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EVALUATING THE MECHANICAL PROPERTIES OF NATURAL FIBRE COMPOSITE FOR AUTOMOBILE STRUCTURE

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ABSTRACT
The natural fiber are currently replacing the synthetic fiber for automobile structural application. This paper evaluates mechanical strength of varying stacking sequences of the Natural fiber reinforced with polymer matrix composites and find applications in many fields of industrial applications. In this study the abaca and kenaf fibers are incorporated with carbon fiber by using epoxy matrix hybrid composite has prepared. We are using to fabricate the component by hand layup technique with desired composite. The structure of the composite is such that abaca is present in the centre of the composite, kenaf in the middle and carbon fiber as the outer skin provided higher mechanical strength. Natural fibers are used in the woven form to increase the strength of the produced composite material. It was found that the abaca-kenaf-carbon fiber has better properties than abaca-kenaf fiber alone and used to fabricate the automobile structure.

Keywords: Abaca fiber, Kenaf fiber, Carbon fiber, Automobile structure.

INTRODUCTION

. Natural fibers are characterized as substances created by plants and creatures that can be spun into fiber, string or rope and further be woven, weaved, tangled or bound. Flax, jute and balsa are the characteristic strands we picked as essential materials for our incomparable items. [1-5]

They are sustainable, shoddy, completely or partly recyclable, and also having biodegradable characteristics. For example, flax, cotton, hemp, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, and wood, from ancient times were used as a source of lignocelluloses filaments, are increasingly and regularly connected as the fortification of composites. [6] Their accessibility, inexhaustibility, low thickness, and cost and in addition excellent mechanical properties make them a preferred environmental choice for glass, carbon and other artificial fibers used for creating composite materials. The regular fiber-containing composites are all the more naturally agreeable, and are utilized in transportation (vehicles, railroad mentors, aviation), military applications, building and development ventures (roof framing, parcel sheets), bundling, buyer items, and so forth. [7-8]. Applications of natural fibers composite materials in Automotive sector :Automotive - Composites are being considered to make low weight, more secure and more eco-friendly vehicles. A composite is made out of a high quality fibber (carbon or glass) in a network material (epoxy polymer) that when combined furnishes amplify properties contrasted and the individual materials by themselves. Many components like controlling wheel, dashboard, situate, rooftop, bring forth, mats, vitality safeguard, instrument bunch, interior and outside board, leaf spring, wheels, motor cover and so on created by composite materials.[9-15]

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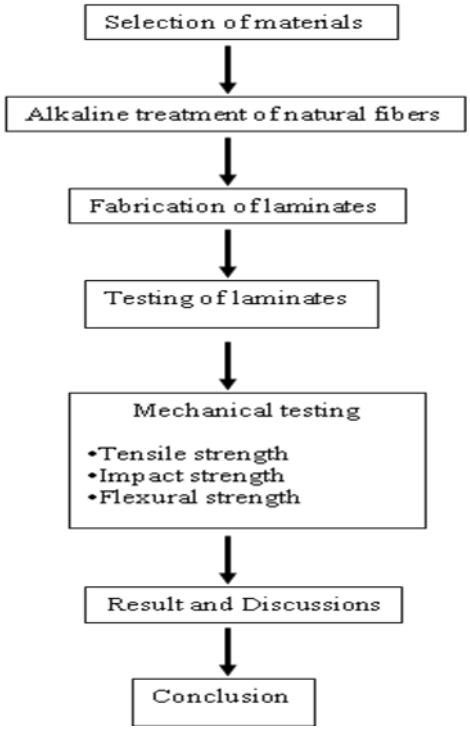
METHODS AND MATERIALS



