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Studies on Treated Sunnhemp and Treated Jute Fibre Reinforced Epoxy Composites

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***Abstract*—*Natural fibre reinforced polymer composites are being worked upon for various engineering applications. Various natural fibres such as Sunnhemp, jute, sisal, palm, coir and banana are used as reinforcements. In this paper, sunnhemp and jute fibres have been used as reinforcement in Epoxy resin matrix. The influence of different volume fraction of the fibres in the composite is studied. It is seen that in case of treated sunnhemp fibre reinforced epoxy composites increase in the fibre volume fraction, the tensile strength , tensile modulus, flexural strength, flexural modulus, impact strength have increased after an initial dip. At 20% of fibre volume fraction. The mechanical properties it can be deduced that sunnhemp fibre can be reliably reinforced with Epoxy resin which may be used various application such as Transportation, Marine, Construction, Furniture etc.*

Keywords*—*Composites, Reinforced, Matrix.

I. INTRODUCTION

The potential and advantages of natural fibers as reinforcement material have been given significant attention for the past few decades[1]. This is due to the fact that natural fibers are lightweight, low in cost and environmental friendly. Natural fiber composites with thermoplastic and thermoset matrices are now utilized for door panels, seat backs, headliners, dashboards and other interior parts by European car manufacturers[2]. In this research, investigations are done on the mechanical properties of chemical treated Sunnhemp and Jute fibers. These fibers are easily obtained in India and are a major concern to be recycled as reinforcement material to substitute synthetic fibers. The tensile test, flexural test and Impact strength test were done and comparison were made between treated Sunnhemp and treated Jute fiber reinforced with Epoxy resin matrix composites. The results may be used to further investigate the relevant chemical treatment or manufacturing processes to optimize the mechanical properties of sunnhemp fibre as a replacement material for synthetic fiber.

II. MATERIALS AND METHODS

The major materials in this research are sunnhemp and jute fiber and epoxy resin. The sunnhemp and jute fibers are obtained from local sources. The raw fibers are cut into lengths of 25 mm , opened and form a nonwoven web on Rando feeder machine by spraying 10% PVA on one side and dried in a heated chamber at 110 ^{0}c – 130 ^{0}c before chemical treatment. Chemical solution for fiber treatment was sodium hydroxide (NaOH). Following figure 1 & 2 shows sunnhemp, jute fibre webs

Fig.1: Sunnhemp fibre web

Fig. 2: Jute fibre web

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Composite fabrication

Chemical treated sunnhemp and jute webs were taken for composite manufacturing. Volume fraction ratios of the fiber and matrix were calculated by using the fibre weight fraction calculator (0.15 V_f, 0.20V_f, 0.25V_f). Treated sunnhemp, jute fiber webs were first left to dry naturally. Both fibre webs were treated with the 8% NaOH solutions and thoroughly washed with water for 1 hour. Then webs were oven dried to remove moisture content. After drying the treated webs were cut as per the V_f ratio. These composites were fabricated separately by using thermoset method of composite manufacturing. The mixture of sunnhemp fiber and jute fibre epoxy resin were poured into the mould of 200 x 200 x 5 mm size and pressed in a hydraulic press at the room temperature for 12 hour with a pressure of 10 ton. After pressing for required duration the composite kept for drying for 24 hours followed by cutting the samples into specified shape & size according to ASTM standard for each different test.

III. EXPERIMENTAL DETAILS

In our research, we have performed three types of testing were done in VJTI physical lab Mumbai, tensile strength test[3], flexural modulus test[4] and impact strength test[5] were conducted on both treated samples the results were compared. The entire tests are conducted according to American Standard Testing Material (ASTM). The tensile test are conducted using TINIOUS OLSEN (test machine at a cross head of 2mm/min. The specimens are dog-bone shape specimens. The guage sample length is 115mm, width 19mm and thickness 4mm. The flexural tests are conducted using the same test machine . The specimen dimensions are 120 mm × 12.75 mm × 4.2 mm in thickness. The impact tests are conducted by using Izoid impact strength tester.

