COMPARATIVE ANALYSIS OF THE TENSILE PROPERTIES OF POLYESTER TO EPOXY MATRIXES COMPOSITES

UENF

Academic Work

Introduction

- Is a growing interest in the use of natural vegetable fibers as reinforcement in polymer matrices.
- Disadvantages: Irregularity in shape and dimension, **high absorption and hygroscopicity**, great variability of the mechanical properties.

Introduction

- **Advantages of using natural fibers**: low cost, renewable, biodegradability, low toxicity, abundance and its attractive resistance and specific stiffness and **low density.**

Introduction

- Most of the polymer matrices used in the composites are thermoset resins such as epoxy resins and polyester;
- Generally, the tensile properties of the composites are improved by the addition of fibers to a polymeric matrix;

Objective

- The work analyzed to comparatively the tensile properties of polyester matrix composites with those of epoxy matrix reinforced with hemp fibers in different fiber volume fractions, 0, 10, 20 e 30%.

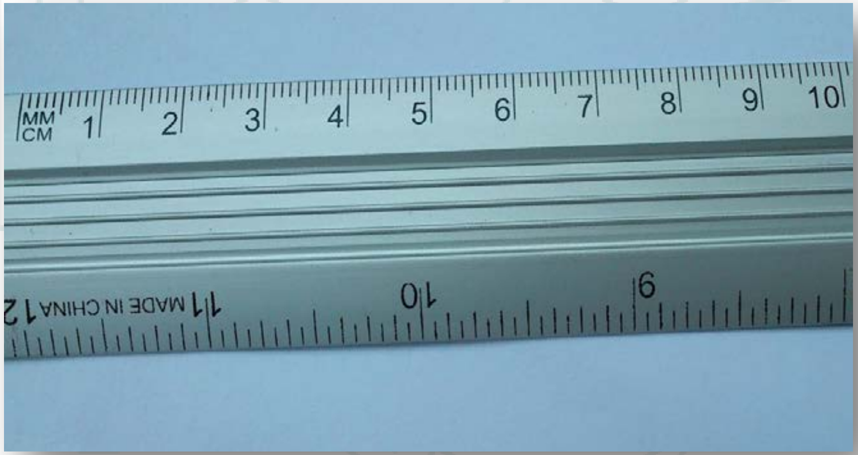
Fiber characterization

The hemp fiber was characterized by:

