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FABRICATION AND TESTING OF E-GLASS FIBRE AND COCONUT FIBRE COMPOSITE MATERIAL USING HAND LAYUP METHOD.

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ABSTRACT: Polymeric materials reinforced with synthetic fibres such as glass, carbon, and aramid offer the advantages of higher stiffness and strength-to-weight ratio as compared to conventional construction materials like wood, concrete, and steel. Despite these advantages, the widespread use of synthetic fibre-reinforced polymer composites has a tendency to decline because of their high initial costs and adverse environmental impact. In recent years, natural fibre composites have attracted substantial importance among structural materials. There has been a fast-growing interest in using natural fibres as reinforcements in composites. The attractive features of natural fibres are their low cost, lightweight, high specific modulus, renewability and biodegradability. Among many natural fibres (like jute, sisal, bamboo, coir, banana etc.), bamboo fibre is one of the most promising ones, because of its low cost, light weight, short growth cycle and high availability. The objective of this project work is to investigate the fibre orientation reinforced hybrid polymer nanocomposites that combine with hybrid composites i.e. COCONUT COIR /E-GLASS and isophthalic polymer in the ratio of E-glass fibre 70%+coconut coir 30%, E-glass Fibre 30%+ coconut coir 70%, E-glass Fibre50%+ coconut coir 50% of volume are to be considered. The mechanical properties are to be calculated by carrying out tests on the specimen's tension, and hardness in accordance with the test procedure laid down in ASTM standards. Finally, after obtaining the tested results, those values are checked

INTRODUCTION

Increasing concern about global warming and depleting petroleum reserves have made scientists to focus more on the use of natural fibres such as bagasse, coir, sisal, jute etc. Thishas resulted in creation of more awareness about the use of natural fibres-based materials mainly composites [1]. In past decade there has been many efforts to develop composites to replace the petroleum and other nondecaying materials-based products. The abundant availability of natural fibre in India gives attention on the development of natural fibre composites primarily to explore value-added application avenues [2]. There are various reasons why new materials can be favoured. Typical examples include materials which are less expensive, lighter, stronger or more durable when compared with common materials, as well as composite materialsinspired by animals and natural sources with a low carbon footprint. Reinforcement with natural fibre in composites has recently gainedattention due to low cost, easy availability, lowdensity, acceptable specific properties, ease of separation, enhanced energy recovery, biodegradability and recyclable in nature. Agricultural wastes can be used to prepare fibre reinforced polymer composites for commercial use. Although glass and other synthetic fibre- reinforced plastics possess high specific strength, their fields of application are very limited because of their inherent higher cost of production. In this connection, an investigation has been carried out to make use of coir; a natural fibre abundantly available in India [3]. Composite materials are widely used for buildings, bridges and structures such as boat hulls, race car bodies, shower stalls, bathtubs, and storage tanks, imitation granite and cultured marble sinks and countertops. Its mostadvanced applications are useful applications for aircrafts & spacecraft in demanding environments [4]. It has found that fiber- reinforced composites [GFR] possess superior properties such as high strength-to-weight and stiffness-to-weight ratios and good corrosive resistance. Development of the composites with natural fibers and fillers as a sustainable alternative material for some engineering applications, particularly in aerospace, automobile, defense and sporting goods industries [5]. The tensile strength of GFR- Isophthalic composites with coconut coir asfillers is comparable to that of plain

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GFR- Isophthalic composite [6].

Glass fiber, composites have higher impact strength and excellent surface finish and high modulus to weight ratios compared to other fiber reinforced composite materials, and therefore extensively used in industries [10]. Because of their low specific gravity, the strength- weight ratio, and modulus- weight ratios, these composite materials are markedly superior to those of metallic materials.

