

STUDIES AND EXPERIMENTAL RESEARCH OVER THE INFLUENCE OF PLASTICS GROUND MATERIAL PERCENTAGE OVER THE SHRINKAGE OF INJECTION MOLDED PIECES

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Key words: injection molding, shrinkage, plastics ground material percentage,

Abstract: The paper present the influence of plastics ground material percentage over the shrinkage of injection molded pieces. Mixtures were made in different plastics ground material percentages of the same material, injected and shrinkage calculated according to ISO 294-4.

1. THEORETICAL CONSIDERATIONS.

The shrinkage of injection moulding piece is define as a decrease of the volume of plastic melt due the cooling. The shrinkage is influenced by injection mould process parameters in accordance with next relation:

$$C_V = 1 - \frac{V_p}{V_m} = 1 - \frac{\frac{V_m}{1 + \alpha_v k_{pi} (T_m - T_o)}}{V_m} = \frac{\alpha_v k_{pi} (T_m - T_o)}{1 + \alpha_v k_{pi} (T_m - T_o)} \quad (1)$$

Where:

α_v - coefficient of volume dilatation, indicate the influence of temperature over the melt of thermoplastics materials,

k_{pi} - coefficient that indicate the influence of injection and holding pressure over the coefficient of volume dilatation,

T_m - melt temperature,

T_o - ambient temperature,

Coefficient of volume dilatation has a value that characterize each thermo-plastic material, and is influenced by the degree of purity of the material.

According to standard ISO 294-4:2001 for calculating the linear shrinkage formula is:

$$C_L = \frac{L_M - L_P}{L_M} \cdot 100 \quad (2)$$

Where: L_M – mould dimensions,

L_P – dimensions of injected molded piece,

The shrinkage calculation is based on the melt flow direction, longitudinal, and transverse or perpendicular to the flow direction, figure 1. Following measurements will result two dimensions for molded injected pieces: L_L – longitudinal dimensions and L_T – transverse dimension. Shrinkage calculation in the two directions will be reported to the similar size inside the mold.

Longitudinal and transverse shrinkage depending by structure of thermo-plastic material, semi-crystalline or amorphous. In this paper we study the contraction of two materials, one semi-crystalline: polyoxymethylene, [POM], and one amorphous: acrylonitrile-butadiene-styrene, [ABS]. We study the longitudinal and transverse shrinkage in fixed ground material percentages of 0%, 20%, 40%, 60%, 80%, 100%.

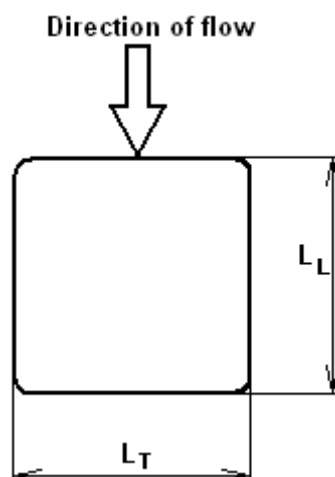


Figure 1. Injection molded piece dimensions.
L_L- longitudinal dimension, L_T- transverse dimension,

2. EXPERIMENTAL RESEARCH.

Experimental research conducted with support from SC Plator SA Oradea, with a special mold, built for verification of mechanical properties of thermoplastic materials and dimension of injection molded pieces, according to standard ISO 294-4:2001.

For each plastics ground material percentages were made 10 injections, and or measured part dimensions, on longitudinal and transverse direction. For shrinkage calculation have been eliminated the lowest value and highest value, then did the average size.

First thermoplastic material that was studied is Polyoxymethylene,[POM], semi-crystalline, injected at a temperature of 200°C, mold temperature 50°C, cooling time inside the mold 15", total cycle time 33". For all samples or kept the same injection parameters.

In table 1 are presented the average value of longitudinal and transverse dimension, the longitudinal and transverse shrinkage variation of injection molded piece with percentage of ground polyoxymethylene [POM].

Tabel 1. Dimension and shrinkage variation of injection molded piece with percentage of ground polyoxymethylene [POM].

percentage [%]	longitudinal dimension L _L [mm]	longitudinal shrinkage [%]	transverse dimension L _T [mm]	transverse shrinkage [%]
0, natur	48,516	2,264	48,274	2,674
20	48,574	2,147	48,338	2,549
40	48,612	2,071	48,341	2,538
60	48,614	2,067	48,344	2,532
80	48,631	2,032	48,355	2,511
100	48,696	1,901	48,429	2,361

After shrinkage calculation is found decrease in both its directions, both longitudinal and transverse. Also observed that the value of transverse shrinkage is greater than the longitudinal shrinkage.

