Investigation on Tensile and Flexural Strength of KOH Treated Ridge Gourd Fiber-Polyester Resin Composite

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Abstract:- Natural fiber is abundantly availing in nature. Nowadays this is used in composite materials. In general ridge gourd fiber is very strength material due to its woven. So this fiber is using in composites. Here potassium hydroxide (KOH) treated ridge gourd fiber is used in composite. One of the traditional methods, hand lay – up method is to use for preparing ridge gourd fiber reinforcing polyester composite. Specimens are to be test as per ASTM standards. Tensile and flexural strength are analyzed and optimize the parameters. Then, the fractured surfaces are analyzed with the help of SEM images.

Keywords*: Ridge gourd fiber, KOH, polyester resin, composite, SEM.*

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1. Introduction

As the usage of polymers in general and the polymer composites in particular is increasing every day, the dangers posed by them to the environment are also increasing simultaneously. Many of the polymer composites have glass fiber as reinforcement. As the glass fiber or fabrics are non-degradable, the disposal of composites using them as reinforcement is a problem. Moreover, the glass fibers are non-renewable. Hence the trend is slowly shifting towards using natural fibers/fabric as reinforcements as they are environmentally friendly and renewable [1-5].

Luffa aegyptiaca is an annual vine that quickly covers any support it finds. When it finds no support it crawls along the ground. The leaves are large and lobed with silvery spots on the top. The yellow, striking flowers measuring 5-7.5 cm in diameter and have five petals. The fruits are green, up to 60 cm long and 7.5 cm in diameter. They are cylindrical and smooth and slightly wider at the tip. The young fruits are small and look like cucumber. The fiber is treated in a chemical solution to remove the dead cell in the raw fiber. Natural fibers as composite reinforcements have grown in recent years. A survey of recent literature shows a significant increase in the number of articles and patents relating to the use of natural fibers. Attempts have been made by other researchers for the preparation of hybrid composites of natural fiber and synthetic fiber to improve the mechanical properties of the composites [1] [4]. The natural fibers have attracted substantial importance as a potential structural material. The attractive plus point of natural fibers in terms of industrial usage has made its availability more demanding Keeping this in view the present work has been undertaken to develop a polymer matrix composite (epoxy resin) using luffa sponge fiber as reinforcement and to study its mechanical properties and performance. The composites are prepared with 30% volume fraction of fibers [1] [6].

Usually the fiber reinforcement is done to obtain high strength and high modulus. Hence it is necessary for the fiber to possess higher modulus than the matrix material. So the load is transferred to the fiber from the matrix more effectively. Fiber reinforced composites are popularly being used in many industrial applications because of their high specific strength & stiffness. The physical properties of natural fibers are mainly determined by the chemical & physical composition, such as structure of fibers' cellulose content, angle of fibrils, cross section and by the degree of polymerization. Only a few characteristics values but especially the specific mechanical properties can reach the compensable values of traditional fibers [7]. In the pursuit of visualising the importance of this fiber is the effects of Fiber weight ratio, structure and fiber modification on to the Flexural Properties of Luffa-Polyester composites. It is observed that the chemical modification of luffa fiber enhanced the flexural strength and the flexural modulus [9]. Available literatures on luffa cylindrical fiber reinforced polymer composite are scare. Hence the present work has been undertaken to develop luffa cylindrica fiber reinforced epoxy composite. The composites were prepared with single, double and triple layers. The tensile, flexural and interlaminar shear strength (ILSS) of the composite have been studied and reported in this work [10].

2. Experimental

2.1 Fiber treatment

The natural fiber ridge gourd fiber (luffa aegyptiaca) is cut in to two half to remove the inner rough portion of the dry fruit. The fiber is washed with water and KOH solution to remove the contaminants and adhering dirt. Thereafter, they were air dried for 72h at room temperature, and then Fiber were placed in packets, preserved in polyethylene bags and stored. After the storage period, fiber was cut in angle such a way that the fiber are not in straight, it is cut in to 6cm lengths [5]. That treated fiber is used to fabricate the laminates by using hand layup technique. Here, fiber and resin are mix in 70:30 ratio.

2.2 Tensile Test

The tensile test is generally performed on flat specimens. The commonly used specimens for tensile test are the dog-bone type and the straight side type with end tabs. During the test a uni-axial load is applied through both the ends of the specimen. The ASTM standard test method for tensile properties of fiber resin composites has the designation D 3039-76. Dimensions of tensile test specimen are shown in Fig.1. The tensile test is performed in the universal testing machine (UTM) Instron 1195 and results are analyzed to calculate the tensile strength of composite samples.

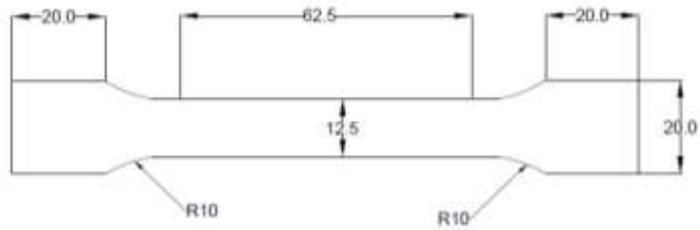

Fig.1 Dimensions of tensile test specimen

2.3 Flexural Test

The short beam shear (SBS) tests are performed on the composite samples at room temperature to evaluate the value of flexural strength (FS). It is a 3-point bend test, which generally promotes failure by inter-laminar shear. The SBS test is conducted as per ASTM standard (D2344-84) using the same UTM. Span length of 40 mm and the cross head speed of 1mm/min are maintained.

