

Improvement in mechanical and thermal properties of unsaturated polyester- based hybrid composites

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Abstract Polymer matrix composites are used in automobile, structure and aerospace industries due to their light weight and high strength. The present research has an aim to reinforce locally developed silica nanoparticles and glass fibers in unsaturated polyester to produce polymer-based hybrid composites. Composites were synthesized by hand lay-up method with 1, 2, 3 and 4 wt% of silica sand nanoparticles and glass fiber. Mechanical tests like tensile, impact and micro-hardness were performed on the obtained polymer hybrid composites. The results of mechanical properties of the hybrid polymer matrix composites revealed an increasing trend. The SEM analysis was performed on the developed and fractured tensile testing samples. The SEM analysis showed the presence of silica nanoparticles in the samples and pulling action of fibers were seen under fractured tensile tests. The pulling actions of fibers from polymer matrix delayed the fractured mechanism and enhanced the mechanical properties. Silica nanoparticles filled the cavities generated during tensile test and extensive enhancement was revealed in tensile as well as impact energy. Toughness of the hybrid composite was also enhanced as a result. The thermal properties of the hybrid polymer composites were analyzed using thermogravimetric analysis. Thermal stability of the composite has been marginally increased with increasing wt% of reinforcement.

Keywords Unsaturated polyester resin · Silica nanoparticles · Glass fiber · Mechanical properties · Microstructure · TGA

Introduction

Several modern technologies require materials, with unique combinations and superior properties than a material with limited performance. Fiber reinforced composites are such materials, which have revolutionized the conception of high strength. Composite materials are formed by an amalgamation of two or more separate materials. The combination of two or more materials is defined as composite, a solid material, in which specific components keep their separate identities [1]. Ajay et al. [2] reinforced glass/polyester laminates by different sizes of fillers and studied the mechanical properties of the developed composites. The results showed that the composites have very good load bearing capacity with the addition of fillers. A research was conducted to inspect the outcome of silica on different properties possessed by polyester composites reinforced with natural fiber. Composites were made by silica and without silica through adding 100% recyclable reinforcement as natural fibers in polyester medium [3]. Outcomes showed an increase in tensile strength of silica-based composites and found to be 1.5 times better as compared to composites which were made without silica. Tensile modulus of a composite made with silica was also 1.8 times better as compared to a composite which were made without silica. Composites impact energy was also studied and found to be 1.36 J which was 1.8 times greater than the composite without silica. Inceoglu et al. [4] studied the effect of clay addition in glass fiber in polymer-based composites. The result showed that ultimate tensile strength, elastic modulus

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