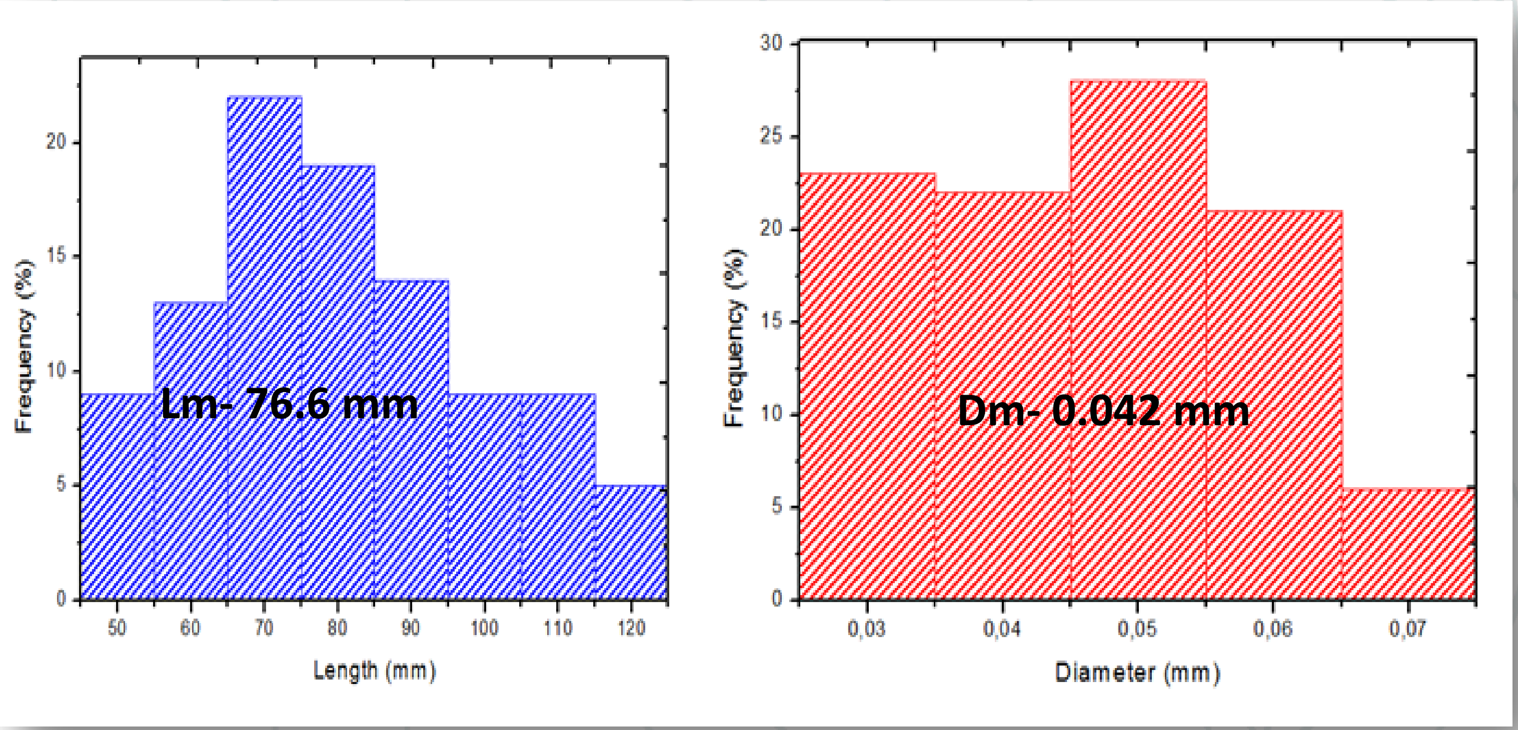
Diameter

Nikon profile Projector Model 6C, LAMAV / UENF

Length

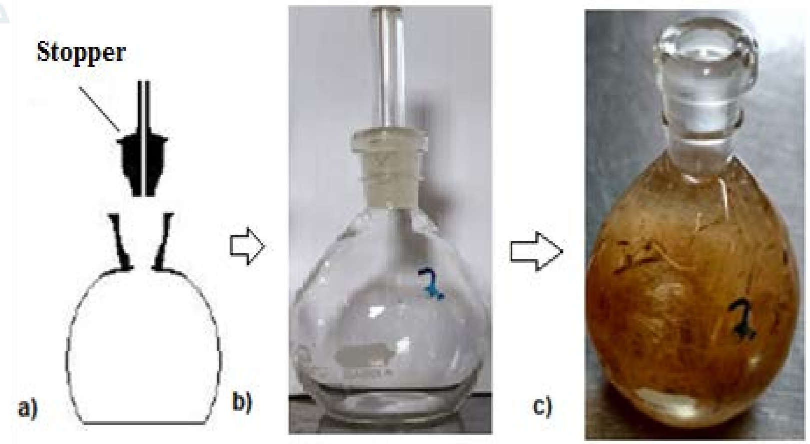


Diameter and length of hemp fiber



Real density

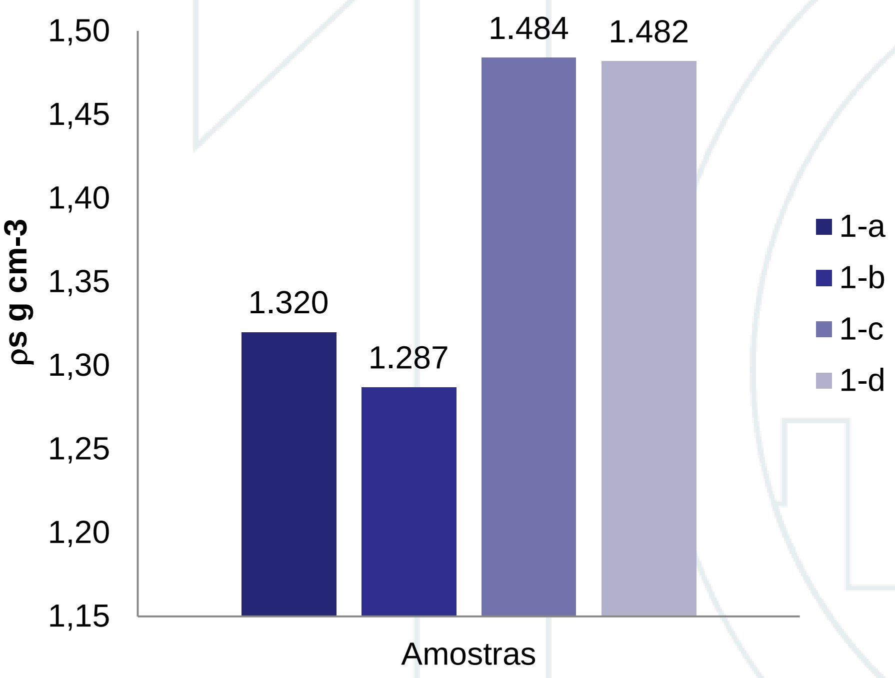
- The determination of the relative density of the hemp fibers using the pycnometry method was performed in the Soil Laboratory of UENF (LSOL) using four pycnometers due to the test was done in four repetitions

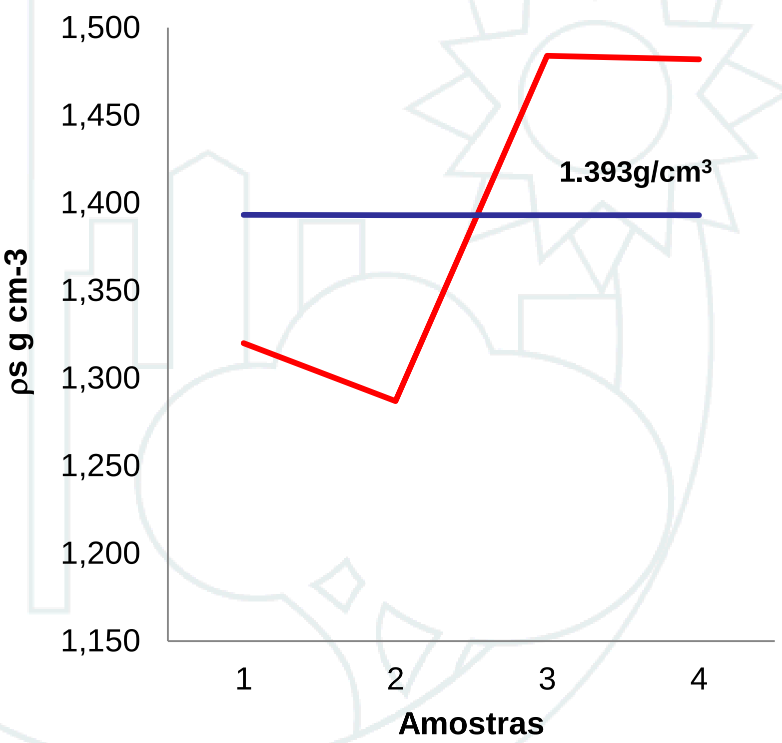


ρfiber=m1(m3−m2)−(m4−m2−m1)/ρwater

m_1 - mass of the clean and dried pycnometer (g);
m_2 - mass of the pycnometer filled with water (g);
m_3 – mass of the dry specimen (g);
m_4 – mass of the pycnometer with water and the dry specimen (g);
ρ_{H2O} – density of the water.

Real density





Apparently density

- The estimation of the apparent density of the hemp fiber was obtained from the dimensional and individual values of the fiber
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  ρap= 4mπd 2

The apparently density - 0.952 g / cm 3.

