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DAMAGE MODELLING IN THERMOPLASTIC LAMINATES REINFORCED WITH STEEL AND GLASS FIBRES UNDER QUASI-STATIC INDENTATION LOADING AT LOW-VELOCITY

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Abstract: This paper deals with experimental and numerical investigations of the composites damages with ductile and fragile reinforcement under quasi-static indentation loading. The main goal of the work is to increase the postdamage residual strength and ductility of thermoplastic composite. Two types of composite laminates with polypropylene (PP) matrix are tested: glass fibre laminate (GFPP) and steel fine wire mesh laminate (SWPP). The specimens are [0° 90°]2s stacking sequence and prepared by using a compression moulding technique. Quasi-static indentation tests were performed with two distinct penetration scales under low velocity (1.2 mm/min). The diameter of the hemispherical indenter is 16 mm. The failure mechanisms of composite layers were examined by the field emission scanning electron microscope (SEM). The results show that the failure mode of SWPP laminates is principally dominated by the plastic deformation component. In contrast, the GFPP laminate exhibits a fragile behaviour which is related to the fragile failure of glass fibres. In addition, the SEM shows that matrix cracking, fibre breakage, debonding and fibre pull out are the major damages observed around the indentation area. A model based on the combined use of plasticity, damage and fracture, was developed and applied to simulate quasi-static indentation behaviour and predict the resulting damage.

Keywords : Indentation, laminates, damage, modelling, thermoplastics, energy absorption