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Processing and Strength Analysis of Composite Material for Packaging

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Abstract: ***For environment purpose the using of natural fiber as an alternative composite material in packaging, automotive and building construction related issue. Natural fibers have low cost and these are available in huge amount, lightweight and most important feature is its biodegradability. These fibers help for developing polymer based composites. However their applications are still limited due to several factors like moisture absorption poor wettability and large scattering in mechanical properties. The internal bond between the resin matrix and the reinforcing fiber is an important element due to these elements the mechanical properties of the composites material affected. This research paper focused on the treatment of fiber to improve their bonding with the resin matrix. The natural fiber composite [1] plays an important roll which is composed of natural or synthetic resins, reinforced with natural fibers. In current time renewable resources in the field of manufacturing engineering has been pursued by researchers across the world as they are environmentally friendly. This paper includes the processing, characterization of Jute fiber reinforced Polymer composites. It is a type of natural fiber and synthetic matrix composites. The experimentation involving investigation of flexural strength and tensile strength were conducted to evaluate the suitability of the said composite for packaging purpose.***

Keywords: jute fiber, wettability, synthetic matrix composite, Natural fibers, reinforced Polymer composites, resin matrix UTM, packaging

I. INTRODUCTION

Packaging becomes essential in current time. It helps to protects and surrounds the goods which we are purchasing from showroom storage to the final consumer. In present time without packaging, materials handling would be a difficult, inefficient and costly exercise and online consumer marketing would be virtually impossible [2]. The historical development of packaging has been well documented elsewhere and will only be touched upon here. This is to say that the highly sophisticated packaging industries which characterize modern society today are far from the simple packaging activities of earlier times [3]. Packaging is the core of the modern industry, and successful packaging technologists must bring to their professional duties a wide-ranging background drawn from a multitude of disciplines. Good & Efficient packaging is a necessity for almost every type of product manufactured by the industry. This will create an essential link between the product makers and their customers. If the packaging operation is not performed correctly, the reputation of the product will suffer and the goodwill of the customer will be lost. [2] All the quality, skill and reliability built into the product during development and production will be wasted, unless care is taken to see that it reaches the user in the correct condition. Properly packaging is the main way of ensuring safe delivery to the final user in good condition at an economical cost.

II. PROCESSING OF THE COMPOSITES

Polyester which is belonging to the Ester family is reinforced with Jute fibers which are used as the matrix material. The polyester resin and the hardener are purchased by the chemical market. Polyester resin has modulus of 2.5GPa and possesses density 1.145 g/cm^3[4]. The samples of composite material within the glass mould were cured at room temperature for 24 h followed by a post curing in an oven at 80°C for 4 h. The mould was inverted to release the composite specimen. The composites with three different layers (1, 2 and 3) of treated jute fibers were prepared for further investigation. After that we have performed the alkali treatment on the specimen.The jute fibers were cut into 30 cm of length and were allow to soak in a 5% NaOH solution at a temperature 30°C maintaining a liquor ratio of 15:1. The fibers were kept immersed in the alkali solution up to 6 hrs. The fibers were then washed so many times with fresh water to remove any NaOH sticking to the fiber surface. After that neutralized with dilute acetic acid and finally washed again with distilled water. The final PH value 7 obtained. The specimens were then dried at room temperature for 24 hrs followed by oven drying at 100°C for 6 hrs. [5]

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III. TESTING

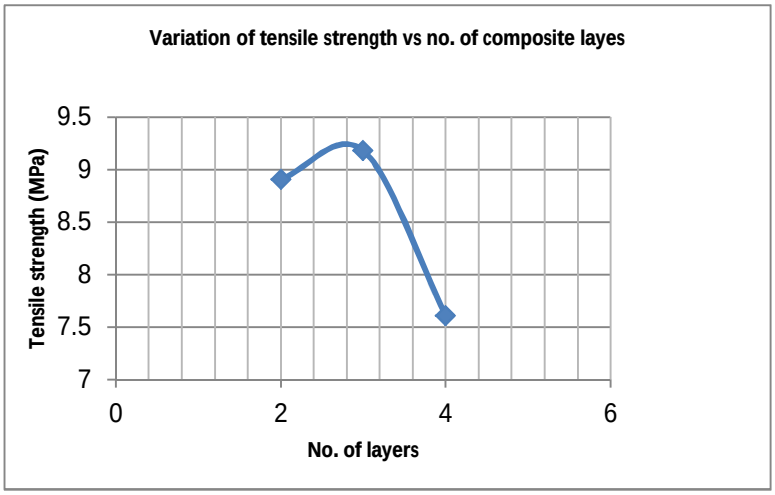
For performing the test on the specimen we cut the specimen in to small samples and prepared as per the requirement or simply said follow the ASTM code D3039-76 for tensile test and ASTM D790 03 for flexural test. The samples size is same for both tests i.e. (120mm X 10mm). But the thickness of the specimen varies according to the number of layer used.