IV. RESULTS AND DISCUSSION

4.1 Effect of chemical treatment on tensile properties of sunnhemp and jute fibre-reinforced epoxy composites

The summarized results for tensile test are shown in figure 3. It shows a significant increase of tensile strength for both treated fiber composites but the treated sunnhemp fibre composites shows better tensile properties. However, after 0.20 V_f fiber load, the tensile strength decreases in case of treated sunnhemp fiber epoxy resin composites . The treated sunnhemp fiber composite exhibits higher tensile strength value compared to treated jute fiber composite for all fiber loading ratio[6].

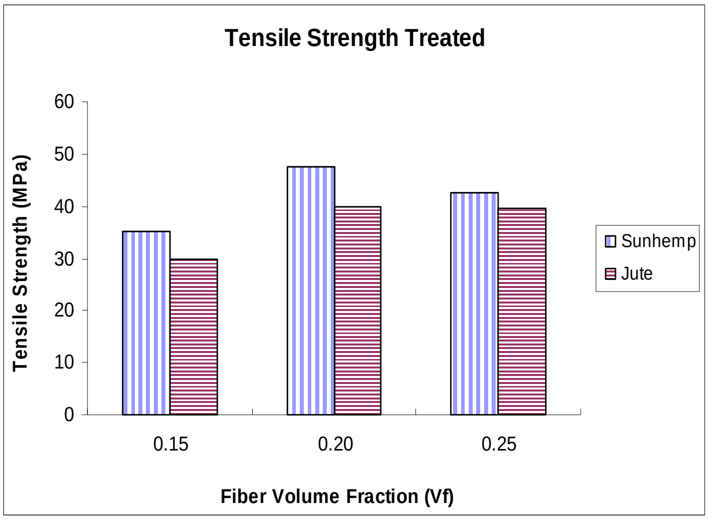

Fig. 3: Tensile strength of Treated Sample

4.2. Effect of chemical treatment on tensile modulus of sunnhemp and jute fibre-reinforced epoxy composites

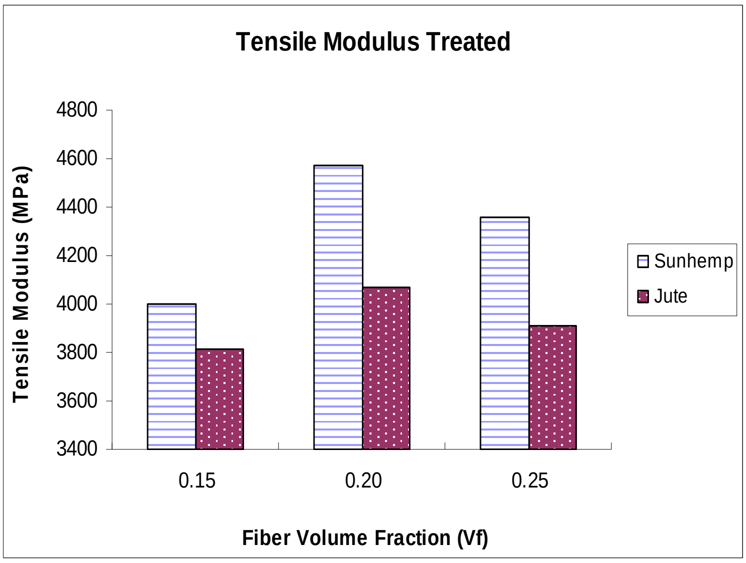

Fig.4: Tensile modulus result for treated

Figure 4 shows measured of tensile modulus of treated, Sunnhemp, Jute fibre reinforced epoxy composites. The result shows increase in tensile modulus with increase in the fibre volume fraction up to 0.20 V_f in case of treated sunnhemp fibre reinforce epoxy composite. A treated sunnhemp fibre reinforced epoxy composites comparatively shows better tensile modulus results than Jute fibre reinforced epoxy composites. The composites reinforced with short cellulose fibres, the tensile strength is strongly dependent on the magnitude of adhesion bonding, it is

