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Hardness and Flexural Strength of Rice Husk and Rice Husk Ash on Coconut Fiber Reinforced Polyester Composites

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Abstract – Fiber-reinforced polymer composites played a dominant role for a long time in a variety of applications for their high specific strength. The fiber is classified in to synthetic and natural. Although glass and other synthetic fiber-reinforced plastics possess high specific strength, their fields of application are very limited because of their inherent higher cost of production. In this connection, an investigation has been carried out to make use of coconut, a natural fiber abundantly available in India. Natural fibers are not only strong and lightweight but also relatively very cheap. The present work describes the development and characterization of a new set of natural fiber based polymer composites consisting of coconut fiber as reinforcement, polyester resin, some additional materials like rice husk and rice husk ash. Experiments are carried out to study the hardness and flexural strength of different fiber composition such as coconut fiber, rice husk and rice husk ash and polyester composites. In the present work, polyester and rice husk ash composition gives better flexural strength. These results indicate that coconut fiber can be used as a potential reinforcing material for many structural and non-structural applications. This work can be further extended to study other aspects of such composites like effect of fiber content, fiber orientation, loading pattern, fiber treatment on mechanical behaviour of coconut fiber, rice husk and rice husk ash and polyester composites.

Index Terms – Coconut fiber, rice husk, rice husk ash, polyester, Mechanical properties.

1. INTRODUCTION

The bio fibers are cellulose in nature and are included of lignin, cellulose, hemicellulose, pectin and wax. Therefore, all natural fibers are hydrophilic in nature. Normally, the bio fibers are found better the synthetic fibers (i.e. glass and carbon fiber) with the properties such as low density, bio- degradable non-abrasive, eco-friendly, low cost, high toughness and so on . However, it has some of the disadvantages as a quality variation, more moisture absorption, poor surface characteristic, etc.

Now, newer the various synthetic fibers like glass, nylon, rayon, acrylic, carbon etc. are used as reinforcement in a polymer matrix which are getting a mechanical properties. However, they are entirely high price materials. bio fibers such as coconut, hemp, flux, sisal, jute, kenaf, coir, banana, etc. It can be alternatively used to reduce the cost of the composite materials. Various mechanical properties of natural composites such as tensile strength flexural modulus, impact strength and Young's modulus can be improved by treating it by Sodium Hydroxide (NAOH).

The surface treated bio fibers showed better efficiency than the untreated. Alkaline treatment (mercerization process) is illustrious. Chemical treatment of surface modification of natural fibers reinforced composites. This alkaline treatment removes wax, hemicellulose and lignin hiding the surface of the fiber.it is accepted that the alkaline treatment result from increases surface roughness which create better mechanical interlocking between hydrophilic fibers and hydrophobic matrices .

Among the bio fibers, coconut fiber is nowadays widely used in many industrial applications. Coconut fiber possesses elongation at break highest among typical bio fibers. Besides, it is high failure strain, which provides a better contact between the fiber and matrix in reinforced composites. The high lignin content in coconut fiber is responsible for other beneficial properties such as weather resistance. The lignin content in coconut fiber is quite high, so the fiber becomes stiffer and tougher.

Bio fibers are used in different forms as reinforcement in composite materials, such as random, continuous unidirectional and weaving patterns. In weaving patterns are found to be more excellent adhesion reinforcement as they can be applied in the development of the structure of the material. Thus, weaving bio fiber in different forms is significant in defining their final properties. Weaving patterns such as knitting are used for various bio fibers using fabric technologies to make bio fiber reinforced composites with better mechanical properties.

In the present work describes the development and characterization of a new set of natural fiber based polymer composites consisting of coconut fiber as reinforcement, polyester resin, some additional materials like rice husk and rice husk ash. Experiments are carried out to study the hardness and flexural strength of different fiber composition such as coconut fiber, rice husk and rice husk ash and polyester composites.

2. MATERIALS AND METHOD

The purpose of this research is to represent the essential information on the main mechanical properties such as tensile strength, impact strength, hardness and flexural strength. This part experimental work a fiber- reinforced composite material prepared from raw coconut coir.

2.1. Raw material

In this present work, rice husk and rice husk ash on coconut fiber and polyester resin are used as natural fiber and matrix, respectively. The coconut fibers were collected from Ravi industry, Andhra Pradesh. Coconut can be extracted from the husk of coconut using the process of pulling out and it used to rang in diameter between 200-300µm is shown Figure 1

Figure 1: raw material

2.2. Surface treatment of coconut fiber

Coconut fiber through surface treatment with NaOH solution for 60 minute at room temperature. Then after, fibers were washed with fibers were then heated at 80 c for 30 min to remove moisture.

