Effect of thermal spike conditioning on the tensile behavior of glass/epoxy composites

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ABSTRACT

Fiber reinforced polymeric (FRP) composites establish as outstanding electrical, thermal, and mechanical properties, which in turn have exciting potential applications. But, the impact of various environmental parameters are dreadful to structural integrity of FRP composites. In this paper we have experimentally investigated on the quasi static tensile behavior of glass/epoxy (GE) composite exposed to thermal spike environments. The specimens were thermally spiked to 50 °C, 100 °C, 150 °C, and 200 °C temperatures for a holding time of 5, 10, 15 and 20 minutes respectively. The tensile testing of the thermal spiked specimens were done at 1 mm/min loading rates. The experimental results reveals that the ultimate tensile strength (UTS) is increasing with increase in the holding time for all the thermal spike temperatures. The tensile modulus of thermal spike GE composited conditioned at 100 °C and 150 °C is found to be consistent. Similarly, strain at break is maximum in case of thermal spike GE composite conditioned at 100 °C and 150 °C temperatures and minimum in case of thermal spike GE composite conditioned at 200 °C temperature. The performance of FRP composites is mainly governed by the properties of fibre/matrix interfaces. Better interfacial bonding between fiber/matrix are essential to ensure effective stress transfer from polymer matrix to reinforcement, which in turn reduces stress concentrations and increases in the mechanical properties. During thermal spiking differential coefficient of thermal expansions and induced thermal stresses is a major cause in FRP composites. The interface behavior is strongly influenced by the existence and nature of residual stresses present in between fiber and matrix. Different failure patterns were observed for thermal spiked specimen tested at different holding time and temperature. Various fractured modes of failures were analysed using scanning electron microscope (SEM) for the thermal spiked GE composite. Temperature modulated differential scanning calorimetry (TMDSC) was performed to evaluate the glass transition temperature (Tg) of the GE composite.

Key Words: FRP composite; Thermal spiking; Ultimate tensile strength; Fractography