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RESEARCH ON THE IDENTIFICATION OF HEMP COMPOSITES USING TENSILE TESTING

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Abstract: *For use in automotive design composite components is necessary to know their mechanical properties, in order to determine the stresses that they can resist exploitation. Below is determined these properties for hemp composites using tensile tests.*
Keywords: *Mechanical properties, Hemp composites, Static tests.*

1. INTRODUCTION

Composite materials made of hemp fiber reinforced resins are frequently used materials in vehicle construction. Their use requires knowledge of the structure of their mechanical properties. There are various theoretical methods for calculating these quantities but in practice, it is found that these methods lead to values sometimes differ than actual values. For this it is necessary to experimentally determine the mechanical characteristics of these types of composite materials. Tensile testing determines these values [1], [2], [3], [4].

2. MATERIAL AND METHOD

We used specimens made according to the standards specified above to perform tensile tests. In Figure 1 are shown a series of specimens of composite materials reinforced with hemp fiber. If the break was made at one end of the grip, samples were replaced with a representative sample of reservation. For tensile test was performed a set of 8 samples

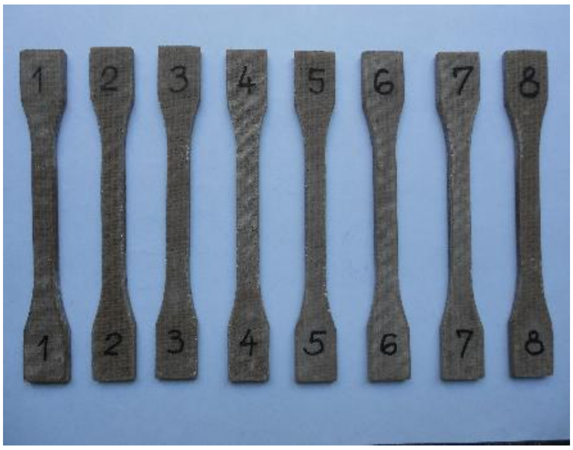

Figure 1. Composite samples of hemp fiber reinforced

Tensile testing machine tried to use existing SIM Faculty laboratory and test drive of the laboratory strength of materials. Were performed tensile tests with composite samples of hemp fiber reinforced.

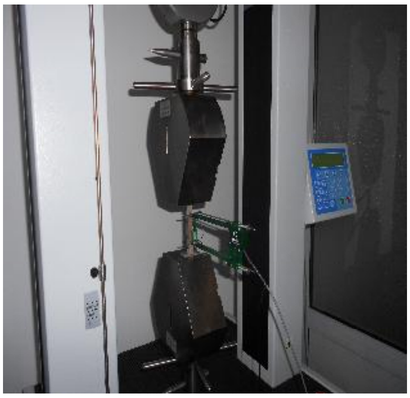

Figure 2. Tensile testing machine tried

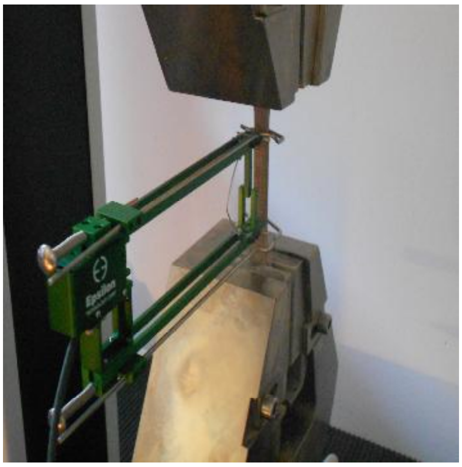

Figure 3. Tensile testing machine tried specimen mounted between the device terminals tensile test

Following main features have been experimentally determined:

- Stiffness (N/m);
- Young's modulus (MPa);
- Load/stress/strain at maximum load;
- Load/stress/strain at maximum extension;
- Load/stress/strain at minimum load;
- Load/stress/strain at minimum extension;
- Tensile strength;
- Load/stress at break;
- Work to maximum load/extension;
- Work to minimum load/extension.

Test and specimens features are:

- Test speed: 1 mm/min;
- Number of specimens: 8;
- Preload/stress: 1.4680 kN;
- Specimens mean width: 9.8375 mm;
- Specimens mean thickness: 5.0500 mm;
- Mean cross-sectional area: 49.649 mm^2.

