A Numerical Study of Online Cure Kinetics Characterization During Liquid Composite Molding In Liquid Composite Molding (LCM)

Kuang-Ting Hsiao
University of South Alabama

ABSTRACT

The resin impregnates the fiber preform and cures to form the composite part. The resin cure is an exothermic process and requires the mold heating profile to be optimized to reduce the cure cycle time and the cure induced thermal stress in the composite part. To optimize and control the cure cycle, it is necessary to obtain the resin cure kinetic parameters, which are usually measured offline by differential scanning calorimetry (DSC) or Fourier transform infrared spectroscopy for neat resin and sometimes can be substantially changed due to the presence of fibers. In this paper, a model-based fitting technique to characterize the cure kinetics during LCM and its accuracy are studied numerically. A non-isothermal cure simulation of a composite part is performed based on a given set of cure kinetic parameters, which are the targets of the fitting process. A global search technique is used to determine the cure kinetic parameters by fitting the predicted temperature field based on the guessed parameters with the one the composite part experienced in the cure simulation. An uncertainty in temperature reading, which usually happens in real temperature measurement, is introduced to evaluate the accuracy of this characterization technique at various time steps during the cure process. Since the mold heating profile will affect the cure history and the cure kinetics characterization, the influence of the mold temperature profile on the measurement accuracy is also investigated. The results show that by appropriately choosing the mold temperature profile, one will be able to enhance the accuracy of the cure kinetics characterization within a reduced characterization time and hence can leave more time for the online cure optimization and control in the cure cycle.