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EXPERIMENTAL APPROACHES REGARDING THE ELASTIC PROPERTIES OF A COMPOSITE LAMINATE SUBJECTED TO STATIC LOADS

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Abstract: *Design and analysis of products made of polymer composites behavior is based on results of tests conducted on specific categories of material.*
Based on specific tests several considerations of applicative nature can be made and a number of conclusions can be drawn. Mono-axial tensile testing is considered to be the most important but also the most used static test because of its simplicity of procedure for obtaining strength and plasticity features. Static and dynamic bending tests are considered as types of tests providing significant data on mechanical properties and behavior of polymeric materials.
Keyword: *bending, tension, stiffness, Young's module, specimens*

1. INTRODUCTION SAMPLES PREPARATION AND COMPOSITE MATERIALS PROPERTIES DETERMINATION

Fibrous structures can be used in resistance structures, only if inserted to a support material called matrix. In composite construction, most often completely different substances can be combined so that their individual properties reach an optimal action. Typically, it is about pairs of materials one of which having a support function, while the other aims to contribute to the moment of inertia overtaking.
SR STAS 11268/1979 Standard establishes the method of determining traction characteristics of plastics reinforced with glass fibers, namely: the initial tangent elasticity modulus and tensile secant elasticity modulus, maximum tensile stress, elongation at maximum force and elongation at break.
Bending properties can only be used in engineering studies for materials with linear stress-strain behavior. For non-linear material behavior, bending properties are only nominal. Bending test must be used preferentially at fragile materials because it is difficult to subject them to the tensile test.

2. TECHNICAL REQUIREMENTS

Tensile and bending tests were performed using specimens according to standards. Experimental tests on samples manufactured by SC COMPOSITE SRL Brasov have been made in the testing materials laboratory of the Department of Mechanical Engineering, University Transilvania Brasov.
Test pieces were taken from a plate with a thickness of 7 mm, covered with a layer of white gelcoat. Samples were polymerized 24 hours at a temperature of about 20 ° C.
The following materials have been used:
• MAT 600 - fiberglass composite (short wires) in the matrix of epoxy resin with specific weight 2x600g / m2, 2-2,6 mm thick;
• RT 800 - fiberglass composite (fabric) in the matrix of epoxy resin with specific weight of 4x 800g / m2, thickness 3,2-3,6 mm;
• MAT 450 - fiberglass composite (short wires) in the matrix of epoxy resin with specific weight 2x450g / m2, 1.6-2mm thick.
The software of the tensile testing machine allowed statistical calculation of average values for: longitudinal modulus of elasticity E (Young's module); tensile stiffness EA, as shown in Table 1:

Table 1: Valorile medii ale caracteristicilor mecanice de tracțiune

Stiffness	20019000
Young's modulus	14572

Figure 1: Samples 1-8 after they were subjected to tensile

Figure 2: Samples 9-12 before being subjected to tensile

In Table 1 parameter we present the parameters values of the test pieces subjected to tensile testing.

Table 2: Values of testing parameters

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12
Calibrated part length [mm]	50	50	50	50	50	50	50	50	50	50	50	50
Load speed [mm / min]	1	1	1	1	1	1	1	1	1	1	1	1
Test-piece width [mm]]	10	9,5	9,3	9	9,5	9,5	9,2	9,2	9,8	9,2	9,5	9
Test-piece thickness [mm]	7	7,2	7,6	7,1	7,2	7,1	7	7,8	7	7,1	7,3	7,5
Area [mm2]	70	68,4	70,68	63,9	68,4	67,45	64,4	71,76	68,6	65,32	69,35	67,5

Figure 3 is presents the rigidity values of the 12 test pieces. It is noted that the minimum stiffness 15530000 N / m is corresponding to test-piece 8, and the maximum one 25,899,000 N / m to test-piece 5.

