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To Develop and Evaluate Impact Behaviour of Natural Fibre Reinforced Composite-Review

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ABSTRACT- During last few years, the interest of using natural fibres as reinforcement in polymers has increased considerably. Natural fibres are not only strong and lightweight but also relatively very cheap and bio-degradable. This study is to investigate the impact behaviours natural fibre composite consists of Jute & Banana fibre as reinforcement and epoxy resin as matrix. The Banana fibres treated with acetone to improve its surface properties. The conventional hand layup technique is used to prepare different composite specimens samples. 15 numbers of different composite specimens are to be prepared with varying compositions of Jute and Banana fibres and epoxy resin. The objective of this study is to investigate the impact behaviour of natural fiber composite material by using Experimental Technique. The nature of hybrid reinforcement at different composition is also studied. The commercial Izod impact test machine is used for experimental study. The results will shows the specific impact energy of fibre composite is sufficient to partly replacing currently used glass fibers composite reinforcement.

Keywords: Natural Composite, Jute and Banana Fibre, Impact strength, Epoxy Resin.

I. INTRODUCTION

The attention in using natural fibres such as different plant fibres and wood fibres as reinforcement in plastics has increased affectedly during last some years. With regard to the surrounding aspects it would be very motivating if natural fibres could be used instead of glass fibres as reinforcement in some structural applications. Natural fibres have many advantages compared to glass fibres, for example they have low density, and they are recyclable and biodegradable. Additionally they are renewable raw materials and have relatively high strength and stiffness. Their low density values allow producing composites that combine good mechanical properties with a low specific mass [2] The banana fibres, due to its ease of availability and increasing demand in environmental friendly materials, marked its importance in composite engineering. Focus on natural fibres is increased as its low cost when compared to synthetic fibres which are petroleum based products. Natural composites are manufactured using epoxy resin with reinforcement as natural fibres [6].

Banana fibre at present is a waste product of banana cultivation. Hence, without any including cost input, banana fibre can be obtained for industrial purposes. Banana fibre is found to be good reinforcement in polyester resin. The properties of the composites are strongly depended on the fibre length [2]. The applications of jute polyester composites in use are lampshades, suitcases, paper weights, helmets, shower, bath units, electrical appliances, covers, pipes, post-boxes, roof tiles, grain storage silos, panels for partition and false ceilings, bio-gas containers, and in the construction of low cost mobile as well as pre-fabricated buildings for use in times of natural calamities. The study of natural fibre reinforcement is due its abundant availability in wide variety .The jute fibers have a uniform cross section with micro fibrils having a multicellular structure. However, its physical and mechanical properties are highly inconsistent and mainly depend on geographic origin, climatic growth conditions and processing techniques. [7]. However, the impact resistance of a composite material is always difficult to determine due to some other factors such as delamination at the interface, fibre breakage, matrix cracking and fibre pull out.[9]

Epoxy resin is a thermosetting resin , it is made of tightly linked adhesive polymer structure that are often used in surface coating. For the fiber reinforced polymer Epoxy resin is used as the matrix to efficiently hold the fiber in place. For the matrix phase epoxy resin (Lapox HY 951) & Hardener (Lapox LY 556)is used for bonding the fibers .[13] Epoxy resin is used for the composite as a binder with hardener , having the outstanding properties as Excellent adhesion to different materials , Great strength, toughness resistance , Excellent resistance to chemical attack and to moisture , Excellent mechanical and electrical properties, Odourless, tasteless and completely nontoxic , Negligible shrinkage. In application of bio-composite as part of structural unit, the major obstacle is their low impact properties, which can be improved by incorporation of discrete layers of tough resin. As thermoplastic resins need a processing temperature which is higher than natural fibre, they cannot be used for natural fibre composites. Whereas thermosetting resins can cure in room temperature and they are used widely in natural fibre composites. Epoxy can present better properties as a matrix.[1]

Chemical treatment with NaOH removes moisture content from the fibres thereby increasing its strength. Also, chemical treatment enhances the flexural rigidity of the fibres. Last, this treatment clears all the impurities that are adjoining the fibre

material and also stabilizes the molecular orientation. [12] in this study acetone is used to clean the banana fibres . The surface modification by alkali treatment has improved the Mechanical properties than untreated fiber composites. The alkali treatment of banana fiber has improved the mechanical properties like tensile, flexural and impact strength of both the epoxy/vinyl ester and hybrid composite. Therefore it is conclusive from the above result that the alkali treatment has provided better mechanical properties. In future various other natural reinforcing material could be used to mix with banana fiber to form a better hybrid composite which has a better mechanical properties and as well as cost effective.[18]

