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An investigation on effects of acid etching duration on adhesive bonding of polyethylene to E-glass/epoxy composites

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Abstract

The quality of bonding between the liner and composite shell of a type IV pressure vessel is a crucial point to prevent the leakage of this vessel subjected to fill and refill cycles. In the present research, acid etching was used for surface treatment of a plastic liner to increase the bonding strength. The numerical and experimental study was conducted to investigate the effect of surface treatment duration on the adhesive bonding of E-glass/epoxy composites to the polyethylene (PE) liner. The contact angle and asymmetric double cantilever beam (ADCB) tests were performed to determine the bonding strength. According to results, by increasing acid etching exposure time, bonding strength increased and adhesive bonding became more stable. It was also found that 120 minutes acid etching exposure time of PE presented the lowest contact angle on the surface of PE; and the highest strain energy release rate (SERR) in ADCB specimens. The virtual crack closure technique was used to simulate the delamination initiation of ADCB specimens in Abaqus 6.14. The numerical results of G_c for the crack initiation deduced by the virtual crack closure technique were consistent with the experimental data. It was observed that the magnitude of G_{II}/G_c was larger than that of G_I/G_c . Also, nailing phenomenon was observed in the crack tip of ADCB specimens and was remarked as two jumps in the distribution of mode II SERR across the width of ADCB specimens.

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