Investigation on Tensile and Flexural Behavior of Bi-directional Natural Fiber Composites by VARTM

Project Overview

This project investigates the tensile and flexural behavior of bi-directional natural fiber composites fabricated using the Vacuum Assisted Resin Transfer Molding (VARTM) process. The focus is on understanding the mechanical properties of flax fiber composites in an epoxy matrix when subjected to tensile and three-point bending tests.

Objectives

- To fabricate bi-directional flax fiber composites using the VARTM process.
- To analyze the mechanical properties, including tensile strength, modulus, elongation at break, flexural strength, and modulus of the composites.

To evaluate the impact of fiber orientation on the performance of the composites under different loading conditions.

Methodology

Materials Used:

- Bi-directional natural flax fiber
- Epoxy resin and hardener
- Acetone, sealant, mesh ply, peel ply

Manufacturing Process:

- Step 1: Clean the working glass base using acetone and apply wax.

- **Step 2:** Mix epoxy resin and hardener in a 100:33 ratio.
- **Step 3:** Arrange the flax fibers on the glass base, apply peel ply and mesh ply.
- **Step 4:** Apply vacuum cover and remove excess resin using a vacuum pump.
- **Step 5:** Cure the specimen for 24 hours, followed by post-processing.

Testing:

- **Tensile Test**: Evaluate tensile strength, modulus, and elongation at break.
- **3-Point Bending Test:** Assess flexural strength and modulus.

Key Results

- The bi-directional flax fiber composites exhibited improved tensile and flexural properties, making them suitable for lightweight and high-performance applications
- The stress-strain and force-displacement graphs provided insights into the behavior of the composites under different loading conditions.

Conclusions

- The VARTM method is effective in producing high-quality composites with superior tensile and flexural properties compared to traditional manufacturing techniques.
- The results are valuable for designing and selecting materials for specific engineering applications

Discussion

- The strategic placement of bi-directional flax fibers significantly enhanced the mechanical properties of the composites.
- The study highlights the potential of using natural fibers in sustainable and lightweight composite materials.

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