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Characterisation of Natural Fiber Polymer Composite

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Abstract: Need of the hour is to develop new material with optimal use of natural, non-polluting and renewable resources. In this paper we fabricated and tested some of the non-conventional polymer composite with phenolic resin for mechanical characteristics under universal tensile machine and impact testing machine. Future scope of work in these newly evolved materials is also discussed.

Keywords: Composite materials, phenolic resins, mechanical characteristics, coir, jute, almond powder.

I. INTRODUCTION

Due to the problem of pollution there is large demand for advanced polymer composite and natural fiber such as jute, coir are very good options for the same, also these materials are abundance in India, but are not used up to their full potential. Other materials which are generally considered to be waste such as almond dust, wood dust can also be helpful in development of this new advanced composite.

Natural fibres have the following advantages:

(i) These fibres, though they have poor strength properties due to low density, can lead to high specific strength properties. Wood flour, for example, used as 50% filler in thermosetting phenolic resin, is found to improve strength and impact resistance of the resin. In addition, these fibres have high work of fracture (- 105 J/m 2) so that composites containing them are also expected to have high resistance to crack propagation [1,2].

(ii) Non-toxic behaviour of natural fiber.

(iii)Fibre strength has been extensively helpful in consumer goods and transportation [1].

TABLE 1Yearly availability of coir and jute (in Tonnes)

Fibre	India	World	Cost per kg ($US)
jute	1,92,511	2,26,500	0.59
coir	2,12,500	2,50,000	0.66

II. COMPOSITES

Coir-Wood dust-Phenolic composite

In this composite we have varied wt% of coir and wood dust keeping wt% of phenolic resin to be constant(40% by Wt) and examined the characteristics of the samples made.

Jute-Wood dust-Phenolic composite

Samples were made with varying wt% of jute and wood dust keeping same wt% of phenolic resin and characteristics were determined.

Coir-Almond dust-Phenolic resin

The composite was made by varying the wt% of coir and almond dust keeping phenolic resin wt% constant and was examined for the mechanical characteristics.

Jute-Almond dust-Phenolic resin

Characteristics were examined by varying wt% of jute and almond dust keeping phenolic resin wt% to be constant.

III.TESTING

Charpy test

The test determines the total amount of energy absorbed in a material during fracture; this energy is a measure of toughness and helps to study ductile to brittle translation and temperature dependence of a material. It is used in industries due to ease of testing and for accurate comparative results. In our experiment we tested various samples of above stated composites and analysed the comparative study. Testing was performed as per ASTM A370.

Universal Testing Machine

The universal tester is used to test ultimate tensile strength and young's modulus. The machine is named universal as it can do many standard tensile and compressive test on various materials of varying shape and structure. Ultimate tensile strength is measured by the maximum stress that a material can withstand while being stretched or pulled before breaking. Young's modulus is the ratio of stress to strain and it was measured in GPa. We examined various samples in UTM and the data is shown below:

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TABLE 2 MECHANICAL PROPERTIES OF COIR-WOOD DUST

Resin	Coir (wt%)	Jute (wt%)	Wood dust (wt%)	YM (GPa)	UTS (MPa)	Impact strength (J/m)
Phenol	0	-	60	32	54	60.12
Phenol	30	-	30	18	130	69.65
Phenol	40	-	20	44	154	83.54
Phenol	60	-	0	35	102	102.58

TABLE 3 MECHANICAL PROPERTIES OF JUTE-WOOD DUST

Resin	Coir (wt%)	Jute (wt%)	Wood dust (wt%)	YM (GPa)	UTS (MPa)	Impact strength (J/m)
Phenol	-	0	60	30	53	56.87
Phenol	-	30	30	17	147	68.25
Phenol	-	40	20	42	156	88.34
Phenol	-	60	0	33	104	99.85

TABLE 4 MECHANICAL PROPERTIES OF COIR-ALMOND DUST(A.D)

Resin	Coir (wt%)	Jute (wt%)	A.D (wt%)	YM (GPa)	UTS (MPa)	Impact strength (J/m)
Phenol	0	-	60	31	97	58.9
Phenol	30	-	30	17	151	66.58
Phenol	40	-	20	40	164	73.36
Phenol	60	-	0	34	103	92.26

TABLE 5 MECHANICAL PROPERTIES OF JUTE-ALMOND DUST

Resin	Coir (wt%)	Jute (wt%)	Almond dust (wt%)	YM (GPa)	UTS (MPa)	Impact strength (J/m)
Phenol	-	0	60	29	96	54.23
Phenol	-	30	30	15	145	67.55
Phenol	-	40	20	38	159	87.26
Phenol	-	60	0	31	106	100.56

Table 2, Table 3, Table 4 and Table 5 shows the mechanical characteristics like young's modulus; ultimate tensile strength and impact strength of the various samples keeping phenolic resign same.

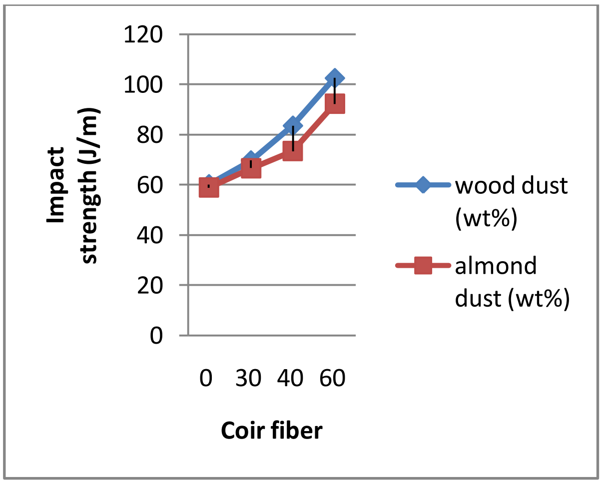

Fig. 1 Line graph showing variation in impact strength with change in wood dust and almond dust wt% along with coir fiber.

