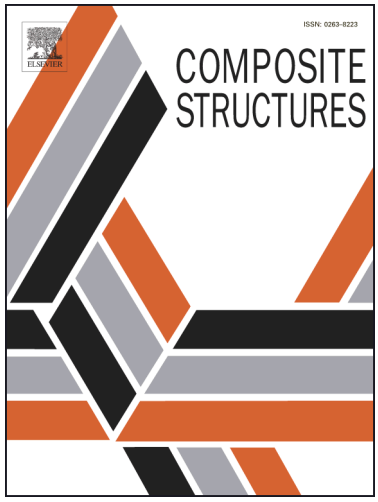

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The mechanism of rate-dependent off-axis compression of a low fibre volume fraction thermoplastic matrix composite.

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Abstract

This paper reports on the mechanism of rate-dependent off-axis compression of a unique unidirectional composite with unusually high matrix volume fraction of 65%. The test material is an E-glass fibre reinforced polypropylene composite and was subjected to quasi-static, medium and high strain rates (with strain rates from 10^{-3} s^{-1} to 10^{3} s^{-1}). This paper has shown experimental evidence of significant rate-dependence of yielding, strain softening and fracture strain of the test composite. Also, the study reports on the effect of strain rates on evolution of different failure modes of the composite. The observed rate-dependence was shown to result from the influence of the pure matrix on the constitutive behaviour of the composite. The work has used a *two-process Ree-Eyring* yield model of the matrix to demonstrate the origin of the observed rate-dependent yielding of the composite. The data derived in this study will be significant for further micro-mechanical modelling of finite deforming composites used in especially damage tolerant applications. Composite design engineers and stress analysis experts should benefit also from the findings in this work.

Keywords: Thermoplastic matrix composites, Impact behaviour, Rate-dependence, Finite deformation, High strain rates.

1. Introduction

Polymer matrix composites have found wide ranging and increasing application in airplanes, spacecraft, light weight structures, medical prosthesis, sandwich structures and sports equipment manufacture industries. In many of these applications, thermoset composites are commonplace but in the last two decades, thermoplastic matrix composites have become prevalent particularly in applications where high damage tolerance is a design

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