International Journal of Technology and Emerging Sciences (IJTES)

www.mapscipub.com

Volume 03 || Issue 04 || October 2023 || pp. 01-05 E-ISSN: 2583-1925

A Review on effect of fiber materials of Glass Fiber Composites

Y. Seetharama Rao[1], O. Kavya Deepika[2]

[1]*Associate Professor, Department of Mechanical Engineering, Gayatri Vidya Parishad College of Engineering, Visakhapatnam, Andhra Pradesh, India*

[2] *Student, Department of Mechanical Engineering, Gayatri Vidya Parishad College of Engineering, Visakhapatnam, Andhra Pradesh, India*

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Abstract - *In various technological applications, natural fiber-reinforced composites have gained significant prominence, particularly within the automotive and construction sectors. The demand for innovative natural fibers has witnessed a rapid surge in recent times. These composites represent an apex of advanced and versatile engineering materials. Filler materials, comprising particles integrated into resins or binders, play a crucial role in enhancing specific properties, cost-effectiveness, or a combination of both. By augmenting the efficiency and performance of composite materials, they find applications across diverse fields including automotive, aerospace, and marine industries. The merits of composites are numerous, encompassing high stiffness-to-weight and strength-to-weight ratios, alongside fatigue and corrosion resistance. The current study delves into the evaluation of mechanical properties in reinforced composite materials employing filler materials, in conjunction with chopped mat glass fiber.*

Key Words: Effect of filler composites. Fabrication.

1. INTRODUCTION

The origins of composite materials trace back to the 1940s, marked by the introduction of fibers as reinforcement. Composites are the result of skillful combinations of two or more chemically distinct materials, offering specialized properties. Within the context of this study, the introduction of filler materials has yielded improved outcomes, particularly as the weight ratio of walnut shell powder and bentonite clay powder increases. The efficacy of these fillers in influencing composite performance is contingent upon factors including size, shape, aspect ratio, surface area, and the dispersion of the filler within the composite.

These composite materials are recognized for their amplified strength and durability, coupled with the advantages of facile processing and cost-effectiveness. As a result, they have gained widespread adoption across the manufacturing industry, often substituting traditional materials. This transition is largely due to their attributes such as remarkable specific strength, substantial damping capacity, and elevated specific modulus.

2. LITERATURE REVIEW

Twenty two articles are taken into consideration in this area to explore the effect of filler materials on composites and fabrication of composite materials.

Prabhuram *et al.* [1] analyzed that, the integration of synthetic fiber (e-glass) mats with natural or metallic fibers/fillers (sandalwood ash). This combination was aimed at achieving enhanced strength, stiffness, strength-to-weight ratio, and other mechanical properties. Through a series of tests conducted on the created materials, the outcomes demonstrated that composite materials composed of wood powder and groundnut powder exhibited significantly improved load-carrying capacity. Hitesh Sharma *et al.* [2] performed research that deals. The study focused on creating a partially green hybrid composite by combining walnut shell powder and basil jute. Walnut shell powder was employed as a filler, with different proportions - 0wt%, 5wt%, 10wt%, and 15wt% - mixed with epoxy resin. A comprehensive analysis of properties was conducted to contrast composites both with and without walnut shell filler. The findings revealed noticeable enhancements in mechanical properties. Specifically, the impact strength of the developed composites exhibited an increase as the filler content rose, attributed to improved capacity for absorbing impact energy.