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depend on several factors chief among them being the properties of the reinforcement and matrix and the fibre volume fraction. The fibre mechanical properties, such as initial modulus and ultimate tensile stress, are related not only to the chemical composition of the fibre but also to its internal structure.[7]

4.3. Effect of chemical treatment on Flexural strength of sunnhemp and jute fibre-reinforced epoxy composites

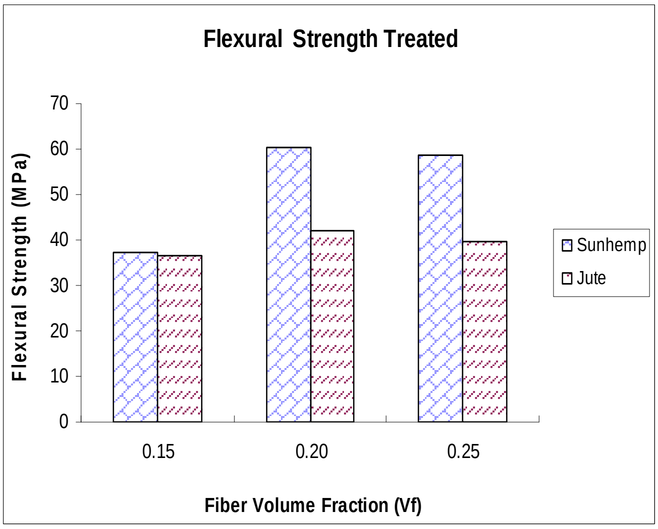

Fig.5: Flexural strength result for treated

The flexural test results for treated sunnhemp and jute fiber composite are shown in figure 5. It is observed that the flexural strength decreases after 20% fiber load for treated composites. Treated sunnhemp fiber composites yielded higher flexural strength compared to treated jute fiber composite.

4.4. Effect of chemical treatment on Flexural modulus of sunnhemp and jute fibre- reinforced epoxy composites

Figure 6 indicate flexural modulus for treated sunnhemp and jute fibre reinforced epoxy composites. It shows flexural modulus were sharply increases with in fibre loading, where flexural modulus shows better results at 0.20 V_f in case of treated sunnhemp composites. The increase in the flexural strength with fibre loading , primarily attributed to reinforcing effect imparted by the fibres which allowed a uniform stress distribution from polymer matrix to disperse fibre phase. Similarly enhancement of modulus at higher loadings due to the fact that the fibres act as point of mechanical restraint in the system. Consequently restrict the mobility of the polymer chain during mechanical deformation. The decrease in the flexural properties at higher higher fibre volume fraction implied poor fibre matrix adhesion , which promoted micro back formation at interfaces as well as non uniform stress transfer because of fibre agglomeration within the matrix[8].