MANUFACTURE OF COMPOSITE MATERIALS

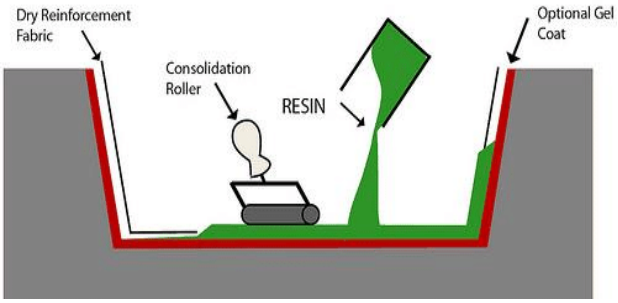


Figure 1. Hand layup method

Hand lay-up is the most widely recognized and slightest costly open-embellishment technique since it requires minimal measure of hardware. Fiber fortifications are set by deliver a shape and sap is connected with a brush or roller. This procedure is utilized to make both substantial and little things, including water crafts, stockpiling tanks, tubs and showers. Hand lay-up system is the least difficult technique for composite preparing. The infrastructural prerequisite for this strategy is likewise insignificant.

They getting ready advances are exceptionally clear. Regardless of anything else, a release gel is sprinkled on the shape surface to avoid the clinging of polymer to the surface. Thin plastic sheets are used at the best and base of the shape plate to get extraordinary surface finish of the thing. Support as woven tangles or sliced strand mats is sliced by the shape measure and put at the surface of frame after Perspex sheet. By then thermosetting polymer in liquid casing is mixed out and out in fitting degree with a supported hardener (reestablishing administrator) and poured onto the surface of tangle viably put in the frame. The polymer is reliably spread with the help of brush.

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Second layer of tangle is then put on the polymer surface and a roller is moved with a smooth weight on the tangle polymer layer to clear any air got and also the wealth polymer present. The system is reiterated for each layer of polymer and tangle, till the required layers are stacked. Resulting to putting the plastic sheet, release gel is showered on the internal surface of the best shape plate which is then kept on the stacked layers and the weight is associated. In the wake of diminishing either at room temperature or at some specific temperature, shape is opened and the made composite part is taken out and moreover arranged.

The period of diminishing endless supply of polymer used for composite getting ready. For example, for epoxy based system, normal mitigating time at room temperature is 24-48 hours. This procedure is generally sensible for thermosetting polymer based composites. Capital and infrastructural need is less when diverged from various methods. Creation rate is less and high volume division of help is difficult to achieve in the readied composites. Hand lay-up method finds application in various districts like flying machine sections, auto parts, boat bodies, daises stack up, deck et cetera. Generally, the materials used to make composites through hand lay-up system.

The hybrid composite specimen (carbon/Abaca/Abaca/Abaca/Carbon) were manufactured to evaluate the variation in its mechanical properties and compare the same with the existing material for the desired appliance. The hybrid composites were fabrication using hand lay-up process.

Table 1. Composition of the composite material used in the research.

Sample code	Reinforcement arrangement (number of layers)			Fiber content (Volume %)			Matrix (vol. %) Epoxy & Hardner
	abaca fiber	**kenaf fiber**	**Carbon fiber**	**abaca fiber**	**kenaf fiber**	**Carbon fiber**	
CAAAC	3	0	2	36	0	24	40
CKKKC	0	3	2	0	36	24	
CAKAC	2	1	2	24	12	24	
CKAKC	1	2	2	12	24	24	

Flat metallic mould dimensions are 300×300×10 mm is used for manufacturing of the hybrid composite materials. Polyethylene sheets covered with wax were used as separating layers to avoid sticking of the composite material to the mould. Hence 100 ml of hardener was added to one litre of epoxy resin. 8 % vol. chemically treated abaca/ kenaf was added to the epoxy resin and hardener mixture.

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TESTING OF COMPOSITE MATERIALS

The produced composite materials were tested for finding its mechanical properties

Tensile testing

All the tests were conducted atmospheric temperature; the tensile sample was designed according to the ASTM D638 standards. The test conducted by using in the (UTM) Universal Testing Machine. The tensile specimen clamp into the gripper and then test is conducted by given tension load until the fracture occurred

Fig.2 Tensile test specimen

Figure 2 shows the image of the four specimens prepared from the carbon abaca kenaf fibre composite material for the tensile test. The tensile strength results of the three specimens are given in Table 3.3.