Isophthalic resin, also known as polyepoxides are a class of reactive prepolymers and polymers which contain epoxide groups. Isophthalic has a wide range of applications, including metal coatings, use in electronics / electrical components, high tension electrical insulators, fiber-reinforced plastic materials, and structural adhesives etc. Hardener is a high viscous liquid material, mixed with resin in suitable proportion during the process of preparation of composites which helps in the solidification of the wet, smooth composite.

LITERATURE REVIEW

Fabrication and characterization of coir/carbon fibre reinforced isophthalic based hybrid composite for helmet shells and sports-good applications: influence of fibre surface modifications on the mechanical, thermal and morphological properties :

Coconut-coir, a natural fibre, strong and lightweight, abundantly in India and Vietnam, can be an excellent choice to produce polymer composites. Due to the higher specific modulus and durability, these composites have a myriad of applications. The composite samples were formulated with distinct fibre weight percentages viz. 30%, 20%, and 10% using the vacuum bagging technique. Mechanical behaviour (tensile, compressive, flexural, and impact strength) and thermal behaviour (Thermogravimetric analysis) of coir fibre/carbon fibre/isophthalic resin hybrid composites were studied according to the ASTM standards. Moreover, Scanning Electron Microscopy (SEM) was performed to examine the morphological characterization of tensile fractography specimens and analyze the properties of the fibre/matrix bonding of the surface before and after alkaline treatment. Thetreated fibre shows good matrix binding and less fibre pull-out as compared with untreated fibres. The result also revealed that the hybrid composite has more robust properties under mechanical loading than single fibre-reinforcedcomposite.

Coir carbon fibre/Isophthalic hybrid composite specimens were fabricated of thicknesses 3 mm, 3.5 mm, and 4.5 mm with different fibre- weight percentages of 30%, 20%, and 10% of coir fibre using the vacuum-assisted hand- layup technique. The experimental investigation of the mechanical, thermal, and morphological behaviour made the following conclusions:

i. A significant difference in mechanical behaviour is achieved for untreated coir fibre and chemically treated coir fibre reinforcement. A chemically treated coir fibre provides a rougher fibre surface, which is advantageous for interfacial adhesion of coir fibre/matrix, which leads to mechanical interlocking and lesser pull out.

ii. Compared with the untreated coir fibre/carbon fibre/ isophthalic resin hybrid composite, treated composite shows superior results in terms of tensile strength. However, a tensile property varies with the decrease in the percentage of weight fibre loading. Maximum tensile strength is achieved at 10% fibre loading, and this is because woven carbon fibrehas better tensile performance.

iii. Compressive properties increase as fibre loading increases from 10% to 30%. Maximum compressive strength is achieved at 30% fibre loading, which is 0.23 MPa. Compared with untreated coir fibre/carbon fibre/isophthalic resin, hybrid composite increased compressive strength was obtained due to alkali treatment.

Fabrication and Investigation of Isophthalic resin-based Glass Fibre-CoconutFibre Hybrid Composite Material:

Composite materials are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics

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different from the individual components. Materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components are known as composite materials. Its most advanced applications are useful applications for aircrafts & spacecraft in demanding environments. A hybrid composite material consisting of coir fibres, e-glass fibresand isophthalic resin was fabricated. The weight percentages of each material used were: 5%, 25% and 70% respectively. The coir fibre used was first treated in a sodium hydroxide solution. Three different percentages of the solution were used to treat the coir fibres: 4%, 6% and 8%. The coir fibre was immersed in the solution for a period of 4 hours. Afterwards were fibres are neutralised, washed and dried and cut; ready to be used for the fabrication of the test specimens three specimens were fabricated, each containing coir fibres treated with different percentages of Sodium Hydroxide. The prepared composites were tested to study the mechanical properties of thecomposite such as tensile strength, flexural strength, impact strength and water absorption tests.This work shows that successful fabrication of a coir fibre reinforced isophthalic composites with different fibre lengths is possible by simple hand.lay-up technique According to the results obtained for Tensile testing as seen from the graph 6% treated coir fibre specimens show the 75 best tensile characteristics. This could be attributed to better bonding with the resin and therefore increasing strength. The tensile strength and Young's Modulus were found to be decreased with incorporation of coir fibres which again points to the ineffective stress transfer between fibres and polyester resin The Impact test results in the table 3 shows that the impact strength is highest for the 4% treated coir fibre specimens, a trend is observed in this case that as the percentage of alkali treatment of fibres increases, the impact strength decreases. From the results of the flexural test (Fig 3) it is evident that 6% treatedfibres yield the best results. Once again, this could be due to the fibres bonding better with the resin. A higher percentage treatment could cause degradation to the fibres. Here a decreasing trend in strength after the 6% treatedcoir fibre specimens is seen i.e. a peak value isreached and then it starts decreasing

