Investigation of Reinforcement Areal Weight Effects on Laminate Thickness in Unidirectional Carbon Fiber Composites

Melisa Yeke*[1], Gülnur Başer*†[1], and Berk Aygün‡[1]

[1]METYX-Telateks Tekstil Ürünleri San. ve Tic. A.Ş. – Turkey

Abstract

Carbon fiber–reinforced polymers (CFRPs) are widely used in high-performance applications due to their high specific stiffness and strength. While unidirectional (UD) prepregs offer superior properties, their cost has driven interest toward textile-based reinforcements and out-of-autoclave processes such as vacuum-assisted resin infusion (VARI). In VARI, laminate thickness is not mold-constrained and is mainly governed by reinforcement architecture and resin uptake.
This study investigates the effect of carbon fiber areal weight (AW) on laminate thickness in vacuum-infused UD composites. Non-crimp stitched UD fabrics with AW ranging from 596.6 to 634.9 g/m^2 were produced by varying tow density. Dry compaction behavior was assessed using 100-ply stacks under vacuum, while cured laminate thickness and fiber volume fraction (FVF) were measured from 20-ply infused samples.

A strong linear relationship was observed between AW and cured ply thickness (CPT) ($R^2 \approx 0.93$), with an increase of 10 g/m^2 in AW corresponding to ˜0.035 mm increase in CPT. Dry stack thickness also showed a strong correlation with AW ($R^2 \approx 0.90$), while FVF exhibited a slight decreasing trend.
These results provide a practical basis for thickness prediction and reinforcement selection in infusion-based UD CFRP manufacturing.

Keywords: Unidirectional carbon fiber, areal weight, fiber volume fraction, cured ply thickness, NCF compaction

*Speaker
†Corresponding author: gulnur.baser@telateks.com
‡Corresponding author: berk.aygun@metyx.com