International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

DEVELOPMENT AND MECHANICAL CHARACTERIZATION OF TEAK, PATTAK- POLYESTER NATURAL FIBRE COMPOSITES

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Abstract: Natural fibres, which were traditionally used as fillers for thermosets, are now becoming one of the fastest growing performance additives for thermoplastics. TEAK wood fibre and PATTAK wood fibre were treated with alkali solution to improve the compatibility with matrix resin. The fibres were processed by Hand-lay-up method. The fibres were chopped into small pieces and the fibre pieces were mixed with polyester resin and suitable catalyst. Finally the mixture was poured into required shape of the mould. In this research work, a series of experiments have been conducted to investigate the effect of mechanical properties of natural fibre composite. Composites were prepared by varying 5% and 10% weight percentage of randomly chopped TEAK wood fibre and PATTAK wood fibre in polyester matrix. Tensile strength, impact strength and flexural strength were investigated and compared with both natural fibre composites. The result shows that the tensile strength and flexural strength of the PATTAK wood fibre composite was 40% higher than the TEAK wood fibre. There was no much difference in impact strength values in both composites

Keywords: Wood fibre, polyester, composite, thermal stability

I. INTRODUCTION

In recent years the demands of the conventional metal/ materials have been increased. This conventional material can be replaced by polymers. This replacement is possible because of the advantages of polymers, which offer over the conventional material. The most important properties are low cost, low density and corrosive resistance. The major demerit of the polymer material is its low mechanical strength compare to conventional metals/materials. The mechanical properties can be improved by adding fillers and fibres. In most of the applications of the conventional material can be replaced by fibre reinforced polymer composites. Researchers suggest that the natural fibre can be used as a filler material for polymer matrix. Because it offers more advantages over the conventional filler material [1].Cellulose fibres from recycled newspaper as reinforcement for thermoplastic starch in order to improve its mechanical, thermal and water resistance properties [2]. The composites were prepared from corn starch plasticized by glycerol (30% wt/wt of glycerol to starch) as matrix to form a Thermo Plastic Starch (TPS) that was reinforced with micro-cellulose fibres, obtained from used newspaper, with fibre content ranging from 0 to 8% (wt/wt of fibres to matrix).The results showed that higher fibres content raised the tensile strength and elastic modulus up to 175% and 292%, respectively, when compared to the non- reinforced thermoplastic starch. The addition of the fibres improved the thermal resistance and decreased the water absorption up to 63%. Besides, scanning electron microscopy illustrated a good adhesion between matrix and fibres. The mechanical properties of Green Composites from Cellulose Fabrics and Soy Protein Resin were studied [3]. Because of the highly polar groups on both cellulose and SPC the fibre/resin interface is expected to be strong which improve the tensile and flexural properties.These composites have sufficient mechanical properties (when compared to other materials, such as wood and soft steel) to find use in some interior structural applications.

Bamboo fibres were reinforced with cross poly green composites, which improve the strength of the composites [4]. In this work he addressed chemically treated fibres give more strength than that of untreated fibre composites. This chemical treatment increases the surface area of the fibre which improves the interaction between the matrix and fibre reinforcement. It leads to improve the mechanical properties of the natural fibre reinforced composites. In another study conducted on effect of thermal, mechanical properties of micro wave processed luffa- epoxy reinforced natural fibre composites [5]. In this work he used treated luffa fibre and micro wave method for processing the composite material. Which improve the mechanical properties of the natural fibre composite. Experiments were conducted to study the mechanical characterization of the scalable cellulose nano fibre based composites made using liquid composite molding process [6]. The investigation performed reveals that, the silane treated samples shows superior mechanical behaviour compare to untreated samples and also silane treated composites show high elastic modulus compare to pure epoxy sample. The popular Euroamericana wood fibres were reinforced with cement and the mechanical properties of wood fibre composite were investigated for three different wood treatment conditions [7]. The alkaline hydrolysis was found as the most effective treatment for the suppression of inhibitory substance and the highest decreases of mechanical properties of resulting composition. The main objective of this work is to fabricate the two different treated natural fibre composites with two different weight percentages of the natural fibre composites. Characterized and compare the Tensile strength, impact strength and flexural strength of both the composites with two different weight percentages.

II. EXPERIMENTAL

Materials used

Matrix and fibre material

Polyester unsaturated synthetic resin, MEKP (Methyl ethyl ketone peroxide) hardener and cobalt octane accelerator supplied by Hunstman crop were used to prepare the matrix phase. The TEAK wood fibre and PATTAK wood fibre were isolated from dried TEAK and PATTAK plant supplied by the market. To improve the interaction between the fibre and polymer matrix, a chemical treatment using NaoH was carried out on the fibre after isolation.

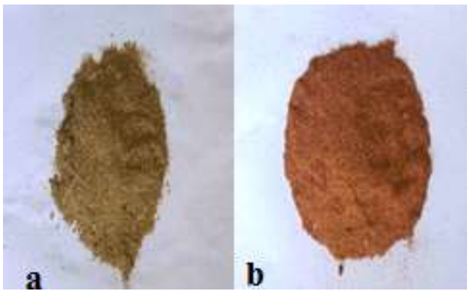

Fig.1 a. TEAK wood b. PATTAK wood

The treatment increased the effective surface area which contributes to increase the fibre-matrix adhesion, and in FRCs good fibre matrix adhesion is a key contributor to good mechanical properties. The TEAK wood and PATTAK wood fibre were immersed in 1N 10% NaOH solution for 2 hours followed by washing in distilled water and drying. Then the wood fibres were chopped randomly into small pieces.

