A REVIEW ON THERMAL BEHAVIOUR OF NATURAL FIBER REINFORCED COMPOSITES

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ABSTRACT

For various engineering applications, particularly in aerospace applications and automobile applications development of the composites with natural fibers with fillers are sustainable alternative material. Natural fibers such as jute, coir, sisal, bamboo etc are renewable, cheap, biodegradable, and environment friendly materials. This paper concludes the thermal properties of the composites where Epoxy resin is used as binder adding with the Filler to the Natural fibers materials like jute ,sisal , coconut bamboo fiber etc. commonly used fillers like Carbon black, Calcium Carbonate, Alumina, Magnesium Hydroxide, Bone powder, Coconut Powder, Hematite powder, Tio2, Sio2 Graphite etc.

Keyword : - *Composite material, Composite, Sisal fiber, Jute fiber, Glass fiber, Bamboo, Silicon Carbide, Mechanical properties, Thermal behavior, Epoxy*.

1. INTRODUCTION

Composites Materials are combinations of two phases in which one of the phases, called the reinforcing phase, which is in the form of fiber sheets or particles and are embedded in the other phase called the matrix phase. The reinforcing phase materials may be in the form of fibers, particles or flakes. The matrix phase materials are continuous. Basically, composites can be categorized into three groups on the basis of matrix material. They are: a) Metal Matrix Composites (MMC) b) Ceramic Matrix Composites (CMC) c) Polymer Matrix Composites (PMC) 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. Advantages of natural fiber are low weight, they are recyclable and biodegradable. They are also renewable and have relatively high strength and stiffness. On the other hand, there are also some disadvantages: moisture uptake, quality variations and thermal stability [3].

1.1 Natural Fiber

Natural fibres will take a major role in the emerging "green" economy based on energy efficiency, the use of renewable materials in polymer products, industrial processes that reduce carbon emissions and recyclable materials that minimize waste. Natural fibres are a kind of renewable resources, which have been renewed by nature and human ingenuity for thousands of years. They are also carbon neutral; they absorb the equal amount of carbon dioxide they produce. These fibers are completely renewable, environmental friendly, high specific strength, non-abrasive, low cost, and bio-degradability. Due to these characteristics, natural fibers have recently become attractive to researchers and scientists as an alternative method for fibers reinforced composites. This review paper summarized the history of natural fibers and its applications. Also, this paper focused on different properties of natural fibers (such as hemp, jute, bamboo and sisal) and its applications which were used to substitute glass fiber[4]

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 Orthophthalic Isophthalic Phenolic ,Vinyl ester resin and Epoxy. Most of industrial applications of epoxy resin react with a curing cross link agent known as a hardener.

1.3 Filler

Fillers are particles added to material (plastics, composite material, concrete) to lower the consumption of more expensive binder material or to better some properties of the mixtured material.. Among the 21 most important fillers, calcium carbonate holds the largest market volume and is mainly used in the plastics sector. For modifying the chemical and physical properties of the matrix polymers to reduce material costs, improve processability and to improve product performance.*[5]* 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 [6] 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. Three different samples with 0%, 5%, 10% SiC powder are considered. With the addition of SiC filler powder, thermal conductivity increases, specific heat capacity gradually increases then decreases, thermal diffusivity increases and thermal stability improves with Sic powder.

Parmeet Singh Saluja, et al [7] study shows that addition of TiO2 particles improves the effective thermal conductivity of Polyester-TiO2 composites. Apart from enhancing thermal conductivity, incorporation of TiO2 results in improvement of glass transition temperature (Tg) and reduction in coefficient of thermal expansion(CTE).

Madhusudhan T, et al [8] 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.

Saravana Bavan D, et al [9] made the Experimental Investigation by Thermo gravimetric analysis and differential scanning calorimetric test for maize fiber and polyester resin coated maize fiber samples and found the initial degradation temperature was around 200°C but Tmax for raw fiber is around 330°C and for the polyester coated maize fiber, it was around 410°C, and thus increase in thermal stability could be seen. They also Conclude natural fiber composite material is processed by vacuum assisted resin transfer molding technique and the fibers are maize stalk fibers with matrix of unsaturated polyester resin. With suitable catalyst and accelerator composite material is fabricated and thermal properties for the material is examined by thermal gravimetric analyzer, differential scanning calorimeter and the results are also compared with finite element method.

R. Sakthivel, et al [10] conclude the Chemical treatment like NaOH will increases the flexural strength of the fiber up to 20-30% and removes the moisture content of the fiber. The mechanical properties of the natural fibre and synthetic fiber platescom-posites tested were found to compare favourably with the corresponding tensile and flexural properties increasing volume fraction of fiber percent. natural fiber and glass hybrid composites were fabricated by using epoxy resin combination of hand lay-up method and cold press method .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. the hybrid composite material shows the highest mechanical properties. This High performance hybrid composite material has extensive engineering applications such as transport industry, aeronautics, naval, automotive industries.

A Gowthami, et al [11] investigate The tensile strength of composite with silica is 1.5 times greater than that of composite without silica and 2.5 times greater than that of pure resin. · Tensile modulus of composite with silica is1.809 GPa, whereas for composite without silica is about 1.67 GPa. · The impact strength of composite with silica is 80% greater than that of matrix. · The specific heat capacity of all samples increased with increase of temperature (30°C - 85 °C), and then decrease beyond 85 °C. Hence, the addition of silica exhibit favorable both in mechanical and thermal properties.

