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EFFECT OF FIBER REINFORCEMENT ON THE LOW VELOCITY IMPACT BEHAVIOR OF WOVEN FABRIC REINFORCED COMPOSITES: INTEGRATED CONTRIBUTION OF THE THERMOGRAPHIC, INTERFEROMETRIC AND SPECKLE INSPECTIONS

Stefano Sfarra[*], Clemente Ibarra-Castanedo[†], Carlo Santulli[϶], Alfonso Paoletti[*], Domenica Paoletti[*], Fabrizio Sarasini[϶], Abdelhakim Bendada[†], Xavier Maldague[†]

[*] Department of Mechanical, Management and Energy Engineering, Las.E.R. Laboratory (DIMEG)
University of L'Aquila
Piazzale E. Pontieri n. 1, Monteluco di Roio, I-67100 Roio Poggio, L'Aquila (AQ), Italy
e-mail: {stefano.sfarra, alfonso.paoletti, domenica.paoletti}@univaq.it, web page: http://laser.ing.univaq.it

[†] Department of Electrical and Computer Engineering, Computer Vision and Systems Laboratory (CVSL)
Laval University
1065, av. de la Médecine, G1V 0A6 Quebec City, Canada
e-mail: {IbarraC, Bendada, MaldagX}@gel.ulaval.ca, web page: http://vision.gel.ulaval.ca/

[϶] Department of Chemical Engineering Materials Environment (DCEME)
University of Rome Sapienza
Via Eudossiana n. 18, I-00184 Rome, Italy
e-mail: {carlo.santulli, fabrizio.sarasini}@uniroma1.it, web page: http://www.uniroma1.it

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Summary. *Like parts or structures assembled from common isotropic engineering materials, fiber reinforced composites can be subjected to impact loading during their service life. Fiber composites have, nevertheless, a unique interaction with the externally applied load, since severe internal damage can be generated without any external sign. In fact, several damage mechanisms can be operating, viz. matrix cracking, fiber breakage, fiber pullout, fiber-matrix interface rupture and delamination. The challenge of non-destructive quality control is to establish safe boundaries for the use of a composite part or structure, which has been subjected to an impact event not causing non-repairable failure. For the range of possible impact velocities many parameters could be involved on the composite response, such as the mass and the geometry of the impactor; the laminate stacking sequence; among others, the kind, architecture and volume of reinforcement fibers. In our work, we have focused our attention on two woven fabric reinforced composites: one reinforced with E-glass fibers and the other with basalt ones, both subjected to low velocity impact at different energies. Basalt* *fibers are produced from basalt rock using single component raw material by drawing and winding fibers from the melt. Once the basalt fibers have been produced, they are transformed into a suitable form for particular application. Basalt fibers is a contemporary material, which combines ecological safety, natural longevity, and fire safety (incombustibility). Water-absorbing capacity of basalt fiber is much less than 1%, of fiberglass – up to 10-20%. For comparison, industrially manufactured fiberglass, before chemical sizing, absorbs substantial amount of moisture in humid air, which weakens its physical-technical and longevity properties and eventually leads to fiber damage. In contrast, low non-volatile water absorbency of basalt fiber ensures stability of thermal and physical characteristics in case of continuous service. Basalt fibers have high chemical stability and pertain to the first dimming class and greatly exceed fiberglass as regards acid, alkali and steam resistance. Basalt fibers composites may have a longer operating life as compared to glass fiber composites and are ideally suited for demanding applications requiring high temperatures, chemical resistance, durability, mechanical strength and low water absorption. Infrared thermography techniques have proven to be an effective way to detect and quantify the degree of surface and subsurface damage on such components. In this work, an external source of energy (a lamp of 500 W in reflection mode) is used to produce a thermal contrast between the non-defective and the defective material. The experimental results presented herein demonstrate that is possible to detect delamination-type defects and to assess the impact severity on composite materials with glass and basalt fibers through active thermography techniques, specifically Square Pulse Thermography (SPT). Digital Speckle Photography (DSP) and Holographic Interferometry (HI) were performed as well with the intention of providing supplementary and integrated results.*