- where:
- m is the average mass of the fiber (g)
- V (πd2) is the mean volume of the fiber (cm3)
- ρap is the apparent density of the fiber (g / cm3)

Properties of hemp fiber

Length (mm)	Diameter (mm)	Real density (g/cm³)	Apparently densityr(g/cm³)
76.6	0.042	1.393	0.952

Literature...
Diameter - 0.017 to 0.023 mm
Length - 8.3 to 14mm
Density - 0.86 to 1.51g / cm3

Morphological characterization

- The images were made by scanning electron microscope (SEM) ZEISS EVO 40 of the LBCT / UENF

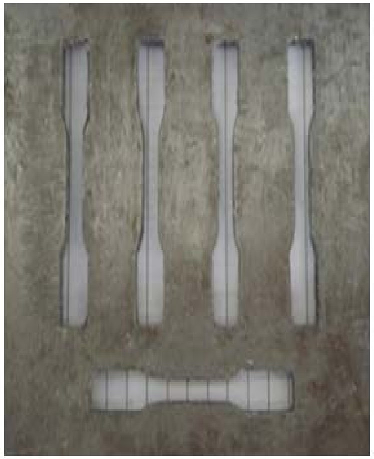
- Micrograph of hemp fiber surface

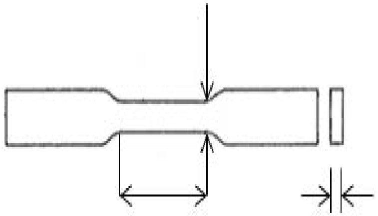
Characterization of composites

- **Reinforcement** – Hemp fiber

- **Matrices-** unsaturated orthophthalic **polyester resin** hardened with 0.5% methyl ethyl ketone and bisphenol A diglycidyl ether **epoxy resin** (DGEBA) with triethylene tetramine hardener (TETA) in the stoichiometric ratio corresponding to phr = 13 (13 parts hardener per 100 parts resin).

- **Metal molds-** matrix with the dimensions 5.8 X 76.7 X 4.5 mm, in the shape for tensile test.





Tensile Testing

- These samples were tensile tested by an INSTRON, model 5582 LAMAV / UENF universal machine.

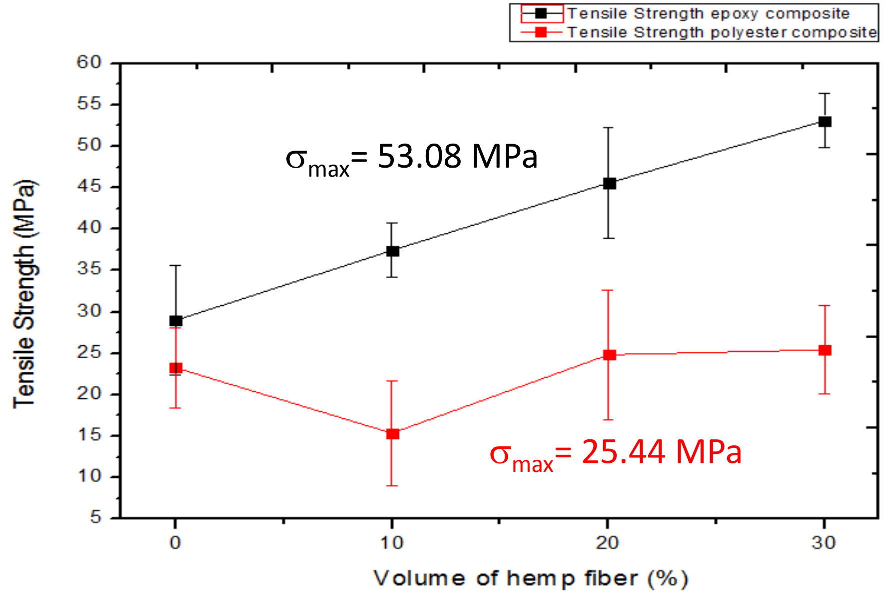
- The calculation of maximum tensile stress (σm) and tensile modulus (E) of the specimens were obtained through the following equations:

