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INVESTIGATING THE MECHANICAL PROPERTIES OF POLYESTER-NATURAL FIBER COMPOSITE

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Abstract : *Reinforced polymer composites have played an ascendant role in a variety of applications for their high meticulous strength and modulus. The fiber may be synthetic or natural used to serves as reinforcement in reinforced composites. Glass and other synthetic fiber reinforced composites consists high meticulous strength but their fields of applications are restrained because of their high cost of production. Natural fibres are not only strong & light weight but mostly cheap and abundantly available material especially in central uttar Pradesh region and north middle east region. Now a days most of the automotive parts are made with different materials which cannot be recycled. Recently European Union (E.U) and Asian countries have released stringent non concerning Automotive end-life requirements i.e; the parts of the automotives should be recycled.It has been consider as a alternative of conventional material. This increased the use of natural fibers in composite materials. Natural fibers have recently become more attractive to researchers, engineers and scientists as an alternative reinforcement for fiber reinforced polymer composites. Due to their low cost, low density stiffness, fairly good mechanical properties, high specific strength, nonabrasive, eco- friendly and biodegradable characteristics, they are exploited as a replacement for the conventional fiber, such as glass fiber and carbon. There is a wide scope for future scholars to explore the current research area. The present work can be further extended to study other aspects of composites like use of other natural fibers and evaluation of their dynamic mechanical, thermal, tribological properties and the experimental results can be similarly be analyzed.*

Key Words: ***Jute fibre, cotton fibre, compression moulding, polyester, glass fiber, catalyst and accelerator***

1. INTRODUCTION

Environmental awareness is growing day by day. Worldwide researchers triggered by this reason to implement and utilize materials which are eco friendly. When compared to synthetic fibres and manmade fibres natural fibres become best alternative and it is cheaper and more economic and environmental friendly composite material. In this experiment coconut coir fibre is the natural fibre component chemically treated with alkaline solution. Here chemically treated and untreated fibres were mixed separately with polyester matrix and by using hand lay –up technique these reinforced composite material is moulded into dumbbell shape. Five specimens were prepared in different arrangement of natural fibres and glass fiber in order to get more accurate results.

In the present era of environmental consciousness, more and more material are emerging worldwide, Efficient utilization of plant species and utilizing the smaller particles and fibers obtained from various lignocellulosic materials including agro wastes to develop eco-friendly materials is thus certainly a rational and sustainable approach. Any lignocellulosic waste matter can, therefore, be turned into composite products through appropriate R & D work and development in technological aspects.

These approaches offer much simpler materials for future use in comparison to metal based composites. Resilience property which makes plastics ideal for many applications like food industries, packaging, construction field and sanitation products etc. petroleum-derived plastics can lead to waste disposal problems, as these materials are not readily biodegradable and because of their resistance to microbial degradation, they accumulate in the environment.

2. FIBER

Nowadays natural fibers form an interesting alternative for the most widely applied fiber in the composite technology, the use of fibers like flax, hemp, jute or sisal is small since availability of a durable semi-finished product with constant quality is often a problem. Recent research and development have shown that these aspects can be improved considerably.

2.1 Natural fiber:
- 2.1.1.Cotton
- 2.1.2.Jute

2.2 Glass fiber
- 2.2 Polymer
- 2.2.1 Polyester

3. CHEMICAL MODIFICATION OF FIBER

This chemical treatment is used to improve the adhesion between the polymer matrix and surface of the fiber and the strength of the fiber. Water absorption capacity of the fibers will also be reduced and helps to increase the mechanical properties. Out of the available chemical treatments, here we are using alkali treatment. A. Alkaline Treatment Treatment with alkaline or mercerization is one of the most used chemical treatment for natural fibers. This treatment will remove some amount of lignin, oil and wax from the external layer of the fiber cell; it decomposes cellulose into small segments and exposes the short length crystallites.

Thus process of alkaline directly effects the cellulosic fibre and the degree of polymerization and the pulling out the lignin and hem cellulosic compounds. This treatment has two effects on fibres.

1) Surface roughness is increased to result good mechanical properties.

2) It effects fiber strength and stiffness of it.

4. MATERIAL

4.1.resign - polyester, 2 ltr.

4.2.catalyst- 100 ml

4.3.accelerator – 100 ml

4.4.cotton fiber, 500gm

4.5.jute fiber , 1 kg

4.6.glass fiber , 250 gm

Fig. 4.1 materials

fig 5.1 mould

5. DESIGN OF EXPERIMENT

Different possible composition of polyester with glass fiber, cotton and jute fibre

1. IST COMPOSITION

Polyester	Glass fiber
88 %	12 %

2. IIND , IIIRD, IVTH COMPOSITION

Polyester	Glass fiber	Cotton
73 %	12 %	15%
68 %	12 %	20 %
63 %	12%	25 %

3. Vth, VITH, VIITH COMPOSITION

Polyester	Glass fiber	Jute
73 %	12 %	15 %
68 %	12 %	20 %
63 %	12 %	25%

Table 5.1 different composition

And in polyester resine 2% hardener and 2% accelerator is included.

