CARBON-PHENOLIC AND GLASS/VINYL-ESTER COMPOSITES UNDER COMBINED THERMAL AND MECHANICAL LOADING

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Abstract:
The deformation response of fiber-reinforced carbon-phenolic (FRCP) and glass/vinyl-ester (GVE) composites under combined thermal and mechanical loading is difficult to assess, in part due to the temperature-dependence of the mechanical (modulus, strength, lifetime, etc.) and thermal (specific heat, conductivity, etc.) properties. Analytical procedures incorporating the variable nature of these properties exist in literature but lack experimental verification. This yields a need for accurate quantitative values of these thermomechanical properties as functions of temperature to produce stronger and more rigid composites. The present study experimentally characterizes some of these properties for FRCP and GVE composites as functions of temperature. The study also measures the temperature and deformation response of a GVE composite exposed to compressive and thermal stresses, assuming one-dimensional heat transfer over a small area. An analytical finite-difference method is employed to analytically verify the experimental findings above and back out the incident heat flux. The effect of temperature on these thermal and mechanical properties can then be input into a finite-element package, ANSYS®, to model the local deformations that occur in a larger geometry.