- $\boldsymbol{\sigma} = \frac{F}{A}$

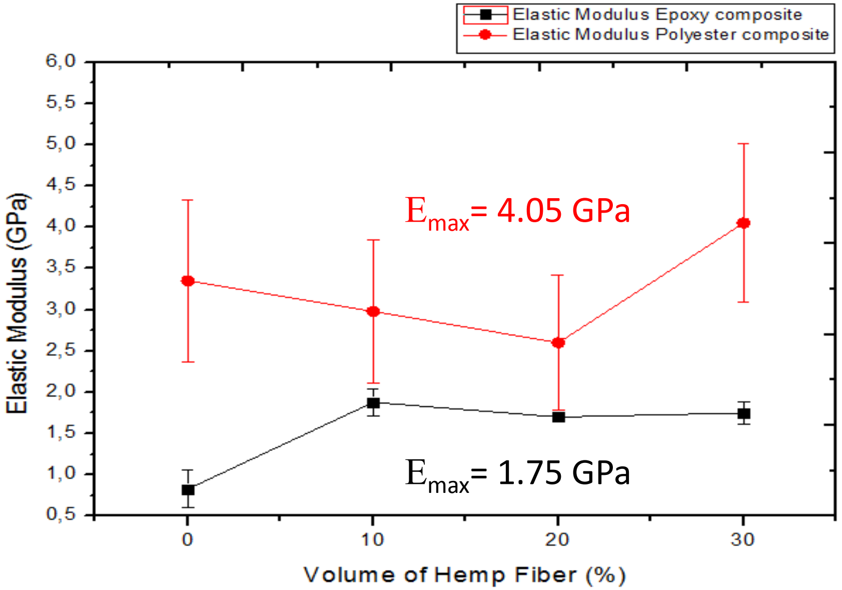
- $E = \frac{\sigma}{\varepsilon}$

Results

Tensile strength variation with the amount of hemp fiber in the epoxy and polyester composites



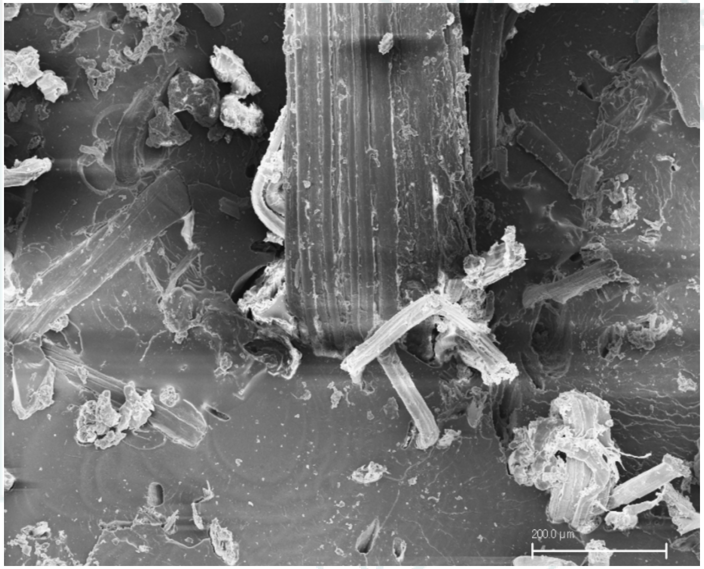
Elastic Modulus of the epoxy and polyester composites in function different amounts of hemp fiber



Discussions

- Epoxy Composite with 30% in vol. of hemp fiber

- Polyester Composite with 20% in vol. of hemp fiber



Literature

Rouison et al. (2005)

- Obtained a tensile strength of **60.2MPa** and elastic modulus **1.74GPa**, of polyester matrix composites reinforced with 35% hemp fibers.

Conclusion

- Epoxy composites reinforced with hemp fibers showed higher tensile strength than polyester composites reinforced with hemp fibers.
- Polyester matrix composites presented higher stiffness compared to the epoxy ones.
- The analysis of the tensile strength of this new material, contributed to the search for new sustainable and technologically advanced materials.

Thank you very much for yor attention

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