PROCESSING

Tecopet® compounds can be processed in all commercial injection molding machinery.

Injection Molding Machine

Selecting the proper design injection molding machine is important to have economic and quality moldings.

As a general rule, capacity of an injection molding machine should have 0.50 – 0.75 tons of clamping force for every square centimeter of projected shot area.

General purpose screw designs with compression ratios between 2.0:1 – 3.5:1, and screw size of 17D to 23D are recommended. Standard nitride screws and barrels are not resistant to the abrasion of fillers, especially glass fibers. However, bi-metallic barrel liners and surface hardened screws show outstanding resistance to wear.

Due to reduced shear general purpose open nozzles that are as short as possible are suggested. The temperature control of the nozzle is very important in order to avoid thermal loss or overheating. In general nozzle diameters should be 3 to 6 mm depending on the size of the part.

It is important to have precise temperature control for processing PET compounds therefore several heating zones of the barrel are necessary.

Cooling system of the feed throat is important to prevent sticking of the granules and to have consistent feed of material to barrel. On the other hand, too low throat temperature will cause condensation, resulting hydrolysis and melt foaming. Temperatures between 50°C – 70°C are suggested.

When molding PET the shot size should be between 25% - 75% of barrel capacity. Shots larger than 75% may generate improper melting, where shots less than 25% will increase the residence time of the material in the machine that can cause degradation, brittleness and discoloration.

Residence time of Tecopet® compounds in the barrel at correct processing temperatures should not exceed 4 minutes.

Molding Conditions

For PET compounds, moisture content should be less than 0.02% before processing. Moisture causes immediate hydrolytic degradation during process which causes molecular weight reduction and thus reduction in resistance. Therefore Tecopet® grades should be dried at 120°C - 140°C for 4 hours.

The recommended pre-drying method is using desiccant driers where drying is independent of atmospheric environment. Controlling the performance of drying in desiccant driers depends on the dew point that indicates the proportion of water in the air. In order to obtain proper drying, values below –20°C for the dew point is suggested.

When using air circulating ovens, the quality of the drying depends on the atmospheric conditions. High relative humidity of air reduces the quality of drying and therefore circulating air ovens are not suggested to pre-dry PET.

Some guide recommendations for processing parameters are presented in Table 1.

The temperature of the melt in injection molding depends on barrel temperature settings, material residence time, screw design and speed. As it is difficult to estimate the effect of each parameter on melt temperature, it is suggested to be measured periodically with a pyrometer from the purged molten polymer. Tecopet® compounds should always be molded in a temperature-controlled mold. Uniform mold temperature within the cavity is very important to have good quality parts.

Maximum quality with minimized post-shrinkage is obtained by sufficient crystallinity. Therefore, for Tecopet® compounds minimum 90°C of mold temperature is necessary for optimum crystallization, surface aspect and dimensional stability. Mold temperatures in the range of 60 - 80°C will result in

	Grade	Feed Throat Temperature (°C)	Processing Temperature (°C)	Mold Temperature (°C)	Hold Pressure (MPa)
Tecopet® PT (PET)	Impact Modified	50-70	260 – 280	90 - 140	60 - 100
	Reinforced	50-70	270 – 290	90 - 140	60 - 100
	Flame Retardant	50-70	260 – 280	90 - 140	60 - 100

Table 1. Recommended processing parameters for Tecopet®

poor surface, lower shrinkage and warpage, however if the use temperature of the part exceeds 70°C dimensional change occurs with post-shrinkage.

For PET the peripheral screw speed should be maximum 200 mm/s in order to minimize fiber breakage, material degradation and discoloring.

Back pressure should be as low as possible to protect material properties.

The actual required injection pressure depends on many variables, such as melt and mold temperatures, part thickness and flow length. It is only necessary to have enough injection pressure to fill the cavity of the mold.

Due to crystalline nature of PET, it is required to use fast injection rates especially in reinforced grades. Slow injection rates can be used at the start-up of the injection to prevent jetting and burning of material.

The mold shrinkage of PET mostly depends on the holding pressure and the holding time. During this stage material melt is continuously pushed into the part cavity which compensates the shrinkage of the part during solidification. The level of holding pressures and time that depend mainly on the part thickness and runner geometry are generally 1:2 to 2:3 of the maximum injection pressure.

Effects of main processing parameters on material properties are shown in Table 2.

Processing Parameter	Weld Line Strength	Surface Quality	Cycle Time	Shrinkage	Sink Mark
Melt Temperature ↗	↗	↗	↗		
Mold Temperature ↗	↗	↗	↗	↗	
Hold Pressure ↗				↙	↙
Injection Speed ↗	↗	↗			

Table 2. Effect of processing parameters on material properties

Recycling

Regrind levels up to 25% can be reused depending on the application and requirements. However for flame retardant grades maximum 10% addition is recommended. Regrinds should be free of contamination, should not be thermally degradated and must be dried prior to reuse.