Viscoelastically prestressed polymeric matrix composites: An investigation into fibre deformation and prestress mechanisms

Bing Wang, Kevin S. Fancey

PII: S1359-835X(18)30192-1
DOI: https://doi.org/10.1016/j.compositesa.2018.05.013
Reference: JCOMA 5038

To appear in: *Composites: Part A*

Received Date: 6 November 2017
Revised Date: 18 April 2018
Accepted Date: 12 May 2018

Please cite this article as: Wang, B., Fancey, K.S., Viscoelastically prestressed polymeric matrix composites: An investigation into fibre deformation and prestress mechanisms, *Composites: Part A* (2018), doi: https://doi.org/10.1016/j.compositesa.2018.05.013

Viscoelastically prestressed polymeric matrix composites: An investigation into fibre deformation and prestress mechanisms

Bing Wang [a,b], Kevin S. Fancey [a*]

[a] GW Gray Centre for Advanced Materials, School of Engineering & Computer Science, University of Hull, HU6 7RX, UK
[b] Department of Engineering, University of Cambridge, CB2 1PZ, UK

Abstract

A viscoelastically prestressed polymeric matrix composite (VPPMC) is produced by subjecting polymeric fibres to a creep load, which is removed before moulding the fibres into a polymeric matrix. The resulting fibre viscoelastic recovery creates compressive stresses within the cured matrix. Although mechanical properties can be improved by up to 50%, the effect of fibre creep stress magnitude on VPPMC performance is unknown. In this paper, viscoelastic effects were investigated for 24 h creep stress values of 330-590 MPa. This involved recovery force measurement and wide-angle X-ray diffraction (WAXD) on nylon 6,6 fibres and Charpy impact testing of nylon fibre-polyester resin VPPMCs. Greatest performance was achieved with an intermediate value (460 MPa), suggesting an optimum creep stress condition. Moreover, with increasing creep stress, WAXD demonstrated a progressive reduction in regions with viscoelastic energy storage capability. By considering polymeric three-phase microstructural and latch-based mechanical models, a viscoelastic fibre-generated prestress mechanism is proposed.

Keywords: A. Polymer-matrix composites (PMCs); B. Impact behaviour;
B. Residual/internal stress; Viscoelasticity.

[*] Corresponding author. Tel.: + 44 1482 465071; fax: +44 1482 466664.
E-mail address: k.s.fancey@hull.ac.uk (K.S. Fancey).