Effect of Interface Gradation on the Impact Response of Composites based on PEN and Woven Aramid, Basalt and Carbon Fibres

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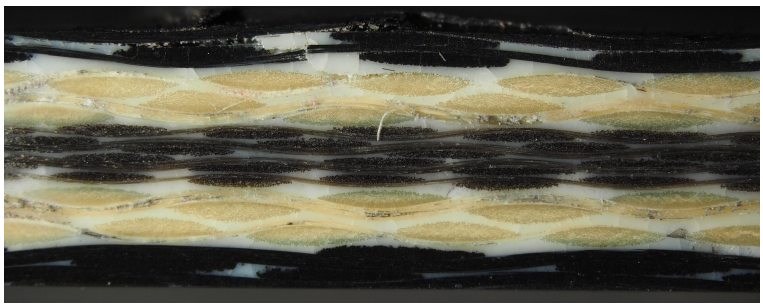
Abstract

Reinforced composites based on engineering and high performance thermoplastics are encountering a growing interest due to their inherent characteristics. Thermoplastic composites are often processed by stacking alternating layers of fibres and polymer sheets in a hot press. They present superior handling, formability, virtually infinite shelf life, reduced cost, short processing times and, potentially, recyclability. Other advantages, such as the improved fracture toughness, high damage tolerance and good resistance to micro cracking, the possibility to re-shape or re-mould the laminates at high temperatures, lead to relevant perspectives in many industrial fields. Conventionally composites are designed by maximizing static performances, while impact resistance is considered as a secondary feature. Composite laminates are hence very prone to impact damaging, which significantly reduces the in service structural properties, and show a brittle behaviour during impact that limits the dissipated energy.

A growing concern in structural applications is low velocity impacts, representative of real events occurring during fabrication, maintenance and service of such composite systems. Various approaches have been used to enhance the impact damage resistance of composite laminates but they are mainly focused in improving the toughness of the matrix. Among the possible approaches, it is worth to mention that hybridization of fibres can be a very effective way to increase of the impact resistance of the composite [1-4]. The inclusion of high strain-to-failure fibres in the composite configuration has been demonstrated to be a very effective way to improve the impact energy absorbing capability. With such hybrid laminated composites combine the good static performances of highly stiff fibres with the excellent impact resistance of ductile ones. Furthermore, as recently proved [5], the gradation of the interface strength through the laminate thickness can be a very effective way to keep high the static properties while allowing significant increase of the impact resistance.

In this framework, thermoplastic composites based on PEN and woven fibres were prepared by stacking specifically designed hybrid sequences of carbon, basalt and aramid fibres. The stacking sequence has been studied to maximize the flexural strength of the laminate, to preserve flexural modulus and strength as much as possible similar to a fully carbon reinforced laminate, but with enhanced impact properties, coming from the use of basalt and aramid fibres.



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