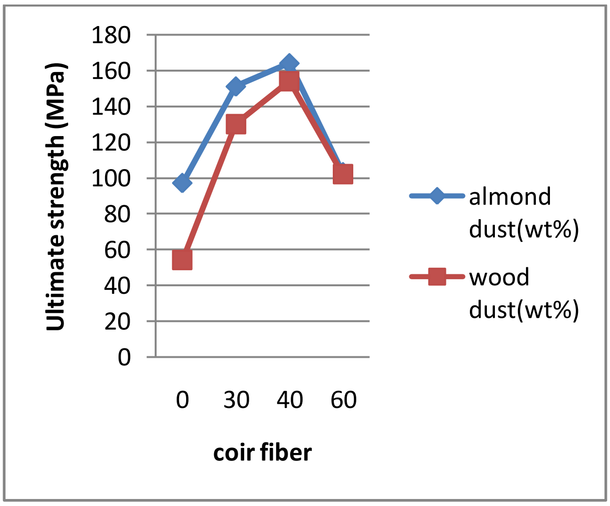

Fig. 2 Line graph showing variation in ultimate tensile strength with change in wood dust and almond dust wt% along with coir fiber.

Fig. 1 range of line graph shows the impact strength of variation in wt% of almond and wood dust respectively.

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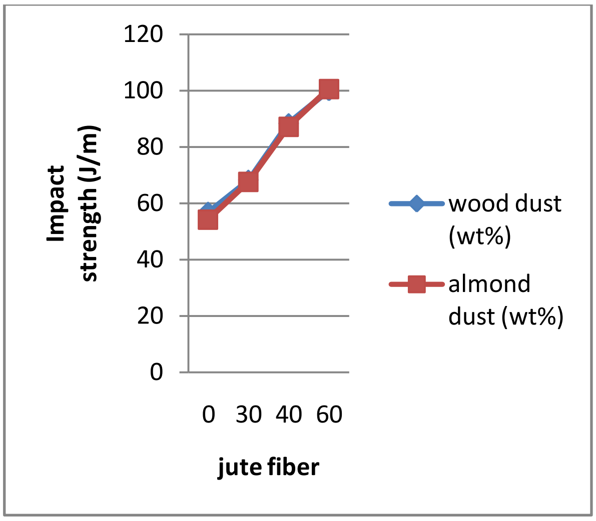

Fig. 3 Line graph showing variation in impact strength with change in wood dust and almond dust wt% along with jute fiber.

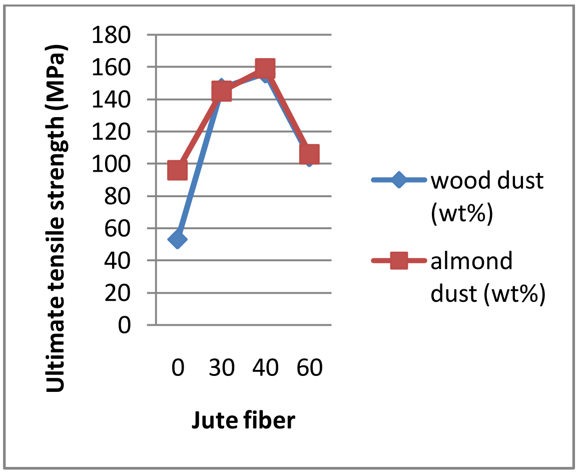

Fig. 4 Line graph showing variation in ultimate tensile strength with change in wood dust and almond dust wt% along with jute fiber.

The samples show almost the same nature with impact strength increasing with quantity of coir fiber increases but sample with 60% by weight wood dust has more impact strength as compare to the sample with 60% by weight almond dust. Fig. 2 graph shows ultimate tensile strength of phenolic resin and coir fiber reinforced with different wt% of almond and wood dust and almond dust has higher ultimate tensile strength than wood dust under same quantity.
Fig. 3 line graph indicates impact strength with phenolic resign and jute along with almond dust and wood dust varying and it can be seen that wood dust has slightly more impact strength than almond dust. Fig. 4 graph represents ultimate tensile strength of different almond and wood dust variations along with jute and phenolic resign and it can be analysed that almond dust has a lead in comparison to wood dust.

IV. CONCLUSION

In this paper mechanical characteristic of advance natural composites with almond dust and wood dust has been described. Ultimate tensile strength, young's modulus and impact strength of almond dust and wood dust reinforced in phenolic resign matrix along with jute fiber and coir fiber in fix quantity are observed to have improved results than the individual component observations. Ultimate tensile strength was maximum for coir 40% along with 20% almond dust to be 164MPa where as the least ultimate tensile strength was with wood dust 60% and jute 0% by weight. Young's modulus is maximum for sample with coir fiber 40%and wood dust 20% and is minimum in sample with jute fiber and almond dust to be 30% each by weight. Sample with coir fiber 60% and wood dust 0% showed best impact strength of 102 J/m where as sample with jute fiber 0% and almond dust 60% has minimum impact strength. Thus almond dust and wood dust along with fiber reinforce in phenolic resign resulted in composite having encouraging mechanical properties, which may result in application of these hybrid natural composites in building materials and automotive products.

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