Production interruption or stop
Arnite T, without flame retardants, is a relatively stable material that does not emit noxious products, even at prolonged residence times or elevated temperatures. PBT melt has a typical sweet, but fully harmless odor. An effective exhaust system at the machine is always advisable and a must for flame retardant materials. During short production stops of about ¼ hour, the machine can be left at actual settings, but purging at restart is recommended.

For longer production interruptions or stops, it is necessary to lower the cylinder settings. To facilitate the subsequent restart, it is recommended to purge the cylinder with PP or HDPE or a cleaning compound before decreasing the temperatures.

These longer stops may lead to accumulated degraded material in dead spots where hot runner tools are being used. To prevent or reduce this problem, a quick lowering of hot runner settings is imperative. Purging with above media can be done, but should be restricted only to worst case, since they will be difficult to remove again from the hot runner once production is resumed. As before, the hot runner should be switched on just prior to production restart.

Mold shrinkage behavior
Shrinkage behavior of Arnite polyesters is related to reinforcement content of the material, but also directly related to mold temperature and processing conditions. For the final part, geometry, gating and orientation of glass fibers play an important role. As a consequence, it is very hard to provide exact shrinkage values. Guide values for shrinkage are given in the product data sheets

Safety
For all safety aspects we refer to our Material Safety Data Sheets, which are available upon request from our Custumer Service Centre. Info and contact addresses can be found on our website: www.dsmep.com

Contact
At DSM Engineering Plastics, our customers are key. Focusing on the advantages for the end user is essential. If the end user is satisfied, so are our customers. And so are we. We do not settle for ordinary solutions. Instead, we strive to find Living Solutions™, working together with customers in a dedicated, resourceful and reliable way.

If you share our values and are looking for your own Living Solutions™, please get in touch.

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Arnite® T (PBT and blends)

Recommendations for injection molding

In general, Arnite polyesters are easy to process. Nevertheless, specific recommendations can be given to obtain optimum results in the injection molding of Arnite resins. Below are recommendations for processing Arnite T PBT resins as well as PBT/PET and PBT/PC blends. Similar recommendations are available for Arnite A and Arnite D resins, i.e. PET resins.

Drying and handling
If small amounts of water are present, PBT resins are inherently sensitive to degradation in the melt. This degradation process, which results in a lowering of the molecular weight (breakdown of the polymer chain), is known as hydrolysis.

To prevent hydrolysis, the moisture content of the granules should be maintained at an absolute minimum during processing.

In general, to obtain good parts of constant quality during production, PBT grades should be dried to a level below 0,020 wt%. The same holds for PBT/PET blends and for PBT/PC blends. For applications that require ultimate mechanical performance, it is recommended to dry to levels in the range 0,010 to 0,015 wt%.

Reaching the desired moisture level typically requires drying at 100-120°C during 3-6 hours. Higher temperature settings should be avoided to prevent material discoloration. A dehumidifying hopper drier or stand-alone drier with regenerating dessicants should be used, attaining dew points in -20°C to -30°C range.

Warm, dried granules should be prevented from cooling down and coming into contact with ambient air before entering the cylinder. Pellets should be fed with hot dried air straight from the hopper drier into the cylinder or via a closed loop system using hot dried air, from the stand-alone drier into the cylinder.
When using a colorant master batch, this should also be dried.

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Temperature settings

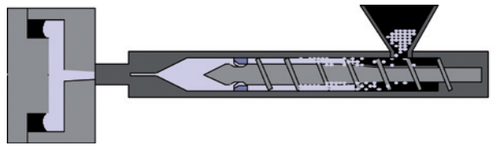
Mold
Arnite T grades should be processed in uniformly heated tools with temperature settings of 60°C to 100°C (actual measured surface temperature). For unfilled PBT, use the lower end of this temperature range.These temperatures are necessary to produce well crystallized PBT parts. A proper measuring device or built-in sensor to control the temperature is highly recommended.

In order to ensure a uniform temperature distribution in the cavities, multiple heaters are recommended for bigger or more complex molds, e.g. with slides, since parallel cooling is preferable to inline cooling. The use of multiple heaters also makes it possible to maintain a fixed temperature differential between mold halves to facilitate mold release.

To maintain a uniform temperature distribution in the tool and thus reduce warpage, we also recommend the use of a cooling channel with a diameter of at least 10 mm in addition to a symmetrical configuration around the cavity at 1 to 1,5 times their diameter distance from the cavity surface.
To ensure a safe operation, use qualified equipment, with proper temperature controls, using specified tubing and fixtures.
To reduce heat flow from the mold to the machine platen, mold isolation plaques may be used.