Eeday.Saranya, **et al [12]** Found that the toddy palm fiber acts as a Thermal insulating reinforcement component in development of insulating green composites .This toddy palm composites doesn't require any corrosion or painting so, longer life is achieved and also can be pre- fabricated in to different shapes and installation time required will be also less. Hence toddy palm fibers are favorable reinforcing materials for the development of load –bearing light weight materials.

Anshu Anjali Singh, **et al [13]** conclude that the maximum degradation temperature of all the composite compositions are higher that of the matrix, and increase with increasing Jute fiber content. The temperatures of highest rate of degradation of 10/90, 20/80 and 30/70 JF/ CF-HDPE composites are 483°C, 485°C and 488°C respectively, and at 550°C the composite compositions show the residual mass of 4.3%, 5.8% and 7% respectively.

3. CONCLUSIONS

The Following may be concluded based on this review.

- With the addition of SiC filler powder, thermal conductivity increases. thermal diffusivity increases and thermal stability improves with Sic powder.
- addition of TiO2 particles improves the effective thermal conductivity of Polyester-TiO2 composites.
- the Chemical treatment like NaOH will increases the flexural strength of the fiber up to 20-30% and removes the moisture content of the fiber..
- Hybrid composites jute/E-Glass fiber has better properties than that of the jute fiber.
- The treated composites showed higher strength than untreated composites.
- toddy palm fiber acts as a Thermal insulating reinforcement component in development of insulating green composites
- Banana-Glass-Banana, & Glass-Banana-Glass exhibit higher mechanical properties due to chemical treatment to natural fibers.
- addition of silica exhibit favorable both in mechanical and thermal properties.

4. REFERENCES

[1] Nayak Rajlakshmi, Dr. satapathy(2010).A study on thermal conductivity of particulate reinforced epoxy composites..

[2] Braga R. A, Silva R. S Magalhaes Jr, P. A. A. Comparative the analysis of the mechanical and thermal properties of polyester hybrid composites by jute and glass fiber. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 5, Issue5, (Part -2) May 2015, pp.113-118.

[3] Oksman, K., Skrifvars, M. and Selin, J.-F., Natural fibers as reinforcement in polylactic acid (PLA) composites, Compos Sci Technol, 63, 1317-1324, 2003.

[4] "Market Study: Fillers (3rd edition)". Ceresana. *January 2014*. Retrieved 7 September 2015.

[5] Ashik K. P., Sharma Ramesh S. , R & D Center, Department of Mechanical Engineering, R.V. College of Engineering, Bangalore, India. JMMCE, Vol.3 No.5, September 2015.

[6] Malla Surya Teja, M V Ramana, D Sriramulu and C J Rao. Experimental Investigation of Mechanical and Thermal properties of sisal fiber reinforced composites and effect of Sic filler material.IOP Conf. Series: Materials Science and Engineering 149 (2016) 012095 doi:10.1088/1757- 899X/149/1/012095.

[7]Parmeet Singh Saluja, J.K.Tiwari, Gaurav Gupta3. Department of Mechanical Engineering, SSTC, SSGI, FET, Bhilai (C.G.), India, Preparation and Thermal Behaviour of Polyester Composite Filled with TiO2, International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056, p-ISSN: 2395-0072

[8]Madhusudhan T , SenthiL Kumar M. Mechanical Characterization of Jute and Rubber Particles Reinforced Epoxy Polymer Composites. IOSR Journal Of Pharmacy, (e)- ISSN: 2250-3013, (p)-ISSN: 2319-4219, Volume 6, Issue 12, Version. 1 (Dec 2016), PP. 23-27

[9] Saravana Bavan D and Mohan Kumar G C. Thermal Properties of Maize Fiber Reinforced Unsaturated Polyster Resin Composites. Proceedings of the World Congress on Engineering 2013 Vol III, WCE 2013, July 3 - 5, 2013, London,U.K.

[10] R.Sakthivel, D.Rajendran. Experimental Investigation and Analysis a Mechanical properties of Hybrid Polymer Composite Plates. International Journal of Engineering Trends and Technology (IJETT) – Volume 9 Number 8 - Mar 2014.

[11] A.Gowthami, K.Ramanaiah, A.V.Ratna Prasad,, K.Mohana Rao , G. Sridhar Babu. Experiment on Effect of Silica on Thermal and Mechanical Properties of Sisal Fiber Reinforced Polyester Composites. J. Mater. Environ. Sci. 4 (2) (2013) 199-204 ISSN : 2028-2508.

[12] Eeday. Saranya, Goteti. Satyanarayana, Anne Srihari Prasad. made the Experimental Investigation of

Mechanical and Thermal properties of Borassus Flabellifer Reinforced Composites and Effect of Addition Of Fly Ash. International Journal of Engineering Trends and Technology (IJETT) – Volume 15 Number 8 – Sep 2014, ISSN: 2231-5381.

[13] Anshu Anjali Singh* and Sanjay Palsule Department of Polymer & Process Engineering, Indian Institute of TechnologyRoorkee, DPPE IIT-R SRE Campus, Paper Mill Road, Saharanpur 247 001 India, Thermal Properties of Jute Fiber Reinforced Chemically Functionalized High Density Polyethylene (JF/CFHDPE) Composites Developed by Palsule Process, polymerjournals ,Applied Polymer Composites, Vol. 2, No. 2, 2014