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Experimental Evaluation of Mechanical Properties of Natural Fibers (Hemp &Wool)

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***Abstract* – Composites are in general combinations of two or more material in which the reinforcing the phase is either polymer or ceramic/metallic material. There are different types of fiberswhich are reinforced in the matrix of which natural fibers have gained much importance in recent past. Fiber Reinforced Polymer (FRP) composites play an important role in all spheres of day to day life due to their low cost, processing advantage of lower density and possessing good mechanical behavior over traditional reinforcement materials. In the present investigation natural fibers hemp and woolen is reinforced with epoxy resin. These fiber reinforced composites were successfully prepared by simple and cost effective synthesis methods by hand lay process. The synthesized composites were subjected to different characterization techniques to test it's suitability in different mechanical components. To test it's suitability, mechanical properties such as tensile strength and hardness subjected to different composition of the hardener and resin percentage.**

They are Epoxy resin 70% + Hardener 30%, Epoxy resin 75% + Hardener 25% and Epoxy resin 80% + Hardener 20%. The mechanical yield for different compositions of fiber and resins is discussed in detail.

***Keywords*– Epoxy, Fiber Reinforced Polymer, ceramic etc.**

I. INTRODUCTION

The interest in natural fiber composite material is rapidly growing in the mechanical sector. Due this there is a vast change in both the industrial application and the fundamental research. Natural fibers are mostly preferable because they are renewable source, non-toxic to nature, cheap, partially recyclable and biodegradable in nature. Plants like flax, cotton, hemp, jute, sisal, pineapple, bamboo, banana, silkworm etc., are mostly used since very long years back due there properties. They are generally used as lignocelluloses fibers. The availability, renewability, low density and price as well as satisfactory mechanical properties make them an attractive ecological alternative to glass, carbon and man-made fibers used for manufacturing of composites.

These are very environmental friendly in nature and are used in transportation like railway coaches, aerospace, military applications, building and construction consumer products etc. Recently, car manufactures have been interested in incorporating natural fibre composites into both interior and exterior parts. So, many companies such as Mercedes Benz, Toyota, and DaimlerChrysler have already accomplished this and are looking to expand the use of natural fiber composites. This serves to lower the overall weight of the vehicle thus increasing fuel efficiency and to increase the sustainability of their manufacturing process. The two main major factors currently limit the large scale production of natural fibers composites, Firstly they are strength of natural fiber composites which is very low when compared to glass, Secondly limiting large scale production of natural fiber composites in water absorption. Generally the natural fibers absorb water from the air and direct contact from the environment.

II. LITERATUREREVIEW

A composite material is composed of two or three distinct different materials combined to form new materials, keeping their identity as it is, which gives new material property superior to the individual materials. The new material is named as "composite material" because they are composed of different materials. They find applications in all fields of engineering; few examples are building construction, automobile, aerospace, sporting goods.

The commonly fabricated composite material for many daily life applications are glass fiber reinforced with polypropylene resin. This material low cost and gives good mechanical properties. The properties of composite material are decided by the nature of fiber and resin. The resin binds the fibers together; resin protects fibers from external contact of materials which may cause wear. The bonding between the fiber and resin makes the composite material stronger.

Nicolas Martina, Nicolas Mouretc, Peter DaviesbandChristopheBaleya [1] found that the tensile strength of fibers increased with more retting of fibers. Tensile strength also depends on aspect ratio of fibers, defects in fiber will reduce the tensile strength of fibers.

R. Hemanth, M. Sekar, B. Suresh [2] note that Polyoxymethylene POM polytetrafluroethylene PTEE resin based composites have better hardness, tensile and flexural properties when compared with Thermoplastic polyester elastomeric/ polytetrafluroethylene PTEE resin based composites. By adding more filler materials, the tensile strength is decreased further.

G. Ramakrishna, T. Sundararajan and S. Kothandaraman [3] found that, interaction of resin (matrix) with other medium will influence the tensile properties of composites, so the use other mediums for any purpose should be evaluated properly. Generally the composites will be in NaOH medium for curing.
SilvanaZhezhova, SanjaRisteski, Vineta Srebrenkoska1 [4] stated that for the textile fibers can be used to make the FRP composites, the advantage of the textile fibers is that they can be easily woven in 3Dimimentional array and can be woven in complex geometries. The fabrics have good physical, thermal, mechanical properties. They are good corrosion and wear resisting materials. With the good understanding of the behavior of fibers better FRP composites of textile can be fabricated. Textile fibers can be classified in four ways, fibers, yarns, two dimensional fabrics, and 3 Dimensional fabrics. There are new types of textile fibers like interlaced two dimensional fabrics, interlaced three dimensional fabrics, 2.5 D fabrics can be made by using different techniques of the wooing.

Maria Cristina Santos Ribeiro[5] concluded that, there are no clearly defined methods for recycling the FRP composites. There are no better means of scrap of FRP composites, there no recycling units, no good marketing for FRP composites made from recycling. There is no FRP composites waste management. The landing by FRP composite waste creates environmental problems. Energy saving methods while producing the composites should encouraged a lot. The existing manufacturing methods should change with low energy input methods, this will decrease the cost of production and also environment pollution will be minimized.

