Abstract

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1 Introduction

2 Experimental activity

2.1 Compounding (Internal Mixer)

The process has been carried out with the instrument Thermo Haake Rheomix 600.
The processing parameters used are the following:

- Temperature T = 200°C
- time t = 10 min
- Rotation speed $\omega = 50$ rpm

The sample used has the same composition as Plate 1 sample with a mass of 32.05 g.

2.2 Compression molding

Prepared amount of polypropylene mixture has been used for compression molding process. A press by Carver has been used, as illustrated in Figure **??**.

Figure 1: Carver press for compression molding.

The material to be pressed is put between two stainless steel plates, one having a frame of $12 \times 12\,\text{mm}^2$ in order to produce a square plate of some mm of thickness. To avoid any adhesion with the plates, that are used to evenly distribute the pressure and to confine the melt (since the press is able to provide heat), two Mylar® foils have been put in between the steel and the material. The press has been set to produce a pressure of 8 tons, equivalent to 5.45 MPa, in the frame. The material has undergone an heat treatment under this pressure of 200°C for 10 minutes. After this, the press has been cooled with water circulating in a refrigerating circuit inside of it and the molded piece extracted. Produced plate is then visually analyzed and weighted in order to estimate weight losses.

2.2.1 Production of dumbbell specimens

After the analysis of the plate, this has been cut to obtain ISO 527-1BA shaped specimens, that are used in another laboratory activity.

2.3 Injection molding: sample evaluation

Different speciments of unknown polymeric materials have been analysed and identified. They have been produced by injection molding according to specific standards (ISO and ASTM).

- ISO 10.0 x 4.0 x 172 (mm);
- ASTM 12.7 x 3.2 x 165 (mm);

Size of all speciments and the mold cavity have been measured through a caliper in order to evalaute the shrinkage after the process. ASTM samples (with sprue and bar) have been weighted through the balance METTLER PM 4600 in order to compare the total weight and polymer density.

3 Results and discussion

3.1 Compression molding

The mold before and after pressing is reported in Figure **??**.

(a) (b)

Figure 2: Mold (a) before and (b) after compression.

The produced plate after manual mixing is illustrated in Figure **??**.

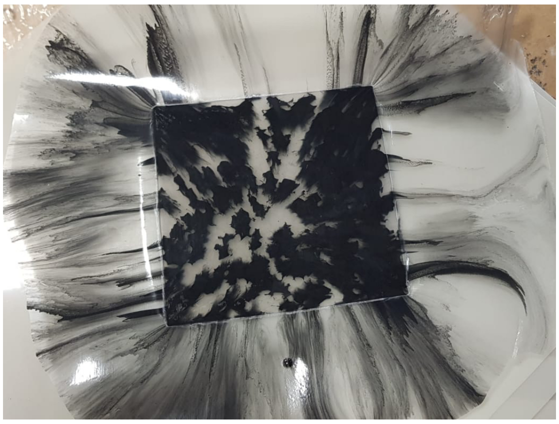

Figure 3: Plate produced in compression molding.

As it can be easily noted, the distribution of black PP in the white one is absolutely non-homogeneous, typical consequence of a manual mixing of the pellets (without any homogenization mixing in between). The other evident property of the pressed plate is the flash of melt outside of the mold: this is due to the too high amount of polymer inserted in the mold. The weights of the product before and after compression are reported in Table **??**.

Table 1: Mass of the sample before and after pressing.

Mixture mass (g)	**Plate mass** (g)	**Variation** (%)
34.00	32.50	−4.41

3.1.1 Production of dumbbell specimens

In Figure **??** the dumbbell specimens produced are displayed.

Figure 4: Produced specimens from compression molding plate.

As it can be seen, these specimens are characterized by low isotropy and homogeneity of the mixture. This will be a probable issue when mechanically testing and in resistance to flame propagation. Since the flame retardant is a weakener of strength (it introduces organics with poor adhesion and thus stress intensifiers), these specimens may have higher deformation at break than the more homogeneous ones produced in melt compounding.

3.2 Injection molding: sample evaluation

ISO speciments are reported in Figure 5.

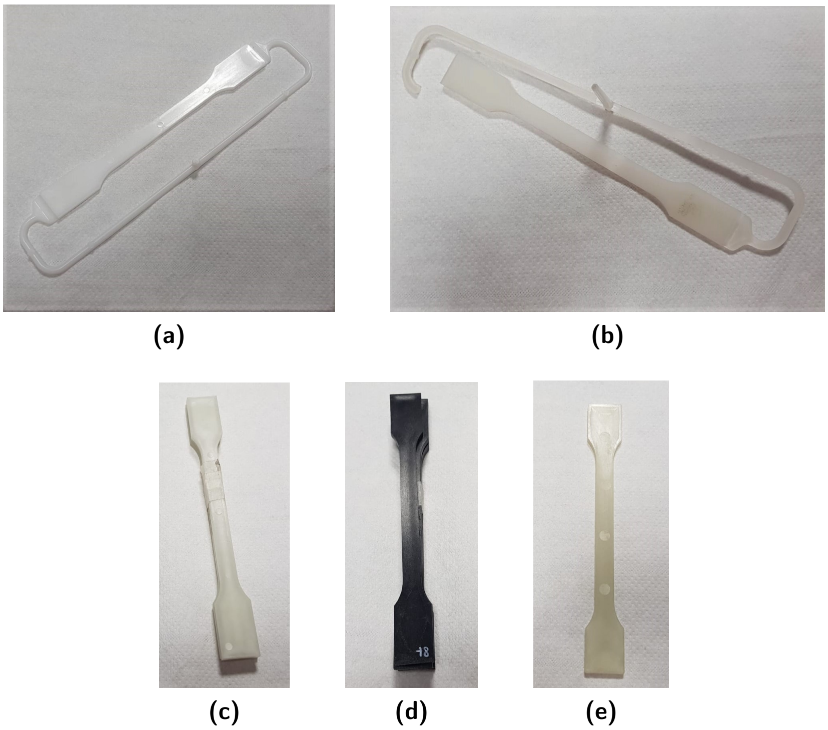

Figure 5: ISO samples: a) POM; b) PA11; c) PP-GF30; d) PP-GF35; e) PA6-GF50.

In Table 2 different types of ISO speciments are classified with their sizes.

Table 2: ISO speciments and characteristics.

Figure	Material	Size (mm)	Description
a	POM	$9.74 \times 3.94 \times 167.06$	white and presence of cold junction
b	PA11	9.86x4.05x168.98	opaque and white
c	PP-GF30	9.88x4.00x172.11	white and stiff
d	PP-GF35	9.80x4.00x171.86	black and stiff
e	PA6-GF50	9.99x3.98x154.71	very stiff

In Table 3 the values of the shrinkage of ISO samples are reported.
From Table 3 it can be noticed that in reinforced polymers the shrinkage is very small, almost negligible. The presence of glass fibers gives to polymers better dimensional stability during cooling.
ASTM speciments are reported in Figure 6.
In Table 4 different types of ASTM speciments are classified with their sizes.

In Table 5 the values of the shrinkage of ASTM samples are reported.
From Table 5 it can be observed that semycristalline polymers (such as PP, HDPE, PA11) have higher values of shrinkage respect to amourphous polymers (such ABS and COC).
In Table 6 weights and densities of ASTM samples are reported. Densities have been taken from .....
For PE/PP blend it has been considered a blend constituted by PE/PP 50%. From Table 6 it can be noticed that, for the same volume, weights of samples are in accordance with values of densities taken from literature.