Cylinder temperature settings
Because of the high melting point of PBT resins, around 225°C, materials must be processed well above this temperature, typically in 240°C to 260°C range.
As a standard, a flat or a slightly increasing temperature profile should be applied from the feeding section to the nozzle of the cylinder. These are general indications that may require specific adaptation, also in relation to product or gate design, (hot) runner layout, material flow as function of actual achieved moisture content, filler content, etcetera. In general, long cylinder residence time should be avoided, i.e., from 6 to 10 min, in combination with the highest cylinder settings.

Temperature setting range for different Arnite T types:



	Mold	Melt	Nozzle	Front	Center	Rear
Non-reinforced, non-flame retarded Arnite T	60 - 100°C	240 - 270°C	240 - 260°C	240 - 260°C	230 - 250°C	230 - 240°C
Non-reinforced, flame retarded Arnite T	60 - 100°C	240 - 250°C	240 - 250°C	240 - 245°C	235 - 240°C	230 - 235°C
Reinforced, non-flame retarded Arnite T	60 - 100°C	240 - 270°C	240 - 260°C	240 - 260°C	230 - 250°C	230 - 240°C
Reinforced, flame retarded Arnite T	60 - 100°C	240 - 260°C	240 - 260°C	240 - 255°C	235 - 250°C	230 - 240°C
Reinforced, non-flame retarded Arnite T PBT/PET blends	60 - 100°C	260 - 270°C	260 - 270°C	260 - 270°C	250 - 265°C	250 - 260°C
Reinforced, non-flame retarded respectively flame retarded Arnite T PBT/ PC blends	60 - 100°C	260 - 270°C	260 - 270°C	260 - 270°C	250 - 265°C	240 - 250°C

Molding equipment

Arnite T can be processed on conventional injection molding machines. A low compression 3 zone screw is recommended with the following characteristics:

- L/D ratio in 17 to 23 range
- A compression ratio in 1: 2 to 2,5 range
- A check valve on the screw tip

In certain specific cases an alternative screw design, special treatment or mixing devices could help to optimize melt homogeneity and reduce screw wear. A barrier screw can be helpful to prevent unmelts in unfilled PBT.
The cylinder diameter should be such that the product weight is within a 40-70% range of maximum shot capacity. We recommend the use of a short nozzle and a wide bore, over 3mm at least, including a well functioning heater band, as this will minimize frictional heating and pressure losses. Arnite T may be processed using hot runners, provided they meet certain specific demands like open nozzle, full external heating, good temperature control and wide, unrestricted flow channels. For best results, use the system in combination with a cold runner to the part. We will be happy to advise you in more detail upon request.

Molding parameters

Injection rate
The preferred injection rate should be high to fill the mold quickly so as to obtain best surface quality and maximum fiber orientation. A high injection rate also helps to avoid poor weld line quality and premature freezing of the gate during filling.
In case of visible (diesel) defects in products, the injection rate should be reduced, provided that the defects are not caused by insufficient venting. A moderate filling speed can best be achieved by using a stepped injection profile.

Holding pressure and time
Holding pressure is preferably 40 to 60% lower than injection pressure. This compensates for volumetric shrinkage of solidifying and crystallizing melt. The holding pressure must be sufficiently high to prevent sinks in the thickest section of the product, but on the other hand, it should not be set so high that the product starts to flash or residual stresses are built-in. Holding time should be prolonged proportionally as wall thicknesses and gate sizes increase. Time should be maintained until the gate freezes and constant product weight is achieved. A small buffer should be maintained to ensure the full effect of follow-up pressure.

Plasticizing screw speed and back pressure
Depending on screw diameter, speed should be set in 50 to 100 rpm range, whilst maintaining a 5-10 bar backpressure. Plasticizing time should fall well within limits set by the actual cooling time.After plasticizing, some screw retraction should be employed to prevent melt leakage from the nozzle.

Regrind
In general, to prevent loss of mechanical properties as a consequence of fiber length damaging, regrind quantity should be restricted to 25%. This also applies to flame retardant grades, so as to comply with UL regulations. For best results, choose in-line regrinding and feed directly back into the dried air circuit. When only offline regrinding is possible, a full drying process should be applied.

Production start
Before starting production, it is important to clean the cylinder properly. This may mean that Arnite T initially has to be processed at an elevated temperature, only for a short period until the remains of e.g. a polymer from high heat resin family with even higher melting temperature has been completely purged from the cylinder.
In most cases, lower melting polymers do degrade at PBT settings and need to be well flushed out, eventually by the use of PP or HDPE or a cleaning compound before actual startup, since contaminations may lead to delamination, black specs or even degradation, resulting in reduced mechanical strength of the final products. In case of use of hot runner tools, these should be switched on when all other preparations have been completed, just prior to start-up.