Impact and Friction Test on Hybrid Fiber Rainforcer Composite (Sisal and Borassus)

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1. **Abstract:- The hybrids composite has emerged and have the potential reinforcement material for composites and thus gain attraction by many researchers. This is mainly due to their applicable benefits have they offer low density, low cost, renewable, biodegradability and environmentally harmless and also comparable mechanical properties with synthetic fiber composites. In the project natural fiber composites were fabricated by using epoxy resin combination of hand lay-up method and cold press method. Specimen was cut from the fabricated laminate according to the ASTM standard for different experiments for friction test, and impact test. Exhibit higher mechanical properties due to chemical treatment to natural fibers. So, the hybrid composite material shows the highest mechanical properties. This High performance hybrid composite material has extensive engineering applications such as transport industry, aeronautics, naval, automotive industries. Epoxy resins are available in liquid and solid forms and are cured into the finished plastics by a catalyst, Matrixes/Resins are impregnated by hand into fibers which are in the form of chopped strand mat woven, knitted, stitched or bonded fabrics. This is usually accomplished by rollers or brushes, with an increasing use of nip-roller type impregnators for forcing resin into the fabrics by means of rotating rollers and a bath of resin. Laminates are left to cure under standard atmospheric conditions by using hand layup technique.**

Keywords:-Hybrid composites, mechanical and tribological properties, epoxy, hand layup.

2. INTRODUCTION

Many modern technologies require materials with uncommon combinations of properties not found in the classical ceramics, metals, alloys, and polymeric materials of traditional engineering. This particularly applies to applications used underwater, and in aerospace and transportation. Generally, a composite material consists of a form of reinforcement (particles, flakes, fibers, or fillers) embedded in a matrix (metal, polymer, or ceramic). The matrix holds the reinforcement together to obtain the desired shape while the reinforcement improves the overall mechanical properties of the matrix The natural fiber present important advantages such as low density, appropriate stiffness, mechanical properties with high disposability and renewability.

In this project are used the natural fibre, Nature continues to provide mankind generously with all kinds of rich resources in plentiful abundance, such, In recent years, polymeric based composites materials are being used in many application such as automotive, sporting goods, marine, electrical, industrial, construction, household appliances, etc. Polymeric composites have high strength and stiffness, light weight, and high corrosion resistance.

Natural fibers are available in abundance in nature and can be used to reinforce polymers to obtain light and strong materials. The information on the usage of banana fibre in reinforcing polymers is limited in the literature. In dynamic mechanical analysis, have investigated The hybrids composite has emerged and have the potential reinforcement material for composites and
thus gain attraction by many researchers. This is mainly due to their applicable benefits have they offer low density, low cost, renewable, biodegradability and environmentally harmless and also comparable mechanical properties with synthetic fiber composites.

In the project natural fiber and glass hybrid composites were fabricated by using epoxy resin combination of hand lay-up method and cold press method. Specimen was cut from the fabricated laminate according to the ASTM standard for different experiments for tensile test, flexural text, and impact test.

3. LITRATURE REVIEW:

Improving mechanical properties of banana/kenaf polyester hybrid composites using sodium laulryl sulfate treatment. Materials Physics and Mechanics [9]. M. Thiruchitrambalam *et al* chemical treatment on natural fiber composite and mechanical properties will applied them .. properties of woven banana fiber reinforced epoxy composites[10] Sapuan *et al.* natural fibers will properties on banana treat with hemical content reinforced epoxy composites

4. COMPOSITE MATERIALS

Broadly, composite materials can be classified into three groups on the basis of matrix material. They are

i. Metal Matrix Composites (MMC)
ii. Ceramic Matrix Composites (CMC)
iii. Polymer Matrix Composites (PMC)

i. *Metal matrix composites*

Higher specific modulus, higher specific strength, better properties at elevated temperatures and lower coefficient of thermal expansion are the advantages of metal Matrix Composites over monolithic metals. Because of these attributes metal matrix composites are under consideration for wide range of applications viz. combustion chamber nozzle (in rocket, space shuttle), housings, tubing, cables, heat exchangers, structural members etc.

ii. *Ceramic matrix Composites*

One of the main objectives in producing ceramic matrix composites is to increase the toughness. Naturally it is hoped and indeed often found that there is a concomitant improvement in strength and stiffness of ceramic matrix

iii. *Polymer Matrix Composites*

Polymeric matrix composites are the most commonly used matrix materials. The reasons for this are two-fold. In general the mechanical properties of polymers are inadequate for many structural purposes. In particular their strength and stiffness are low compared to metals and ceramics. By reinforcing other materials with polymers these difficulties can be overcome. Secondly high pressure and high temperature are not required in the processing of polymer matrix composites. For this reason polymer composites developed rapidly and became popular for structural applications with no time. Polymer composites are used because overall properties of the composites are superior to those of the individual polymers.

