Effect of water sorption on the mechanical properties of a CNT-based epoxy resin

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Abstract.

Epoxy resins are frequently utilized as matrices in structural composites for aerospace, automotive, and civil engineering applications. Their popularity stems from their excellent thermal and mechanical properties, along with strong chemical resistance. However, for certain applications, their sensitivity to moisture must be considered. Water absorption generally leads to a decline in the mechanical performance of epoxy-based components. Alterations to the epoxy resin structure or the addition of fillers have been shown to enhance water absorption properties [1] and introduce additional functionalities [2]. This study aims to assess the impact of water absorption on the mechanical properties of CNTs-composite using Dynamic Mechanical Analysis (DMA). Water absorption results in a decrease in mechanical properties, such as Storage Modulus and Tan δ, due to swelling and plasticization effects. Specifically, the presence of water in the matrix causes the Tan δ peak to broaden. According to the method proposed by Stimonaris et al.[3], which considers the Tan δ peak as comprising multiple relaxation mechanisms activated at different temperatures, an average glass transition temperature reduction of 20°C (from approximately 180°C to 161°C) was observed, along with a decrease in "network homogeneity" from 0.95 to 0.62 as water absorption increased.

References.

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