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 & Characterization of Natural Fiber Reinforced Polymer Composite for Stretcher Application

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***Abstract*— The paper discusses Composite materials' vital role in a wide range of applications.Their adaptability to different situations and desirable properties attracted many industries. Medical industry also requires lightweight applications. So all the researchers are concentrating on new materials which will be strong enough, low cost, less weight, recyclable, high specific strength, non abrasive, eco-friendly, fairly good mechanical properties with biodegradable characteristics. In nature, none of the single materials will have all the required properties.Hence much amount of researchis intensified on the composite materials. This project will be an Innovative attempt to develop Natural Fiber Composites for Stretcher application.**

***Keywords*— Natural fiber, Glass fiber, Composite material,**

I.Introduction

Natural fibers have played a very important role in human civilization since prehistoric times. The Natural fiber reinforced composite has recently attracted the attention of researchers because they are environmentally friendly, being lightweight, strong, cheap, non abrasive, highly specific mechanical properties and abundantly available.

In present research we have decided to characterize the behavior of Hemp & Glass fiber. Hemp fibers are considered as one of the strongest members of the bast natural fibers family, which are derived from the hemp plant under the species of Cannabis.

The physical properties of natural fibers like density and diameter are the most important properties to make lightweight composites. The mechanical performance of the fiber-reinforced composites is mainly the function of the fiber dispersion, fiber-matrix compatibility and aspect ratio of the reinforcement. The tensile properties such as tensile strength, modulus and strain-to-failure of natural fibers play an important role in deciding the properties of polymer composites. To use these properties of natural fiber to fabricate NFPC with similar properties as steel and comparatively lower in weight that is what we aim to achieve in this project.

II. Literature Review

Hajnalka Hargitai, Ilona Ra´cz, Rajesh Anandjiwala (2006) The water uptake is due to the hydrophilic nature of cellulose, and also due to the capillary effect when fibre-ends are exposed to water. In our case, when the composite samples are cut from sheets, the capillary effect of free fibre-ends has a leading role in the water uptake. That is the explanation of the higher water uptake at higher fibre content. Differences being found even after the first day of immersion in water, for example, the weight of the composites increased by 2.4%, 6%, 13% and 42%, for hemp fibre contents of 30%, 40%, 50% and 70%, respectively.
At higher fibre content higher water uptake is noticed, and differences were found even after the first day of immersion in water. For example, the weight of composites increased by 2.4%, 6%, 13% and 42%, for the hemp fibrecontent of 30%, 40%, 50% and 70%, respectively. The rate of water absorption decreased significantly after the fifth day, the saturation was achieved on 17 to 19 days in the case of composites containing lower fibre content, however, no saturation was found in composites containing 50% and 70% hemp fibre. Fig. 2: The maximum water uptake as a function of fibre content in parallel and in perpendicular to the directions of carding [1]

- Table I Mechanical & Physical Properties of Fibers[5]

Material	Density (g/cm^3)	sile Strength(MPa)	Young'sModulus (GPa)
Hemp	0.86	690	30-70
Glass (S)	2.46	4890	86

Fig. 1 Mechanical Properties of Natural Fibers & Glass Fiber

Nonwoven hemp fibres of 100mm & 80mm length (from Varanasi, India) were prepared in sheet form for hand lay up process & Glass fiber(S) were prepared in woven sheet both, the fibers were arranged in random orientation . After observation hemp fiber was treated in NAOH of 6 wt% for 24 hrs and dried in 40^{0}C for better bonding of hemp fibers and resin . After studying previous research on this matter 60%wt of fibers and 40% wt of resin was used for fabrication of composite

Woven Glass fiber with random oreintetion of 100 mm to 80 mm long fiber was used for glass fiber composite.

Fig. 2 Hemp Fiber NaOH Treated

Fig. 3 Glass Fiber

To fabricate the samples there are multiple methods like Pultrusion, Injection Moulding, Hand lay up process, Vacuum bag, Pressure bag, Spray-up, and Filament winding, closed molding process, including Compression Molding, Injection Molding, and Continuous pultrusion. After reviewing these processes Hand Lay Up Process is more efficient when it comes to the point where woven mats of fiber are used as reinforcement.

This project also focuses on fabrication of hybrid composite material which will contain Hemp fiber and Glass fiber as reinforcement & epoxy as matrix. The glass fiber used in this hybrid material is to enhance properties of hemp fiber whether it isphysical & mechanical. In case of Hybrid Composite ratios were taken as 30%wt of hemp fiber 30%wt of Glass fiber &40%wt of Epoxy resin.

