COMPARATIVE STUDY OF MECHANICAL PROPERTIES OF COIR FIBER REINFORCED COMPOSITE

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***Abstract*— Use of naturally gained fiber, is rapidly growing in the working and manufacturing industries. Natural fiber is nothing but the fiber which is get extracted from the trees, animals or any natural thing, like jute fiber, aloe-Vera fiber, banana fiber etc. In this experimental work we characterized the mechanical properties of coir fiber reinforced composite. Alumina is used as filler. Three weight proportions (10,20 and 30 wt.%) were used for the fabrication of composites. Composites were prepared by hand layup method. After sample preparation various mechanical tests such as tensile, flexural, impact were carried out on it, as per ASTM standard.**

Keywords— Natural Fiber Reinforced Composite, Coir, Alumina, Mechanical Testing

I. INTRODUCTION

The material selection systems that satisfies industrial requirement is current necessity. From the past experiences, we know that, the material characterization and also determining the utilization of those material for long term and short term is necessary. The composite is a substance in material science in which component having matrix along with reinforcing agents, fiber is commonly used reinforcing agent in manufacturing that yields. Fiber reinforced composite fabricated by bonding the fiber with a matrix with various number of boundaries between them. Fiber is act as principle load carrying constituent weather the matrix hold them at specific position and orientation at the same time. It acts as medium to transfer load and also saves the fiber from any environmental damages. Further addition of filler helps to enhance their functional properties. The composite consisting of matrix, fiber and filler are called as hybrid composite.

Lots of researches have been carried out on the natural fiber reinforced hybrid composite. Arun Rout [1] focused on development and validation of mathematical model which based on principle of conservation of energy then we used Taguchi's Orthogonal array for testing the wear performance of hybrid composite, the final result shows that impact velocity, impigmented angle, filler content are the factors which are influences on wear rate. Narendiranath Babu [2] fabricated the composite having aloe-Vera and palmyra fibre as reinforcement and epoxy matrix, and analyse the variation tensile, flexural and hardness properties with different orientation of fiber. From the result they conclude that, Aloe-Vera fiber has higher hardness than the Palmyra fiber composite. The impact properties are higher in unidirectional arrangement of the both fibers. Arunkumar Rout [3] prepared jute-epoxy composite in which waste granite powder as filler is used. Different weight proportions were prepared and result is compared with the fabricated samples with unfilled ones. V. Arumuga [4] investigates the properties of composites in which sisal and banana fiber was used as reinforcement and red mud as filler.

Akash [5] characterized the mechanical properties of hybrid composites in which sisal and coir fiber were used as reinforcement. Cold pressing method for the fabrication of composite was used. A. Shadrach Jeya Sekaran [6] evaluate the mechanical properties of hybrid composites having woven aloe-Vera and sisal fiber as reinforcement. For the preparation

of composite hand layup method was conducted. M. Ramesh [7] concern about evaluation of mechanical properties of polyster composite in which banana fiber is used as reinforcement. Preparation was done by hand layup method. Their result indicates that the banana fiber gives better mechanical properties i.e. 112.58 MPa as tensile strength. 77.21 As Flexural strength, 11.22 as Impact strength. Md. Mominul Haque [8] introduced a coir fiber reinforced polypropylene composites prepared by using injection molding machine and single extruder. They increase the compatibility of raw coir fiber with polypropylene matrix by treating it with bronze diazonium salt. Five levels of fiber loading were utilized in manufacturing of composite, and the mechanical tests were carried out. Finally, they conclude that, in order to improve the mechanical properties, the bonding between propylene matrix and coir finer has to be increase.

S. Nallusamy [9] used bone and sea shell and independently integrated with coir finer composite and assess the mechanical and fracture analysis. With the help of SEM fractography is explored fracture faces. Their final result shows that sea shell powder composite gives better tensile and flexural test than bone powder composite. Ajith Kumar [10] prepared the composite in which the ratio of polypropylene and coir fiber is 9:1. Then the mechanical properties like tensile, flexural hardness are tested and the graph were plotted according to the tabulated result. S. M. Sapuan [11] the composite fabricated by using coconut shell as filler particles and epoxy resin. Three different filler proportions were used and the mechanical tests were carried out according to the ASTM standard on UTM machine. The result shows that the properties are increases with increase in filler content. S. Harish [12] developed the coir fiber reinforced composite and compare their mechanical properties with glass fiber composite. The interfacial properties were evaluated with the help of electron micrographs obtained from the fracture surface. Coir used as potential reinforcing material for low load bearing composite. Paul Wambua [13] prepared a sample of composite using various fibers such as sisal, kenaf hemp and coir. The mechanical tests were carried out and result was compared with each other. From the result, tensile modulus, ultimate tensile test of kenaf fiber composite were increase with increase fiber loading. A. S. Singha [14] hibiscus Sabdariffa is used as reinforcing material and Urea-Formaldehyde polymer resin was reported. After the testing result shows that urea-formaldehyde increased tensile, compressive and wear resistance. J. Sarki [15] the composite were prepared by using coconut shell and epoxy resin and its effect on the properties of composite were investigated. The result shows that the value of tensile modulus and tensile strength increase with increase in filler content.

II. GAPS IN LITRATURE

- From the above literature, experiments were done on natural fiber composite in which filler is used. But very limited research is available related to the coir fiber combine with filler.
- Researcher used, bone and sea shell powder, coconut powder are used as filler. No research paper available where alumina or silicon carbide powder is used as filler.

III. OBJECTIVE

- To fabricate Coir fiber reinforced composites using Alumina as filler as per ASTM standard.
- To perform various mechanical tests such as flexural and impact.
- To compare the result with no filler composite used in literature.

IV. EXPERIMENTAL WORK

Material:

Coir fiber has been extracted from the husk of coconut, cocos nucifera, and a tropical plant of palmae family. The diameter of small treads of reddish brown fiber is 12-14 um (0.00004 in.). The mature brown coir is stronger but less flexible, because it contains more lignin and less amount of cellulose than the other fibers like flax and cotton, it is waterproof and it is the only fiber which provides the resistance to damage from the salt water.

Preparation of matrix:

Material	Name	Density (g/cm3)
Epoxy resin	CY205	1.15-1.30
Hardener	HY951	0.97-0.99

The weight ratio used for mixing is 10:1.

Sample preparation:

For the preparation of samples the moulds are prepared according to the size of the sample for the compression. The moulds are first cleaned and dried. Now, for the fabrication of coir and epoxy sample, matrix mixture of epoxy and hardener is applied uniformly. Then the calculated quantity of coir finer is place over the matrix and the another layer of epoxy is apply on it with help of brush. The process is continuing till 3 layers of epoxy and fiber is applied. Now the mould gets close and compressed it for the curing time 24hrs.

For preparation of coir and epoxy sample along with alumina as filler, again the moulds are getting cleaned and dried. Then alumina in proportion of 10% of wt. is mixed in epoxy and hardener mixture. Now this mixture is applied over the mould and the calculated amount of fiber is placed over it. The same process is continuing till 3 layers of epoxy/filler mixture and fiber is applied. Then the mould get closed and compressed for curing time 24hrs.

Mechanical tests:

After the fabrication the samples are prepared for the testing, the specimen selected as per ASTM standards. The ASTM standard D790-03 having size 3.2*12.7*125 (mm) is use for flexural test. The ASTM standard D256-05 having size

64*12.7*3.2 (mm) is use for impact test. These tests are carried out on 6 specimens so to obtain the statistical result for each condition.

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