The composite are fabricated by hand lay-up technique. The mould used for fabricating the composite is made up of aluminium with a deboning agent applied on the inner side. The inner cavity dimension of the mould is 150mm x 150mm x 10mm.[18] Izod impact test methods were conducted according to the ASTMD256-04 standard hybrid kenaf /glass reinforced composites[3]. [Glass laminate - Impact strength -17.82 J/m2], [Ukam Laminate fiber -Impact 9.8 J/m2],[Banana - 7.47 J/m2] Standard ASTM D256-05[5]. Roselle & Banana – Fracture energy 20 Joul , Impact - 0.23125 j/mm2 2.Sisal & Banana - Fracture energy 21 j - Impact - 0.2625 j/mm2.[12]

II METHDOLOGY

2.1 Preparation of Natural Fiber Reinforcement

In this study we use Jute and banana fibres, due to its ease of availability and increasing demand in environmental friendly materials, marked its importance in composite engineering.

5.1.1. Banana Fibers

The banana fibres are imported from Gujarat , Initially the fibre length is measured as 50 -60 cm as shown in fig no.1 . then this fibres are first sort out properly with same length after that the selected fibres are deeper in to the Acetone solution for 5-6 min. for cleaning purpose that the all moisture & dust particles removed from the fibres after removed from Acetone solution & this clean fibres are kept for soaking for 24 hours at room temperature , then this acetone treated fibres are cut in 5cm pieces . with this 5cm fibres we made a banana mat as (random discontinues mat) shown in figure 2 this mats used as a laminate during the preparation of composite reinforcement .

Figure 1 loose banana fibers

Figure 2 Banana fibers mat

2.1.1 Jute Fibres

Mainly two types of jute fibers are available in the market White jute or Capsularies jute & Olitorious jute fibers Capsularies jute is whitish in nature and Olitorious comes in yellow , gray , brown verities the jute used for this study is Olitorious jute it was gray in colour this jute fiber is purchased in the form of mat as shown in figure.3

Figure 3. Jute fiber mat

2.2 Matrix Preparation

In this study we used the Epoxy resin (Grade – L-12 (3202) for the composite as a binder with hardener (K6) as shown in fig.no.4 , The epoxy and hardener used in ratio 100 :50 as directed by supplier .we use epoxy resin because such outstanding properties as Excellent adhesion to different materials , Great strength, toughness resistance , Excellent resistance to chemical attack and to moisture , Excellent mechanical and electrical properties , Odourless, tasteless , completely nontoxic and Negligible shrinkage.

Figure 4 Epoxy resin & Hardener Used for matrix preparation.

2.3 Release Agent

Two A3 size plastic paper sheet used as the release agent in this study which avoided the sticking of the composite with the

mold.one plastic paper placed over the bottom or base plate another is on top of the composite to avoid the sticking with upper plate of the mold.

2.4 Pattern Preparation

Hand layup Manufacturing Technique is used to prepare Natural fiber reinforced composite for this purpose Two stainless steel plates of size 30CM X 30 CM and Thickness 10 MM is used as Bottom or Base plate and Top plate of the mold , each corner & side center of plate 7mm hole is drilled and M6 Nut-Bolt assembly use for Tightening purpose as per pressure requirement on two plates , Four Washers are used to maintain the thickness of reinforced composite . The mold is shown in fig. no.5 as below.