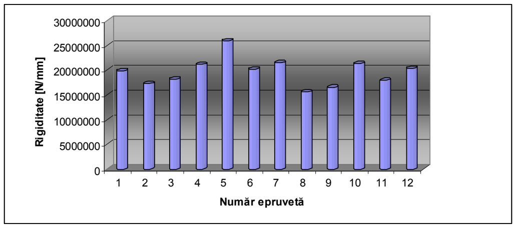

Figure 3: Distribution of stiffness for tensile testing

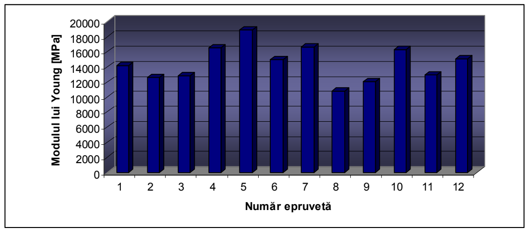

Figure 4: Diagram obtained in tensile testing for Young's Modulus

In case of bending, the program automatically calculated the statistical mean values for: longitudinal modulus of elasticity E (Young's module); bending rigidity EI_z ..

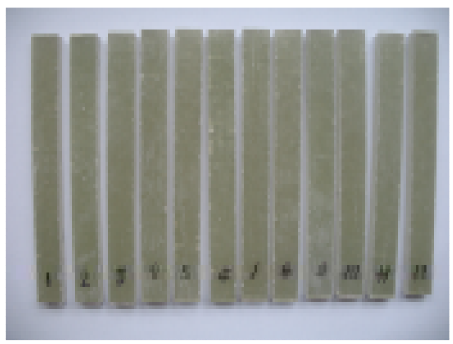

Figure 5: Test pieces before being subjected to bending

Table 3: Average values of the bending mechanical characteristics

Stiffness [N / m]	69111
Young's module [MPa]	3815,9
Bending stiffness [Nm ²]	1,9164

Figure 6: Test pieces after being subjected to bending

Table 4 presents the parameter values of the samples subjected to bending.

Table 3: Values of parameters for test-pieces subjected to bending

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12
Calibrated part length [mm]]	110	110	110	110	110	110	110	110	110	110	110	110
Load speed [mm / min]	3	3	3	3	3	3	3	3	3	3	3	3
Test-piece width [mm]	15	15	15	14,9	15	14,9	15	15	14,9	15	15	14,9
Test-piece thickness [mm]	7,2	7	7,4	7,8	7,5	7,4	7,8	7,5	7	7,3	7,5	7
Area[mm2]	108	105	111	116,22	112,5	110,26	117	112,5	104,3	109,5	112,5	104,3

Figure 7 presents the rigidity values of the 12 test pieces. It is noted that the minimum stiffness 60,330 N / m is for test-piece 10 and the maximum 79,870 N / m is for test-piece 7.

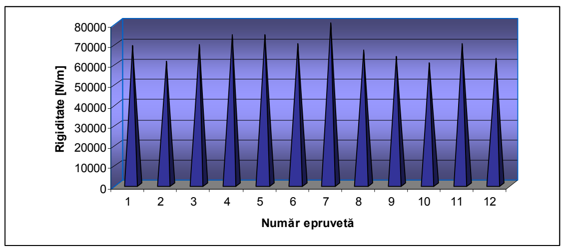

Figure 7: Diagram of bending rigidity test

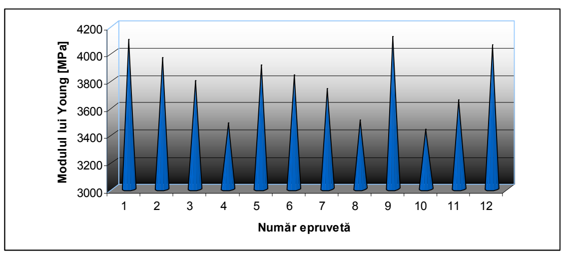

Figure 8: Diagram of bending Young's modulus

3. CONCLUSION

Test results are strongly influenced by test speed, which is chosen to provide an elongation of about 1 ... 2% / min. Results of the matrices tests are quite largely spread, requiring a relatively large number of tests for a reasonable confidence coefficient and however the conclusions are limited.

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