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Braiding and processing characteristics of thermoplastic composites

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Abstract

Circular braiding is one of the common methods of making textile perform for composites. However, challenges exist to produce thermoplastic matrix composites by braiding due to high viscosity of thermoplastic polymers in the molten state. One method for enhancing thermoplastic resin penetration and fiber wetting in textile composites is to use a combined resin-fiber system as yarns, such as comingled yarns containing the reinforcing fibers and matrix-forming fibers, and yarns of reinforcing fibers coated with matrix powers. Such towpregs show different characteristics in braiding. In this study, the towpregs are characterized for the friction and high-curvature bending characteristics. The braidability of towpregs are studied by both braiding runs and off-line braiding simulations on a specially designed simulator. Braiding studies reveal that the towpreg properties of flexibility and friction coefficient have significant effects on the braidability of these towpregs. Commingled tow is easier to braid than powder coated tow, and wrapping facilitates braiding both types of tows. Laminates from ± 45? braided performs are consolidated by compression molding. The mechanical properties along the braid axis show that those made with powder coated tows demonstrate better properties compared with commingled tows for similar processing conditions.

Key words: *Braiding, Towpregs, Simulator, Powder coated tows*

1. Introduction

Textile preforms offer the potential for producing low cost, complex shaped, advanced composite structures (Chou and Koeds, 1989). Circular braiding is one of the common methods of making textile performs for composites. The two dimensional fabrics are widely used in many applications, ranging from aerospace, industry, recreation, infrastructure, biomedical, among others (Karbhari and Wang, 2007; Ayranci and Carey, 2008).

There are two general routes for the fabrication of textile composites: (1) preform formation followed by resin infiltration and hardening, and (2) fabrication of fabrics from tows containing both the reinforcing fibers and the matrix, followed by melting and hardening of the resin.

Thermoplastic matrix composites offer some unique characteristics and advantages for many applications such as long shelf life, re-shapeable, better damping and toughness compared with typical thermo-set composites. For thermoplastic composites in particular, it is advantageous to incorporate the resin in the tow prior

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