Finite element analysis of natural fibre composites under impact loading

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Key Words: *Natural fibre composite, Flax, Hemp, Impact, Finite element analysis, Modelling and simulation.*

Natural fibre composites (NFCs) are composite materials, in which at least the reinforcing fibres are derived from renewable and carbon dioxide neutral resources such as plants, animals and minerals. Recently many industries, such as automotive sector, are demanding a shift of their design from oil-derived polymers and mineral reinforcement materials to natural materials to exploit the recyclability and/or biodegradability of 'green' products at the end of life. The drastic reduction in worldwide reserves of petroleum, the high disposal costs of petroleum-based composites and the European directives play an important role as driving force towards a sustainable mobility.

Therefore, natural fibre composites seem to be a valid alternative to the existing synthetic fiber composites, due to their advantages such as abundance in nature, relatively low cost, lightweight, high strength-toweight ratio, and most importantly their environmental aspects such as biodegradability, renewability, recyclability, and sustainability. Most of the studies on the NFCs are about the characterization of natural fibres and their comparison with conventional composites regarding mechanical behaviour to identify their reliability and accessibility for being involved in various engineering fields, such as aircrafts, automotive, marine and sports' equipment. Modelling and simulation is a useful and valuable method that contributes to enhance the design and performance of natural fibres composites. Recently some researchers have applied finite element method to analyse NFCs' characteristics, even if such investigation is still limited.

This article aims to reproduce numerically, through a finite element model, the impact behaviour of specific green composites, obtained using flax and hemp fibres. The results obtained have been compared to experimental tests. The comparison demonstrated that the numerical simulations are very close to the experimental data, pointing out the ability of the model to reproduce the damage phenomenon.

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