Fabrication

Specimen Preparation: The fabrication was designed and constructed in accordance with the American Society for Testing and Materials (ASTM) standard plate dimensions of 250 250 10 mm. At first, we have to mix resin and hardener with tabulated/calculated proportions and assured by weight measuring equipment. Figure 2 and Figure 3 shows the e-glass and coconut fibre, and Table 1 shows theproperties of e-glass fibre and Table 2 shows the properties of coconut fibre. Table 3 displays the material composition in which the samples were fabricated.

Figure 1

Figure 2

Figure 3

Table 1: Properties of e-glass fibre.

Property	Unit	E – glass fiber
Density	gr/cm^3	2.56
Tensile strength	MPa	3,445

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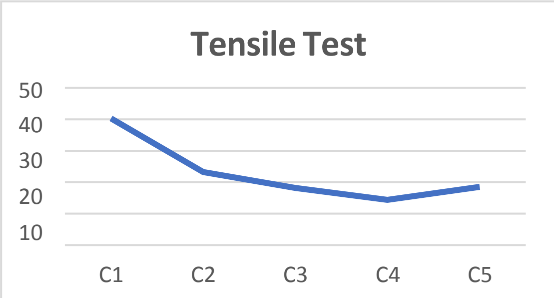
Modulus of elasticity	GPa	76
Tensile elongation	%	2.75
Chopped Length	mm	3
Moisture content	%	Maks.0.1
Chemical composition	%	52.4 SiO_2 14.4 Al_2O_3

Properties	Value
Length in inches	6-8
Fiber fineness	50-300 (micro gram)
Density	1.40
Tenacity	10.0
Breaking elongation	30%
Diameter in mm	0.1 to 1.5
Rigidity of Modulus	1.8924 dyne/cm^2
Swelling in water (dia)	5%
Mositure at 65% RH	10.50%

Table 2: Properties of coconut fibre.

Table 3: Composite Types

Composite	E-Glass Fibre	Coconut Fibre
C1	100%	0%
C2	70%	30%
C3	50%	50%
C4	30%	70%
C5	0%	100%



Result and Discussions

Mechanical testing is performed on five separate compositions (tensile, hardness, and flexural, impact izode testing). The testing ranges may vary depending on thecompositions. Figure 4,5,6,7,8,9 shows the average values for each testing result. Figures 4 and 5 show the maximum hardness for which the composition type was suitable. Figure 6,7 shows the maximum tensile of 40.3 MPa. Figure 8,9 shows maximum Izode impact of 34kj/m^2.Similarly, figures 10,11 shows maximumflexural of 260.52 Mpa.

