AN OVERVIEW ON THERMAL AND MECHANICAL PROPERTIES OF NATURAL FIBER REINFORCED HYBRID COMPOSITES

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Abstract

The usage of composite material for engineering applications is increasing to derive various advantages such as reduction in weight, corrosion resistance, ability to tailor designing, manufacturing process flexibility, high strength to weight ratio. However the usages of synthetic reinforcements are not biodegradable, the usage is restricted for commercial applications since this leads to environmental problems.

In this paper Hybrid composites are in the form of sisal/Sic/Glass Fiber, jute/sansevieria fiber, sisal/jute fiber, jute/bamboo fiber. The Thermal and mechanical properties are discussed here, for the hybrid composites the Epoxy resin is used as binder, by adding the Filler to the Natural fibers materials, can further improve the performance of the composites. Some of the commonly used fillers are Carbon black, Calcium Carbonate, Alumina, Magnesium Hydroxide, Bone powder, Coconut Powder, Hematite powder, TiO_2, SiO_2 Graphite etc. In this paper Silicon Carbide is used as filler material.

Key Words: Composite material, Hybrid Composite, Jute fiber, Glass fiber, Silicon Carbide, Mechanical properties, Thermal properties, Epoxy.

1. INTRODUCTION

Composite material is a material system composed of two or more dissimilar materials, differing in forms, and insoluble in each other, physically distinct and chemically inhomogeneous. The resulting products' properties are much different from the properties of constituent materials. A composite is combination of two materials in which one of the materials is called reinforcement, in the form of fiber, woven fabric sheets, or particles, embedded in the other materials called matrix. Composites are used because the overall properties of the composite are superior to those of the individual components. These are the following reasons why composites are selected for certain applications.

Composites Materials are classified into Ceramic Matrix Composites (CMCs), Metal Matrix Composites (MMCs), Polymer Matrix Composites (PMCs). When the polymer resin is used as a matrix material then it is called as polymer matrix composite. Polymer composites are having properties such as low density, good thermal and electrical insulator & low cost. PMCs and MMCs are most commonly used. The polymer matrix composites consisting of polymer (e.g., epoxy, polyester) reinforced by fibers The metal Matrix composites have a metal matrix. Metals are mainly reinforced to increase or decrease the properties. The glass is the most commonly fiber used in polymer matrix composites Because of its high strength, low cost, high chemical resistance and easy available fiber.

1.1 Natural Fiber

Natural fibers such as jute, coir, sisal, bamboo etc. Natural fibers are renewable, cheap,

biodegradable, and environment friendly materials. Fibers from plants such as cotton, hemp, jute, sisal, pineapple, ramie, bamboo, banana, etc. as well as wood and seeds of flax are used as the reinforcement in polymer matrix composites. Their availability, low density and price as well as satisfactory mechanical properties, make them attractive reinforcement to glass, carbon and other manmade fibers. Although glass fibers possess high specific strength, their fields of application are very limited because of their inherent higher cost of production. Natural fibers such as sisal jute fibers are replacing the glass and carbon fibers due to their easy availability and cost.

1.2 Resin

The resins that are used in fiber reinforced composites can also be referred to as 'polymers'. All polymers exhibit an important common property in that they are composed of long chain-like molecules consisting of many simple repeating units. Man-made polymers are generally called 'synthetic resins' or simply 'resins'. Polymers can be classified under two types, 'thermoplastic' and 'thermosetting', according to the effect of heat on their properties. There are three types of resins used in the composite material industry i.e. Epoxy Resin, Polyester resin and Vinyl ester resin. Most of industrial applications of epoxy resin react with a curing cross link agent known as a hardener. Epoxy resin.

1.3 Filler

Filler materials are the inert materials which are used in Natural fiber reinforced composites. For modifying the chemical and physical properties of the matrix polymers to reduce material costs, improve processability and to improve product performance. Filler forms the addition strength to the mechanical and thermal properties of the composite material. In this filler silicon carbide (SIC) is one of the fillers available. The silicon carbide when used as reinforcement. It will increase the properties like young's modulus, ultimate tensile strength, tensile strength, hardness of the composite materials.

2 LITERATURE REVIEW

Malla Surya Teja, et al [1] made the Experimental Investigation of Mechanical and Thermal properties of sisal fiber reinforced composites and effect of Sic filler material. In this they exhibited that the tensile strength of composite with 10%SiC 2.53 times greater than that of composite without Sic. Thermal properties includes thermal conductivity, specific heat capacity, and thermal diffusivity.

