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Viscoelastically prestressed polymeric matrix composites – effects of temperature on Charpy impact behaviour.

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Abstract

By applying tensile creep to polymeric fibres, a viscoelastically prestressed polymeric matrix composite (VPPMC) can be produced by removing the creep load before the fibres are moulded into a resin matrix. The viscoelastically strained fibres impart compressive stresses to the surrounding matrix, following curing. Previous work has demonstrated that nylon 6,6 fibre-polyester resin VPPMCs can improve mechanical properties by up to ~50%, compared with control (unstressed) counterparts. This paper focuses on the effect of temperature (from -25 °C to 45 °C) on these composites, under Charpy impact conditions. It was found that impact energy absorption by the VPPMC samples was greater than their control counterparts over the full temperature range, the increases being ~40% at 20 °C and above, reducing to ~20% at lower temperatures. The principal mechanism for energy absorption from the VPPMC samples was fibre-matrix debonding. At lower temperatures however, resin impact toughness decreased, which facilitated energy absorption through matrix cracking. Here, as VPPMC prestress impeded this effect, energy absorption through matrix cracking was more prominent within the control samples and this is believed to be a major contribution to the observed reduction in VPPMC performance relative to control samples at lower temperatures.

Keywords: A. Polymer-matrix composites (PMCs); B. Impact behaviour; B. Debonding; Viscoelasticity.

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