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Teodor Daniel MÎNDRU*

„Gheorghe Asachi" Technical University of Iasi, Iasi, Romania
*mindru.daniel@gmail.com

THE INFLUENCE OF INPUT PARAMETERS ON THE FLEXURAL STRENGTH FOR PARTS OBTAINED BY INJECTION

Abstract: The polymeric materials known a strong development in all fields. In order to improve the mechanical properties of the polymer, composition is reinforced with different materials. Polyamide 6.6 is a natural polymer with a high level of stiffness, hardness and resistance to shock. In this research studies the influence of the input parameters of the injection process on bending resistance for parts made from materials that have the basic polymer polyamide 6.6, using the glass microspheres reinforcement material at the rate of 30%. Experimental research was based on Taguchi method with six factors and two levels of variation. After the samples were obtained the results are focus on: variation of load deformation during flexural tests, XRD analysis, EDAX analysis and scaning with electron microscope (SEM).
Keywords: fibres, microspheres, glass, mechanical properties, spectrum.

1. Introduction

Due to the way different materials, a demeanor of their classification can be done and after some laboratory experiments. The most common are the trials of mechanical experiments which consist in external loads appropriate request made, on samples that have standardized sizes and shapes depending on the type of tests [3].

It is known a great number of retries due to mechanical action oriented way, their direction, the conditions of the tests, etc.

At mechanical testings to measure the loads applied on each of the analyzed material analyzed must, a courtier to the effects produced on the samples and then by applying a mathematic model suitable mechanical characteristics shall be of material.

An test at flexural is one of the most complex mechanical solicitations, because displacements are produced simultaneously both linear and rotation around the axis of bending, this becoming a request made.

Flexural strength of a material is defined as the ability to resist deformation under load. For materials that do not break after deformation, flexural resistance is calculated to the value of 5% of the deflection [2].

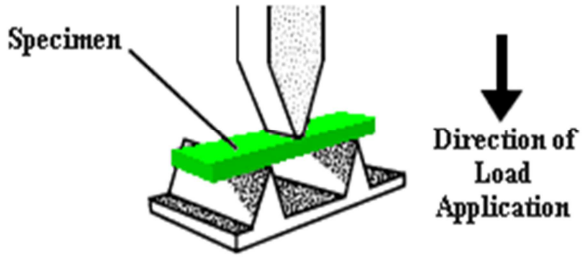


Fig. 1. Flexural strength model [1]

In the plastics industry, reinforced or unreinforced materials, the most commonly used standards are ASTM D638 and D790 [4].

The flexural tests is made on the flexural universal testings machines which have in their composition, special devices for bending in three points [3]. In figure 1 it is shown the general scheme of the request to the flexural strength.

2. Experiment preparation

The experiment was designed using Taguchi methodology with six input factors and two levels of variation. Consider factors and levels of variation for polyamide 6.6 with 30% glass microspheres are presented in table 1, where T_{top} - melt temperature [^oC]; t_{inj} - injection time [s], t_r - cooling time, [s], V_{inj} - injection speed [m/min], P_{inj} - injection pressure [MPa], T_{mat} - mould temperature [^oC], table 2 presents only the experiments whose results are most relevant.

Tab. 1 The levels of variation of the input parameters for Polyamide 6.6% 30 with GM

Param. Levels	T_{top} [^oC]	t_{inj} [s]	t_r [s]	V_{inj} [m/min]	P_{inj} [MPa]	T_{mat} [^oC]
Level 1	265	10	4	10	40	40
Level 2	285	15	10	30	70	70

Tab.2 Experiments

Param. Experiments	T_{top} [^oC]	t_{inj} [s]	t_r [s]	V_{inj} [m/min]	P_{inj} [MPa]	T_{mat} [^oC]
9	2	1	1	2	1	1
10	2	1	2	1	2	2
11	1	2	1	2	2	1

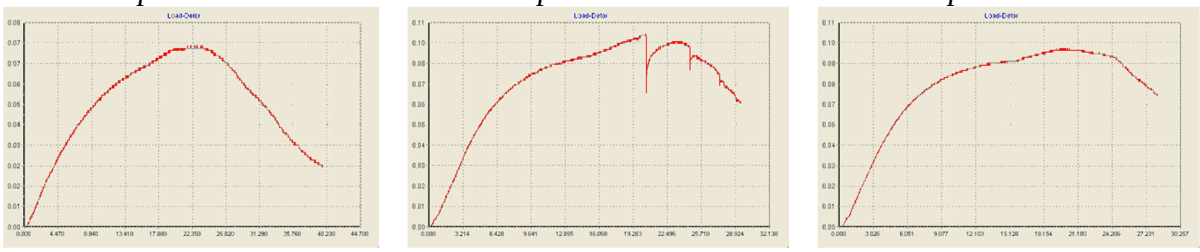
Tests at flexural modulus were made in accordance with the standards in force, the dimensions of the test specimens being 80x10x4 [mm]. Universal machine for an tests at felxural is WDW 50E on which was set a speed of 2 [mm/min] for each samples.

3. Results and discuitions

After tests at flexural of polyamide 6.6 reinforced with 30% glass microspheres were obtained graphs load-deformmation curves presented in figure 2. Analyzing the results, you can observe the differences that appear depending on the adjusted parameters for each type of specimen. It can be seen in figure 2a (experiment 9) maximum loading value of 0.073 [kN] with a maximum deformation before breaking 39.6637 [mm]. In the case of figure 2b (experiment 10), the maximum load value is 0.1 [kN] and maximum deformation before

breaking 29.3837 [mm]. In figure 2c (experiment 11), the maximum load is 0.098 kN with maximum deformation before breaking 28.2787 mm. In figure 2d shows an overlay of the three experiments to highlight the differences between experiments.