2.3. Preparation of composite and test specimen

The fiber sample and polyester were weighed using the electronic balance. The fiber was mixed with the polyester at room temperature and stirred continuously for 3 minutes until a homogenous mixture was observed. 1% (by weight of polyester) of the accelerator; cobalt was added and stirred for another 3 minutes. Finally, 2% (by weight of polyester) of the catalyst, methyl ethyl ketone peroxide (MEKP) was added using the syringe and stirred continuously for another 3 minutes The reaction temperature was taken and the different composite was cast in the moulds and allowed to cure for one hour..

The composites prepared by a hand layup process with different composite specimen, as shown in Figure 2.

2.4. Number of samples composition

1. work piece S1= 95% polyester, 5% rice husk

2 .work piece S2= 90% polyester, 10% rice husk

3 .work piece S3= 80% polyester, 20% rice husk

4 .work piece S4= 95% polyester, 5%rice husk ash

5 .work piece S5= 90% polyester, 10%rice husk ash

6 .work piece S6= 85% polyester, 15% rice husk ash

7 .work piece S7= 95% polyester, 0.5%coconut fiber

8 .work piece S8= 90% polyester, 1% coconut fiber

9.work piece S9=89% polyester, 1%coconut fiber,5%rice husk ash,5% rice husk

Figuer2: different composite specimens

The mixture was poured slowly into the zinc sheet mould. It was executed according to the ASTM test (ASTM D for hardness test and ASTM D 790 for flexural test). Sample production to obtain a smooth surface can by using a sheet of Mylar on the upper and the lower part of the sample. Then, leaving some composite for curing at room temperature for 2 days and then removed from the mould. Finally, take a sample to test the mechanical properties survey.

3. RESULTS

All the type composites prepared in this work are presented in the mechanical properties values of composites reinforced with coconut fiber at different oriented forms are in table 1.

Table 1 Result of composites tested the mechanical properties

Type composites	Flexural strength (MPa)	Hardnees (HV)
Work piece S1= 95% polyester, 5%rice husk ash	57.419	302
Work piece S2= 90% polyester, 10% rice husk ash	51.581	181
Work piece S3= 80% polyester, 20% rice husk ash	36.630	92
Work piece S4= 95% polyester, 5%rice husk	43.372	127
Work piece S5= 90% polyester, 10%rice husk	34.298	93
Work piece S6= 85% polyester, 15% rice husk	28.359	84
Work piece S7=95% polyester ,0.5%coconut fiber	49.916	210
Work piece S8= 90% polyester, 1% coconut fiber	55.437	255
Work piece S9=89% polyester, 1%coconut fiber, 5% rice husk ash,5% rice husk	62.784	246

3.1. Flexural Strength

Flexural strength is also known as bending strength or rapture strength. The flexural strength of a material is defined as its ability to resist deformation under load. Flexural specimen was prepared according to ASTM D790M. The strength may be calculated for any point of the load deflection by means of the following equation,

$$S=\frac{3PL}{2BD^2}$$

Where,

S = stress in the outer fibers at mid-span,

P = load at a given point on the load – deflection curve, N,

L = support span, mm,

B = width of specimen tested, mm,

D = depth of tested specimen, mm.

The strength of the rice husk and rice husk ash on coconut fiber reinforced with polyester composite depends on the orientation of fibers and the interfacial adhesion between the fiber and the matrix. The effect of different fiber orientation on the flexural strength of coconut fiber reinforced polyester composites is shown in Figure 3.

