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STUDY OF MECHANICAL PROPERTIES OF NATURAL FIBER COMPOSITES.

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ABSTRACT- In today's world we use plastic in many things .This plastics are generally traditional glass, carbon, boron fibres etc. This plastic impacts on environment and the cost of the plastic is also high. Instead of these fibres we are using natural composite fibres .Many types of natural fibres are investigated used for plastics. Such natural fibres are jute, hemp, banana, sisal, etc. Natural fibres are biodegradable and renewable and hence they have good marketing appearance. The waste of agriculture can be used for making natural composite fibres and hence their cost is much less than synthetic fibres. Application of natural composite fibres presented the need for engineering analysis. The present work concentrated on natural fibres like banana and jute which are plenteous in nature. With the help of various patterns and determining the characteristics, conducting various tests like tensile test, hardness test, water absorption test, impact test and comparing these results with various sections of materials concluding the use natural composite fibre for automotive and commercial manufacturing. The present experimental study aims of realising the mechanical properties of natural composite fibres. Samples of banana and jute composite fibres are manufactured by using hand lay-up method, where banana, jute mats and matrix keep at 30%-70%. As per ASTM standards we cut the specimens for different tests; like tensile, hardness, impact, etc.

Keywords-Natural fibre, Mechanical properties, composite matrix.

I. INTRODUCTION

The demand of natural fibres increases day to day and hence it is necessary to pay attention on that for academia and industries because of environmental and economic reasons in addition to health concerns. The natural fibres composites are biodegradable, renewable than traditional glass, boron, carbon, Kevlar fibres. It also offers low densities and cost with addition to offering less abrasive tooling, less irritating to skin. It has well acoustics and thermal properties, and also they are formed in to light weight composites. Which are making interest in automotive and aerospace industries. Because of which it is leading to weight reduction and increases fuel efficiency.

In few years various types of green fibres such as banana, coconut, hemp, jute have been used as a natural composite fibres for production of composites with thermosetting and thermoplastics polymers. Because they are renewable and biodegradable and combined with good structural

properties. That's why they are attractive for automotive and plastic industries

Increasing demand of environmental concerns and vehicle energy system are forcing the automobile industries to generate and to prepare light weight, bio- based composite material. Use of natural composite fibre has advantages over synthetic fibre such as bio-degradability, minimum cost, widely availability in market. In automotive industries for the evaluation of synthetic composite fibre NDE methods are adapted.

Synthetic fibres has more market potential all over the world because of its easy handling. However, the use of synthetic fibres causes several impacts on the environments and also they are non-biodegradable. Due to this it is necessary to develop the new natural composite fibres.

I. LITRATURE REVIEW

The review of literature related to various retting techniques which have been summarized, it is apparent that water retting technique is inexpensive and produces fibres with high tensile strength compared to other techniques. Even though enzymatic, chemical and mechanical retting techniques reduce retting time, these techniques are costly and produce blast fibres of low quality compared to the water retting technique [1].

Hand Laminating Moulding is used for fabricate the natural fibre composites [2] .The base plate is fixed inside the frame for fabricate the natural fibre composites 70% of rein hardener mixture and remaining natural fibres are used. The mixed resin and hardener is filled in the pattern. The prepared natural fibres are randomly poured in the resin hardener mixture without any gap. The roller is rolled in the mould. Again the mould is filled in pattern by next layer and fibres poured randomly. This process is simultaneously done till the height of the mould 10mm.The lid is fixed on the top of the frame for distribute the load evenly on the mould. The setup is kept in the dry place for 24 hours. After 24hours the mould is take away from the pattern, finally the natural fibre composite is fabricated.

The mechanical properties of a hybrid kenaf / glass reinforced composites for utilization in

Passenger car bumper beam [3]. A twisted kenaf hybrid Material, which is fabricated by hot impregnation method present a good mechanical properties. The comparison charts shows some mechanical advantages compare to LFRT bumper beam material. This implies that a hybrid kenaf/glass reinforced material could be utilized in automotive structural components such as bumper beams and front end modules. More over impact properties could be improved by optimizing the structural parameters like thickness, beam curvature, and strengthening ribs.

The lamination thermoforming technique is one of the successful composite fabrication methods that is suitable for both thermoplastic and thermosetting material property [4]. The processes are not too difficult and do not take too much time. The Bombyx Mori silk polymer composites are the natural composites that are very crucial and can be the alternative choice for studying in the medical fields.

A study case to use Guadua Angustifolia kunt (GAK) as reinforcement in a polymeric matrix base. Also includes analysis about tensile resistance tensile strength, Young's modulus, flexural strength and flexural modulus of short bamboo fibre polymeric composite reinforced [4]. In this research has been used a commercial orthophthalic unsaturated polyester resin (UP), methyl ethyl ketone (MEK), polyvinyl alcohol, and natural fibers such of bamboo. This fibers can be obtained using traditional methods, manipulating different parts of GAK cane for small pieces and then through a shredder achieve fibers with a uniform thickness.

Natural fibres in simple definition are fibres that are not synthetic or manmade. They can be sourced from plants or animals. Hence, these fibers are actually in abundance stock around the world. Several plants from which fibers can be sourced are Sisal (*Agave sisal Ana*), Hemp (*Cannabis sativa*), Bamboo, Coconut (*Cocos nucifera*), Flax (*Linumusitatissimum*), Kenaf (*Hibiscus cannabinus*), Jute (*Corhorus capsularis*) and Ramie (*Boehmeria nivea*). Fibres from animals are for example wool (Sheep) and feathers (Chicken).

II. PROBLEM STATEMENT

To determining the mechanical properties and behaviour of natural composite fibre used in automotive industries.

