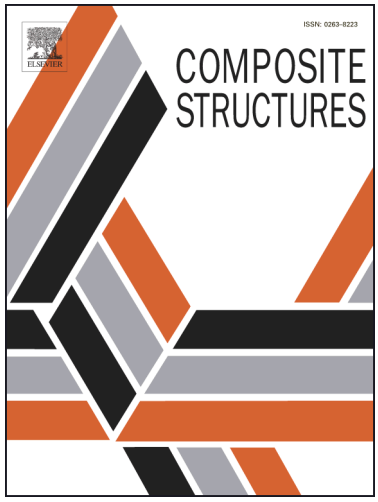

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Virtual curing of textile polymer matrix composites

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Abstract

A homogenization approach to simulate the curing process in textile composites is presented. Internal stresses build-up in a thermosetting polymer matrix during cure because of thermal expansion/contraction mismatch, chemical shrinkage and lack of uniformity in the thermal field. The matrix cures within the fiber tows as well as in the pockets outside the tows. Although the explicit modeling of each fiber and matrix is preferred, it is computationally prohibitive for tows containing large numbers of fibers. Instead, a homogenization approach that is presented here models the effective curing of the tow by extending the *cure hardening instantaneously linear elastic* (CHILE) model, originally developed for matrix curing. The possibility of damage and/or failure in the matrix during cure is modeled using the Bažant-Oh crack band model. Using cure parameters for the IM7-8552 material system, the effectiveness of the homogenization procedure is assessed by comparing the curing of a homogenized tow with the curing of discrete fiber-matrix tow, followed by the virtual curing of a 8-harness satin (8HS) weave. Subsequently, the 8HS weave mechanical response is computed. Lastly, the 8HS mechanical response when cure induced effects (manufacturing process) are not taken into consideration are assessed.

Keywords: Curing, stress evolution, textile, satin weave, crack band model

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