The materials testing machine allows determination of experimental results in electronic format by help of the NEXYGEN Plus software.

Figure 4. Resin specimens reinforced with hemp fiber, torn by traction

3. TENSILE TEST RESULTS

The maximum mechanical properties of eight composite materials made of hemp fiber reinforced resins determined in tensile tests are presented in table 1. Typical load-extension from preload distributions of eight composite materials made of hemp fiber reinforced resins is presented in figs. 5-7 and stress-strain distributions are shown in figs. 8-9.

Table 1. Specimens' maximum mechanical properties

Feature	Value
Load at maximum load (kN)	1.4680
Load at break (kN)	1.4612
Young's modulus (MPa)	10250.0
Tensile strength (MPa)	29.649
Machine extension at maximum load (mm)	0.28674
Stress at break (MPa)	29.512
Strain at break (-)	0.0057074
Machine extension at maximum extension (mm)	0.53770
Stress at minimum extension (MPa)	14.745
Strain at maximum load (-)	0.0057281
Strain at maximum extension (-)	0.010747

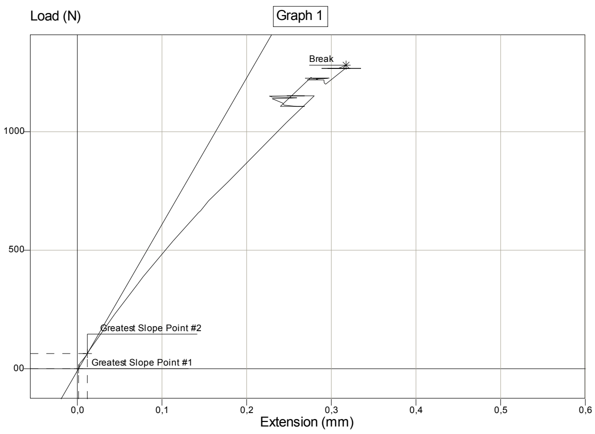

Figure 5. Load-extension from preload distribution of specimen 1

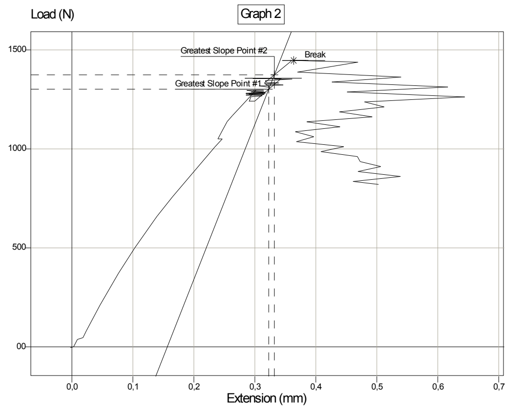

Figure 6. Load-extension from preload distribution of specimen 2

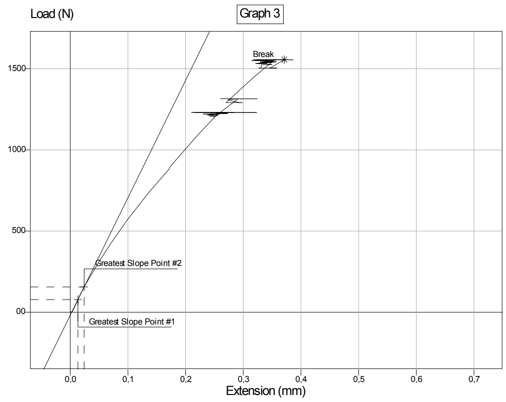

Figure 7. Load-extension from preload distribution of specimen 3

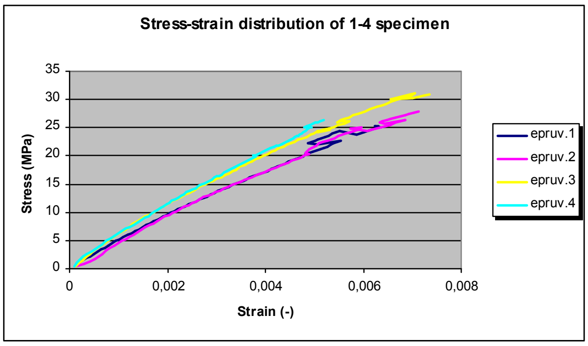

Figure 8. Stress-strain distribution of specimen 1-4

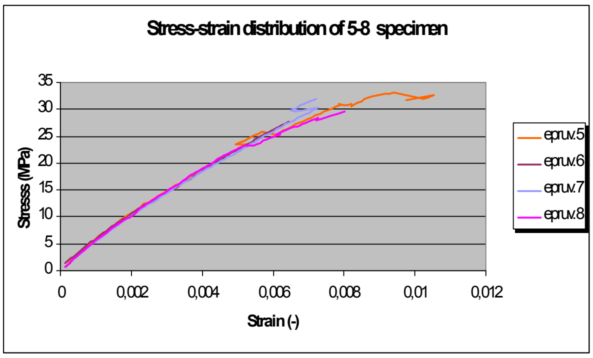

Figure 9. Stress-strain distribution of specimen 5-8

Young's modulus distributions of eight composite materials made of hemp fiber reinforced resins are presented in fig. 10 as well as a distribution between Young's modulus and tensile strength (fig. 11).

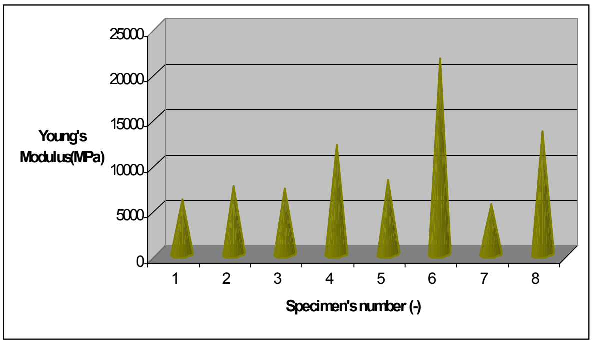

