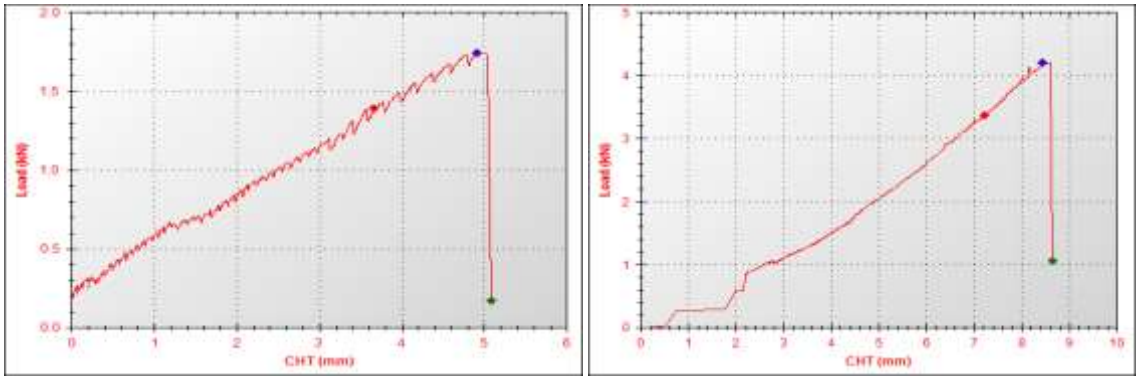


Fig.7 (3% SHFE & 5% SHFE)

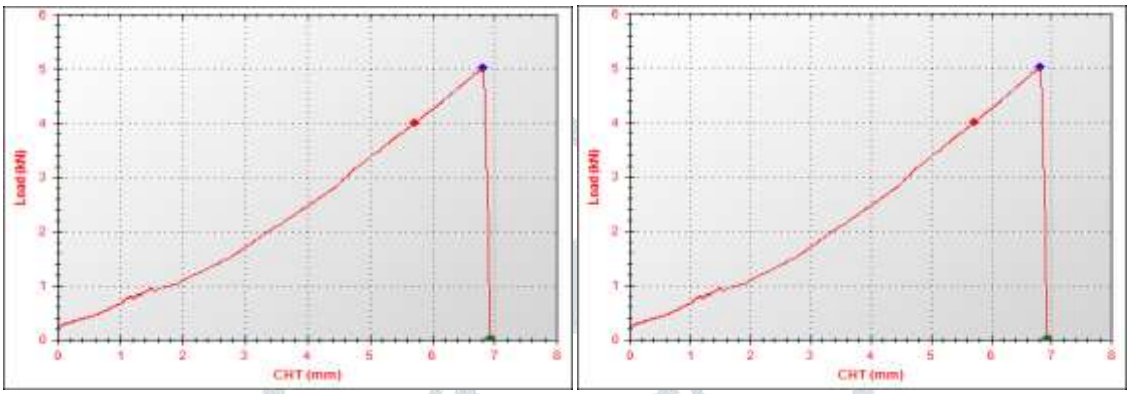


Fig. 8 (3% CFE & 5% CFE)

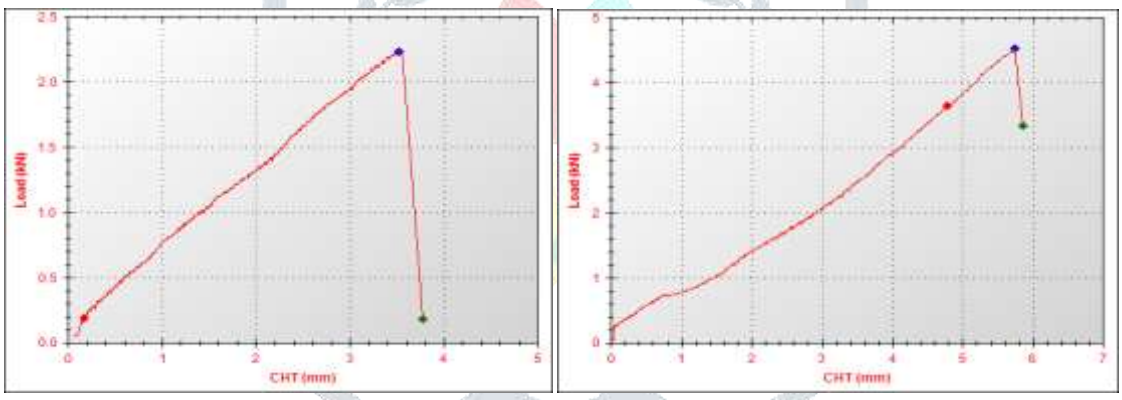


Fig.9 (3 % SH-CFE(Hybrid) & 5% SH-CFE(Hybrid))