4.1 SISAL FIBER

The botanical name ***Agave sisalana***, is a species of agave native to southern Mexico but widely cultivated and naturalized in many other countries. It yields a stiff fiber used in making various products. The term sisal may refer either to the plant's common name or the fibre, depending on the context. It is sometimes referred to as "sisal hemp", because for centuries hemp was a major source for fibre, and other fibre sources were named after it.

The sisal fibre is traditionally used for rope and twine, and has many other uses, including paper, cloth, footwear, hats, bags, carpets, and dartboards.

Fig.1 Sisal fiber

Properties of sisal fiber

1. Sisal Fiber is exceptionally durable with a low maintenance with minimal wear and tear.
2. It is Recyclable.
3. Sisal fibers are obtained from the outer leaf skin, removing the inner pulp.
4. It is available as plaid, herringbone and twill.
5. Sisal fibers are Anti static, does not attract or trap dust particles and does not absorb moisture or water easily.
6. The fine texture takes dyes easily and offers the largest range of dyed colours of all natural fibers.
7. It exhibits good sound and impact absorbing properties.
8. Its leaves can be treated with natural borax for fire resistance properties.

Chemical composition of sisal fiber

Cellulose	65%
Hemicelluloses	12%
Lignin	9.9%
Waxes	2%
Total	100%

BORASSUS FIBER

Borassus fibers were extracted from the ripened fruits based on the procedure reported elsewhere[16]. Acetic acid, benzene, ethanol, sodium bisulphite, sodium chlorite and sodium hydroxide pellets (Merck Chemicals) were used as purchased. The coupling agent, Poly (propylene)-graft-maleic anhydride (MAPP) (Aldrich) and Sodium hydroxide (NaOH) (Dae-Jung Chemicals) were purchased and used as received. Polypropylene was obtained from Honam Petrochemical Corporation,

Fig.2 borassus fiber

4.3 Epoxy resin

Epoxy resins are available in liquid and solid forms and are cured into the finished plastics by a catalyst. They are cured at room temperatures as well as elevated temperatures of about 275^{0}C. The erosion resin of grade LY-556 was used of density 1.1-1.2gm/cc at 298K. It having the following outstanding properties has been used as the matrix material.

Fig.3 epoxy resin

a) Excellent adhesion to different materials.
b) High resistance to chemical and atmospheric attack. High dimensional stability.
c) Free from internal stresses.
d) Excellent mechanical and electrical properties. Odourless, tasteless and completely nontoxic. Negligible shrinkage.

5. EXPERIMENTALMATERIALS AND METHODS THE MATRIX

The materials used for matrix are epoxy, unsaturated polyester and vinyl ester. Epoxy resins are the most common matrices for high performance advanced polymer composites, but they are also inherently brittle because of their high degree of cross linking. The densely cross linked structures are the basis of superior mechanical properties such as high modulus, high fracture strength, and solvent resistance. However, these materials are irreversively damaged by high stresses due to the formation and propagation of cracks.

MATERIALS OPTIONS

Resins: Epoxy, polyester, vinyl ester, phenolic and any other resin.
Fibers: Glass, Carbon, Aramid, sisal, borassus and any

Fiber Reinforced composite

Fibers are a significant class of reinforcement materials, and the main use of fibers in composite materials is to improve the mechanical and physical properties of the matrix resin with their high strength to weight ratio. Fiber materials are characterized by high tensile and compression strength and high elastic modulus.

The epoxy-polysulfide blend was reinforced by other reinforcement, although heavy aramid fabrics can be difficult to wet-out by hand.
Cores: Any core materials can be used provided that should be compatible with resin system, i.e. polystyrene core cannot be used with polyester or vinylester resin system.
cutting and weighting the fibers; using a volumetric friction of 20% and the rules of mixtures, the weight ratio of the fibers could thus be determined from the total weight of the blend. The method used was to pour an amount of the blend into the mould before adding the first layer of fiber , then adding another amount of the blend, continuing this process to develop a composite material reinforced with three layers of fiber. the samples created in this way. The composite materials were left at room temperature for 24 hours before being extracted from the moulds and placed in the drying oven at 60 °C for 8 hours to complete the process of solidification and to eliminate any stresses that may have formed during the process of reinforcement. Finally, the samples were cut according to the standard specifications for each test

Range of material

- 60% of Epoxy resin
- 20% of sisal fiber
- 20% of borassus
- **Fiber range**
  Sisal fiber and borassus fiber length 300mm
- **Die size**
  Length 1feet*1feet
  Width 5mm

5.1 Description of hand layup technique

Matrixes/Resins are impregnated by hand into fibers which are in the form of chopped strand mat woven, knitted, stitched or bonded fabrics. This is usually accomplished by rollers or brushes, with an increasing use of nip-roller type impregnators for forcing resin into the fabrics by means of rotating rollers and a bath of resin. Laminates are left to cure under standard atmospheric conditions

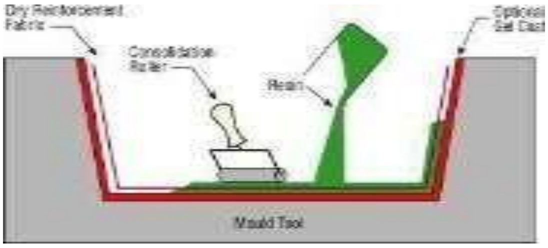


Fig.4 hand layup

6.CHARPY IMPACT (ASTM D-256)

The Charpy impact test, also known as the Charpy v-notch test, is a standardized high strain-rate 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. A major disadvantage is that all results are only comparative. The apparatus consists of a pendulum axe swinging at a notched sample of material. The energy transferred to the material can be inferred by comparing the difference in the height of the hammer before and after a big fracture. The notch in the sample affects the results of the impact test, thus it is necessary for the notch to be of regular dimensions and geometry. The size of the sample can also affect results, since the dimensions determine whether or not the material is in plane strain.

