Determination of Modulus of Elasticity of Hybrid composite material with reinforcement of Coconut coir

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Abstract: High performance demands on engineering material leads extensive research and developing engineering applications such as insulating walls, floors, ceilings and insulating covers by changing mixing proportions of ingredients to develop new material. The emerging trends of hybrid composite materials are cheap, eco-friendly and the resulting material will have improved properties when compare to individual fiber (coconut coir) and POP (Plaster of Paris).

This paper discusses about the elastic property of hybrid composite material consists of coconut coir reinforcing in Plaster of Paris as a base material and a binding resin supposed to be a good insulating material in both domestic and industrial applications. Coconut coir binds with POP transfer heat to the reinforcing fiber (coir). For the preparation hand layup process is used to develop the samples by a mold preparation consists of a flat straight molding boxes of confined dimensions and reinforcement fiber laid in the mold with its base material by proper mixing proportions up to the edges of molding box and after proper curing of material the samples are cut for testing to determine the mechanical properties with deflection of hybrid composite material beam samples. The mixing proportion of coconut coir is varied at 0 and 300 grams respectively with 1000 grams of POP and made two attempts for samples.

Keywords: POP (Plaster of Paris or Super fine), Coconut coir, Deflection, Modulus of elasticity.

Literature Review

D. Verma, et al, [1] review has been undertaken, with an objective to explore the potential of the Coir fiber polymer composites and to study the mechanical properties of composites. The present review reports the use of Coir fibers, as reinforcements in polymer matrix.

[2] Nikhilesh Chawla,* and Yu-Lin Shen,"Mechanical behavior of a particle "A journal of advanced engineering materials, Vol.6 (2001) ISSN: 1438-1656/01/0606-0357. Nikhilesh Chawla, determined Characterizing the matrix as an isotropic ally hardening elastic-plastic solid (following the experimental stress-strain curve of a peak-aged Al-3.5Cu alloy) and the SiC particles as an elastic solid, the calculated tensile stress-strain response of Al/Si-C/20p composites.

[3] Dyzia*, J. Œleziona." Aluminium matrix composites reinforced with AlN particles formed by in situ reaction", Vol.31 (2008), 17-20. International Scientific Journal of World Academy of Materials and Manufacturing Engineering. M. Dyzia found ultrafine reinforcement particles are formed as product of reaction between reactive components. Those kinds of materials have good mechanical properties (higher yield stress and creep resistance). Via in situ reaction between liquid metal and reacting substance (solid or gas) is possible to obtain aluminum matrix composites similar to SAP composites by casting methods. Presented results of researches concerning possibilities of obtaining ultrafine aluminum nitride particles via in situ reaction between aluminum alloys (with addition of Mg) and nitrogen. Using the in-situ reaction in order to form AlN dispersion reinforcement in the aluminum alloy matrix.

[4] G. Kranthi Kumar and B. Praveen Kumar, P. Vara Laxmi and Dr. Anil Kumar Birru," A Study on Thermal Conductivity of Hybrid Composite Material with Reinforcement of Coconut Coir" A journal of Advance Research and Innovations in Mechanical, Material Science, Industrial Engineering and

Management ,Vol-51(2014), ISBN 978-93-82338-970 © 2014 Bonfring. G. Kranthi Kumar, For the tests by pre-determined values of thermal conductivity(K), thermal resistance(R) and heat transfer rate(q) could be determined at NTP (normal temperature & pressure) conditions. As a result, it is found that the thermal resistance(R) obtained from developed material varied nearly 20-30% compare to the unmodified POP and it may suitable to the insulating walls for various applications.

[5] Khyati Tamta, A journal of Advance Research and Innovations ,material science, Industrial Engineering and management Icarmmiem-2014," Fabrication and Analysis of Almond Shell Based Composite Material Vol-1- ISBN 978-93-82338-97-0 © 2014 Bonfring.Khyati Tamta, in this paper, She noticed the mechanical behavior of Almond shell powder reinforced epoxy composite has been discussed. Four different samples containing 10%, 15%, 15.13% and 21.1% of Almond by weight mixed with CY 230 epoxy resin has been prepared and subjected to various mechanical tests viz. tensile strength, compressive strength, impact strength, flexural strength, fracture strength and mechanical properties were compared to the properties of wood. Similarly, [6, 7, 8] made an attempt on composites and hybrid composites by their mechanical properties of their indent physical and chemical structures.

