Effect of thermal shock cycling on hardness and impact properties of composites reinforced with basalt and carbon fibers

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Abstract
The polymer-matrix composites may be significantly affected by cyclic temperature changes. This study investigated the effects of thermal shock cycles on hardness and impact resistance of various types of polymer-matrix composites (phenolic resin reinforced with woven basalt and carbon fibers at a total volume fraction of approximately 35%). The effect of thermal shock cycling on hardness and impact resistance was material-dependent. While thermal shock cycling extremely decreased the hardness of composites reinforced by carbon fibers, it gradually decreased the hardness of basalt/phenolic composites. The Charpy impact strength of carbon/phenolic and basalt/carbon/phenolic composites was not significantly affected by thermal shock cycles. While Charpy impact strength of basalt/phenolic composites shows a sharp decline with increasing thermal shock cycling, and reaches a plateau after 20 cycles. In conclusion, basalt/phenolic composites was significantly harder than carbon/phenolic and secondly, the composites containing carbon fibers in spite of demonstration of low impact resistance at primal cycles, possessed very gradual decline in impact resistance compared to basalt/phenolic composites after thermal shock cycling.

Keywords: Polymer-matrix composites; Thermal shock cycling; Cross-linking; Post-curing; Basalt fiber; Carbon fiber; Phenolic resin