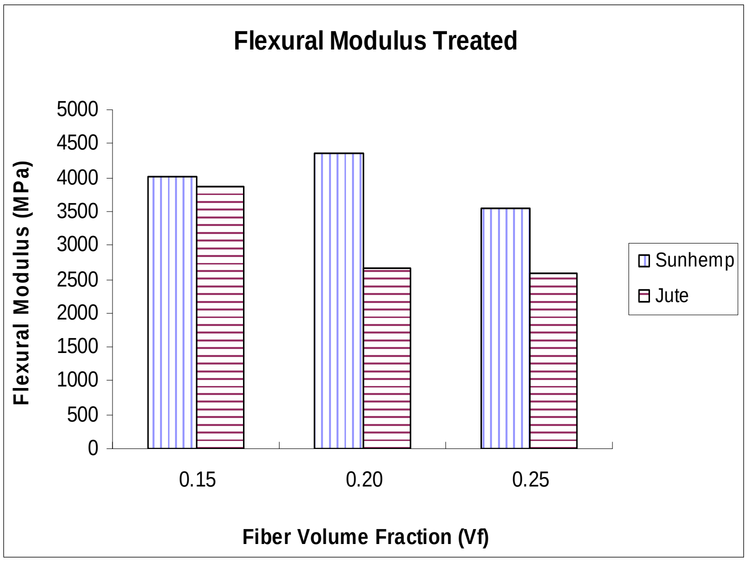

Fig.6: Flexural modulus result for treated

4.5. Effect of chemical treatment on Impact strength of sunnhemp and jute fibre-reinforced epoxy composites

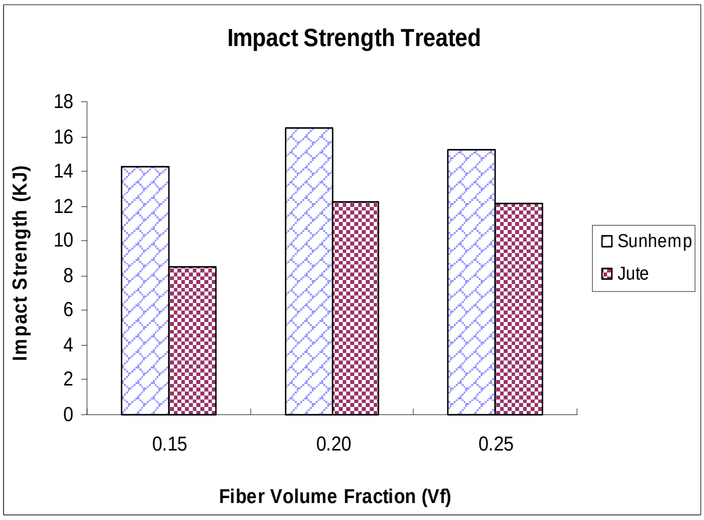

Fig.7: Impact strength result for treated

Figure 7 indicates that Impact strength of composites generally depends on nature of fibre, matrix, fibre/matrix interface and the test condition. Other factors such as micro scale morphological changes in composites also affect the impact properties. A composites having good impact resistance should absorb most of the impact energy and propagate crack very slowly. The effect of fibre volume fraction on the notched. Impact strength of treated Sunhemp fibre reinforced epoxy composites shows better impact strength at 0.20 V_f. It has also been reported that higher interfacial adhesion between matrix and filler require higher for initiation and propagation of crack during the impact test.

The failure mechanism was mainly by fibre pullout due to weak interfacial strength between the fibre and matrix. Sharp drop in impact strength at 0.25 V_f due to delimitation of fibres and pull out fibre easily. The pull out theory assumes that the filament break due to presence of flaws that are randomely distributed and in the absence of this randomness, the fibre will break in the crack plane and no pull out will occur. The non uniformity of fibre will also lead to a more complex relation due to uneven fibre surface , the stressed fibre will twist and turn. So that it can fit in the socket or tunnel created by fibre. This interlocking will then cause mechanical keying point between the fibre and matrix and their by altering the friction stress[9].

V. CONCLUSION

The mechanical properties of treated Sunnhemp fiber reinforced composite are investigated in terms of tensile strengths, flexural strengths and impact strength . Treated sunnhemp fiber reinforced epoxy composites exhibits higher tensile and flexural strength and impact strength properties as compared to treated Jute fiber reinforced epoxy composites. The tensile strength, flexural strength and impact strength are at the highest value at 0.20 V_f.. It can be concluded that the chemical treatment conducted to the Sunnhemp fiber have improved the mechanical properties of the fiber by modifying the surface of the sunnhemp fiber and make it more compatible with epoxy resin matrix. Thus, the interfacial bonding between fiber and matrix are also increased. Epoxy resin which may be used various applications such as Transportation, Marine, Construction, Furniture etc.

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