In figure 2 is presented the graphic of the longitudinal shrinkage variation of injection molded piece with percentage of ground polyoxymethylene [POM], and in figure 3 the transverse shrinkage for the same material.

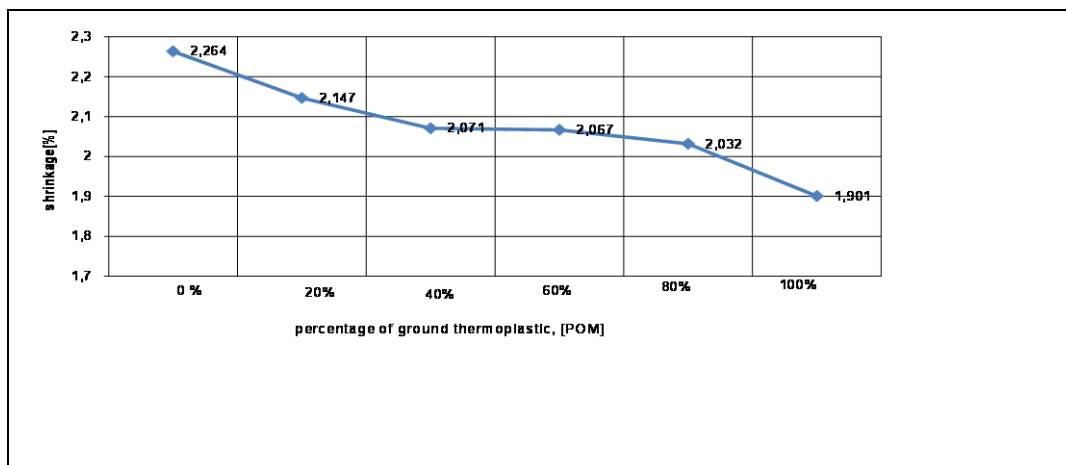


Fig.2. The graphic of the longitudinal shrinkage variation of injection molded piece with percentage of ground polyoxymethylene [POM].

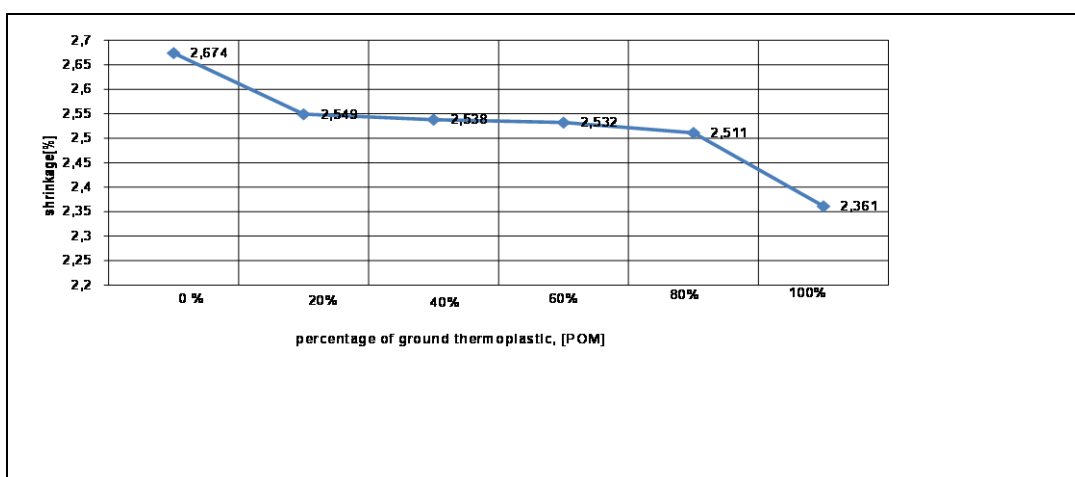


Fig.3. The graphic of the transverse shrinkage variation of injection molded piece with percentage of ground polyoxymethylene [POM].

The second thermoplastic material that was studied is acrylonitrile-butadiene-styrene, [ABS], amorphous: injected at a temperature of 230°C, mold temperature 50°C, cooling time inside the mold 20", total cycle time 43". For all samples or kept the same injection parameters.

In table 2 are presented the value of longitudinal and transverse dimension, the longitudinal and transverse shrinkage variation of injection molded piece with percentage of ground acrylonitrile-butadiene-styrene[ABS].

Tabel 2. Dimension and shrinkage variation of injection molded piece with percentage of ground acrylonitrile-butadiene-styrene[ABS].

percentage [%]	longitudinal dimension L_L [mm]	longitudinal shrinkage [%]	transverse dimension L_T [mm]	transverse shrinkage [%]
0, natur	49,39	1,01	49,384	1,1
20	49,486	0,91	49,398	1,08
40	49,525	0,831	49,414	1,05
60	49,545	0,791	49,421	1,04
80	49,586	0,709	49,431	1,02
100	49,61	0,661	49,442	0,99

After shrinkage calculation is found decrease in both its directions, both longitudinal and transverse.