III. SCOPES

Natural composite fibre would be the alternate for the synthetic fibre which is biodegradable and cheap and also renewable. It reduces the environmental impacts.

IV. RAW MATERIALS

For making natural composite fibre we use natural fibres (Banana, Jute),

Fig.1.Raw natural fiber (Banana & Jute).

Matrix solution used for this composite fiber is Epoxy Resin and Hardener in the mixing ratio of 100:50.

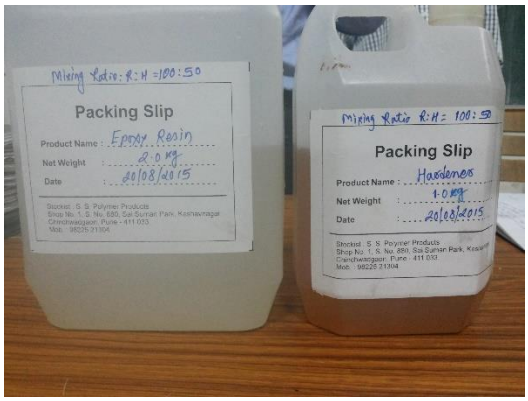

Fig.2.Epoxy Resin & Hardener.

For cleaning purpose we used acetone solution and for pattern making we used die and glass plates.

Fig.3. Pattern making die.

V. SAMPLE PREPARATION

In this project we are using hand lay-up method for making natural composite fiber. First of all we selection of the natural fibre & matrix solution is done in the ratio of 70:30. Then following procedure is followed step by step:

2 glass plates are used for the making of composite fibre out which one glass plate used as base plate. The base plate is covered with a plastic sheet to avoid any sticking action of the mixture of the natural fibre and matrix solution. If the plastic paper is not used or not covered on glass, the composite to be formed on glass will stick to the glass .This will create problem while removing it. Some samples of banana fibres are formed of suitable length of 100mm which are cut properly with seizer. This samples are mixed in random orientation i.e. in multi direction pattern properly.

Fig.4. Multi direction pattern of banana fibre.

Fig.5. Pattern of jute fibre.

The first layer of banana fibre is kept above the base plate or bottom plate which covered with the plastic paper. Then the matrix solution of epoxy resin and hardener is applied directly on the layer of banana fibre with the help of brush by hand. The care to be taken while applying the solution that it should be uniformly spread all over the layer. After confirming uniform distribution of layer the second layer of the banana fibre is placed properly on previous layer. Again the solution of

matrix is applied on this layer uniformly with hand brush. Similarly, next layer of the banana fibre is kept gradually on previous layers properly and matrix solution is applied continuously over it by hand brush. So, such layers of banana fibres are formed by keeping it over each other to get required width of composite fibre. To get the required thickness of composite fibre sheet up to 5mm to 6mm such arrangement is done. After keeping the layers one over another the plastic sheet is covered over it. The roller is used for rolling purpose. The roller is rolled over layers of banana fibres smoothly and continuously. After this another glass plate kept on the natural fibre sheet. So now the banana fibre sheets are in between the two glass plates. At last the weight is kept on the overall pattern to get the required thickness or with of natural fibber sheet. The weight is kept for the two to three day. After three days the weigh will be unloaded for checking its mechanical properties.

Similar process is used for making jute composite fibres.

By using die we can also make composite fibre. First of all at the base plate of the die is covered with a plastic paper then on the paper we spread the matrix solution. Then pattern of jute or banana placed on it. After that the matrix solution is spread uniformly on pattern and covered it with another plastic paper. The roller is rolled over it to get uniform thickness. At last the upper plate is bolted tightly by bolts to base plate. The pattern is removed from die after 24 hours.

Fig.6.Banana composite fibre sample.

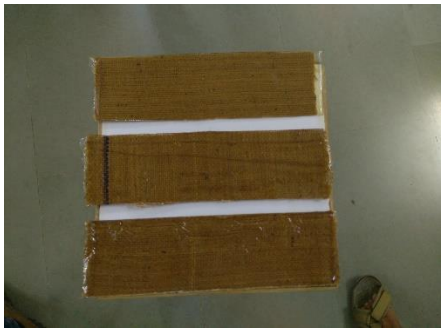

Fig.7.Jute composite fibre sample.

Fig.8.Bnana & Jute composite fibre sample.

VI. MECHANICAL TESTING PROCEDURE

[A] Tensile testing:-

A wire hacksaw block is used for cutting the laminate into smaller pieces. For tensile testing sample is cut into dog bone shape .the dimension of specimen (150*10*5)mm as per ASTM standard D638.Then test will be performed on universal testing machine (UTM).

Fig.9.Dog bone shape for tensile testing.

[B] Flexural test:-

For flexural testing sample will be cut into flat bar shape (20*150*5) mm as per ASTM standard D790. And the test will be performed on UTM

Fig.10.Flat bar shape for flexural testing.

[C] Impact testing:-

For impact testing, as per ASTM standard D256 the specimen will be cut into dimension of (64*12*3) mm and then using impact tester the test will be performed.

[D] Hardness testing:-

As per ASTM standard D2240 Rockwell hardness tester will be used for the hardness testing. The specimens of two groups of fibre will be used for hardness testing.

[E] Compressive testing:-

According to ASTM standard D659-02a test will be performed on the specimen with a dimension of (5*5*10) mm. To performed compressive test Hounsfield tensometer and compressive force should be used.

VII. CONCLUSION

From this we conclude that the natural composite fibre is more beneficial than synthetic fibre because of it is biodegradable, renewable, lesser cost and it is eco-friendly. Due to that in future this fibre will be replace the synthetic fibre use in automotive and commercial application.

VIII. ACKNOWLEDGMENT

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