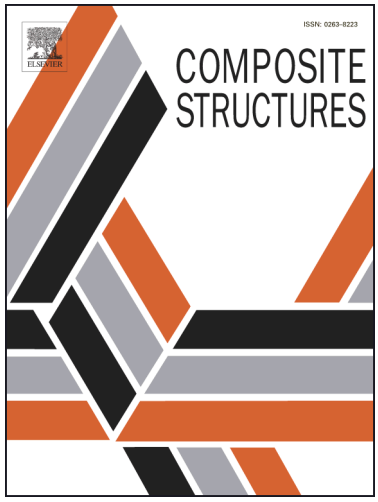

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Effects of elevated temperatures on mechanical behavior of epoxy adhesives and CFRP-steel hybrid joints

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Abstract:

High environmental temperatures can significantly degrade the mechanical behavior of CFRP-steel composites, due to the reduced bond performance of epoxy adhesives. Here, we systematically investigate the effects of elevated temperatures on the mechanical behavior of epoxy adhesives and CFRP-steel hybrid joints. First, the glass transition behavior and mechanical properties of four distinct epoxy adhesives subjected to elevated temperatures were studied via dynamic mechanical analysis (DMA) and tensile tests. The failure process of CFRP-steel double-lap joints was subsequently investigated under different elevated temperatures. Digital image correlation (DIC) technique was utilized to capture the full-field strains on the specimens during the testing. The results indicate that adhesive Araldite 2014 possesses the highest glass transition temperature, followed by adhesive J133. However, adhesive J133 possesses the highest tensile strength and toughness under all testing temperatures and forms the most robust bonding between CFRP and steel at these temperatures. The bond strength is reduced by over 50% at 70℃ compared with that at room temperature, and the degradation of bond strength is correlated with that of the tensile strength of the adhesives. We also find that it is more appropriate to use $T_{g,o}$ as an indicator to determine the working temperature limit of epoxy adhesives.

Keywords:

Elevated-temperature effect; Mechanical behavior; Epoxy adhesive; Bond behavior; Glass transition temperature; Digital image correlation

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