A. Tensile test

The specimen of jute polyester composites is prepared with 2, 3 and 4 layer. Each layer of specimen has own strength. So to find out the tensile strength of each sample (differentiate on the basis of layers) tensile test performed by using UTM machine. The specimen is prepared as per the universal testing machine specification. Minimum three samples were tested and the value given is the mean of those results. Shear fracture was predominant for alkali treated fiber composites imperative of a better bonding at the interface between the fiber and the matrix [6]. Following result have been obtained after the tensile test which is shown in the table no.1. it is clear that the tensile strength is highest for three layers of composite and lowest for four layers of composite, which is due to lack of wettability of fiber with the matrix on account of large volume fraction of fiber as predicted earlier [7]

Table: 1

S.NO	No. of Layers	Tensile Strength (Mpa)
1	2	8.91
2	3	9.18
3	4	7.87



B. Flexural Test

Another test performed on the specimen is flexural test. For calculating flexural strength firstly we collect the load- displacement data with the help of UTM machine. By using that data we calculate the flexural strength with the help of formula shown below-

$$\sigma_b = pl/bd^2$$

b= width of specimen (cm)
d = failure point depth (cm)
l = supported length (cm)
p = max. Load (kg)

From that data point it can be concluded that the three layers of fabricated composite has the maximum load bearing capacity. And this due to maximum displacement of three layer specimen will be seen when the same load is applied on it. Also after the calculation it is found that the flexural strength of three layers of fabricated composite is found highest (17.83MPa) and minimum for five layers of fabricated composite.

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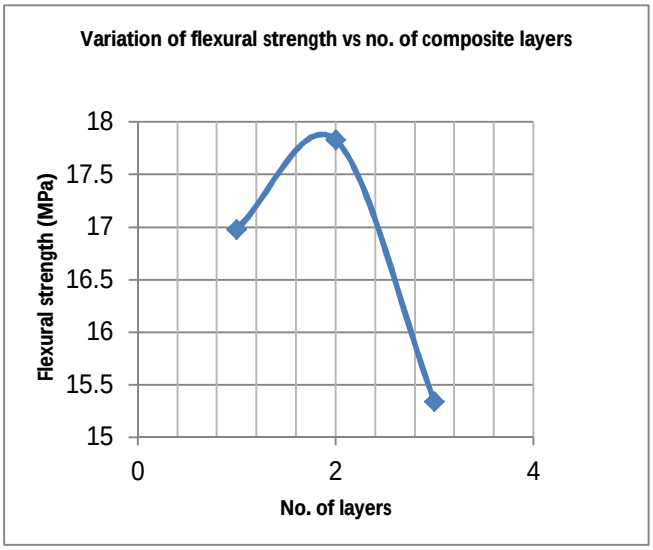
Table: 2

S.NO	No. of Layers	Flexural Strength (Mpa)
1	2	16.98
2	3	17.83
3	4	15.34



IV. CONCLUSION

In this research paper we have performed different test on the specimen prepared by using different layers of natural fiber. This composite material basically formed with Jute fiber. Natural fiber based composite material used in various applications required in industries. Packaging utilities of treated jute fiber reinforced polyester matrix composite were investigated and found some good results.

A. A new type of Jute fiber reinforced laminated composite is developed which is light in weight, having good tensile strength as well as have ability to absorb shock and can be used for packaging application for low load.

