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Prediction of the notched strength of woven-ply Polyphenylene Sulfide thermoplastic composites at a constant high temperature by a physically-based model

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Abstract

A simple physically-based model – the Critical Damage Growth model – derived from fracture mechanics criteria has been applied to quasi-isotropic carbon fibers woven-ply reinforced PolyPhenylene Sulphide (PPS) laminates to predict their notched strength under constant high temperature conditions. The tested notched specimens are characterized by an elastic-brittle response resulting from transverse matrix cracking and fibre breakage near the notch tip. This model requires only, as input parameters, the unnotched strength and fracture toughness of the laminate determined from the measurements of critical strain energy release rates. The translaminar fracture toughness has been calculated by means of the compliance method applied to quasi-isotropic Single-Edge Notch specimens with different initial crack lengths. For various hole diameters, the capabilities of the Critical Damage Growth model are very good to predict the notched strength of quasi-isotropic C/PPS laminates tested at a temperature higher than glass transition temperature when PPS matrix ductility and toughness are exacerbated.

Keywords: thermoplastic, woven fabrics, fracture mechanics, glass transition temperature

1. INTRODUCTION

Many composite structures contain holes for joining purposes and open cut-outs for access [1]. When they are subjected to thermo-mechanical loadings, the damage mechanisms taking place within these structures significantly depend on the constitutive materials (matrix and fibers nature), the type of reinforcement (unidirectional tape or woven fabrics), as well as the testing conditions (type of loading