Thirumoorthy *et al.* [3] analyzed the investigation revolved around enhancing the mechanical characteristics of a composite material through the incorporation of pineapple leaves, bamboo, and banana fiber polymers. To extract long bamboo fiber, a chemical digestion process was employed. Epoxy resin was used as the matrix, while pineapple, bamboo, and banana fibers served as reinforcements during the composite fabrication. Comprehensive tests were conducted to evaluate properties like tensile and bending strength. The analysis of these tests indicated that the newly created composite material, crafted using treated pineapple, bamboo, banana fiber, and epoxy resin, showcased superior strength in comparison to other composite materials. Mihail Iacob *et al.* [4] analyzed that Research investigating the impact of adding bentonite as a filler to composites indicates that while thermal stability remains relatively unchanged, the mechanical properties experience notable alterations. As the amount of incorporated bentonite increases, there is a significant enhancement in dielectric permittivity, rendering the material more cost-effective than alternatives. Dheeraj Kumar Gara *et al*. [5] developed an E-glass epoxy resin composite, incorporating graphene powder as dispersion particles, aimed at bolstering its mechanical attributes. Notably, the tensile strength exhibited a remarkable improvement of 26.7%. Ongoing research is focused on tribological analyses, with the anticipation of developing materials suitable for innovative applications within the aerospace and automotive sectors. Acharya *et al.* [6] discussed that the filler content in the wood apple shell particulate composites rises, there is a concurrent decrease in both density and void contents in comparison to the polymer. The introduction of wood apple shell particles into epoxy resin leads to an augmentation in both tensile and flexural strength. Sheik Abul *et al.* [7] explained that, The study examined how the combination of carbon and glass had hybridization effects on the physical and mechanical characteristics of kenaf mat/epoxy composites. Both pure and hybrid composite samples were created, and various properties including density, tensile strength, flexural strength, interlaminar shear strength, and fracture toughness were tested. The outcomes showed notable improvements in density and tensile properties within the pure kenaf mat/epoxy composite.Wang Lee *et al.* [8] concluded that, the bentonite content contributes to the enhancement of tensile strength, flexural strength, and impact strength in the composite. However, an excessive amount of bentonite content results in a decrease in these properties. The composite with a bentonite content of 1.5% achieves the peak values for tensile strength, flexural strength, and impact strength. Abu Hassan *et al.* [9] analyzed that, the study revealed that the highest strength was achieved with the smallest particle size of walnut shell powder and apple seeds as fillers. However, as the filler content increased, the mechanical properties of these composites exhibited a decline.

Zhang *et al.* [10] explained that, In the study was showcased that by incorporating rigid nanoparticles into the matrix, the compressive and flexural properties of carbon fiber/epoxy composites were greatly improved. Notably, the unique nanotubes played a key role in reinforcing the matrix, resulting in significant enhancements in both the compressive and flexural properties of both the bulk matrices and the composite laminates. Siva Sankari *et al.* [11] performed this present work the impact of incorporating cenosphere filler material on the thermal and mechanical attributes of epoxy resin is examined. For a comprehensive analysis, pure resin and composites were produced with varying compositions. Acoustic emission studies were conducted on filler matrix flexural specimens as an initial step. Furthermore, the addition of filler material in the resin matrix for tensile testing resulted in a significant strength increase of 35%. Ovlga Alkekseeva *et al.* [12] explained The study investigated the antimicrobial effects and mechanical characteristics of epoxy resin-based bentonite composites at various weight percentages of the clay. These composites were created through the hand lay-up technique. The outcomes highlighted how the concentration of the filler influenced both the structure and tensile properties of the composites. In conclusion, incorporating bentonite into composite fabrication exhibited significant potential for enhancing both mechanical properties and antimicrobial effects.

