Processing of Biomer®PHB

Melting behavior

Being highly crystalline and absolutely linear (60-70% crystallinity) Biomer polyesters liquify when heated and freeze when cooled. Crystallization speed is fast between 80°C and 100°C. Below 60°C or above 130°C the speed of crystallization is rather slow. The material then remains amorphous and sticky for hours.

Don't use barrier screws because of the temperature profile!

Consequences

The sharp transition fluid/solid can be used to achieve very fast processing speeds. To obtain this it is best to melt the material right behind the filling zone and to lower its temperature towards the die (see temperature profile on the reverse side). The material then has a viscosity similar to PP of a high MFI, eg. Ducor 110.

Pre-cleaning screw and barrel

As most materials left over in the machine after the last run have high viscosity at 130°C, they will not be displaced by the low viscous PHB. Such materials can be replaced by setting all zones to 180-185°C and purging with a colored batch of a low melting polymer such as PCL (polycaprolactone) or a high MFI PP.

Drying (only thin parts!)

As all polyesters PHB based resins contain bound water (not only surface bound one!). In spite of this drying is recommended only for thin parts (0,1 mm or less). Best results are obtained in dry air dryers: >2 hours at max. 60°C (not higher!).
Please note that the pellets regain the original humidity within 30 minutes if they are removed from the dryer.

Getting the set points:

Crystallization speed depends on many (local) factors. We recommend to find the set points by following these steps:

Start conditions:

- Cooling time 20 seconds (keep fixed till the end of the optimization).
- Temperature profile of 185°C (hopper) to 165°C (die, see temperature profiles below).On large machines start the temperature profile only in zone 2 to not to expose the resins to excess thermal heath.

- Set mold temperature to 45°C.

Optimization:

- Cool barrel in 5°C steps at the tip (and zones in front of tip accordingly, but keep zone 1 at 185°C) till the form no longer is filled. Increase the temperature by 5°C.
- Vary the mold temperature by 5°C up or down so that the melt temperature is cooled to about about 90°C.
    - Reduce cooling time till the article sticks to die. Increase time in 1 – 2 second steps.

Temperatures:

Screw diameter <40 mm numbers in °C					hopper ↓
Grade	Tip	Zone n-1		Zone 1	
P226	145	155	165	180	
P209	140	150	160	180	
P316	140	150	160	175	
P310	140	155	165	188	
Hot runners	150	150			

Screw diameter >40 mm Values in °C						Hopper ↓
Grade	Tip	Zone n-1			Zone 1	
P226	145	155	165	180	60	
P209	140	150	160	180	60	
P316	140	150	160	175	60	
P310	140	155	165	188	60	
Hot runners	150	150	150			

optimal Tool Temperature:

Set tool temperature in such a way that the melt cools to 90°C:

45-55 °C at wall thickness under 1 mm

30-45 °C at wall thickness over 2 mm

Remarks:

- Barrier screws are unsuitable for PHB since pellets are transported into the zones of lower temperatures where they don’t melt.

- The material depolymerizes at high temperatures, therefore
- do not exceed 185°C (be aware of the friction energy induced by backpressure)
- flush after a standstill and restart.
  - Degradation temperature: 195°C (inflammable gases).
  - Molten PHB sticks to the skin.

  - Clean barrel and screw with PP.