In this method we prepare a sample of Resign by mixing catalyst and then take a mould of stainless Steel and then add natural fiber and glass fiber as decided above. And after that put it in to a compression moulding machine for 45-60 min

In the present experimental work the composite material is fabricated using hand moulding method. The test specimens are prepared with standards and were tested to evaluate the mechanical properties like tensile strength, compression strength and flexural strength.

5. FABRICATION METHOD

Open Molding, also known as contact molding, open laminating, and wet lay-up, is the method used longest in the polymer-matrix composites industry to make thermo set composite products, and it is still the selected production process for a wide range of composite products. It is a basic process that provides many of the advantages of composites processing, using relatively basic materials technology and processing methods.

5.1 COMPRESSION MOLDING

Compression molding process is one of the low cost molding methods as compared to injection molding and transfer molding. It is a high pressure forming process in which the molten plastic material is squeezed directly into a mould cavity by the application of heat and pressure to conform to the shape of the mold.

Fig.5 .2 hydraulic press moulding machine

Fig 5.3 prepared sample

7. RESULTS AND DISCUSSION

S. No.	Composites	Hardness (Hv)	Tensile strength (MPa)	Flexural strength (MPa)	Impact strength (Mpa)	Water abosorption test (% change)
1.	PGF Polyester(wt. 88 %) + glass fiber (wt. 12 %)	36	73.65	110.60	78.87	1 % in 24 hr 1.3 % in 48 hr 1.9 % in 72 hr
2.	PGFC-1 Polyester(wt.73%)+ glass fiber(wt.12%)+cotton(wt.15%)	40	75.76	114.76	83.90	1.4 % in 24 hr 1.6 % in 48 hr 1.7 % in 72 hr
3.	PGFC-2 Polyester(wt.68%)+ glass fiber(wt.12%)+cotton(wt.20%)	43	78.65	119	85.78	1.6% in 24 hr 1.9 % in 48 hr 2.0 % in 72 hr
4.	PGFC-3 Polyester(wt.63%)+ glass fiber(wt.12%)+cotton(wt.25%)	41	74.90	112.89	82.23	2.1 % in 24 hr 2.4 % in 48 hr 2.6 % in 72 hr
5.	PGFJ-1 Polyester(wt.73%)+ glass fiber(wt.12%)+jute(wt.15%)	43	82.54	150.76	90.87	1.5 % in 24 hr 1.8 % in 48 hr 2.1 % in 72 hr
6.	PGFJ2 Polyester(wt.68%)+ glass fiber(wt.12%)+jute(wt.20%)	46	86.34	186.90	94.06	2.2 % in 24 hr 2.6 % in 48 hr 2.7 % in 72 hr
7.	PGFJ3 Polyester(wt.63%)+ glass fiber(wt.12%)+jute(wt.25%)	44	81.62	140.23	86.56	2.3 % in 24 hr 2.5 % in 48 hr 2.9 % in 72 hr

Table 7.1 Mechanical properties of the hybrid composites (average)

7.1 COMPARITIVE RESULT

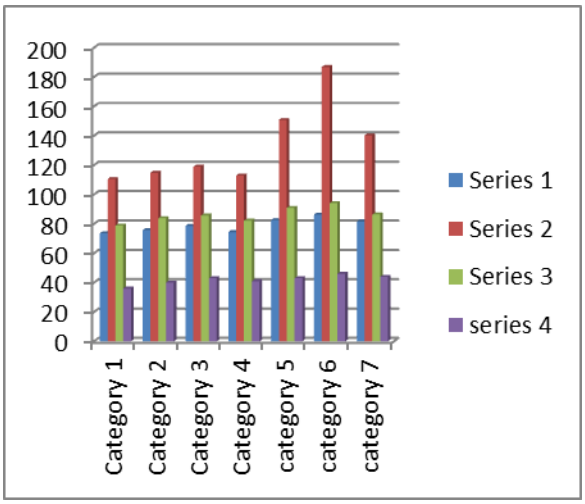

Fig 7.7 comparitive study

7.2 CONCLUSIONS

The experimental study on the effect of fibre loading and orientation on physical, mechanical and water absorption behaviour of jute and cotton/glass fibre reinforced polyester based hybrid composites leads to the following conclusions:

1. The successful fabrications of a new class of polyester based hybrid composites reinforced with jute ,cotton and glass fibre have been done. The present investigation revealed that fibre loading and orientation significantly influences the different properties of composites. The maximum hardness, flexural strength and tensile strength,impact strength,hardness,density is obtained for composites reinforced with 20wt% jute fibre loading.

2. The water absorption rate gradually increases with increase in fibre loading irrespective of fibre orientation. The maximum water absorption is obtained for composites with 25 wt% fibre loading irrespective of fibre orientation. As far as effect of fibre orientation on the water absorption of composites is concerned there is not much influence is observed.

3. It has been observed that ranking of composite materials are as follows: Rank 1(C6), Rank 2 (C5), Rank 3 (C7), Rank 2 (C3), Rank 5 (C2), Rank 6 (C4), Rank 7 (C1),

7.3 SCOPE FOR FUTURE WORK

There is a wide scope for future scholars to explore the current research area. The present work can be further extended to study other aspects of composites like use of other natural fibres and evaluation of their dynamic mechanical, thermal, tribological properties and the experimental results can be similarly be analyzed.

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