Pak. J. Biotechnol. Vol. 15 (Special Issue ICRAME 17) Pp. 89-91 (2018) P. Ramashankar et al.,
www.pjbt.org PISSN: 1812-1837, EISSN 2312-7791

STUDY ON THE MECHANICAL PROPERTIES OF THE NATURAL FIBRE REINFORCED POLYMER COMPOSITE MATERIALS

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ABSTRACT

The studying of mechanical properties of fibre and its reduced cost of treating and several other property variations can achieve the requirement of alternatives in fibre utilization. These chemically treated natural fibers are possessing improved properties than untreated fibers. They are having better results in impact strength, toughness and fatigue limit. The main objective of this review is defining about the research of natural fibre and developing the natural fibre in its reinforced polymer composites.

Key words Natural fibre, fatigue, treated and untreated fibers, mechanical properties.

1 INTRODUCTION

All organism needs to convert and transform components get its own mechanical, chemical and physical properties through the synergistic effect caused by two or more chemically distinct materials (Ashok Kumar et al., 2016). The main components cannot compete with the composites in terms of properties and it can be made or of metal, ceramic or polymer, etc. There is an increase in the fibre reinforced composite usage. Low cost, ease of availability, light weight etc., is some of the important factors for increase of its usage (Vinoth et al., 2016). Its renewable properties he bio-degradable nature are the most important properties. It possesses an economic interest of industry. Lots of green materials are used which make them eco-friendly in these composites and helps agricultural residue in an alternative way. There are two types of natural fibers such as animal and Plant fibers. There are some minor classifications in the natural fibers. Those are primary and secondary (SenthilRajan et al., 2014). Primary fibers are grown from plants whereas secondary are waste product of plant. Leaf fibre, grass fibre, bast fibre, straw fibre, fruit fibre and other like wood roots and pulp are the six varieties of plant fibre (Dharmalingam et al., 2014).

2 MATERIAL AND METHODS

For this experimental investigation, the madar and banana fibers are separated and extracted from the stem of madar plants and banana plants (Kandeepan et al., 2016). These separated fibers are used as the reinforcement material. And for the matrix material, a commonly available unsaturated polyester resin is used, Product trade name satyan polymer supplied by GV Traders, Madurai. Methyl ethyl ketones are used as the accelerator and cobalt naphthenate are used catalyst respectively.

3 RESULT AND DISCUSSION

The mechanical strength of the chopped madar fiber reinforced composites mainly depends on the interface adhesion between the reinforcement and matrix, the length of the fiber, fiber concentration, fiber type and fiber content (Ganeshan et al., 2016). The tensile behavior of the composite, prepared with the fabricated sample, was tested in the Instron UTM (Model No-4301) with a crosshead speed and the gauge length of 5 mm/min and 50 mm respectively. The experiments for the tensile test were conducted according to the ASTM standard D 638-03 (Chandrasekaran et al., 2013). Table 1 illustrates the obtained result from the experimental test. The unreinforced resin specimens are prepared and cured at 30°C for 24 h and the mechanical properties such as tensile modulus and strength of pure un-reinforced matrix are 996.45MPa and 23.9MPa. Figure 1 shows the digital image of the composite specimen.

Figure 1: Digital images of composite specimens for the tensile test

From figure 2 it is clearly evident that for madar fiber composites with the weight percentage of the fiber is less than critical fiber content i.e. the mechanical properties of the matrix material is higher than that of the reinforced composites and with increases in the weight percentage of fiber content, the mechanical strength will also get increased (Yoganandam et al., 2016). The mechanical property such as tensile modulus and strength of the madar fibers reinforced composites attains the mechanical properties of the pure un-reinforced matrix at the composite having the fiber content of 24 wt% and 12 wt% respectively. When compared the tensile strength of unreinforced resin with the madar fiber compo-sites, it has the percentage improvement of 44.75%, 53.9 7% and 64.86% for the different weight percentage of the fiber content such as 30wt%, 42wt%, and 60wt%. The composite having the fiber content of 60wt% exhibit the higher tensile strength of 39.4Mpa. With the increase in the madar fiber content, the tensile strength of the polyester resin gets increased. At the lesser fiber content, the resin controls the mechanical strength of the composite, so the fiber reinforced composite decrease that the pure matrix strength which is occurred for the lesser fiber weight percentage. Only when the contribution of the fiber gets increased for a particular minimum weight percentage which depends on the fiber length, after that only material strength is contributed by the fibers. The 48 wt% of the composite results in the maximum tensile modulus of 1184.81Mpa and up to this weight percentage of the tensile modulus gets increased and beyond that the strength gets decreased which is due to the increase in the weight percentage of the fiber content in the composites above the particular limit.

