

Dpt Industrial Engineering

Polymeric Materials Engineering
A.Y. 2018-2019
Prof. Luca Fambri

Group 3 // LAB SESSION N.4

Polymer Processing

Compression Molding and compounding / Injection molding and shrinkage / Filament Analysis

(Date) May 16th 2019
/ Friday May 17th

List of components

Laboratory of Processing (Ground -2)
Department of Industrial Engineering - Povo

Assistant : Francesco Valentini
or Denis Lorenzi
or prof Luca Fambri

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Processing of Plastics

Compression Molding and compounding / Injection molding and shrinkage / Filament Analysis

1) Compression Molding

Carver Press

Stainless Steel plates and Mylar (PET) foils / Frame dimension
Temperature / Pressure / Time of Cycle. Water cooling
PP amount and manual pellets distribution

32.5 g

adhesion

$$P = 8 \text{ ton} = 8 \cdot 10^3 \text{ kg}$$

$$F = 8 \cdot 10^3 \cdot 9.81 = 78480 \text{ N}$$

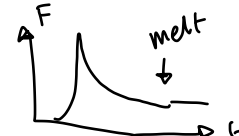
Plate 1: production from pellets (initial weight and final plate size)

→ preparation of dumbbell specimens

ISO 527-1BA

1B) Compounding (Internal Mixer)

piston



$$P = \frac{F}{A} = 5.45 \text{ MPa}$$

144 cm²

Thermo Haake Rheomix 600: temperature, time, rotation blade, PP amount

Final amount of compounded PP

32.05 g

10 min → 50 g/min T = 200

Plate 2: production from compounded PP (initial weight and final plate size)

Same info Plate 1 → preparation of dumbbell specimens

32.05 → 30.50

3 termocoppie

Polymer description (Melt Flow data : from Lab Session 3 or Literature)

2) Injection Molding Sample evaluation

$$9.97 \times 4.07 \times 171.99 \text{ mm}$$

ISO dumbbell specimens : section size 10.0 x 4.0 mm -

Measure the mold cavity : internal mold dimensions length-width-thickness

POM (bi-injected) : length-width-thickness → 9.74 x 3.94 x 167.06,

PA11 (mono-injected) : length-width-thickness → 9.86 x 4.05 x 168.98

PP-GF30 (white) and PP-GF35 black 9.80 x 4.00 x 171.86, 10.72 g

PA6-GF50 (and comment?) 9.99 x 3.98 x 154.71

⇒ Shrinkage evaluation : longitudinal / transversal - thickness

orientation longitudinale

inj con gate
piatto : von
prodotto con
stelo stelo
conque ISO

ASTM dumbbell specimens : section size 12.7 x 3.2 x 165 mm

Various materials : 3 type of recycled ABS (color and year); COC; ~~PP~~

(commercial name-year); HDPE (Eltex yellow); PE/PP blend; PA11; TPU

Dimensions of dumbbell Weight of the sample (Dumbbell+Sprue+Bar)

TABLE (Material / W / length ; width; thickness etc/....)

⇒ Shrinkage evaluation : longitudinal and transversal

⇒ Comparison of total weight and polymer density (assume a blend PE/PP 50%; COC from literature)

value costante, peso → densita'
→ identif.

predizioni
cN/dtex estrapolati

• Sy di
bulk senza
DR

• scala lineare σ

Step: DR effetto?
a freddo

partendo da
MFI diametro
 ~ 1 mm

DR come fattore
multip. sforzo

3) Filament analysis

Evaluate diameter as function of process conditions. Add titer (tex)
Plot average fiber diameter versus collection rate \rightarrow basso

TABLE Calculate the Orientation factor (apparent Draw Ratio in spinning);
 $= (\text{diameter die} / \text{fiber diameter})^2$

Resulting fiber titer : tex and denier

Assuming: PP density of 0.905 g/cc ; stress at yield 25-30 MPa
Stress at break and deformation at break

Calculate load at break and tenacity

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FINAL NOTES Various PP samples have been produced for mechanical characterization in the Lab Session of the Course " Materials Characterization " (prof A Pegoretti)

Summarize the results of processing

Table

Comparison of different processing technique for production of various samples

- i) Compression molding 1 (dumbbell from pellets)
- ii) Compounding in Rheomixer (tangential rate)
- iii) Compression molding 2 (dumbbell from compounded pellets after rheomixing)
- iv) As-spun fibers: rate of collection/rate of extrusion

References

Technical data sheet of PP HiRONlen V15 Nero
Technical data sheet of PP