Braga R. A, et al [2] The author Compare the analysis of the mechanical and thermal properties of polyester hybrid composites by jute and glass fiber. To improve mechanical properties jute was hybridized with glass fiber. The different tests are Flexural, thermal, impact, density and water absorption using hybrid composites samples. The thermal properties of the composites without glass fiber it lost more mass where temperature is a function, more percentage of glass fiber with composite lost less weight with increasing temperature. So that the composite with more percentage of glass fiber absorbs more water when composite with more jute fiber.

Arpitha G R, et al [3] Conclude the Mechanical properties of Epoxy Based Hybrid Composites Reinforced with Sisal/SIC/Glass Fibers. In this Sisal/SIC/Glass Fiber reinforced epoxy composites are prepared. The different samples are used for tensile, Flexural, impact and the natural fibers are added to SIC fiber, Glass fiber and their effects on tensile strength, impact strength, and flexural strength are evaluated. The sisal and glass fiber composite possess good tensile strength, sisal and glass fiber composite filled with 3% Sic possess good flexural strength and also it possess good impact strength compared other composites filled with silicon carbide. The Natural fibers with glass fibers is more with silicon carbide filler it can used in many applications which needs lower strength.

Madhusudhan T, et al [4] made the Comparison of Hybrid Composites with Different Filler Material. He examine the hybrid composites with 2 different fiber materials and tungsten carbide as the filler material has higher tensile strength and hardness when compared to the material with 3 fiber material & Sic as the filler material. The filled Sic with hybrid material with aramid-glass-carbon fibers showed higher strength than hybrid material with aramid and glass fiber filled with WC, this is due to resistance of the material. Hence the material is biodegradable it can be used in Making any of

the household applications for underwater applications.

Madhusudhan T, et al [5] Mechanical Characterization of Jute and Rubber Particles Reinforced Epoxy Polymer Composites. In this tensile and flexural properties are influenced by the fiber composition than the rubber particulate. The combination of these materials in composites can be used as alternative in any synthetic fiber filled polymer composites.

Madhusudhan T,et al [6] Investigation on Wear Resistance Behavior of Sic Filled hybrid Composite The polymer composites with 10% sic show least wear loss in all combinations, the lowest wear loss achieved in glass rubber epoxy with 10% Sic.

Madhusudhan T, et al [7] Experimental Study on Wear Behavior of Sic Filled Hybrid Composites Using Taguchi Method. In This the Tested Filled Hybrid Composites With 10% Sic by weight shows a better tribological properties. By using taguchi wear test on the polymer composites the material influences the wear character, load on the material, and speed rotation of disc. Taguchi material analysis is best suited to minimize the number experiments.

Poddar P, et al [8] Mechanical and Thermal Properties of Short Areca nut Leaf Sheath Fiber Reinforced Polypropylene Composites. TGA, DSC and SEM Analysis. In this study the composite with 10% areca nut leaf sheath fiber possess higher mechanical properties. the mechanical properties were decreased with increasing fiber content on the other hand composite shows better fiber matrix adhesion. These new composites explore new applications and markets in packaging, automotive, aviation, shipping sectors etc.

Mala Ashok Kumar, et al [9] Conclude the Mechanical & Thermal properties of Epoxy Based Hybrid Composites Reinforced with Jute/Sansevieria cylindrica fibers. In this the experimental results of epoxy hybrid jute/Sc fibers are prepared with different fiber lengths where the strength increases when 1cm fiber length impregnated with epoxy matrix. it can be observed that 2cm fiber length hybrid composites have flexural , tensile strength than 1 and 3cm. it is found that the treated hybrid composites showed higher strength than untreated composites.

Eeday Saranya, et al [10] In this study to examine the variation in specific heat, thermal conductivity of composite with respect to temperature, fiber and fly ash. The fly ash varies from 10 to 30% and the temperature range between 30 to 120°c. The composites with and without fly ash have been prepared with Borassus Flabellifer Reinforced Composites in polyester matrix. Borassus Flabellifer Reinforce Composites acts as a thermal insulating component and it does not require any corrosion so, the longer life is achieved and also pre-fabricated to different shapes, installation time is very less, Hence they are favorable reinforcing materials for the development of load bearing light weight materials.

M K Gupta, et al [11] The result shows that the hybrid composites having 50% sisal and 50% jute has higher thermal, mechanical properties & lower absorption property than sisal fiber, glass fiber hybrid composites. Further the hybrid composites can be used in field of building, packaging and automobile.