Experiment 9 *Experiment 10* *Experiment 11*



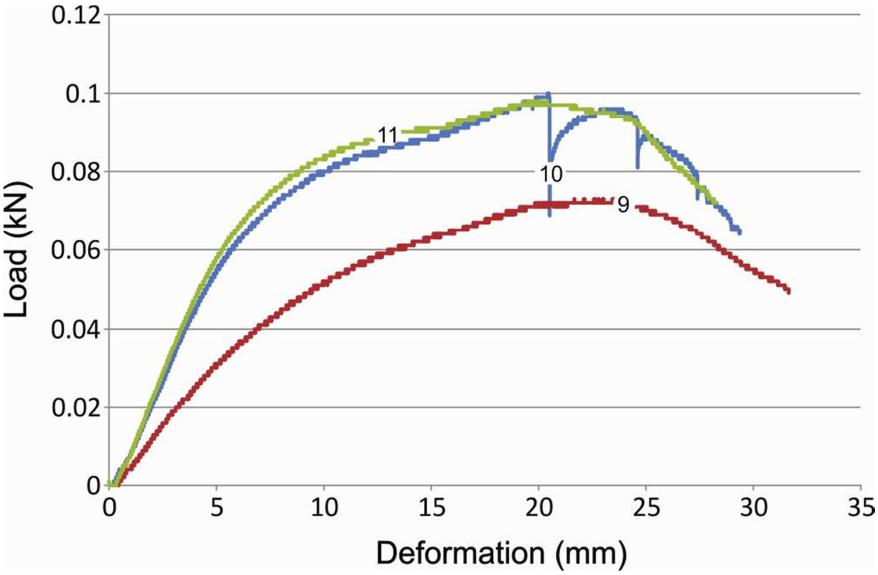
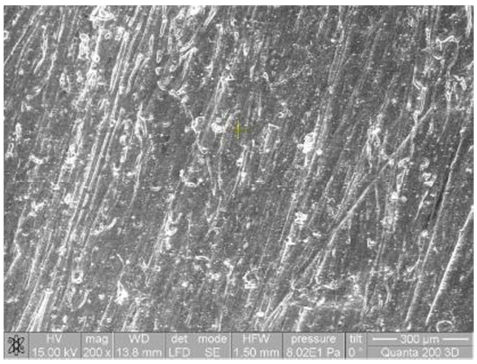
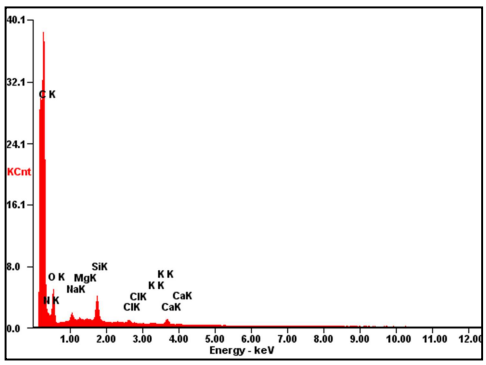


Fig. 2 Loads-deformations variaton

In figure 3a is presented the SEM analysis in which can be seen the structure of the material, the microspheres and can approximate and direction injection, and figure 3b shows EDAX analysis where can be seen the specter of chemical elements.





a. SEM *b. Chemical elements spectrum*

Fig. 3. SEM analysis - polyamide 6.6 with 30% glass microspheres

Figure 4 shows the XRD analysis of polyamide 6.6 reinforced with 30% glass microspheres.

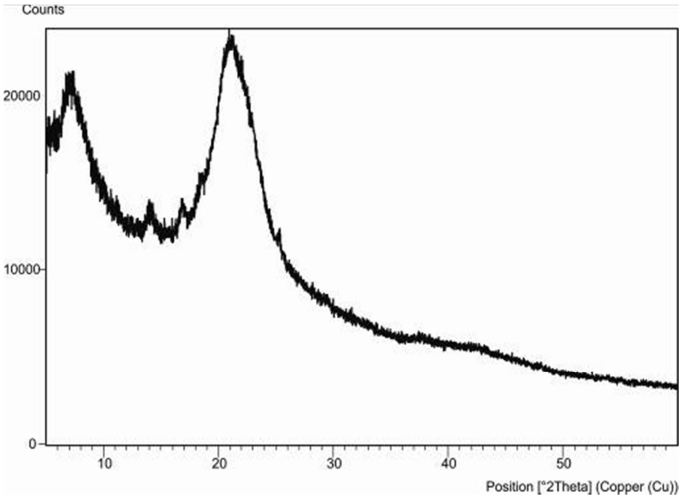


Fig. 4 XRD Analysis

4. Conclusion

Increasing the pressure and temperature of injection cause an increase in loading and a decrease in flexural creep trying what bring out the influence of the input parameters in the process of injection on mechanical properties of finished parts.

The mechanical strength of injected plastic parts depends on the type of material, but the greatest influence are the parameters of injection processing. These parameters determine the permanent unit efforts.

To perform a reduction of the internal stress shall be the choice of the optimal processing regime, this is true only in the case of parts with simple configurations. For parts with complex configurations proceed to adjust the parameters so that the piece to be compliant after applying a heat treatment for reducing internal tensions.

Acknowledgement

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References

1. *** http://www.matweb.com/reference/flexuralstrength.aspx2.
2. *** http://info.admet.com/specifications/bid/42936/How-to-Perform-an-ASTM-D790-Plastic-Flexural-3-Point-Bend-Test
3. Flexural Properties, ASTMD790, ISO 178
4. Fetecău, C. Injectarea materialelor plastice. Ediţia a doua. Bucureşti, Editura Didactică Şi Pedagogică, 2007.