III. EXPERIMENTALPROCEDURE

The experimental technique follows the hand lay method. This has a long wide plate used as a base. The resin and hardener are mixed firstly, and then the coating is applied uniformly on the entire area of the required size of the laminate. Then a layer of fiber is evenly placed oven the resin, then a little amount of force is applied on it with the roller. Then again a coating is kept on it.

This process is repeated until the required thickness is obtained. Then a coating of wax is kept to finish the product or a Teflon sheet is kept on it with a little weight.

Fig. 1. Hand lay method on Teflon sheet.

Fig .2. Mixture of resin and hardener.

Fig .3.Spreading the resin as a composition.

Fig. 4. Laminated profile of hemp natural fiber.

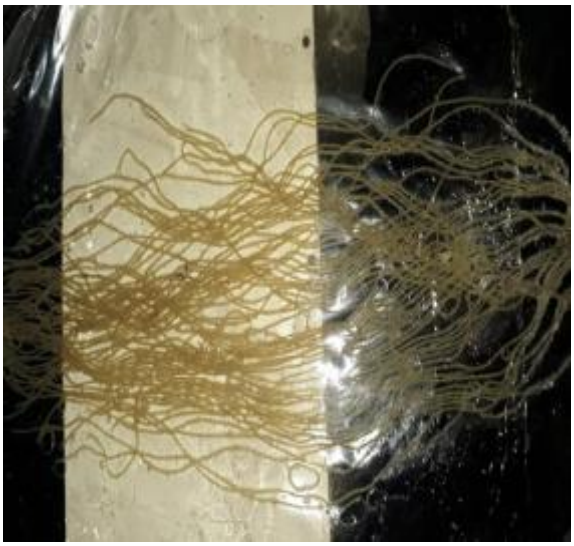

Fig .5. Laminated profile of wool natural fiber.

Fig .6. Formation of laminate on weighted surface.

IV. PREPARATION OF THE SPECIMEN

The laminate setting on the board is gently removed by releasing the Teflon sheet. The laminate has on the edges with the fibers are cut in to make laminate to a uniform shape. Fibers are cut by the carpentry chisel. The extra parts are also cut by the chisel.

The ASTMD 638 specimen shape is marked on a paper; this paper is cut and pasted on the laminate. The shape is to be cut on the laminate to make the specimen. This laminate with the marked specimen is taken to the carpentry shop for cutting a specimen.

Fig .7. Preparation of the Dog-bone shape.

Fig .8. Dog bone shape specimen of hemp fiber.

Fig .9. Dog bone shape specimen of Wool fiber.

4.1 Mechanical Testing Methods:

In this experimental set up the specimens undergo two types of testing methods. They are:

- Tensile testing
- Shore hardness testing

4.1.1 Tensile testing:

This testing is also known as tensile testing. This is the fundamental material testing for all the materials in the engineering field, in which the sample is subjected to the a controlled tension until failure. The purpose of this testing is:

- Selection of a material for an application.
- Predict how a material will perform in use: normal and external forces.
- To demonstrate the utility of a proposed material.

The ability of the material to withstand pull force is called tensile testing. In this testing process we will be finding the strength of the specimen up to the breaking point. The stiffness can be found by tensile modules is found from stress-strain diagram. The tensile test is found by the universal testing machine with the cross head speed of 3mm/min, the grippers are tightened uniformly and evenly.

Fig .10. Grippers of a UTM 2010.

Fig.11. Tested specimens of the wool fiber.

Fig.12. Tested specimen of the hemp fiber.

4.2 Hardness:

Shore hardness is a measure of the resistance in a material to identify. The shore hardness scales foe measuring the hardness of the different materials (soft, rubber, fibers, rigid plates, and super soft gels, are the examples). The scales were invented to the people to have the common point of reference. In this the higher number on the scale indicates a greater resistance to indentation and thus harder materials. Lower numbers indicate less resistance and soft materials. The term is also used to describe a material rating on the scale as in a object having Shore durometer of 90'. This is developed in 1920's to measure the suitable hardness of the materials.

Fig.13. Shore hardness testing machine.

CONCLUSION

1. In this project, we fabricated specimens at different composition of hardener and resin percentages,
2. Epoxy resin 60%+ hardener 40%, and Epoxy resin 80%+ hardener 20%.
3. The laminates are fabricated by hand layup method effectively. The experimental study reveals the enhanced mechanical properties like hardness and tensile strength.
4. The hardness improved by adding reinforcements to the base alloy. The addition of epoxy resinparticles improved the hardness and the improved wear properties results by the addition of hardener and epoxy resin. Further the mechanical properties enriched by heat treatment. Hardness and tensile strength were improved by the composition of Epoxy resin 80% + hardener 20% with hemp fibre compared to wool fibre.

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