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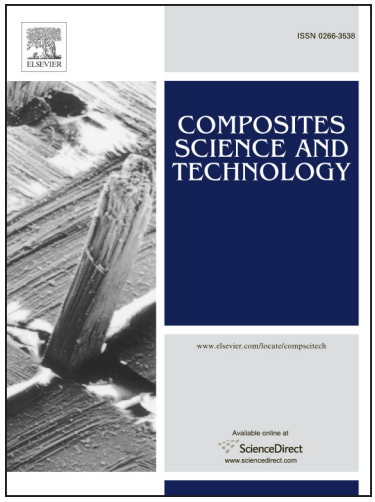

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ACCEPTED MANUSCRIPT

On the In-Plane Mechanical Properties of Stainless Steel Fibre Reinforced Ductile Composites

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Abstract

This paper introduces a ductile stainless steel fibrous reinforcing material containing innovative continuous stainless steel fibre filaments with a 30 µm diameter. The objective was to report on the mechanical properties and failure modes of these stainless steel fibrous layers impregnated with a ductile epoxy resin system. The mechanical behaviour under quasi-static tension and compression was evaluated experimentally in both principle material directions, along with the in-plane shear properties. The in-plane mechanical properties were determined by use of resistance strain gauge measurements and the Digital Image Correlation (DIC) technique, providing full field strain maps during loading and identifying local strain concentrations. It was observed that under tension, steel fibre reinforced epoxy exhibits similar ductile deformation behaviour to that of the dry continuous steel fibre filaments, i.e., an initial elastic response, a definite yield point and consecutive plastic and strain hardening behaviour up to 19.5 % failure strain. A difference in tensile and compressive behaviour of the unidirectional steel fibre composite was reported. The out-of-plane fibre waviness attributed to the warp binder yarns makes the material sensitive towards fibre microbuckling and kink band formation during compressive loading. The damage morphology of failed specimens loaded in different directions was examined using both optical microscopy and Scanning Electron Microscopy (SEM), identifying the principle features of failure.

Keywords: A. Polymer-matrix composites (PMCs), Stainless steel fibre,

B. Mechanical properties, B. Stress/strain curves, D. Fractography

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