1. Introduction

Since coconut is available in India in abundance, the second highest in the world after Philippines, the coir fibre has been investigated most extensively. Most importantly, coir fibre has been recognized as highly durable fibre in all types of matrices viz., polymer, bitumen, cement, gypsum. From centuries, and mankind has used the natural fiber for various types of application including building materials. In most of the countries, users have explored the possibilities of using the natural fibre from different plants, which includes bagasse, cereal straw, corn stalk, cotton stalk, kenaf, rice husk/rice straw etc. Most of the fiber was used mainly for the production of hard board and particle board. Emergence of polymers in the beginning of the 19th century has provided the researcher the new dimensions to use the natural fiber in more diversified fields. At the same time the necessity has also increased the interest in synthetic fiber like glass fiber which due to its superior dimensional and other properties seems to be gaining popularity and slowly replacing the natural fiber in different applications [1]. As a result of this change in the raw material and production process of synthetic fiber based composites, energy consumption has increased. For the present experiment, one of the simple molding processes like hand lay-up is applied to determine the toughness other than the costly molding equipments and also the mixture proportions revealed.

2. Applications

The natural fiber composites can be very effective material for following applications:

- Building and construction industry: panels for partition and false ceiling, partition boards, wall, floor, window and door frames, roof tiles, mobile or pre-fabricated building which can be used in times of natural calamities such as floods, cyclones, earthquakes, etc.
- Storage devices: post-boxes, grain storage silos, bio-gas containers, etc.
- Furniture: chair, table, shower, bath units, etc.
- Electric devices: electrical appliances, pipes. Etc.
- Everyday applications: lampshades, suitcases, helmets, etc.
- Transportation: automobile and railway coach interior, boat, etc.
- Toys

2.1. The reasons for the application of natural fibers in the automotive industry include:

- Low density: which may lead to a weight reduction of 10 to 30%
- Acceptable mechanical properties, good acoustic properties.

- Favorable processing properties, for instance low wear on tools, etc..
- Occupational health benefits compared to glass fibers during production.
- No off-gassing of toxic compounds (in contrast to phenol resin bonded wood and recycled Cotton fiber parts).
- Price advantages both for the fibers and the applied technologies.

3 -Experimental Procedures

Making of samples (**Hand lay-up process**)-Hand lay-up is a simple method for composite production. A mold must be used for hand Lay-up parts unless the composite is to be joined directly to another structure. The molds can bees simple as a flat sheet or have infinite curves and edges. Reinforcement fibers can be cut and laid in the mold. It is up to the designer to organize the type, amount and direction of the fibers being used. Resin must then be catalyzed and added to the fibers. A brush, roller or squeegee can be used to impregnate the fibers with the resin. The lay-up technician is responsible for controlling the amount of resin and the quality of saturation shows the basic process of hand lay-up. Other fabrication processes such as vacuum bagging, vacuum resin transfer molding and compression molding can be used with hand lay-up to improve the quality of the finished part or save time. To develop the samples by a mold preparation consists of flat straight molding boxes of confined dimensions and reinforcement fiber laid in the mold with its base material by proper mixing proportions up to the edges of molding box and after proper curing of material these samples are cut for testing to determine the mechanical properties such as modulus of elasticity [6], [7].

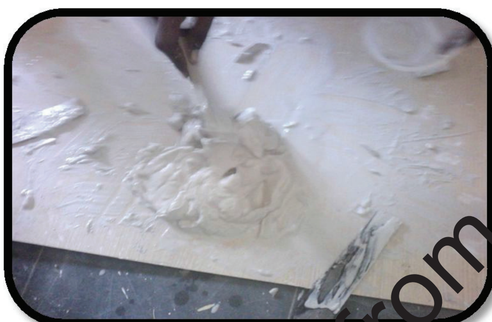

Fig: a) mixing of POP b) hand layup process

4. Material and Equipment

- Hybrid composite material beam,
- Super fine beam(PoP)
- Loading arrangement
- Supports dial
- Gauges
- Magnetic stand
- Vernier caliper
- Weights and scale

4.1. Description

The experimental set up consist of following two knife edge supporting stand for beam .the beam of different cross section material loading pan along with the different weights with magnetic standstill rule

 ISBN : 978-81-925233-3-0

4.2. Procedure

- Measure the dimensions of the given beam using the venire caliper, now place the beam horizontally on the two supports maintaining the require Span.
- Hang the loading pan at the mid-point of the beam fit the dial gauge and set it to zero now load the beam carefully without causing any disturbance.
- Corresponding deflection are noted with the help of dial gauge the loads are change each time the corresponding deflection are noted.
- The experiment repeated for different types of material of the beam.

a b

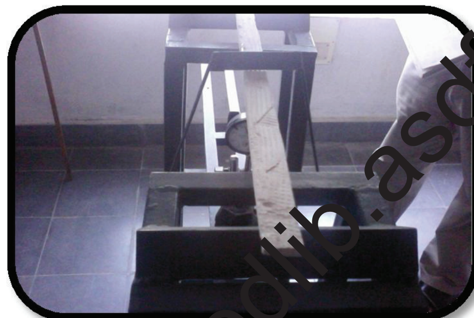

Fig.3Testing for deflection of a) Superfine (POP) composite beam b) Hybrid composite beam

Table: 1. Mixing proportions.

