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EFFECT OF CORK POWDER ADDITION ON THE MECHANICAL BEHAVIOR OF HYBRID FIBER-METAL LAMINATES (HFMLS)

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ABSTRACT

In this study, we investigated the effect of adding cork powder on the mechanical behavior of a hybrid fiber–metal laminate (HFML) made of glass fibers, cork-filled epoxy resin, and aluminum sheets as outer layers. The preparation of the FMLs started with the production of cork powder collected in the Dellys region (Boumerdes, Algeria). After cutting, boiling to remove impurities, drying, and grinding, a powder smaller than 200 µm was obtained and then treated with a NaOH solution (2 wt.%) to increase roughness and improve adhesion with the epoxy. At the same time, the aluminum sheets were prepared by mechanical polishing and alkaline treatment (NaOH 5 wt.%, 40 °C) to enhance surface roughness and strengthen fiber–metal adhesion. Three types of laminates were then produced by hand lay-up: FML-0 (without cork), FML-3 (3 wt.%), and FML-6 (6 wt.%). The prepared specimens were tested under three-point bending and Charpy impact. The results showed a modest improvement in maximum specific flexural strength for FML-3 (97.55 MPa/(g/cm³)) and a decrease for FML-6 (74.75 MPa/(g/cm³)) compared to FML-0 (95.93 MPa/(g/cm³)). On the other hand, a reduction in specific stiffness was observed for the cork-filled FMLs. For the impact tests, FML-3 showed a significant improvement in absorbed energy (3.92 J), specific absorbed energy (1.82 J/(g/cm³)), and impact strength (12.54 J/cm²) compared to the reference (3.64 J, 1.60 J/(g/cm³), and 12.28 J/cm², respectively), while FML-6 showed degradation (3.28 J, 1.58 J/(g/cm³), and 9.05 J/cm², respectively). These results suggest that a moderate cork powder content (3 wt.%) offers the best balance between lightness, flexibility, and energy absorption in hybrid fiber–metal laminates (HFMLs).