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NATURAL FIBER REINFORCED COMPOSITES (COCONUT/JUTE/HENEQUEN FIBERS) USED IN THE CONSTRUCTION OF A HIGH-POWER EXPERIMENTAL ROCKET

Abstract

In the aerospace industry, one of the primary challenges is the identification and development of new materials that combine high mechanical strength, thermal stability, and low density for use in the construction of various devices, including high-power rockets. In this regard, composite materials have significantly captured attention because they meet the required characteristics for this industry; however, the more common composites, such as polymer matrices reinforced with fiberglass or carbon fiber (FGRP and CFRP), have limited biodegradability.

For this reason, the proposal focuses on the development of composites strengthened with natural fibers (coconut, jute, henequen) through an epoxy matrix, analyzing how the number of layers and the orientation of the fibers influence their mechanical properties.

Each of the fibers is subjected to tension, impact, bending, and density tests under standardized ASTM norms with the intention of characterizing each one in a laminated form with an epoxy matrix. From this characterization, an ANOVA is conducted to obtain the best combination in terms of the number and orientation of each laminate. Once the optimal composition is determined, a 3.2 meters tall and 16 cm diameter rocket model is created in CAD, from which finite element tests are carried out to simulate the static structural behavior as well as dynamic tests to determine the material's behavior in response to random vibrations during flight, especially on the fins.

Following the results obtained from the laminate characterization, we have successfully launched 2 high-power rockets in 2022 and 2023, demonstrating that the use of a composite material made of natural fibers represents a significant alternative for the construction of experimental rockets. This achievement also establishes a new research pathway for the optimization of natural fibers for use in the aerospace sector at large.