Fatigue of sisal fibre reinforced composites: Constant-life diagrams and hysteresis loop capture

Authors: Towo, Arnold N., Ansell, Martin P.

Abstract

Composite materials have been manufactured using untreated or 0.06 M NaOH treated sisal fibre bundles in a polyester or epoxy matrix. Mechanical tests have been conducted to establish the static properties of the composites which have been used to calculate the maximum loads used during fatigue testing. Composites containing alkali treated fibre bundles have better mechanical properties than those with untreated fibre bundles. Alkali treatment has the greatest effect for polyester resin matrices. *S–N* diagrams constructed from fatigue data at stress ratios of $R = 0.1$ (tension–tension) and $R = -1$ (reversed loading) show improvement in the fatigue lives of composites following alkali treatment of sisal fibre bundles. Constant-life diagrams for epoxy matrix composites with untreated or alkali treated fibre bundles show the superiority of the alkali treated fibre composites for low cycle fatigue. Composites loaded in tension–tension fatigue ($R = 0.1$) exhibit hysteresis loops with diminishing loop area with increasing number of cycles. The composites loaded in reversed loading fatigue ($R = -1$) generate loops with increasing loop area with increasing number of cycles. Failure modes in tension–tension and reversed loading are very different with a distinctive buckling failure mode at $R = -1$.

Keywords: Natural fibres; Polymer-matrix composites; Fatigue; Damage mechanics; Constant-life diagrams; Hysteresis