A Review: Experimental study of thermal, mechanical and acoustic performance of bagasse fiber reinforced epoxy composite

Preetam Kumar Patel[1], Piyush Tiwari[2]

[1] *M.Tech student, Thermal Engineering, Government Engineering College Jagdalpur, Chhattisgarh, India.*
[2] *Assistant Professor, Department of Mechanical Engineering, Government Engineering College Jagdalpur, Chhattisgarh, India.*

ABSTRACT

This research work mainly concerns the processing and characterization of the epoxy compound reinforced with bagasse fiber. The effective thermal conductivity, mechanical property (tensile and compressive strength) and the acoustic absorption coefficient of the epoxy reinforced with bagasse fiber are experimentally analyzed by consuming the bagasse fiber of the waste material of the sugar cane in the production of the sound-absorbing material by means of a simple manual positioning technique. The thermal conductivity values are measured with the Model 2022 UnithermTM tester according to the ASTME-1530 standard, tensile strength is measured tensile testing machine according to the ASTMD-3039 standard, compressive strength is measured in universal testing machine, while the absorption coefficient values are measured in an impedance tube machine. According to the research analysis, the reinforcement of the bagasse fiber produces a reduction in the thermal conductivity of the epoxy, increase in mechanical property and increases the coefficient of acoustic absorption by increasing the weight fraction of the bagasse fibre.. With an upward gradation in thermal insulation and sound absorption capacity, these reinforced epoxy resins can discover their application in the insulation of walls, in food containers, and in other similar applications of thermal and acoustic insulation.

Key Word: *Effective Thermal conductivity coefficient (Keff), bagasse fiber, Acoustic absorption coefficient (α), mechanical property*

INTRODUCTION

1.1 BACKGROUND

India endowed with an abundant availability of natural fiber such as Jute, Sisal, Coir, Pineapple, Bamboo, Ramie, Banana etc. has focused on the development of natural fiber and particulate composites primarily to explore value-added application avenues. Such natural fiber and particulate composites are well suited as wood substitutes in the housing and construction sector. The development of natural fiber and particulate composites in India is based on two pronged strategy of preventing depletion of forest resources as well as ensuring good economic returns for the cultivation of natural fibers.

The developments in composite material after meeting the challenges of aerospace sector have cascaded down for catering to domestic as well as industrial applications. Composites, the wonder material with lower weight; higher strength-to-weight ratio and stiffness properties have come a long way in replacing the conventional materials like metals, wood etc. The material scientists all over the world focused their attention on natural composites reinforced with Jute, Sisal, Pineapple, Coir, Baggase etc. primarily to cut down the cost of raw materials.

1.2 WHY A COMPOSITE?

Over the last forty years composite materials, thermosetting material and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily and conquering new markets relentlessly. While composites have already proven their worth as weight-saving materials but the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the

composites industry. It is obvious that the improvement in manufacturing technology alone is not enough to overcome the cost problem. It is very necessary that there be an integrated effort in design, material, tooling, process, quality assurance, manufacturing, and even program management for composites to become competitive with metals.

Requirement of Thermal Insulation

The goal of thermal insulation, mainly in the construction and construction of houses, is to maintain a fresh and comfortable hygienic climate in the event of high ambient temperatures or to maintain heat in the event of low temperature conditions by slowing down the heat flow with the help of the means of isolation. The insulation also has several applications in the industry, since it avoids the damage caused by freezing or damage to items by high temperatures, which reduces the cost of heating and cooling. Heat flows spontaneously from a high-temperature body to a low-temperature unidirectional body where insulation helps reduce the speed of this heat flow.

It is observable that the maximum work is concentrated in the area of improvement of the thermal conductivity of the polymer-reinforced composites instead of improving the thermal insulation capacity. Thermal insulation has a great application in refrigeration and air conditioning, insulation of buildings, radiators, food preservation industries, aerospace and automotive industries and many others.

Requirement of acoustic insulation

Sound insulation is the prevention of acoustic energy or waves that are transmitted from one side of the building wall to another. In this rapidly growing modern world, the expansion of electrical, electronic and Mechanical devices in domestic and commercial companies, industries have focused the problem of sound Pollution generated by them. The transformation and the great growth of production activities in the vicinity further increase the need for the latest sound reduction technologies. There are mainly two ways to block the noise produced by various machines in the environment, by suppressing resources and other factors that cause noise, or by using soundproofing materials that will block or absorb sound wave energy. Traditionally, to control the noise, various expensive and synthetic materials have been used that have absorbed the sound, such as glass fiber, carbon fiber and polymer fibers, which represents a further threat to the organism and the environment. For such important problems, a natural fiber substitute such as bagasse, jute, paddy, cotton, linen, ramia, sisal and hemp and most used renewable resources can be used as sound-absorbing materials. They are economical, biodegradable and recyclable and abundantly available. Although today, the natural fiber-reinforced composites are used exclusively for various applications in the automotive industry, construction, construction industries, furniture, etc. When using these natural fiber materials, even the risk of physical damage and health factors is reduced at the minimum. Currently, the main concern of various researchers and scientists to develop a cheap renewable and biodegradable, inexpensive, sound-absorbing non-abrasive material, light materials, good thermal insulators, hygroscopic and automotive fuels, home appliances and structural applications.

