A study of sustainable polyester composites incorporating recycled materials

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Abstract. This research aimed to produce composite materials using three distinct base of a polyester- Poly(methyl methacrylate) and Poly(methyl methacrylate) PMMA in order to enhance their mechanical properties by blend with different weight ratios of glass fibers and steel mesh. The study focuses on evaluating the hardness, elastic modulus and thermal properties of the samples and comparing their properties. Hardness tests demonstrated an increase in hardness with higher doping ratios. Polyester reinforced with glass fibers, steel mesh, and a combination of both demonstrates improved an increase in hardness with higher ratios additions of glass fiber and steel mesh in different number of layers. Similarly, PMMA reinforced with glass fibers and steel mesh provides increased harness and elastic modulus, with a hybrid combination offering optimal performance.

INTRODUCTION

Composite materials are used in a wide range of applications, due to their mechanical and thermal properties. Different materials used as a reinforcement such as fibers continuous, fiber discontinuous, and particles which can randomly arranged or in adding as layers. Hybrid composites of different addition E-glass in resin are significant because of their durability and impact resistance, [1-3].

Zhang, et al. [4] developed a composite of unsaturated polyester resin, reinforced in order to enhance the toughness of a novel hybrid.

Sezavar, et al. [5] improved mechanical properties of PMMA with alumina nanoparticles. Hasan, et al.[6] observed that tensile strength, impact resistance, and thermal conductivity of an polyester-E-glass mix increased with using gamma radiation. El-Wazery et al. [7] studied polyester composites reinforced with glass fibers, finding improved mechanical properties of glass fiber at 60 wt.% of fabricated composites.

Singh and Rajamurugan [8] noted increased flexural strength in polyester composites with steel mesh. Rahman et al. [9] reported enhanced impact resistance in PMMA-glass fiber composites. Aranha et al. [10] found improved mechanical properties glass fiber Polyester composites, while jute fiber polyester composites demonstrated decrease in mechanical properties. Ravishankar et al. [11] observed improved impact properties in PMMA with polypropylene fibers. Gad et al. [12] enhanced PMMA with various nanoparticles and fibers, improving mechanical properties. Zhang [13] and Jagger et al. [14] reported improved Young's modulus and reduced crack propagation in PMMA with glass beads and carbon fibers.

Aykaç [15] improved bone cement with carbon fibers, noting increased tensile strength and impact performance. Shi et al. [16] enhanced fracture toughness in PMMA with aramid fibers.

Tomar and Gope [17] used metal fibers to reinforce PMMA, achieving significant tensile strength improvements.

Demir et al. [18] reported improved mechanical properties in polyester and epoxy composites with glass fibers and alumina particles. Nemati et al. [19] developed polymer-reinforced composites in order to study thermal properties. Abbas et al. [20] improved mechanical properties of PMMA nanocomposites.

This study investigates the hardness, elastic modulus and thermal properties of polymer matrix composites reinforced with glass fiber and steel mesh. Additionally, the research aims to compare these properties across different reinforcement ratios to gain improvement into their performance characteristics.

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