R. Sakthivel, et al [12] Experimental Investigation and Analysis a Mechanical properties of Hybrid Polymer Composite Plates. In this hybrid composite laminates Banana-Glass-Banana, & Glass-Banana-Glass exhibit higher mechanical properties due to chemical treatment to natural fibers, among all the hybrid fiber composites the banana reinforced epoxy hybrid composites shows higher mechanical property & also implementation of eco-friendly fibers in the automotive parts like car bumper, panels etc. by implanting these fibers we can achieve light weight & structural component in automotive parts, which in turn increases fuel efficiency.

S.John Paul Devaseelan, et al [13] Mechanical and Thermal properties of Hybrid Reinforcement Polymer Composite. The Natural fibers such as jute, sisal, betel nut polymer composites are more attractive due to higher specific strength & low cost. It is prepared by compression moulding method with 10, 15 wt% sisal & betel nut fiber into polymer matrix. it is seen that 10 wt% sisal & betel nut fiber the tensile and compressive properties found to be

maximum. The failure morphology is examined by scanning electron microscope (SEM)

K.T.B. Padal, et al [14] The thermal property of epoxy polymer filled with Jute Nano fiber composite under 'Nitrogen' investigated by Thermo gravimetric Analysis (TGA) & Differential Scanning Calorimetry (DSC). Using Nano fiber improves the crystallization temperature. The physical interaction between the polymer composite and Nano fiber restrict the segmental mobility of polymer chains in vicinity of the jute Nano fibers.

A Gowthami, et al [15] the composite with & without silica has 100% biodegradable sisal fibers as reinforcement In the polyester matrix. The effect of silica on tensile strength and tensile modulus shows better properties comparing without silica and pure resin. the specific heat capacity increases in all samples with increase of temperature, Hence the addition of silica exhibit in both thermal and mechanical properties, the effect of fire behavior of composite which under process.In the polyester matrix. The effect of silica on tensile strength and tensile modulus shows better properties comparing without silica and pure resin. the specific heatcapacity increases in all samples with increase of temperature, Hence the addition of silica exhibit in both thermal and mechanical properties, the effect of fire behavior of composite which under process.

Subhankar Biswas, et al [16] The Detailed Investigation on Physical, Mechanical and Thermal Properties of Jute and Bamboo Fiber Reinforced Unidirectional Epoxy Composites. The bamboo fiber shows good results in terms of tensile strength. The jute fiber reinforced epoxy Bamboo and jute fiber composites shows good flexural strength in the longitudinal and transverse distribution, the fibers distribution is not uniform in both jute and bamboo fiber epoxy reinforced composites, it is revealed that the jute fibers showed better thermal behavior compared to bamboo fiber composites.

K. Sudha Madhuri, et al [17] the thermal properties such as Thermo gravimetric Analysis (TGA) & Differential Scanning Calorimetry (DSC) are studied to investigate the influence of change in fiber length of untreated & treated hybrid composites. Tensile, compressive & hardness strength of glass & sisal fiber observed by alkali treatments. It is found that the treated hybrid composites show higher strength than untreated hybrid composites.

Saravana Bavan D, et al [18] in this the fibers are maize. From these we can conclude that it is necessary need to get good adhesion between fiber & matrix, to get a good composite material fibers should change from hydrophilic to hydrophobic characters. The maize fiber and polyester resin coated maize fiber provides a useful information on thermal degradation values of composites. Properties of natural fibers depend on growing conditions & processing conditions. This variation makes more difficult to analyze the effects of the fibers and their interfaces on the thermal properties of the composite material, these difficulties call for development of new strategies

K.Praveen kumar , et al [19] For major applications ,Fabric treated only with Na OH for 24hrs i.e jute fiber washed with water before making composite is always preferred as majority of mechanical properties are showing positive results. From the experimental work specifically it is concluded that based on the application requirement the surface treatment may be selected

3. CONCLUSIONS

The Following may be concluded based on this review.

The combination of the useful properties of two different materials, make them as a versatile material in the field of engineering and technology.

The jute fiber reinforced epoxy composites showed better thermal behavior compared to other fibers reinforced epoxy composites.

The sisal/Glass fiber without filler material had good tensile strength.

Alkali treated Sisal and jute fiber reduces water absorption properties.

Hybrid composites jute/E-Glass fiber has better properties than that of the jute fiber.

The treated composites showed higher strength than untreated composites.

Increasing filler content tends to increase the modulus & hardness but decrease tensile strength of the composite.

Comparing Natural fibers and Glass fiber reinforced composites found that, the natural fibers were superior in Industrial applications.

Unfilled polymer composites shows higher wear loss when compared to composites filled with Sic filler

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