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Effects of the Number of Fatigue Cycles on the Impact Behavior of Glass Fiber/Epoxy Composite Tubes

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Abstract

This paper investigates the impact damage behaviors of filament wound glass reinforced plastic (GFRP) tubes that were fatigued under internal pressure. Damage to the GFRP tubes was investigated, and the tubes' bursting pressures were determined. $(\pm 55°)_3$ E-glass/epoxy composite specimens were manufactured using the filament winding method. Fatigue tests were applied to the specimens at a stress rate of 0.05 and frequency of 0.42 Hz in accordance with the ASTM-D 2992 standard. The specimens were subjected to fatigue tests at a stress level of 35% static burst pressure. Fatigued and non-fatigued composite tube specimens were pre-stressed by applying 32 bar internal pressure. After applying internal pressure, low velocity impact tests at various energy levels (5 J, 10 J and 15 J) were performed on the GFRP tubes. Plots of contact force-time history were obtained. For impact characteristics, such as deflection, absorbed energies were calculated based on the force–time histories. The damaged areas that developed on the specimens were also evaluated. The specimens that fatigued and impacted at the 10 Joule energy level burst in accordance with the ASTM D 1599 standard. It was concluded that for all of the energy levels employed in this work, as the number of fatigue cycle increases, the rigidity of the tubes decreases.

Keywords: glass-reinforced plastic, low-velocity impact, fatigue, damage behavior