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IMPACT BEHAVIOR OF HYBRID CARBON FIBER REINFORCED POLYMERS

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Composite materials are promising materials for structural application. These materials might be applied in many fileds as aerospace, automobile production, marine and mechanical engineering. Special interest is paid for the carbon fiber reinforced polymers. But having outstanding properties such as high specific strength, good fatigue resistance, it prone to delamination, sensitivity to impact damage and has low fracture toughness. One of the possible ways to overcome the low fracture toughness is using hybrid composites where carbon continuous fibers or fabric additionally reinforced by dispersive nano- or microparticles. However there is limited amount of papers devoted to impact toughness investigation of hybrid CFRPs, besides the published results mostly deal with MWCNT but not SWCNT. In this regards, this research is aimed at the study of impact toughness and the behavior of CFRP filled with various additives under Charpy V-notch impact tests.

The specimens were carbon fiber reinforced polymers (CFRP) prepared and tested according to ASTM E2248-18. The lay-up was balanced, symmetric and pseudosotropic: $[0/90;+45/-45]_{4S}$. CBX300 biaxial fabrics made of PAN carbon fiber Mitsubishi Pyrofil TR50S 12K was used along with R&G Epoxy L with GL2 hardener to prepare blanks. The resulting thickness of the blank was ~4 mm thus in order to obtain the specimens with a thickness of 10 mm according to the testing standard 3 blanks were adhesively bonded using 3M D490 epoxy adhesive and the samples were cut and milled to the final size of $10\times10\times55$ mm^3. There were 4 types of hybrid CFRPs: non-modified CFRP and 3 types modified by the addition of milled carbon fibers, single-wall carbon nanotubes and commercially available CNT epoxy modificator. Charpy impact tests were conducted in two orientations of the lay-up – longitudinal and transversal.

Charpy V-notch impact tests show that the application of milled carbon fibers leads to the reduction of the absorbed energy in both directions – transversal and longitudinal. Filling the CFRP with the SWCNT-based additives increases longitudinal but transversal toughness is still negatively affected. Both effects are associated with increase of the mechanical properties of the binder but in the first case it leads to improvement of flexural impact properties of CFRP due to higher interlaminar shear and crack bridging phenomenon. In the second case it reduces the absorbed energy due to higher rigidity of binder, reduction of stress redistribution ability and brittle fiber breakage.

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