Composite Fabrication

The polyester unsaturated resin and MEKP hardener were mixed in the ratio 10:1 and then 6% of accelerator was added with this mixture. The chopped TEAK wood fibres were introduced into this mixture such that the fibre accounted for 5% of the weight of the mixture. The same process carried out for 10% TEAK, 5% and 10% of PATTAK wood fibres. Initially 570gm polyester resin taken in container, then the hardener and accelerator were added with resin matrix. Finally the mixture was processed by hand-lay-up method and the composite was obtained.

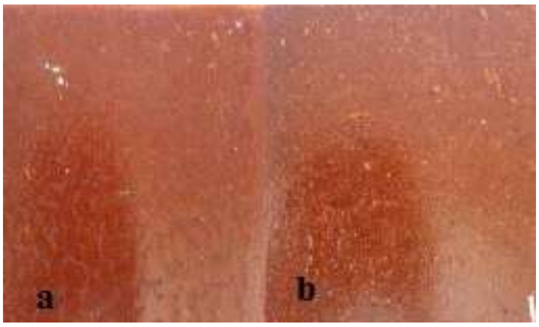

Fig.2. a. PATTAK 5%, b. PATTAK 10%

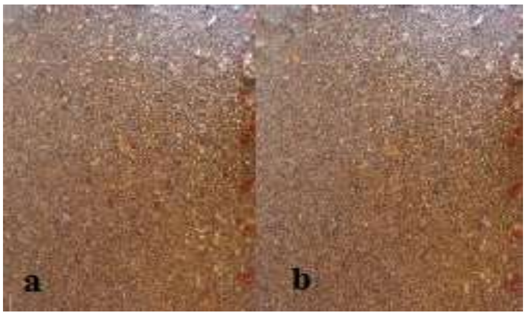

Fig.3. a. TEAK 5%, b. TEAK 10%

III. CHARACTERIZATION

Mechanical

The Ultimate tensile and flexural strength were determined using Universal testing machine according to the ASTM D 3039/D 3039M standard. The impact energy was measured using charpy impact test. The rectangular specimen of dimension 65×12×3mm was prepared for this test.

Result and Discussion

Mechanical properties

The tensile and flexural properties of PATTAK wood fibre composite were higher than the values of TEAK wood fibre composite. This may be due to that the PATTAK wood fibre- matrix interaction was good when compared to TEAK wood fibre- matrix interaction, because the tensile strength and flexural strength more were sensitive to the fibre- matrix interaction and fibre orientation. The tensile property and flexural property of 10% PATTAK wood fibre composite was higher when compared to 5% PATTAK wood fibre composite. Fibre orientation contributes to increase in tensile strength and flexural strength of same wood fibre composite. The fibre length was increased when compared to critical length of the fibre. This was contributed to increasing weight of the wood fibre in polymer matrix

Table.1. Mechanical properties of composites

Wood Fibre	Wt %	Tensile strength (Mpa)	Flexural Load (Mpa)	Impact strength (J)
PATTAK	5	11.28	0.19	2
	10	13.28	0.44	2
TEAK	5	3.28	0.25	2
	10	8.43	0.26	2

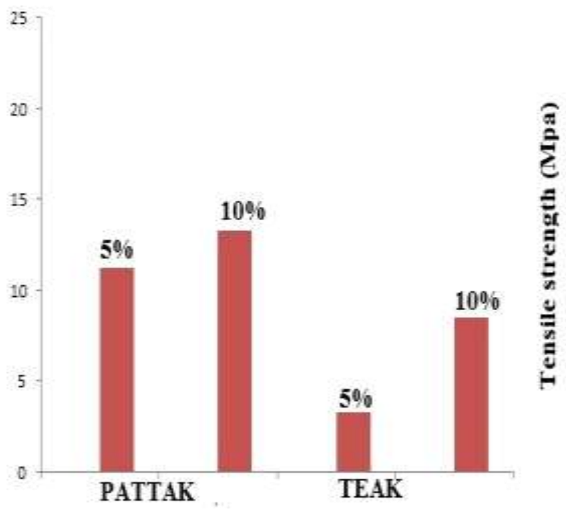

Fig.4. tensile strength Test

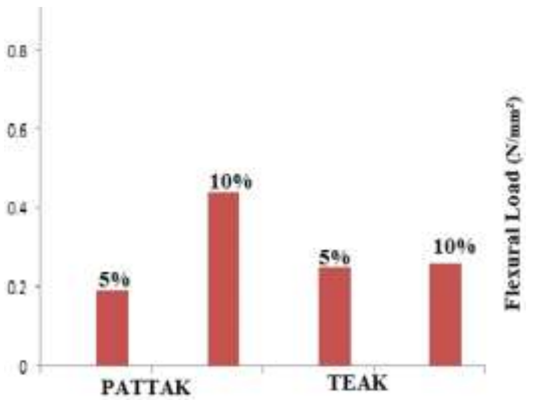

Fig.5. Flexural strength Test

IV. CONCLUSION

In an era of volatile environment usage of natural fibre as reinforcement has been proven as environment friendly alternative to traditional synthetic fibres. Extensive study has been made to compare the mechanical strength of PATTAK and TEAK wood fibre reinforced composites of various proportions, with an outcome proving the superiority of 10% PATTAK over TEAK wood. Tensile strength, impact strength and flexural strength were investigated and compared with both the natural fibre composites. The results show that the tensile strength and flexural strength of the PATTAK wood fibre composite was 40% higher than the TEAK wood fibre. There was no much difference in impact strength values in both composites.

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