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RESEARCH ARTICLE

Mechanical Behavior of Hybrid Laminated Nano Composite Containing Equal Numbers of Glass and Carbon Fiber Plies

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ABSTRACT - Hybrid fiber reinforced polymer with nanofiller composite was introduced into a lot of industries due to its extreme mechanical properties in comparison with non-hybrid material. In this investigation, cross and quasi-fiber laminated epoxy composites with and without nano Al2O3 were fabricated using Vacuum Assisted Resine Infusion Method and Ultrasonic Dual Mixing Method. In general, the results of mechanical properties indicated that the addition of 2% nano Al2O3 enhances the tensile and flexural properties. Cross number 2 with nano Al2O3 laminate had the maximum tensile strength 628 MPa and maximum tensile strain of 1.74%, while cross number 1 with nano Al2O3 laminate had the maximum tensile modulus of 37.756 GPa in the cross group. In the quasi group, quasi number 2 with nano Al2O3 had the maximum tensile strength, maximum tensile strain, and maximum tensile modulus, equal to 294 MPa, 1.98%, and 16.409 GPa, respectively. Regarding the flexural properties, cross number 1 with nano Al2O3 laminate had a maximum flexural strength of 708.2 MPa and maximum flexural strain of 2.027%, while cross number 2 with nano Al2O3 laminate had a maximum flexural modulus of 38.73 GPa in the cross group. On the other hand, quasi number 1 with nano Al2O3 laminate had the maximum flexural strength, maximum flexural strain, and maximum flexural modulus equal to 596 MPa, 2.424%, and 29.2 GPa, respectively in the quasi group. The internal structures of the failure laminated composites through scanning electronic microscopy confirm that the adhesion between fibers and matrix is good.

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1.0 INTRODUCTION

High specific strength (strength to density ratio) and high specific stiffness (modulus to density ratio) connected with lightweight and enhancement in corrosion, wear and fatigue resistance are the essential reason to replace the conventional metal by fiber reinforced polymer laminated composite (FRP) in structural applications like aerospace, automobile and turbine blades [1]. The most common fibers used in industrial applications are carbon and glass. The use of carbon fiber in structural parts alone is unsuitable, despite its high strength and modulus due to its low strain-to-failure. To overcome the disadvantages of carbon, glass fiber was added to it, where the latter has low strength and modulus, but the strain to failure is high[2]. Hybridizing carbon with glass and vice versa is one of the important ways to eliminate the disadvantage of the fibers and to reduce the weight and cost. As a result of the contrastive coefficient of thermal expansions of carbon fiber and glass fiber, the stress-strain curve of CFRP after hybridization moves to higher strain-to-failure because of the formation of residual compressive strain in carbon fiber following the curing process [3, 14]. The objective of this work is to prevent the brittle fracture of carbon fiber laminated epoxy composite by adding some ductility to it through the addition of glass fiber to it. In order to transfer the load completely from matrix to the fiber, nano Al_2O_3 was added to the epoxy resin, which led to an increase in the mechanical properties of the hybrid composite.

In this study, the first section is a very brief introduction to the fiber hybridization idea, followed by a literature review. Then, experimental work with all subdivisions alongside results and discussions are explained, and finally, a concise conclusion is written.

strength and modulus of [C2G3]s were higher by 23% and 64% than [G3C2]s [6]. The tensile and

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