Figure 10. Young's modulus distribution of eight composite materials made of hemp fiber reinforced resins

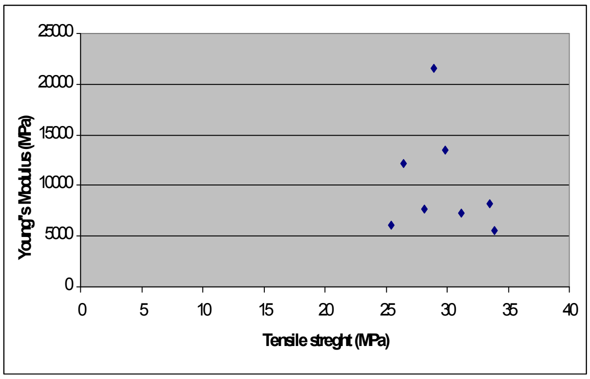

Figure 11. Young's modulus distribution versus tensile strength of eight composite materials made of hemp fiber reinforced resins

4. CONCLUSION

Regarding the load-extension in the first load-extension from preload distribution of specimen 1 presented in fig. 5, the load at break reaches a value of 1277.7 N at an extension from preload of 0.315 mm. The greatest slope points generated by the materials testing machine that give the rigidity modulus, have been determined between 0 – 500 N load and 0.0 – 0.1 mm extension from preload. In case of the second load-extension from preload distribution of specimen 2 presented in fig. 6, the load at break has been reached at 1435.5 N at an extension from preload of 0.35633 mm. The greatest slope points have been generated between 1000 – 1500 N load and 0.30 – 0.40 mm extension from preload. In the last load-extension from preload distribution of specimen 3 presented in fig. 7, the load at break has been experimentally determined at 1549.5 N for an extension from preload of 0.36779 mm.

The Young's modulus distribution of eight composite materials made of hemp fiber reinforced resins specimens presents a maximum value of 21540,85 MPa at specimen 6 and a minimum value of 5605.191 MPa at specimen 7 (fig. 10). These values have been determined using the machine extensometer. Regarding the Young's modulus distribution versus tensile strength of eight composite materials made of hemp fiber resin specimens presented in fig. 11, the eight values of Young's modulus are scattered between 25.41469 MPa and 33.88673 MPa tensile strength.

ACKNOWLEDGEMENTS

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