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DIPLOMA THESIS
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"Analysis of the mechanical behavior of flax fiber reinforced thermoplastic composites"

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Introduction & Scope

This study focuses on the development and mechanical characterization of composites of flax fiber and thermoplastic matrix. Three groups comprising three types of thermoplastic matrix (HDPE) with different Melt Flow Index (MFI) reinforced with flax fibers, one group of thermoplastic matrix reinforced with glass fibers and another one of thermosetting matrix reinforced with flax fibers. The mechanical properties of the five groups of composites, were calculated by tensile and three-point bending tests, from the data of which the modulus of elasticity and stiffness, as well as the tensile and bending strength were calculated and compared.

Materials & Construction methods

Composites made of thermoplastic materials reinforced with flax and glass fibers and also made of thermosetting material reinforced with flax fibers. Five groups of materials were fabricated and used to characterize the materials in a three-point bending and tensile test:

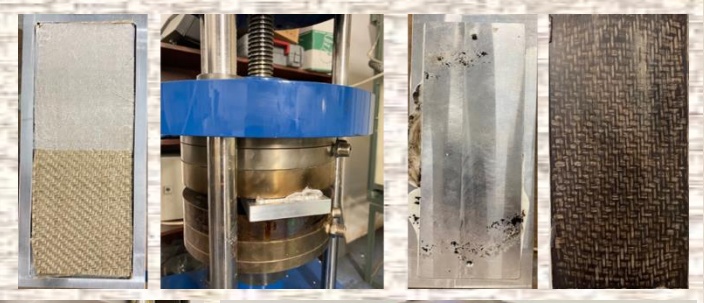
1. HDPE J2200 - Glass
2. HDPE J2200 - Flax
3. Epoxy - Flax
4. HDPE 2030 -Flax
5. Recycled-HDPE – Flax

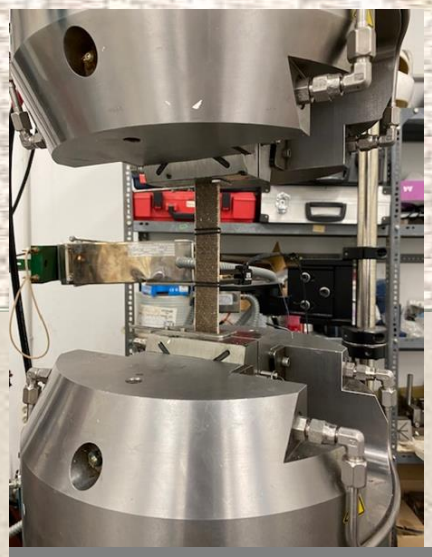
Two types of construction methods were used.

- The composite material with the thermosetting matrix was manufactured using the infusion method. This method involves the production of polymer matrix composites reinforced with fibers by liquid resin infusion (LRI)

- The thermoplastic matrix composite was manufactured by alternately placing layers of thermoplastic material and layers of reinforcing material in a mold. The mold was then subjected to a constant temperature and force in a hot press. This method resulted in four groups of composites. The first three comprised three thermoplastic materials (HDPE) with different MFIs and flax fiber reinforcement, while the fourth one had glass fiber reinforcement.

Stages of manufacture





Tensile and three-point bending experiment

Experimental Procedure:

Three specimens of each composite material were tested to tensile and the three-point bending tests.

- The tensile test carried out according to the standard EN ISO 527.04
- The three-point bending test carried out according to the standard EN ISO 14125.

Experimental results & conclusions:

This paper demonstrates that natural fiber composites have mechanical properties comparable to those of the conventional HDPE-GLASS composite. More specifically:

- The EPOXY-FLAX composite exhibits highest flexural strength (133.24 MPa) than all other materials.
- The Young's modulus in both tensile (about 15GPa) and flexure (about 10GPa) is similar to that of the thermoplastics reinforced with flax fibers, except for the recycled thermoplastic, which is lower than the conventional material.
- Composites with the recycled thermoplastic matrix shown the lowest mechanical properties of all materials.
- The other two thermoplastics reinforced with flax fibers, had the same tensile properties.
- Conversely, the HDPE 2030 - FLAX composite has a higher flexural strength than the HDPE J2200 - FLAX composite, owning to its higher (almost four times) melt flow index.