Table 1 Mechanical properties of chopped madar fiber composites

Fiber content (Wt %)	Tensile strength (MPa)	Tensile Modulus (MPa)	Flexural strength (MPa)	Flexural Modulus (GPa)	Impact strength (KJ/m^2)
0	23.9	996.45	27.8	1.05	0.48
6	19.7	888.25	17.1	0.84	0.5
12	25.6	917.36	21.2	0.89	0.51
18	29.6	954.75	24.8	0.96	0.47
24	32.4	990.56	28.3	1.02	0.57
30	34.6	1006.49	31.9	1.07	0.53
36	36.1	1095.71	37.7	0.98	0.5
42	36.8	1113.96	41.2	1.22	0.46
48	37.9	1184.81	42.6	1.25	0.51
54	39.2	1158.22	43	1.18	0.48
60	39.4	1145.62	43.6	1.17	0.46

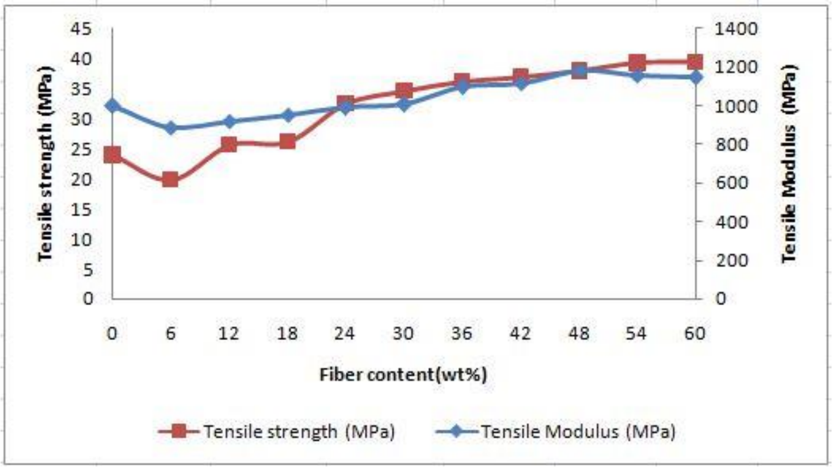

Figure 2 Effect of fiber content on the tensile properties

Table 1 shows that the percentage of increase in the tensile strength, it is clear that when the fiber content in the composite gets increased the percentage of improvement gets decreased. The mechanical property of the composite gets decreased because the stress transfer gets blocked due to the agglomeration with increased in the population of fibers in the high levels of fiber content. Kandeepan et al. investigate that the increase in the higher volume of plant fibers in the composite, the mechanical strength of composites are decreased. Figure 3 illustrate the SEM image of the composite specimen failure due to the weaker bonding between the matrix and fiber.

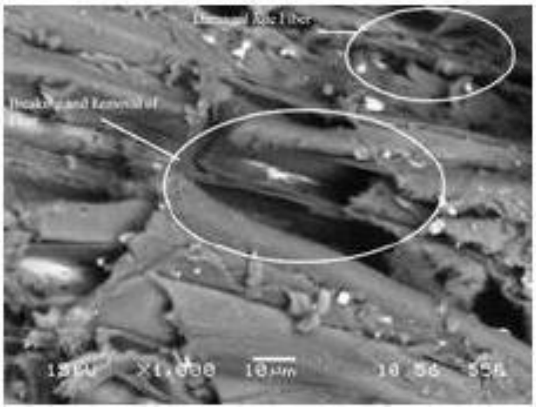

Figure 3. SEM image of Fractured Tensile Specimen

4 CONCLUSIONS

Due to its wide range of eco-friendly than synthetic fibre in almost every aspect such as bio degradation, non-toxic, they can possess a large quantity of usage in near future. The natural fibre is economic, less weight, abundance in quantity. By doing some changes in the properties and modifying its workability, it can be used for wide day-to-day purposes. Thus, they are used in many automobile, constructions and house hold applications. The mechanical properties of the chopped and randomly oriented long madar fiber and madar/banana hybrid fiber reinforced composites were studied. With the increased in the length of the fiber and its content the tensile and flexural strength of the composites gets increased. But the tensile and flexural modulus strength gets decreased with increase in the fiber length and fiber content. In general, for a specified fiber length, increased in the wt % of the fiber content increased the tensile modulus of the composites. From the result, it is clearly observed that the mechanical properties of the madar/banana hybrid reinforced polyester composites. The morphological behavior of the fractured specimens was studied by using scanning electron microscope.

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