Observation table of percentage of elongation of different fiber composite at different percentage of fiber contribution

Table 3 Observation Table of % Elongation of Coconut fiber, Sunn hemp fibre and Hybrid Fiber Composite

S.NO	NAME OF SPECIMEN	% ELONGATION
1.	3% SHFE	12.50%
2.	5% SHFE	2.50%
3.	3% CFE	5%
4.	5% CFE	3.75%
5.	3% SH-CFE(Hybrid)	3.7%
6.	5% SH-CFE(Hybrid)	2.50 %

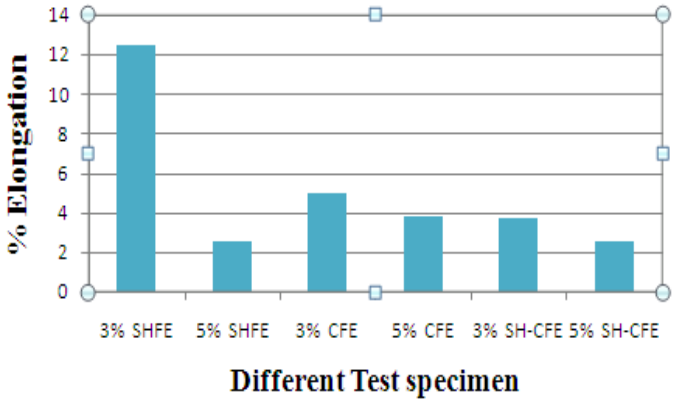


Fig. 10 Percentages of Elongation of Coconut fiber , Sunn hemp fibre and Hybrid Fiber Composite

Observation table of Impact Strength of different fibre composite at different % of fibre contribution as shown in figure below:

Table-4 Observation Table of Impact Strength of Coconut fiber, Sunn hemp fibre and Hybrid Fiber Composite

S.NO	NAME OF SPECIMEN	IMPACT RESULT
1.	3% SHFE	2.3 KJ
2.	5% SHFE	8.2 KJ
3.	3% CFE	9.2 KJ
4.	5% CFE	11.1 KJ
5.	3% SH-CFE(Hybrid)	5.1 KJ
6.	5% SH-CFE(Hybrid)	9.9 KJ

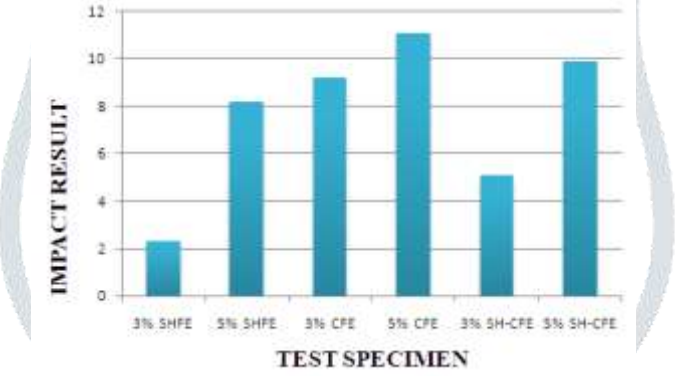


Fig. 11 Impact Strength of Coconut fiber, Sunn hemp fibre and Hybrid Fiber Composite

Comparison Graph of Impact Strength and Tensile Strength of different fiber composite at different % of fiber contribution as shown in figure below:

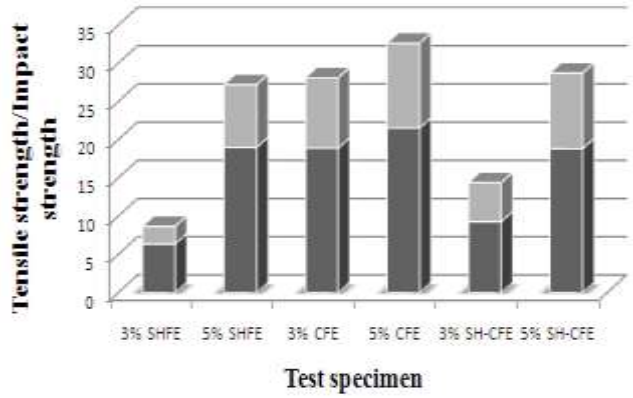
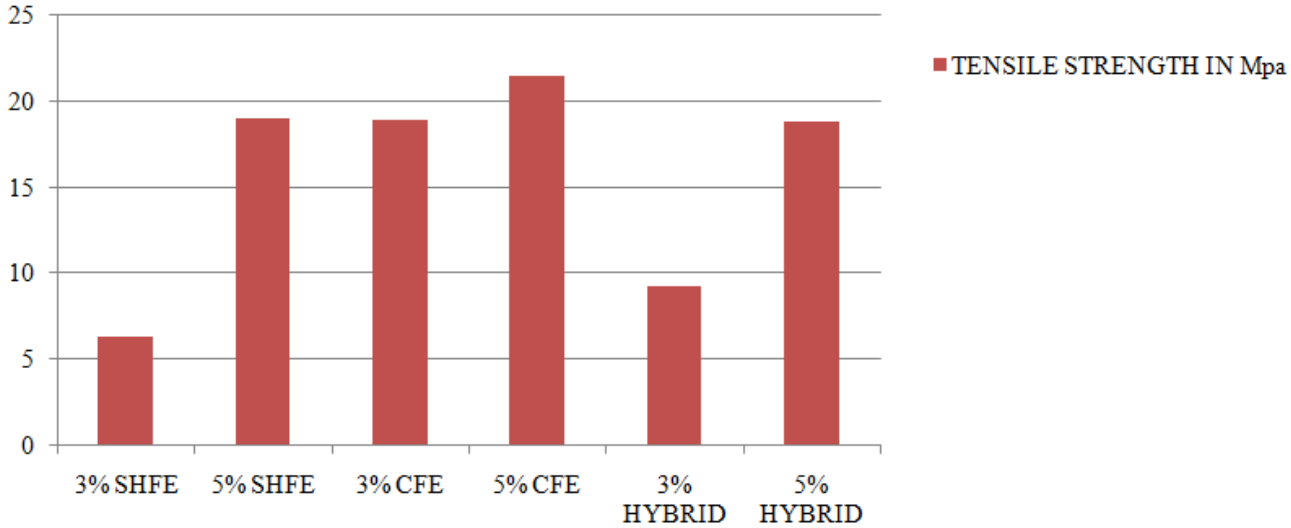


Fig. 12 Comparison Graph of Impact Strength and Tensile Strength for Coconut fiber, Sunn hemp fibre and Hybrid Fiber Composite

VI. CONCLUSION

Coir fiber epoxy samples were fruitfully made by utilizing coir fibers as reinforcement with epoxy resin as a matrix. By performing the tensile test using the Universal Testing Machine it was concluded that by increasing the fiber content, the tensile strength of FE-composites can be increased. The maximum value of tensile strength that was determined through the test was 5% CFE samples and if looking at the percentage elongation the maximum value is found out to be 3% for SHFE. If all the samples are compared, the fiber which has good tensile strength and less percentage elongation is the Coconut fiber than Sunn hemp and Hybrid composite samples. The conclusion is also shown in the following graph.



Therefore, it can be concluded that coconut fiber is a suitable material which can be used to replace the conventional materials for reinforcement purpose and this too is a demand of new era of material science. Coconut fiber have further advantages like easy availability, easy degradation etc. which make it more suitable as a better option in reinforcement purposes.

VII. REFERENCES

1.AsimShahzad ,"Hemp fibre and its composites ",Journal of Composite Materials published online 15 August 2011 ,DOI: 10.1177/0021998311413623

2.KiranRohit* and Savita Dixit," A Review - Future Aspect of Natural Fiber Reinforced Composite", Department of Chemistry, Polymers from Renewable Resources, Vol. 7, No. 2, 2016,Manit Bhopal, 462051, Madhya Pradesh, India

3.T. Prakash, "Processing and characterization of natural fiber reinforced polymer composites," Bachelor's Thesis, National Institute of Technology, Rourkela, 2009.

4.Wambua P., Ivens J., Verpoest I., Composite Science Technology, 63, 2003, 1259-64, Journal of Minerals and Materials Characterization and Engineering, Vol.11 No.4, April 20, 2012

5.D. Tama, M. Isler and M. J. Abreu, Evaluating the thermal comfort properties of Rize's traditional hemp fabric (Feretiko) using a thermal manikin, Materials Today: Proceedings, https://doi.org/10.1016/j.matpr.2019.10.063

6.L.Y. Mwaikambo, M.P. Ansell / Composites Science and Technology 63 (2003) 1297–1305

7.Yadvinder Singh a, Jujhar Singh" Fabrication and characterization of coir/carbonfiber reinforced epoxy based hybrid composite for helmet shells and sports-good applications: influence of fiber surface modifications on the mechanical, thermal and morphological properties"Journal of material research and technology 2020; 9(6): 15593-15603.

8.Schwarzova, I.; Stevulova, N.; Melichar, T. 2017. Hemp fibre reinforced composites

9.Andrea Parenti a , Giovanni Cappelli" SunnGro: A new crop model for the simulation of sunn hemp (Crotalaria juncea L.) grown under alternative management practices" Biomass and Bioenergy 146 (2021) 105975

10.Nilza G. Jústiz-Smith," Potential of Jamaican banana, coconut coir and bagasse fibres as composite materials" MATERIALS CHARACTERIZATION 59 (2008) 1273 – 1278.