Athith *et al.* [13] investigated The study delved into the mechanical and tribological attributes of matrices reinforced with jute/sisal/E-glass fabrics, including natural rubber and epoxy. These matrices were infused with varying amounts of tungsten carbide (WC) powder. Mechanical parameters such as tensile strength, flexural strength, impact strength, and tribological behavior like two-body abrasive wear were thoroughly examined for the composites. The findings underscored a noteworthy transformation in mechanical characteristics, and the inclusion of WC filler particles led to a marked improvement in wear resistance behavior. Guangyong Sun *et al.* [14] experimented with a combination of experimental, analytical, and numerical methods, the exploration centered on the mechanical attributes of a carbon/basalt fiber reinforced epoxy hybrid composite. Seven composite laminates, symmetric in nature, were manufactured, each with distinct hybrid ratios and stacking sequences. The experimental outcomes underscored that stacking sequences distinctly impacted strength and flexural modulus, while exerting a comparatively lesser influence on the tensile modulus. Gulsah *et al.* [15] developed the effect on the investigation focused on the braking efficiency of brake pads incorporating walnut shell powder as a natural additive. Two distinct brake pad variants were created: one with 3.5% (2A) and the other with 7% (2B) walnut shell dust content. These brake pads underwent assessments encompassing thermal conductivity, friction wear, density, hardness, water and oil absorption, as well as microstructure analysis. The incorporation of walnut shell proved to be harmonious with the composition and displayed a beneficial impact on the friction coefficient. Sandeep Kumar *et al.* [16] aimed at learning the study centered on assessing the braking effectiveness of brake pads enhanced with natural additive walnut shell powder. Two brake pad variations were developed: one containing 3.5% (2A) and the other 7% (2B) of walnut shell dust content. These brake pads underwent a range of evaluations covering aspects like thermal conductivity, friction wear, density, hardness, water and oil absorption, as well as microstructure analysis. The integration of walnut shell into the composition demonstrated compatibility and showcased a favorable influence on the friction coefficient. Sneha Latha *et al.* [17] investigated The study explored how the stacking sequence influenced the mechanical and tribological characteristics of hybrid composites formed by weaving bamboo and glass fabrics into a polymer matrix. The laminate samples were created using the hand layup technique within a mold, followed by curing under light pressure at room temperature. The outcomes revealed that introducing glass fiber into the polymer composite notably enhanced the properties of the bamboo composite. Furthermore, the order of layers had a substantial impact on the mechanical and tribological attributes of the hybrid composite. Anand *et al.* [18] conducted experimentation on hybrid composite, fortified by combining synthetic and natural fibers, has been created to harness the benefits of both types of fibers. This approach aims to achieve improved tribological properties while maintaining cost-effectiveness. The ongoing research delves into the mechanical performance of hybrid composites based on bamboo and polyester. Suresh *et al.* [19] performed an experimental study focused on the mechanical analysis of hybrid composites comprising glass fiber and epoxy, the study drew the following conclusions: The successful fabrication of epoxy-based composites, reinforced with glass and particulate fillers, was accomplished using the hand lay-up technique. Key mechanical properties such as tensile strength, tensile modulus, flexural strength, impact strength, inter laminar shear strength (ILSS), and hardness were assessed in accordance with ASTM standards. The application of this technique effectively facilitated the ranking of the composite materials. Vikas Dhawan *et al.* [20] discussed that, this research effort, an array of characterization tests was performed on composites comprising glass fiber reinforced (GFR), polyester, and epoxy materials. Typically, the incorporation of fillers results in decreased costs and reduced weight of conventional glass fiber-reinforced composites. The research also delved into examining the impact of introducing natural fillers into the composites. Beemappa *et al.* [21] investigated The study centered on evaluating the mechanical properties and fracture toughness of hybrid composites consisting of glass and epoxy (G-E), both unfilled and filled with particulates. The findings revealed the successful fabrication of multi-component hybrid composites comprising three distinct constituents, showcasing their potential applicability for structural purposes. Aslam Javed *et al.* [22] studied The study centered on evaluating the mechanical properties and fracture toughness of hybrid composites consisting of glass and epoxy (G-E), both unfilled and filled with particulates. The findings revealed the successful fabrication of multi-component hybrid composites comprising three distinct constituents, showcasing their potential applicability for structural purposes.

3. SUMMARY

Upon analyzing the existing literature, a noticeable enhancement in the mechanical attributes of fiber-based composites becomes apparent through the incorporation of micro fillers. These additives serve as supplementary reinforcement elements, contributing to the augmentation of both mechanical and morphological properties. Importantly, this augmentation is accompanied by a substantial reduction in processing costs. Additionally, the adoption of natural fillers such as walnut shell powder and bentonite emerges as a prudent choice due to their safety profile and economic viability.

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