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The role of stitch architecture on the environmental durability of multiaxial warp knit fabric polymer composites

K. Hazra and J. F. Harper[2]

1Advanced Composites Centre for Innovation and Science, University of Bristol, Queen's Building, University Walk, Bristol, BS8 1TR, UK.

2Department of Materials, Loughborough University, Loughborough, LE11 3TU, UK.

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Abstract

This study investigates the environmental durability of Multiaxial Warp Knit (MWK) reinforced carbon fabric/ epoxy composites manufactured using MTM44 resin film infusion. The distribution of resin rich areas and voids, which in turn were dependent on stitch density, were shown to play a significant part in water ingression in composite samples. Instrumented impact and compression after impact (CAI) testing were used to evaluate the effect of thermo-humid ageing and its relationship with the mechanical behaviour of laminates of varying stitch density. Despite a large scatter in results the laminates with the highest stitch density showed the greatest reduction in CAI strength following water immersion.

Key words: *Multiaxial warp knit fabrics, Polymer-matrix composites, Environmental degradation, Impact behaviour, Damage tolerance*

1. Introduction

The matrix and fibre/matrix interface of carbon fibre composites are of greatest concern when considering the effects of moisture and temperature on these materials. The potential effects of each condition are very similar in nature: interfacial degradation, matrix property degradation, the building up of residual intra-laminar stresses due to expansion and swelling, and changes in fracture toughness and ductility. The presence of moisture may also result in a decrease in glass transition temperature. Under load, visco-elastic effects (e.g. creep, relaxation) may also become important. The extent to which any of these effects are realized may vary significantly between composite material systems. The literatures available (Ellyin and Rohrbacher, 2003; Ellyin and Rohrbacher, 2000; Weitsman and Elahi, 2000; Suh *et al.*, 2001) provide some insight as to what one may expect to find and the various ways in which the effects of temperature and moisture manifest themselves.

The moisture absorption characteristics of specific

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