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ECO-COMPOSITES IN AERONAUTICAL STRUCTURES. POSSIBILITIES AND CHALLENGES

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One of the main reasons that explain the exponential use of composite materials in aeronautical structures is their excellent ratio between mechanical performance and weight. However, if the environmental footprint of the structure is considered, a major drawback of composite laminates based on synthetic fibres is that they are very difficult to reuse once the structure reaches its life-span, and their disposal has a big environmental impact. In this scenario, composite materials made with natural fibres are an excellent alternative to conventional composites; and, although their mechanical properties are lower than those provided by synthetic fibres, many applications do not require of such high-end products, and they do require the weight reduction with a minimum environmental footprint.

Eco-compass project takes a wide look at the different eco-composites available for their use in aeronautical structures, with special attention to those composites that are suitable for secondary structures and interiors. The project evaluates the performance of different fibres, resins and cores; different composite configurations, from sandwich laminates to non-woven composites; and it also looks into several manufacturing processes. Material and composite evaluation is conducted with an intensive experimental campaign. The results obtained by the different tests conducted and the analysis made of those results will provide a comprehensive understanding of the available possibilities to use eco-composites in aeronautical structures.

The use of eco-composites in aeronautical structures requires improving the existing knowledge of these materials and their performance on their required applications, and also the development of numerical tools capable of predicting accurately their behaviour. Eco-compass project will use two different strategies to address this challenge. One is the use of a phenomenological homogenization, the serial parallel mixing theory [1]. This formulation will be used to characterize non-woven eco-composites, as it allows considering the existing dispersion and randomness in the fibre direction of the material, with an affordable computational cost. The second strategy used will be a numerical homogenization, based on a multiscale strategy [2]. This approach will be used to analyse sandwich structures, as it allows a defining a very detailed model of the composite micro-structure in order to account for the different component interactions.

The results obtained so far in Eco-Compass project show a promising future for eco-composites in the aeronautical field. The material performance obtained from the experimental campaign shows that these materials are suitable for their use in secondary structures and interiors of aerostructures; and the numerical analyses conducted have shown that the developed tools provide a good characterization of the material mechanical response.

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