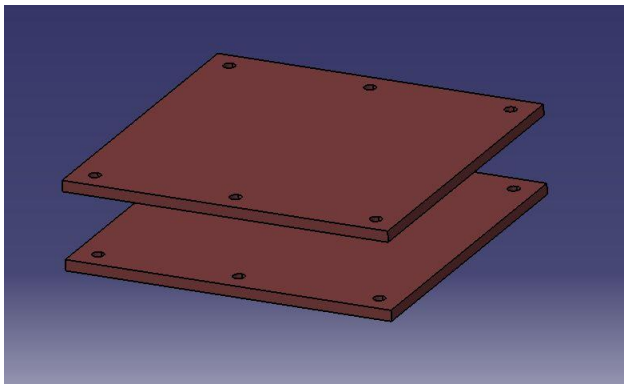

Figure 5 Pattern for Hand layup process

2.5 Hand Layup Manufacturing Method

Hand lay-up technique is the simple method of composite manufacturing. The infrastructural requirement for this method is also minimum. The processing steps are quite simple. First of all, a release gel is sprayed on the mold surface to avoid the sticking of polymer to the surface. Thin plastic sheets are used at the top and bottom of the mold plate to get good surface finish of the product. Reinforcement in the form of woven mats or chopped strand mats are cut as per the mold size and placed at the surface of mold after Perspex sheet. Then thermosetting polymer in liquid form is mixed thoroughly in suitable proportion with a prescribed hardener (curing agent) and poured onto the surface of mat already placed in the mold. The polymer is uniformly spread with the help of brush. Second layer of mat is then placed on the polymer surface and a roller is moved with a mild pressure on the mat-polymer layer to remove any air trapped as well as the excess polymer present. The process is repeated for each layer of polymer and mat, till the required layers are stacked. After placing the plastic sheet, release gel is sprayed on the inner surface of the top mold plate which is then kept on the stacked layers and the pressure is applied. After curing either at room temperature or at some specific temperature, mold is opened and the developed composite part is taken out and further processed. The time of curing depends on type of polymer used for composite processing.

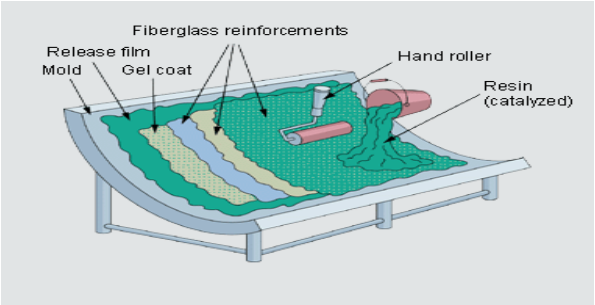

Figure 6 Hand layup process

For example, for epoxy based system, normal curing time at room temperature is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites. Capital and infrastructural requirement is less as compared to other methods. Production rate is less and high volume fraction of reinforcement is difficult to achieve in the processed composites. Hand lay-up method finds application in many areas like aircraft components, automotive parts, boat hulls, dais board, deck etc.

2.6 Hand Layup Manufacturing Procedure

First take the natural fibre & matrix solution in ratio of 30:70 by weight. Then two stainless steel plates pattern is used to prepare natural fiber reinforced composite base plate is covered with a plastic sheet to avoid any sticking action of the mixture of the natural fiber and matrix solution then fibres mat 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 fibre mat 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 mat fibre is placed properly on previous layer. Again the solution of matrix is applied on this layer uniformly with hand brush.

. Similarly , next thread layer of the mat fibre is kept gradually on previous layers properly and matrix solution is applied continuously over it by hand brush. 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 to remove interrupted bubbles during manufacturing. After that keep the upper plate over the plastic paper & tighten two plates with nut bolt assembly to get desired thickness of composite by checking the bush movement which is placed at each corner between two plates. .Once the Free movement of bush is stop we get desired thickness of composite that is 3mm.Finally composite is kept for curing for 48 hours at atmospheric temperature with same setup .After 48 hours the natural fiber reinforced composite is take out .

Figure 7 Banana composite sheet

Finally we cut the samples from unfinished Banana composite sheet through hacksaw & finished by paper as shown in Figure 8 & Produce desired sample for testing as per ASTM standard – D256-4.

Figure 8 Finishing of sample through paper

Figure 9 Finished banana sample.

2.7 Sample for impact testing –

Impact is a single point test that measures a materials resistance to impact from a swinging pendulum. Impact is defined as the kinetic energy needed to initiate fracture and continue the fracture until the specimen is broken test which determines the amount of energy absorbed by a material during fracture. This absorbed energy is a measure of a given material's toughness and acts as a tool to study temperature-dependent ductile-brittle transition. It is widely applied in industry, since it is easy to prepare and conduct and results can be obtained quickly and cheaply. [1]

Impact test is performed on the pendulum impact testing machine as per ASTM D256. A 'V' notch is created at the centre of the specimen having notch depth of 2.54 mm and notch angle of 450, using Impact meter . The respective values of impact energy of different specimens are recorded directly from the dial indicator.[2]

III CONCLUSION

1. To manufacture natural fibre composite using hand lay-up technique as Banana & Jute is a natural fibre reinforcement & Epoxy as a resin.
2. To determine experimentally impact behaviour of natural fibre reinforced composite of Banana and Jute by using Izod Impact test.
3. Analysis of Impact behaviour of Hybrid natural Fibre (Jute & Banana) composite material.
4. Validation of results with FEA software.
5. Finally this project provides an opportunity to replace glass fibre with cost effective natural fibre composite which is eco-friendly in nature and light weight.

IV FEATURE WORK

Manufacture 15 no. of Natural fiber reinforced composite samples with Using Banana, jute & Banana-jute Hybrid fibers as per ASTM D256 Standard for testing impact strength & test the Experimental results by Izod impact test machine , evaluate results by FEA software.

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