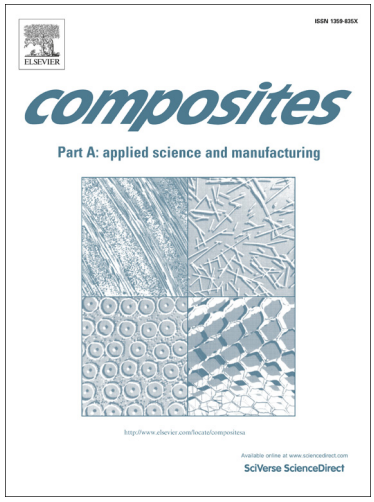

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Modeling of Heat Transfer and Unsaturated Flow in Woven Fiber Reinforcements during Direct Injection-Pultrusion Process of Thermoplastic Composites

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Abstract

This paper provides a methodology for the modeling of heat transfer and polymer flow during direct thermoplastic injection pultrusion process. Pultrusion was initially developed with thermosets which have low viscosity. But the impregnation becomes a critical point with thermoplastics which exhibit higher viscosity. There are very few reported works on direct thermoplastic impregnation with injection within the die. In addition, the rare studies have not adequately addressed the issue of unsaturated flow in woven fiber reinforcements. The solution proposed here, models the polymer flow through dual-scale porous media. A heat transfer model is coupled to a flow model enriched with a sink term. Specific changes of variables are made so as to model the steady state solution of unsaturation along a continuous process. The sink term, added to the continuity equation, represents the absorption rate of polymer by the bundles. Data were measured on a pultrusion line and micrographs confirmed the modeling strategy with an unsaturated flow approach. The flow modeling coupled to heat transfer of the thermoplastic pultrusion process aims at determining the saturation evolution through the die so as to manufacture pultruded profiles with the lowest residual porosity.

Keywords:

A: Thermoplastic resin, B: Porosity, E: Pultrusion, E: Resin flow

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