REVIEW WORK: .

Marom et al. [1] focused on the flexible properties of engineered fiber-strengthened polymer composite materials that relate to biomedical applications and exhibits the scope of solidness realistic through choice of constituents and by decision of edge of fortification. Vijay et al. [2] conveyed an inside and out examination and complete learning to the novices in the field of regular cellulose strands/polymer composites. The primary point of this audit article is to uncover the present improvement and developing uses of normal cellulose strands and their polymer materials. Yongli [3] considered the mechanical practices of unidirectional flax and glass fiber strengthened cross breed composites with the point of examination on the mixture impacts of the composites made by normal and manufactured filaments. Cho et al. [4] examined the mechanical conduct of carbon fiber/epoxy composites and acquired that the composites fortified with nanoparticles enhanced mechanical Properties, for example, upgraded compressive quality and enplane shear properties. Chauhan et al.[5] contemplated on the impact of fiber stacking on mechanical properties, rubbing and wear conduct of vinyl ester composites under dry and water greased up conditions and reported that the thickness of composite examples is influenced barely by expanding the fiber content. Huang et al. [6] contemplated on impact of water retention on the mechanical properties of glass/polyester composites. It was built up that the breaking quality and malleable anxiety of the composites diminished progressively with expanded water inundation time on the grounds that the debilitating of holding in the middle of fiber and framework. Sofian et al. [7] contemplated the impact of different metal powders like copper, zinc, iron and bronze on the warm properties like conductivity, diffusivity

and particular warmth of high-thickness polyethylene network. Mamunya et al. [8] later reported the change in warm conductivity of two distinct classifications of polymers i.e. thermoplastic (polyvinyl chloride) and thermoset (epoxy) loaded with copper and nickel particles. In spite of the fact that in 1990s. Koizumi et al. [9] explored the sound 18 Characteristics of bamboo fiber, which was found nearly equal to sound absorption of glass wool. Yang et al. [10] worked on rice straw-wood particle board to replace wood. An evaluation was done on the basis of industrial-made plywood which was further analysed. It is revealed that the wood particle of rice straw having lower specific gravity which provides enhanced sound absorption within the range of 1- 8 kHz as compared to both plywood board as well as fiber board.

CONCLUSION:

1.Successful fabrication of bagasse fiber reinforced epoxy composites is possible by simple hand layup technique.
2.With addition of bagasse fibre, heat conduction capability is notably decreased with increase in wt% of bagasse fibre.
3. With addition of bagasse fibre, acoustic absorption coefficient is notably increased with increase in wt% of bagasse fibre.
4. With addition of bagasse fibre, mechanical property (tensile and compressive strength) is notably increased with increase in wt% of bagasse fibre.

REFERENCES:

[1] Gad Marom, Albert Reuveni and Daniel Cohn, "Stiffness Variability and Stress-Dependent Elastic Response of Synthetic Fiber-Reinforced Composites for Biomedical Applications", Biomaterials, Vol. 14, No. 2, 1993.

[2] Vijay Kumar Thakur and Manju Kumari Thakur, "Processing and Characterization of Natural Cellulose Fibers/Thermoset Polymer Composites", Carbohydrate Polymers, Vol.109, pp. 102–117, 2014.

[3] Yongli Zhang, Yan Li, Hao Ma and Tao Yu, "Tensile and Interfacial Properties of Unidirectional Flax/Glass Fiber Reinforced Hybrid Composites", Composites Science and Technology, Vol. 88, pp.172–177, 2013.

[4] Cho, J., Chen, J. Y. & Daniel, I. M. "Mechanical Enhancement of Carbon Fiber/Epoxy Composites by Graphite Nanoplatelet Reinforcement", Scripta materialia, Vol. 56 (8), pp. 685-688, 2007.

[5] Chauhan, S. R., Gaur, B. & Dass, K. "Effect of Fiber Loading on Mechanical Properties, Friction and Wear Behaviour of Vinylester Composites Under Dry and Water Lubricated Conditions", International Journal of Material Science,Vol. 1(1), pp. 1-8, 2011.

[6] Huang, G. & Sun, H. "Effect of Water Absorption on the Mechanical Properties of Glass/Polyester Composites", Materials & design, Vol.28, pp.1647-1650. 2007.

[7] Young R.J and Beaumont P.W.R. (1977), "Failure of brittle polymers by slow crack growth Part 3 Effect of composition upon the fracture of silica particle-filled epoxy resin composites", Journal of Material Science, Vol.12 (4), pp. 684–92.

[8] Kinoch A.J., Maxwell D.L. and Young R.J. (1985), "The fracture of hybrid particulate composites", Journal of Material Science, Vol.20, pp.4169–84.

[9] Young R., Maxwell D.L. and Kinloch A.J. (1986), "The deformation of hybrid particulate composites", Journal of Material Science, Vol.21, pp.380–388.

[10] Koh S.W, Kim J.K and Mai Y.W. (1993), "Fracture toughness and failure mechanisms in silicafilled epoxy resin composites: effects of temperature and loading rate", Polymer, Vol.34(16), pp.3446– 3455.