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APPLICATION OF THE NANO-STITCHING TECHNIQUE USING CARBON NANOTUBES FOR INTERLAMINAR REINFORCEMENT IN FC/PPS COMPOSITES APPLIED TO AERONAUTICAL FAIRINGS

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Introduction

Materials such as steel, titanium alloys, and aerospace-grade aluminum are widely used in aircraft structures due to their high reliability, broad market availability, and excellent mechanical properties. However, there is still a demand for materials that offer a better strength-to-density ratio, contributing to reduced aircraft weight, lower fuel consumption, and improved performance. In this context, composite materials stand out for their high strength and low weight. Nevertheless, under certain loading conditions, these materials may exhibit delamination, a phenomenon that can compromise their structural integrity. As a result, there is a growing need to develop composite materials with enhanced resistance to delamination.

Objective

This work aims to develop a carbon fiber (CF) and polyphenylene sulfide (PPS) composite material, nano-enhanced with carbon nanotubes (CNTs) through the nano-stitching technique, with the objective of improving delamination resistance. Furthermore, the study seeks to assess its potential application in aircraft fairings, contributing to the development of lighter, stronger, and more reliable aerospace structures.

Metodology

Graphene suspensions in propylene glycol were prepared at three different concentrations (0.2, 0.4, and 0.8 g/L) and deposited onto the surface of carbon fiber (CF)-reinforced PPS prepreg using the doctor blade coating technique. Subsequently, the material was melted and hot-compression molded. The resulting composite was then subjected to T-Peel Test and Short Beam Shear (SBS) testing to evaluate its interfacial tensile strength and interlaminar shear strength, respectively.

Results and Discussion

The T-Peel test demonstrated that, for all concentrations evaluated, the maximum normal tensile strength increased compared with the neat composite (NEAT), highlighting the effectiveness of carbon nanotubes (CNTs) in enhancing resistance to delamination caused by transverse loads. Among the concentrations investigated, 0.8 g/L exhibited the best performance, achieving a strength 80% higher than that of the NEAT composite and 19% greater than that obtained for the 0.2 g/L concentration. Additionally, the SBS test indicated that, although the incorporation of CNTs does not significantly increase resistance to delamination caused by shear stresses acting along the interface between layers, their presence helps delay failure propagation associated with interlaminar shear, promoting a more stable material response prior to rupture.

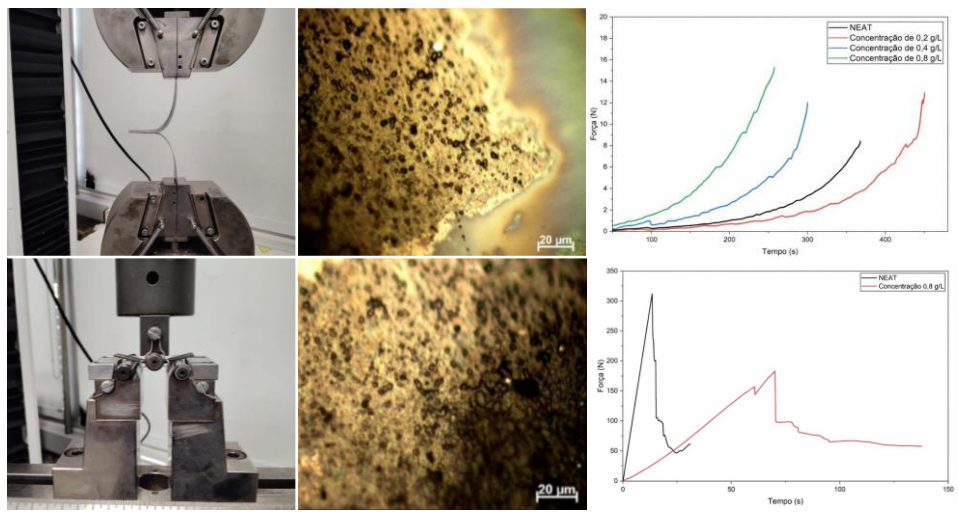


Fig. 1 - T-Peel and SBS Tests; Optical Microscopy of CNTs; T-Peel and SBS Test Results.

Conclusion

CNTs provided the material with greater resistance to delamination when subjected to distributed transverse loads, a condition commonly experienced by fairings and other aircraft structures. Furthermore, CNTs help delay failure caused by interlaminar shear, making this material particularly suitable for applications in which structures are exposed for longer periods to lower-intensity shear loads.

References and Acknowledgements

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