Continuous Near-Net-Shape Forming of Non-Crimp Fabrics for Pultrusion of Lightweight Profiles with Textile Reinforcement

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Abstract

Pultrusion is an established manufacturing technology for continuous and cost-efficient production of lightweight composite profiles. But today's standard pultrusion process is typically limited to simple cross-sections with purely unidirectional (UD) reinforcement in the axial direction of the profiles, which significantly limits the potential areas of application. Such UD reinforcements are suited for purely uniaxial loads but not for more complex loading conditions as they occur in real operation. Furthermore, installation space limitations often require the realization of more complex cross sections. A typical example of such an application is the use of profiles in the frame structures of transport systems, such as rail vehicles or commercial vehicles. This work therefore presents the further development of pultrusion process for the use of multi-axially reinforced textiles in complex cross-sections. Experimental fundamental studies and simulations on the wrinkle-free forming of non-crimped fabrics (NCF), using a U-profile as an example, form the basis for the development of forming devices for more complex pultrusion profiles. The results have been successfully applied to the realization of the first prototypical pultrusion profiles made from carbon fiber-reinforced plastic (CFRP) for highly stressed rail vehicle structures, which offer a weight reduction of 30 % compared to classic steel profiles.

Keywords: Non, crimp fabric, Forming, Pultrusion, Composite, Lightweight, Carbon Fiber

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