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Analysis of Properties of Intra-Layer Jute–Polyester–Glass Fibre Reinforced Composite: A review paper

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Abstract

Composite material which are made with natural fibres having many applications due to their low cost and eco-friendly nature. The paper consists of fabrication and evaluation of natural fibre and polymer composite using jute and polyester along with glass fibres. Each composite is made up of layers of jute fibre and polyester along with glass fibre. The composites are made with four different proportional ratios of jute fibre, polyester and glass fibre. The composite samples thus fabricated are tested to find the mechanical properties they possess.

Keywords*:* Composite, mechanical properties, Layers, Natural Fibres.

1. Introduction

Natural fibers are replacing synthetic fibers in many applications due to their advantages like low weight, low cost and biodegradability. Thermoplastics and thermoset plastics can be used as resin matrices combined with a suitable hardener. Due to the high cost of material and fabrication, applications of synthetic fiber composites are limited to aeronautical and defense applications. Natural fiber reinforced composites are best suited to any design that demands weight savings, finite tolerances, precision engineering and simplified production and operations.
Composite more often than not implies that at least two separate materials are joined on a perceptible scale to shape a basic unit for different engineering applications. Each of the material components may have distinct thermal, mechanical, electrical, magnetic, optical, and chemical properties. Composite materials have some advantages when compared to their components or metal parts.

Types of fibres-

1. Continuous fibre
2. Short fibre
3. Particles

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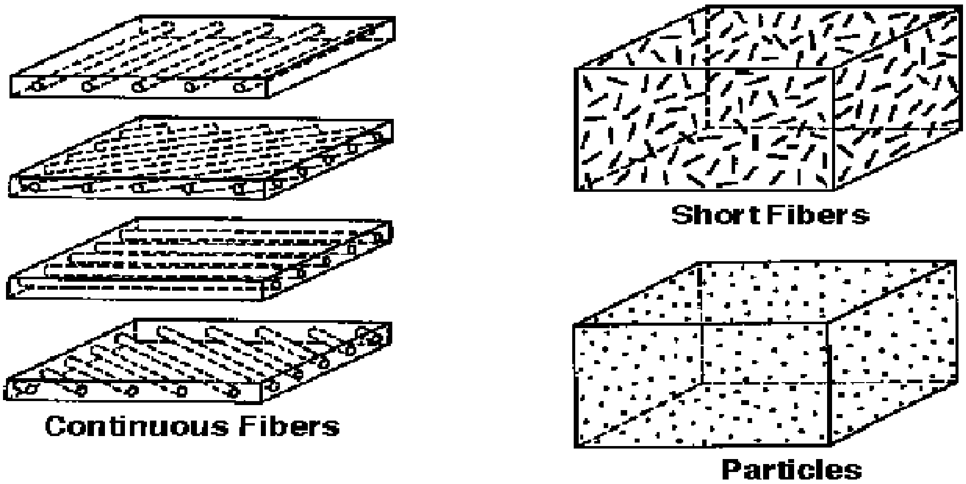

The matrix phase plays a crucial role in the performance of polymer composites. Both thermosets and thermoplastics are attractive as matrix materials for composites. In thermoset composites, formulation is complex because a large number of components are involved such as base resin, curing agents, catalysts, flowing agents, and hardeners. These composite materials are chemically cured to a highly cross-linked, three-dimensional network structure. These cross-linked structures are highly solvent resistant, tough, and creep resistant. The fibre loading can be as high as 80% and because of the alignment of fibres, the enhancement in the properties is remarkable. Thermoplastics offer many advantages over thermoset polymers. One of the advantages of thermoplastic matrix composites is their low processing costs. In thermoplastics most of the work reported so far deals with polymers such as polyethylene, polypropylene, polystyrene, and poly (vinyl chloride). This is mainly because the processing temperature is restricted to temperatures below200°C to avoid thermal degradation of the natural fibres. Thermoplastic composites are flexible and tough and exhibit good mechanical properties. Properties of the fibres, the aspect ratio of the fibres, and the fibre–matrix interface govern the properties of the composites. The surface adhesion between the fibre and the polymer plays an important role in the transmission of stress from matrix to the fibre and thus contributes toward the performance of the composite.

2. Literature Review

Y. Cao etal.2004,prepared biodegradable composites reinforced with bagasse fibre before and after alkali treatments, and mechanical properties were investigated. Mechanical properties of the composites made from alkali treated fibres were superior to the untreated fibres.
After alkali treatment, increase in strength and aspect ratio of the fibre contributed to the enhancement in the mechanical properties of the composites. SEM observations on the fracture surface of composites showed that the surface modification of the fibre occurred and improved fibre–matrix adhesion.