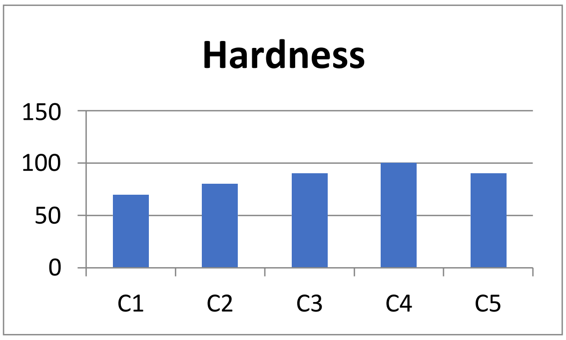


Figure 4

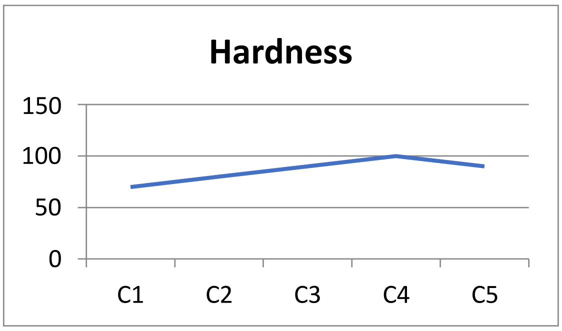


Figure 5

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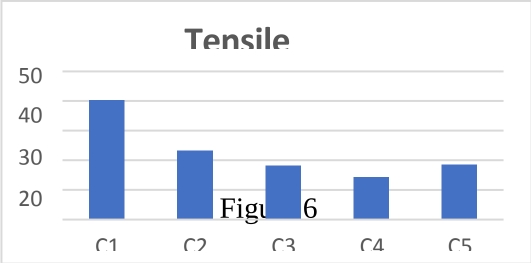

Figure 6

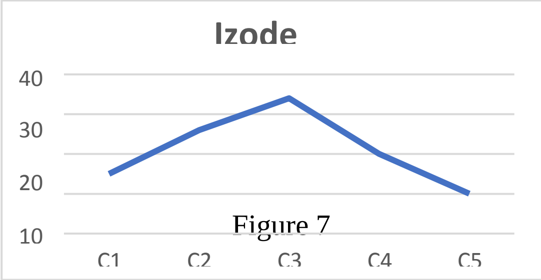

Figure 7

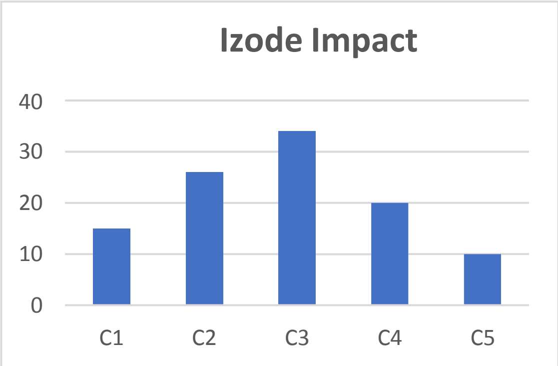

Figure 8

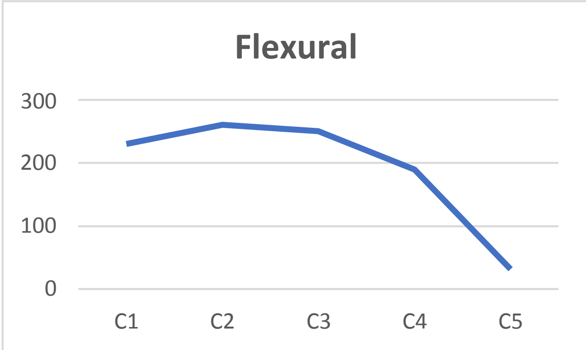

Figure 9

Conclusion:

In the present investigation, various composite laminates with isophthalic resin were fabricated. The fibres involved in this fabrication and testing of coconut coir and e- glass fibre. These are subjected to different coir ratios (E-glass fibre75%+coconut coir 25%, E-glass Fibre 25%+coconut coir 75%, and E-glass Fibre 50%+coconut coir 50%, E-glass fibre 100%+coconut coir 0%, E-glass fibre 0%+coconut coir 100%This experimental fabrication is done by hand layup method. Thetensile strength is found by ASTM D638. The experimental study reveals enhanced mechanical properties like hardness, flexural strength and tensile strength. The mechanical properties will change with a change in the composition of fibres.

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