Impact testing

The impact strength were designed Charpy arrangement is engaged to conduct the test as shown in Figure 3. The impact test conducted according to the ASTM D256 standards. The impact sample was applied to an impact load given in to the specimen until its fractured.

The impact strength results of the composite materials produced are shown in Table 3. The hybrid composite containing treated abaca-kenaf and carbon woven fibres exhibited high impact strength than the pure composite materials. Showed higher impact strength than pure composite. It is inferred that NaOH tested fibre removed the hydrophilic nature to improve the reinforcement efficiency of the epoxy matrix. This resulted in proper bonding between the epoxy resin and the fibre to create a homogenized composite material. The addition of the carbon fibre as its constituent improved its effectiveness to resist the sudden load applied during the impact test. The results were shown that the impact strength of composite material containing chemically treated specimen 2 increased by 72 % compared to that containing specimen 3. However, after the inclusion of the carbon fibres, its impact strength increased.

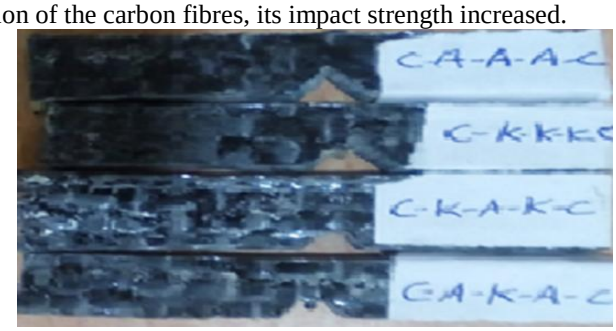

Fig.3 Impact test specimen

Flexural Testing

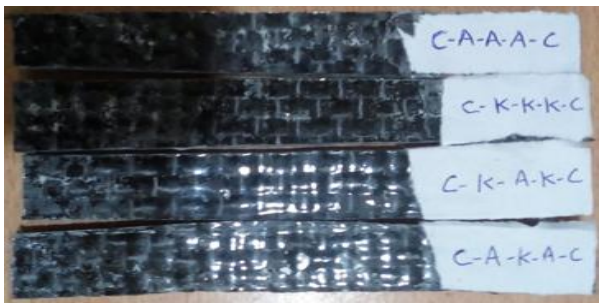

Fig.4 Flexural test specimen

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RESULT AND DISCUSION

Table 2 : Tensile test Analysis.

Specimen No.	Break load (kN)	Maxi. Dis. (mm)	Elong. (%)	Yield strength		Ultimate strength	
				kN/mm^2	MPa	kN/mm^2	MPa
C-A-A-A-C	4.290	8.000	13.33	0.0733	73.333	0.523	523
C-K-K-K-C	4.605	8.600	14.33	0.0708	70.846	0.527	527
C-K-A-K-C	4.705	10.300	17.17	0.0754	75.401	0.610	610
C-A-K-A-C	3.915	8.500	14.717	0.0602	60.231	0.362	362

Table 3 Impact test Analysis.

Sample code	Energy absorbed (J)
C-A-A-A-C	3.8
C-K-K-K-C	1.5
C-K-A-K-C	5.5
C-A-K-A-C	1.9

Table 4 Flexural test Analysis

Sample Code	Flexural load (kN)	Max. displacement (mm)	Flexural strength (MPa)	Flexural modules (Mpa)
C-A-A-A-C	1.250	5.800	16.404	1683
C-K-K-K-C	0.510	6.500	10.039	613
C-K-A-K-C	1.055	4.900	16.614	1682
C-A-K-A-C	0.710	5.200	11.181	1066

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CONCLUSIONS

The three composite materials were prepared using hand layup technique. Mechanical properties revealed that the tensile strength and impact strength of the hybrid composites were improved. The hydrophilic nature of the composites was removed by a chemical process. The properties of composites were considerably increased due to alkali treatment of fibre. This new composite material is more suitable for various structural applications in automobile such as door panels, bonnets, dash boards and dickey.

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