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Effect of excess silane on the viscoelastic behavior of epoxy under hygrothermal conditions

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Abstract

This study investigates the effects of excess organofunctional silane on the elastic and viscoelastic properties of an epoxy resin. Samples were prepared by adding 3-glycidoxypropyl trimethoxysilane (GPTMS) in varying amounts ranging from 0.5 to 8.0 wt. % to diglycidyl ether of bisphenol-F (DGEBF) epoxy cured using an amine-based hardener. Prepared samples were subjected to hygrothermal conditioning by immersion in water at 21°C and 50°C. Subsequently, instrumented nanoindentation was used to determine the elastic modulus and creep compliance. A Fickian model fitted to moisture absorption data indicates that after 48 hours specimens were fully saturated to a depth of approximately 150 μm , which is significantly higher than the maximum indentation depth of 1 μm . This implies that the indentation material response was determined from a fully saturated region. It was found that the addition of silane leads to a reduction in the elastic modulus. In the presence of hygrothermal degradation, this reduction still occurs but is less than the non-conditioned case, especially for exposure at 50°C. For example, the

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