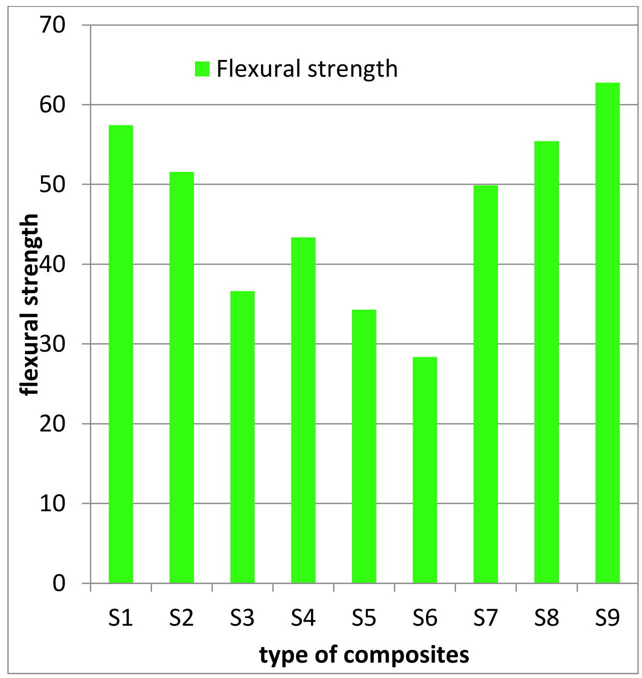

Figure 3: Flexural strength test results

The results indicated that The flexural strength for the composition of 89% polyester, 1%coconut fiber, 5% rice husk ash,5% rice husk gives the better result i.e. flexural strength (bending strength)=62.784 MPa. The effect of addition of rice husk ash and rice husk on flexural strength for rice husk ash and rice husk polyester composite. It reveals that the flexural strength decreases with the addition of rice husk ash and rice husk content. The flexural strength of the composites is lower than polyester resins, so these composites are brittle. Ceramic materials are brittle, hard, and strong in compression, weak in shearing and tension. It shows that the increasing in volume fraction of rice husk and rice husk ash promotes more interfaces and cavities formed in the composite and this can explain the decreasing of flexural strength. The decrease in strength of rice husk and rice husk ash polyester composites on increasing the volume fraction of rice husk and rice husk ash is due to rice husk and rice husk ash being weak in tension.

3.2. Vickers Hardness

The Vickers hardness (HV) is calculated with an equation,

$$VHN=\frac{1.854*P}{d}$$

Where in load (L) is in grams force and the mean of two diagonals (d) is in millimetres: For this measurement, appropriate size of a sample with flat and smooth surface was preferred. During measurements, at least 8 imprints were taken for each load, and the *H* values for all samples were determined with standard errors.

The effect of different fiber orientation on the Vickers hardness of coconut fiber reinforced polyester composites is shown in Figure 4

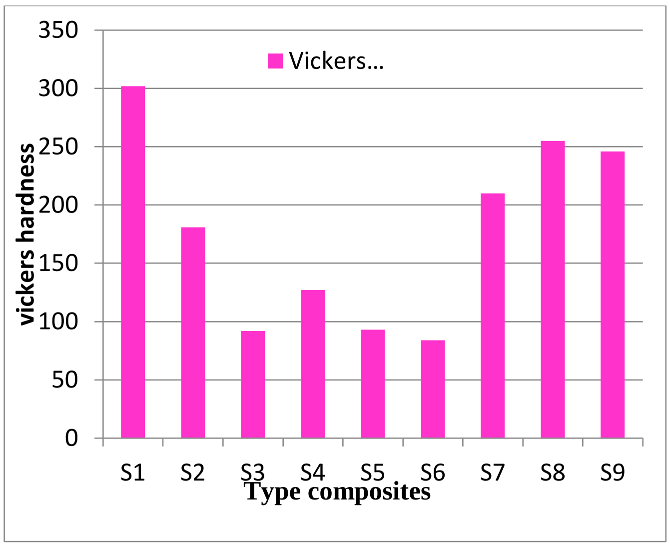

Figure 3: Vickers hardness test results

The results indicated that the highest Vickers hardness is obtained for The Vickers hardness for the composition of 95%polyester and 5% rice husk ash gives the better result i.e. Vickers hardness 302HV

Figuer4 illustrates that Vickers Hardness for rice husk and rice husk ash on polyester composite as a function of the addition of different W_t% of rice husk and rice husk ash. It can be seen that in this composites, Hardness decreased with an increase of rice husk and rice husk ash. It represents that rice husk and rice husk ash on polyester composite is softer than pure sample of the polyester composite.

4. CONCLUSIONS

This paper the fabrication of natural composite using different oriented rice husk and rice husk ash on coconut fiber reinforced polyester composites by hand layup technique. In this study the mechanical properties (flexural strength and hardness). Based on the test results, the following conclusion are observed

As the fiber present increases the flexural strength increases, it reveals that the flexural strength decreases with the addition of rice husk ash and rice husk content. Vickers hardness of composite is increased with increment of coconut fiber, it is free from acidic and basic reactions occur in nature.

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