Kazuya Okubo et al 2004, concluded that bamboo fibre bundles have a potential ability to work as the reinforcement of polymer matrix. The tensile strength of the bamboo fibre bundle is as high as that of jute fibre. High weight content of bamboo fibre enables the bamboo composites to increase their strength in the most effective way, when the bamboo fibre is modified into the 'cotton shape'. The bamboo fibre bundles need to be mechanically modified into the 'cotton shape' after the steam explosion method is applied, in order to benefit from bamboo fibre's potential function as reinforcement of plastics.

M. Brahmakumar et al. 2005 proposed that the natural waxy surface layer of coconut fibre provided a strong interfacial bonding between the fibre and the polyethylene matrix. The waxy layer due to its polymeric nature showed a stronger effect on fibre/matrix bonding than by grafted layer of a C15 long alkyl chain molecule onto the wax-free fibre. The morphological features of the fibre along with its surface compatibility with the matrix favoured oriented flow of relatively long fibres (20 mm) along with the molten matrix during extrusion, in contrast to a fibre length limit of 6 mm that observed for sisal and pineapple fibres under identical extrusion conditions.

Sami Ben Brahim et al. 2007 evaluated the influence of fibres orientation and fibres fraction on the mechanical properties of the Alfa/Polyester composites. It has been observed that it is possible to get with these fibres strong and stiff composites materials useful for many structural applications such as sport articles and automotive parts.

Ahmad Alawar et al. 2009 showed alkali and acetylation treatment applied to DPF and fibres show different properties compare to different types of treatments methods used. Surface morphology shows improvement with soda treatment and high concentration form high biting and groves in the fibre surface. Thermal analysis of DPF shows resistance up to about 260°C and soda treated fibres show better thermal resistance compared to raw fibres. FTIR analysis sows similarity of DPF spectra with other types of plant fibres and no significant alteration between raw and treated fibres.

M.Ramesh et al. 2013 concluded that the sisal/GFRP composite samples possess good tensile strength and can withstand the strength up to 68.55 MPa. The jute/GFRP composite specimen is holding the maximum flexural load of 1.03KN slightly higher than the sisal/GFRP composite sample. The failure morphology of the tested samples is examined by using Scanning Electron Microscope. From the results, it can be concluded that sisal-GFRP composites performing better for tensile loading and jute-GFRP composites performing better for flexural loading. The performance of these natural fibre composites is lower than that of the GFRP, it has been used in many application which requires medium strength.

B.Vijaya Ramnath et al.2014, fabricated and evaluated hybrid natural fibre composite using jute and abaca fibres along with glass fibres. The composites are manufactured with three different fibre orientations and the compositions are varied in three different proportions and determined that with higher content of abaca (natural fibre) the composite specimen exhibited better tensile and flexural and impact properties.

Mohit Sood et al.2014, reviews how fibre treatments upshot to flexural strength and modulus of natural fibre composites during. Chemical treatments improved fibre interface bonding with matrix and impart more strengths to composites. Apart from chemical treatments physical treatments can also be applied to fibre. Alkali treatments can be used as primary treatments for all type of fibres. Coupling agents also ameliorate flexural properties and the combination of treatments is equally supercilious. Different types of combination of treatments can be used on different fibres along with coupling agents.

L. Yusriah et al. 2014 prepared the physical, mechanical thermal and morphological properties of BNH fibre were investigated. The results confirmed that the fibre length, diameter and density of BNH fibre varied at each

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stage of fibre maturity, where the raw BNH fibre was observed with the highest fibre length, followed by ripe and matured BNH fibre, respectively. The diameter of the BNH fibres was found to decrease from raw to matured stage. The moisture content of the BNH fibre at ripe stage was found to be the highest content due to the fact that the moisture content of natural fibres is proportional to the ripening process of the fruit. The cross-sectional of raw BNH fibres were observed with large size lumen structures, whereas the ripe BNH fibre exhibits a slightly smaller and elongated lumen

3. Conclusion

Composites made with natural fibres are discovering applications in a wide assortment of engineering fields due to their low cost and eco-friendly in nature. In comparison to natural fibres polymers such as Kevlar, carbon fibre, polyester, etc. have shown better strength to weight ratio therefore, a blend of both polymer (polyester) and natural fibre (jute) can be used to elevate the mechanical properties such as tensile strength, impact strength, shear strength, etc. of the composites.

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