Epoxy resin LY556 mixing ratio of epoxy LY556 and hardener HY951

Raw Materials The matrix used for the study is a DGBEA based epoxy matrix LY556 cured by using an amine hardener HY951. The resin and the hardener were mixed in 10:1 ratio as suggested by the supplier. Density of the resin is 1.1-1.2. g/cm3 and that of the hardener is 0.98 g/cm3

Releasing agent Application and dosage: G- 172 is a ready to use formulation and is added directly to the epoxy or acrylic resin. To achieve the good results, a careful admixing is imperative.

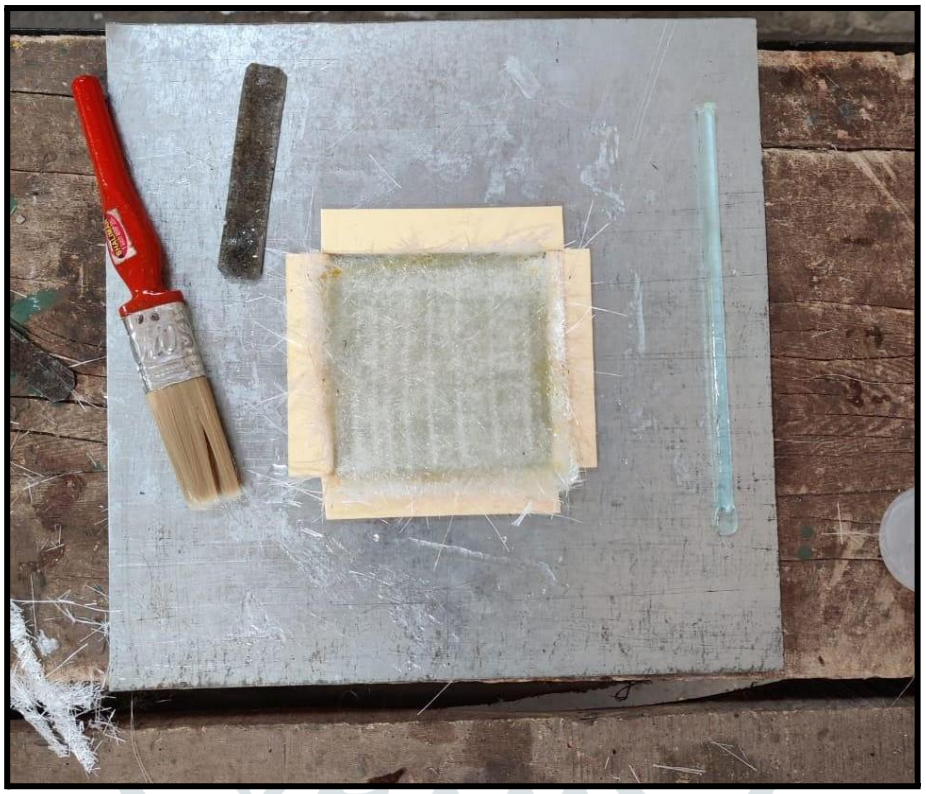

Fig. 4 Fabrication of Composite

After mixing resin and sheets of fibers in a symmetrical manner another sheet of galvanized aluminium was placed up on sample and sample were placed under flywheel press to remove the air present in the resin and fiber. After 2 hours of press material is placed under uniform load for another 48 hours as per instruction of epoxy manufacturer at room temprature for curing.

Finished Samples:

Fig. 5 Hemp Fibre Composite

Fig. 6 Glass Fiber Composite

Conclusions

In foldable stretchers, the mostly used material is steel which has density around 7.87 g/cc and it is heavy so it is required to reduce weight of stretcher by replacing steel with natural fiber and glass fiber composite.
This project is an innovative attempt to introduce hemp fiber in hospital equipments. Hemp fiber has never been used in foldable stretchers prior to this project & glass fiber is used to enhance the properties of hemp fiber in hybrid composite. Also using natural fiber is environmentally friendly.The mechanical properties of hemp fiber are Tensile strength 690 MPa Young's Modulus 30-70 GPa & Density 0.86 g/cc which is remarkable. In glass fiber Density is
2.46 Tensile strength 4890 MPa & Young's Modulus 86 GPa
In this project Three samples were made one with treated Hemp fiber and epoxy resin one with neat Glass fiber and Epoxy resin and one with combination of hemp and glass fiber with epoxy resin.It is expected for hemp to sustain thestresses induced in application and glass fiber is introduced for hybrid composite material which will provide strengthcloser to steel with lower weight.
Further this fabricated material will be tested for physical and mechanical properties such as Density, Hardness, Tensile Strength, Charpy Impact Strength, Flexural Strength.

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