Mise en oeuvre d'un composite biosourcé et caractérisation en fatigue vibratoire

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Abstract

The primary objective of this project is to study the vibration behaviour of a composite reinforced with argan nut shell particles (ANS), with a focus on mechanical and thermal characterisation. This project forms part of a wider initiative to recover agricultural waste from the production of argan oil. The composites under consideration are composed of polypropylene (PP) reinforced with 10, 20 and 30% ANS particles. The products were manufactured using standard plastic transformation processes (extrusion and injection), followed by characterisation to establish the structure-properties relationship and assess quality. The findings showed that the incorporation of ANS particles facilitated crystal formation, acting as a nucleating agent. However, this addition has the unintended consequence of reducing thermal stability. To address this issue, a study was conducted to analyse the effect of processing parameters and composite formulation on thermal stability using a design of experiments. The findings revealed that the addition of a coupling agent, maleic anhydride, and the extrusion temperature have a significant impact on thermal stability. To analyse the vibration fatigue behaviour of the composites produced, we designed specimens using numerical homogenisation and modal analysis approaches. The results of the numerical homogenisation were validated using tensile tests and analytical models. The modal analysis was used to identify the first resonance frequencies that limit excessive specimen self-heating. Vibration-based bending fatigue tests at the first resonant frequency were conducted on PP without and with 30% ANS. The results, analysed through damage mechanisms, highlighted that the addition of ANS to the PP matrix improves the stiffness and, consequently, the life duration of the composites, but leads to a reduction in the damping rate. All the results were discussed on the basis of a review of the literature.