

The effect of stacking sequence on fatigue behaviour of hybrid pineapple leaf fibre/carbon-fibre-reinforced epoxy composites

ABSTRACT

This study examined the fatigue behaviour of pineapple leaf fibre/carbon hybrid laminate composites under various stacking sequences. The vacuum infusion technique was used to fabricate the symmetric quasi-isotropic oriented laminates, in which the stacking was varied. The laminate was tested under static and fatigue tensile load according to ASTM D3039-76 and ASTM D3479-96, respectively. Maximum tensile strength and modulus of 119.34 MPa and 6.86 GPa, respectively, were recorded for the laminate with external PALF ply and internal carbon ply oriented at $[\pm 45^{\circ}2, 0^{\circ}/90^{\circ}2]_s$ (PCCP_45090). The fatigue tests showed that PCCP_45090 and CPPC_09045 (with internal PALF ply and external carbon ply oriented at $[0^{\circ}/90^{\circ}2, \pm 45^{\circ}2]_s$) exhibited a higher useful life, especially at the high-stress level of the ultimate tensile strength. The normalised stress against the number of cycles showed that the stacking sequences of different ply orientations affected the fatigue behaviour more than the stacking sequences of the material. The laminate stacking sequence significantly affected the hysteresis energy and stiffness evolution. The scanning electron microscopy images showed that the fatigue failure modes included fibre pull-out, fibre breakage, matrix cracking, debonding, and delamination. The study concluded that PCCP_45090 exhibited an outstanding fatigue performance.

Keyword: PALF; Carbon fibre; Hybrid composite; Tensile properties; Fatigue behaviour