B. The tensile strength of composite material having three layers is 9.18 MPa. Whereas the specimen containing four layers has low tensile strength because of improper wettability [8] among the fibers.

C. After tensile test when the Flexural strength calculated then it is found that three layer composite having highest flexural strength i.e. 17.83 MPa and lowest for the four layered composite 14.34 MPa.

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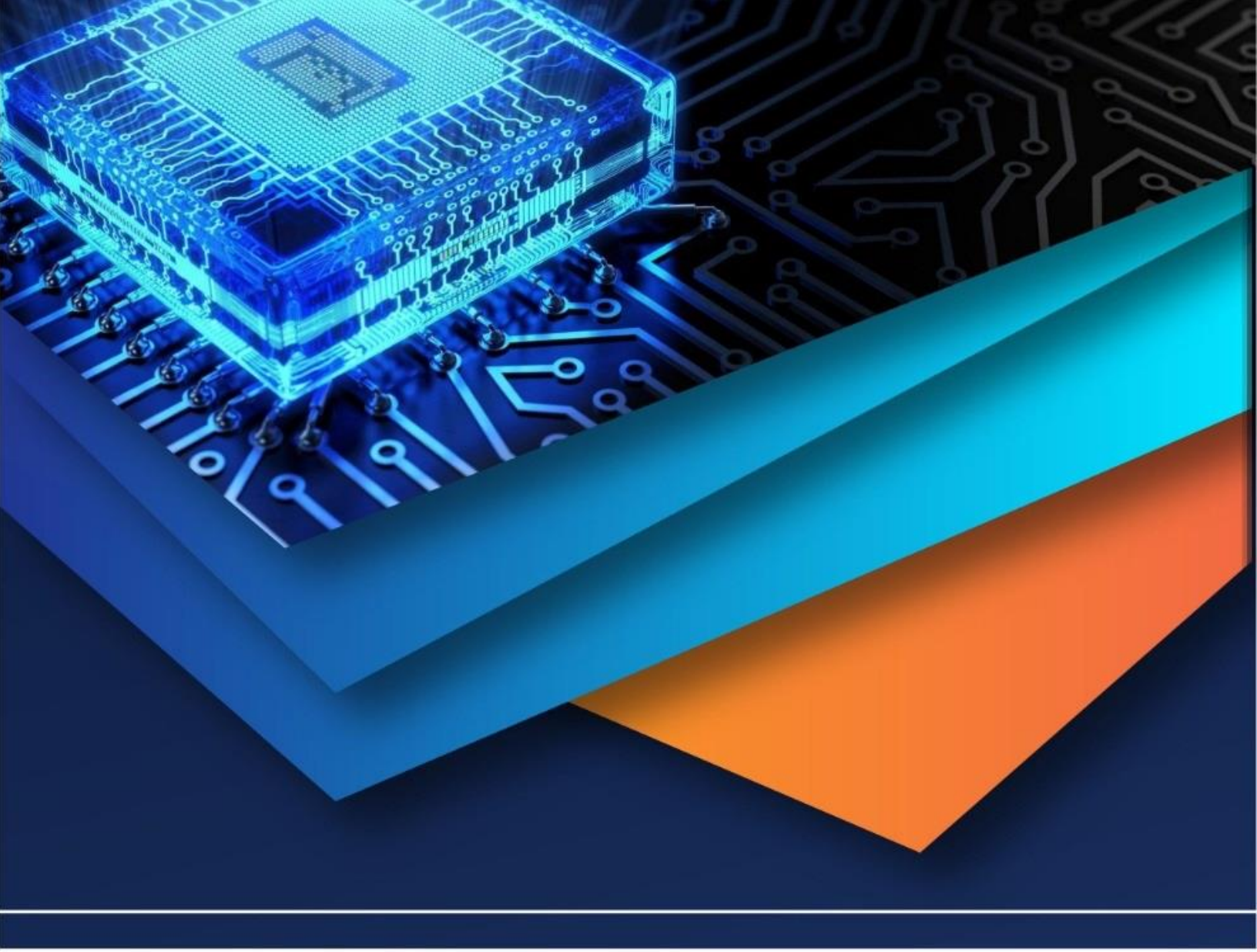

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