Also observed that the value of transverse shrinkage is greater than the longitudinal shrinkage.

In figure 4 is presented the graphic of the longitudinal shrinkage variation of injection molded piece with percentage of ground acrylonitrile-butadiene-styrene[ABS], and in figure 5 the transverse shrinkage for the same material.

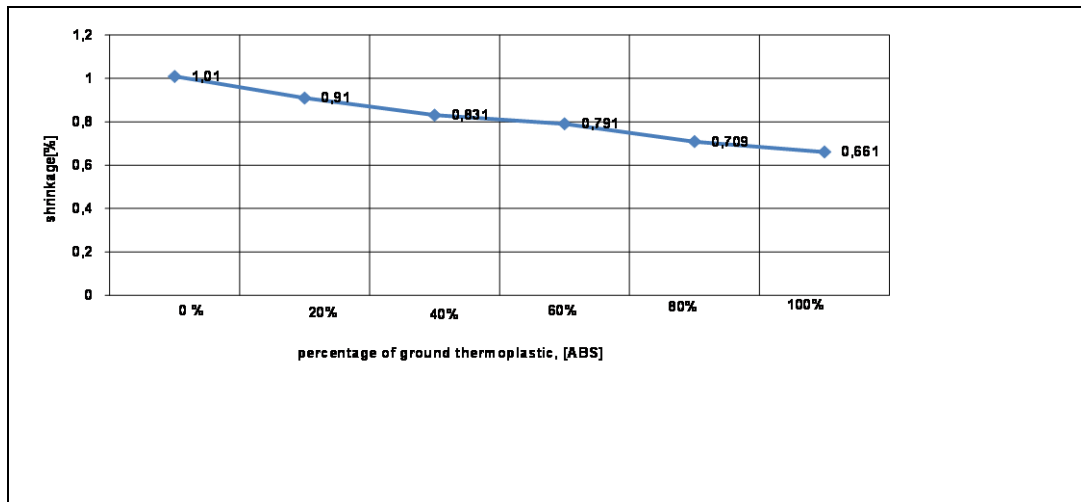


Fig. 4. The graphic of the longitudinal shrinkage variation of injection molded piece with percentage of ground acrylonitrile-butadiene-styrene[ABS].

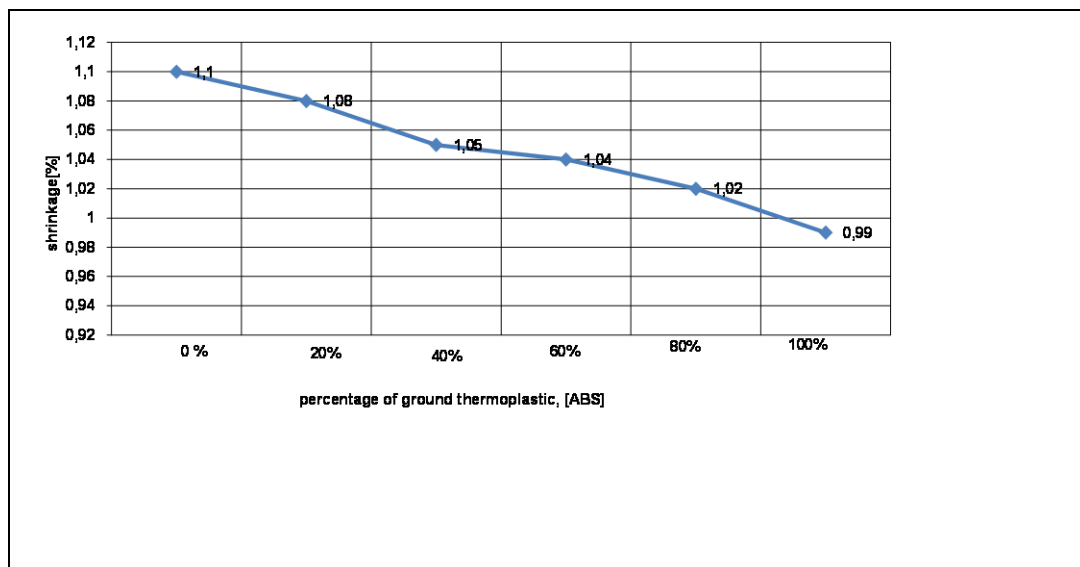


Fig. 5. The graphic of the transverse shrinkage variation of injection molded piece with percentage of ground acrylonitrile-butadiene-styrene[ABS].

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