

Stress relaxation effect on fatigue life of biaxial prestressed woven E-glass/polyester composites

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Abstract In this study, the stress relaxation effect on the fatigue cycles-to-failure of the biaxial elastic fibre prestressed woven composite (E-glass/polyester) was investigated. The fibre pretension load was applied prior and during matrix cure, and then it has been released to induce compressive residual stresses within the matrix. The longevity of these stresses is questionable, and it needs investigation. The time of residual stress redistribution or relaxation was estimated experimentally for the E-glass fibre prestressing level be equal to 50 MPa. Residual stresses within the polyester matrix have declined by (27%) throughout 110 days leading to reduce the improved fatigue life by about 14% due to the stress relaxation process within the polyester matrix material. The study showed that even though the stress relaxation in the matrix reduced the improved fatigue cycles of the biaxial elastic prestressed E-glass fabric/polyester resin system, some improvement still is possible for long-term performance.

Keywords Stress relaxation · Elastic fibre prestressed composite · Residual stress · Fatigue life

1 Introduction

Fibre-reinforced (FR) composite materials are now of great concern due to their high strength and stiffness to weight ratios in comparison with the most common metals. The mechanical properties of these materials and their behaviour were widely studied during the last few years. Generally, the composite constituent materials and their fabrication processes share the total expenses of the composite structure production. For example, the cost of the fibre glass-reinforced polymer is approximately 60% for materials and 40% for the fabrication process (Ashby and Jones 2012). Consequently, the focus on developing the fabrication techniques is still important if they can improve the mechanical properties

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