Impactstrength=E/t×1000 'E'- Energy used to break (J) 't' –

Thickness in mm

7.FRICTION TEST ON PIN ON DISK

What could be simpler than to design an experiment in which we rub a couple of bits of material together and make a few measurements? The problem is that with tribology we are not concerned with single "properties" of materials, but how those materials behave when placed in complex systems.

Friction and wear are not intrinsic material properties but are properties of the system in which the materials operate. It follows that the properties measured in an experiment using a test machine are also a system properties.

Hence the data generated from any properly calibrated test machine has to be valid, but only for the performance of the materials in that machine.

Friction test on FRC

$$W=\Delta w/L\rho F \; mm^3 /Nm$$

8. RESULTS

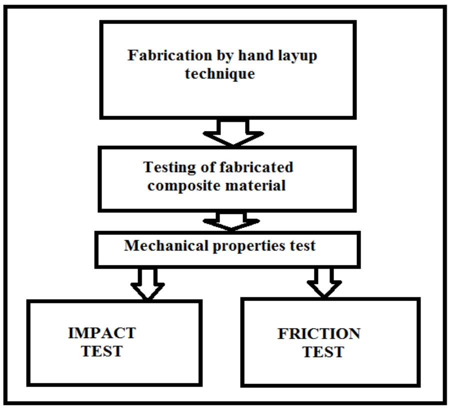


Fig.5 methodology

8.1 Results on impact test

Fig.6 Tested specimen (Impact test)

RESULT TABLE FOR IMPACT TEST

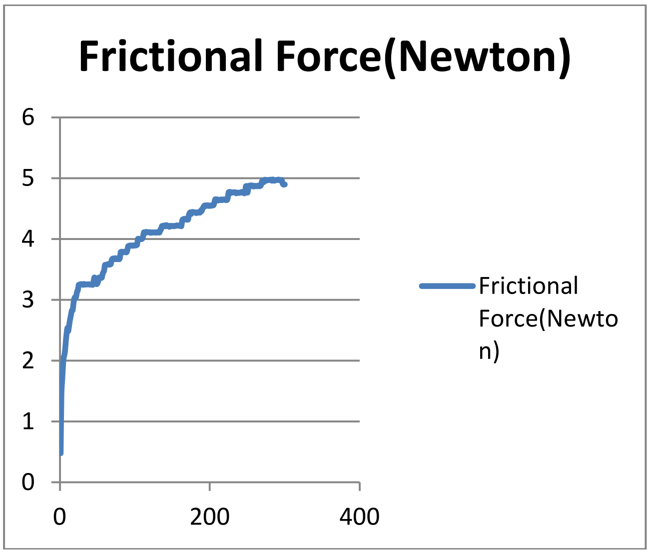
S. N	BREADTH mm	THICKNESS mm	ENERGY USED TO BREAK (J)	IMPACT STRENGTH (J/mm)
1	10	4.00	2	10
2	10	3.40	2	11.76
3	10	3.80	2	10.52
4	10	3.90	2	10.25

8.2 RESULTS ON FRICTION TEST

Fig.7 Tested specimen (Friction test)

RESULT TABLE FOR FRICTION TEST

minutes	friction	Co-efficient	Pin Temperature
1 min	*3.482079*	*0.119052*	*36.3245*
2 min	*4.112955*	*0.37099*	*36.52611*
3 min	*4.43614*	*0.147871*	*36.63553*
4 min	*4.763206*	*0.158774*	*36.85472*
5 min	*4.895486*	*0.163183*	*36.93841*



of the polymer matrix of FRC at an elevated temperature decreased the quantity of leachable residual monomers and increased the flexural strength and modulus of elasticity

8.3 ADVANTAGE

i) Low capital Investment.
ii) Simple principles to fabricate the part.
iii) Low cost tooling, if room-temperature cure resins are used.
iv) Wide choice of suppliers and material types.

9. CONCLUSION

In order to optimize impact strength of a FRC construction with low fiber volume fraction, the fibers should be placed on the tension side of the specimen. In order to optimize friction of the construction, the fiber rich layer should be spread vertically. Light polymerization polymer matrix of FRC at an elevated temperature decreased the quantity of leachable residual monomers and increased the impact strength and modulus of elasticity. Using long fiber at high strength of hybride polymer composites successfully tested

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