Design and Optimization of a Thermoplastic Tow-Placement Process with *in-situ* Consolidation

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ABSTRACT: Thermoplastic tow-placement with *in-situ* consolidation offers the potential for rapid fabrication of composite parts for a variety of applications. Physical models and model-based and experimental analysis of the process phenomena have been previously reported by the authors and other investigators in the literature. This paper presents a methodology for practical design and optimization using the available theoretical process models. Processing windows are developed based on considerations of material degradation through weight loss, final void content, and dimensional change of the tows, all of which determine laminate quality and thus, part performance. Optimum line speed and heat input variations with composite thickness are identified based on parametric studies to maximize interfacial bond strength and minimize fabrication time, subject to constraints on the above-mentioned quality-related parameters. The processing windows and optimum profiles are presented in terms of the controllable process variables, which allows for a ready implementation of the results in practice.

1. INTRODUCTION

THERMOPLASTIC-MATRIX COMPOSITE fabrication is based on fusion bonding, and fundamentally consists of two steps. The first step is the application of

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