2.4 Scanning electron microscopy

The morphology of fibers and composites were performed using a scanning electron microscope (SEM). For morphological characterization, the fracture surface of the tensile specimen was milled and polished by using sandpaper. Then the polished surface was sputter coated with gold and scanned by the SEM [8].The surfaces of the raw fish scales and the composite specimens are examined directly by scanning electron microscope JEOL JSM-6480LV. The scales are washed, cleaned thoroughly, air-dried and are coated with 100 Å thick platinum in JEOL sputter ion coater and observed SEM at 20 kV. Similarly the composite samples are mounted on stubs with silver paste. To enhance the conductivity of the samples, a thin film of platinum is vacuum-evaporated onto them before the photomicrographs are taken.

3. Results and Discussions

3.1 Tensile Strength and Flexural Strength

It has been found that, there is variation in the tensile strength of the material parameters. Tensile Strength and Flexural Strength of composites are shown in Table.1. In this comparison it has been found that KOH treated ridge gourd fiber with polyester matrix has greater tensile and flexural strength. As KOH has the properties to create hardness and roughness on the surface of any material to which it is treated, greater yield point with tensile strength are obtained. And more over to that flexural strength is also increased.

TABLE.1 TENSILE STRENGTH AND FLEXURAL STRENGTH OF COMPOSITES

Parameter	Tensile Strength (MPa)	Flexural Strength (MPa)
Polyester	43.25	29.17
Ridge gourd fiber+ Polyester	48.85	41.26
KOH treated Ridge gourd fiber + Polyester	53.37	52.30

3.2 Scanning electron microscopy

Scanning electron microscope is used to analyze fractured surfaces of fiber and matrix in composites. The magnification of SEM picture is 500 μm.

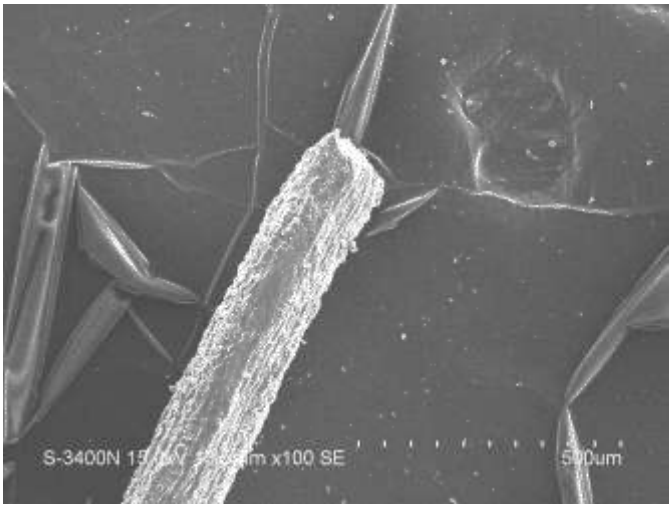

Fig.2 SEM image of fractured fiber after tensile test

Fig.2 and Fig.3 shows the SEM image of fractured fiber after tensile test and flexural test respectively. It is shows modification in the surface of the fiber, which is increase the binding capacity with the resin. Surface roughness is increase the strength of the material. During the tensile and flexural test, the fiber comes out from the matrix. It is visible in SEM image.

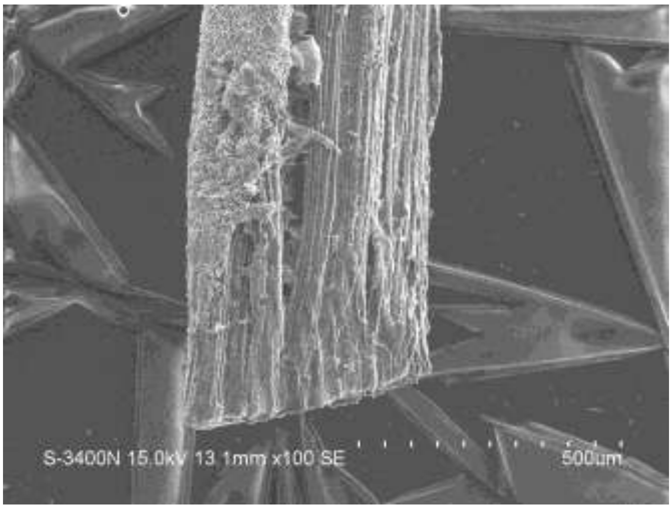

Fig.3 SEM image of fractured fiber after flexural test

4. Conclusion

In this study the influence of with and without alkali treatment (KOH) of fiber with polymer matrix composite for the study of tensile and flexural properties have been studied. It is clear that tensile and flexural strength of the KOH treated fiber with polyester composite is greater when comparing to normal fiber with polyester matrix and simple polyester alone. As it has light weight and resistant to light, heat and moister it can make use in air craft industries, automobile industries, in building spar parts of ships. More over to that because of its toughness, hardness and light in weight it can be used in maximum of mechanical parts. The study of the relationship between alkali treated and without treated materials and their tensile and flexural proprieties are confirmed by many researchers that are reported in else-where and science direct.

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