Material	Amount of POP(grams)	Amount of coir(grams)	Resin(grams)
Unmodified POP	1000	-	-
Modified POP	1000	300	100

The mixing proportion of coconut coir is varied at 300 grams which is named hybrid composite material and alone pop of given proportion. After proper curing of these two materials the samples are cut for testing to determine mechanical properties.

Table: 2. PoP (Superfine) material observation

Load Applied (W) N	Deflection in mm dial gauge reading	Modulus of elasticity $E=WL^3/3I\partial$ IN N/MM^2
W	∂	E
1	10	$0.18*10^5$
2	15	$0.1*10^5$
3	20	$0.7*10^5$

Table: 3. Hybrid composite (POP+Coir) material observation

Load applied(W) IN Newton	Deflection in mm Dial gauge reading	Modulus of elasticity $E=WL^3/3I\partial$ IN N/mm^2
W	∂	E
1	6	$0.14*10^5$
2	12	$0.07*10^5$
3	15	$0.04*10^5$
4	20(break)	$0.02*10^5$

4.3. Calculations

Type of beam : Super fine (POP) material Beam
Dimensions : 20*1.5mm
Moment of inertia of beam,(I) : $bd^3/12$: $5625mm^4$
Effective span length of the beam : 500mm
Modulus elasticity of super fine composite beam (E) : $0.[illegible]8*10^5 N/mm^2$

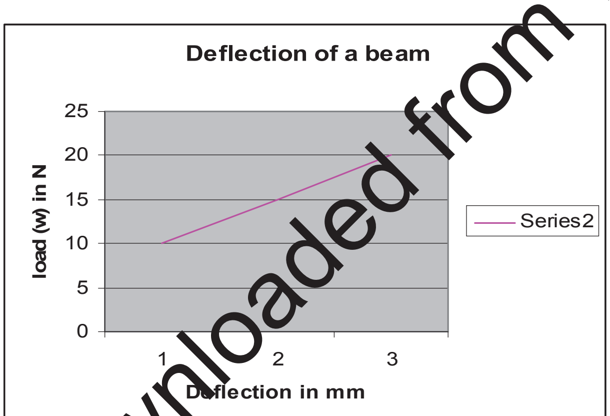

Fig: 4. Deflection vs. load of alone POP beam

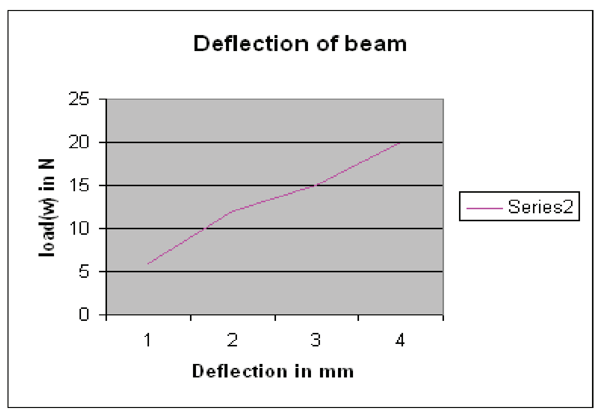

Fig: 5. Deflection vs. load of POP and Coconut coir beam

4.4. Calculations

Type of beam : hybrid composite material
Beam dimensions : 20*1.5mm
Moment of inertia of beam: $bd^3\backslash 12$: $5625mm^4$
Effective span length of the beam : 500mm
Modulus elasticity of hybrid composite beam (E) : $0.14*10^5 N/mm^2$

5. Results and Discussion

Compare to the Modulus of elasticity of alone POP composite bar, the hybrid composite bar got less elastic modulus

- Modulus elasticity of super fine composite beam (E) : $0.18*10^5$N/ mm²
- Modulus elasticity of Hybrid composite beam (E) : $0.14*10^5$ N/mm²

The mixing proportion of coconut coir is varied at 0 and 300 grams respectively with 1000 grams of POP and made two attempts for samples gives the less elastic modulus which denotes high strength in the hybrid composite beam compare to alone POP sample.

6. Conclusion

By these experimental attempts there is a wide scope of composites, especially preparing of hybrid composites from natural fibers.

The improved characteristics by these hybrid composites are

- Optional for new production technologies and materials.
- Favorable accident performance, high stability, less splintering.
- Favorable eco-balance for part production.
- Favorable eco-balance during vehicle operation due to weight saving.

7. References

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