Envalior
Imagine the Future

Arnitel® HT

TPC-ES

Print date: 2024-03-06

Grade coding
This recommendation has been created for the following Arnitel® HT blow molding grade(s):
Arnitel® HT8027
Arnitel® HT7719

MATERIAL HANDLING

Storage
In order to prevent moisture pick up and contamination, supplied packaging should be kept closed and undamaged. For the same reason, partial bags should be sealed before re-storage.
Allow the material that has been stored elsewhere to adapt to the temperature in the processing room while keeping the bag closed.

Packaging
Arnitel® blow molding grades are supplied in airtight, moisture-proof packaging.

Moisture content as delivered
Arnitel® blow molding grades are packaged at a moisture level ≤ 0.05 w%.

Conditioning before molding
To prevent moisture condensing on granules, bring cold granules up to ambient temperature in the extrusion shop while keeping the packaging closed.

Moisture content before extrusion
It is advised to dry the material prior to production (see drying section below). Furthermore, drying is required in case the material is exposed to moisture before blow molding (package damage, open for longer period of time (>2h) or pneumatic transport with normal/wet air). Arnitel® HT takes up moisture rather fast when it is exposed to ambient conditions. Typical moisture content values for a range of relative humidity are shown in figure 1. Moisture content can be checked by water evaporation methods or manometric methods (ISO 15512).

Processing Guideline Arnitel® blow molding grades

Arnitel® HT

Print date: 2024-03-06

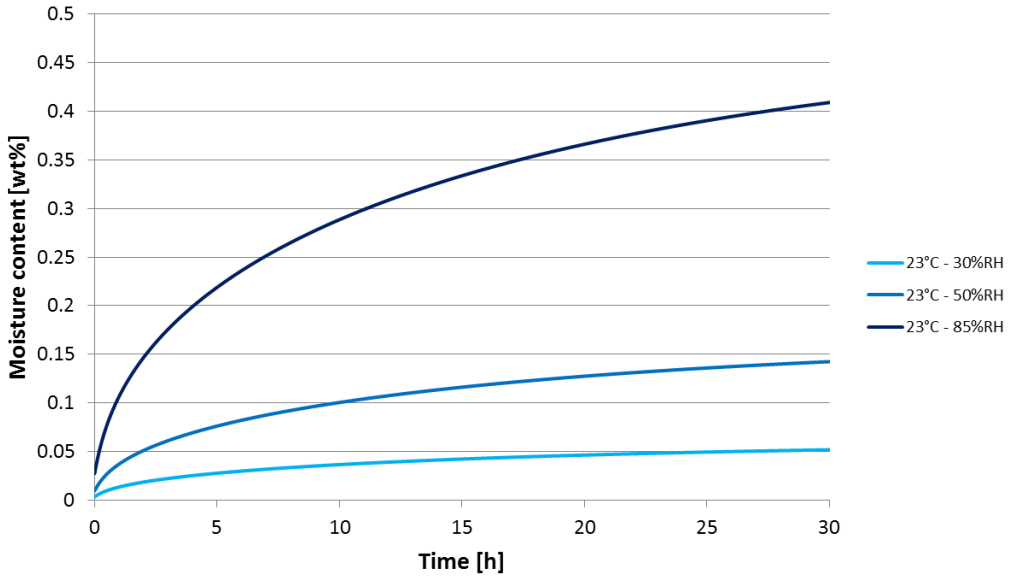


Figure 1. Moisture content as function of exposure time to ambient condition at 30-50-85 %RH. The maximum moisture content for optimal material processing is 200 ppm.

Drying

Arnitel® HT grades are hygroscopic and absorb moisture from the air relatively quickly. Preferred driers are de-humidified driers with dew points maintained between -30 and -40°C / -22 and -40°F. Vacuum driers with N2 purge can also be used. Hot air ovens or hopper driers are not suitable for pre-drying Arnitel® HT grades; the use of such driers may result in non-optimum performance. Table 1 enlists the preferred drying conditions, depending on moisture content, for Arnitel® HT. Be aware that granules typically require a heat-up time of 1 h during the first stage of drying.

Drying conditions

Moisture content	Time*	Temperature	
[%]	[h]	[°C]	*[°F]*
Arnitel® HT < 0.05 and as delivered	4 – 8	120	*248*
Arnitel® HT (open bag) 0.05 – 0.2	16	120	*248*
Arnitel® HT regrind	16	120	*248*

Arnitel® HT

Print date: 2024-03-06

Moisture content: influence on melt viscosity and sagging performance

Arnitel® HT blow molding grades should be handled in the same way as other TPC materials used in (extrusion) blow molding. Especially drying of the material prior to processing is very important. Having too high moisture content in the material will give rise to a reduction of the melt viscosity, depicted in figure 2. Because of the reduced melt viscosity a decrease of the parison stability is expected, see figure 3. Additionally, processing Arnitel HT at elevated moisture content might result in loss of molecular weight and accordingly a drop in mechanical performance might be expected.

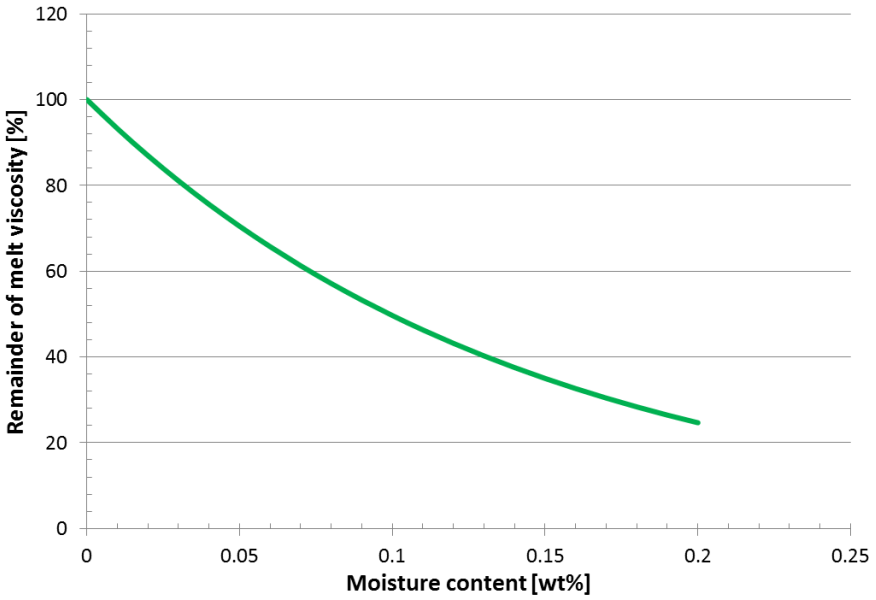


Figure 2. Loss in melt viscosity in relation to moisture content of Arnitel at 230 °C. It is advised to process Arnitel at moisture content values ≤ 200 ppm. For instance, processing at 0.1 wt% moisture content will decrease melt viscosity by 50% of its initial value.

Arnitel® HT

Print date: 2024-03-06

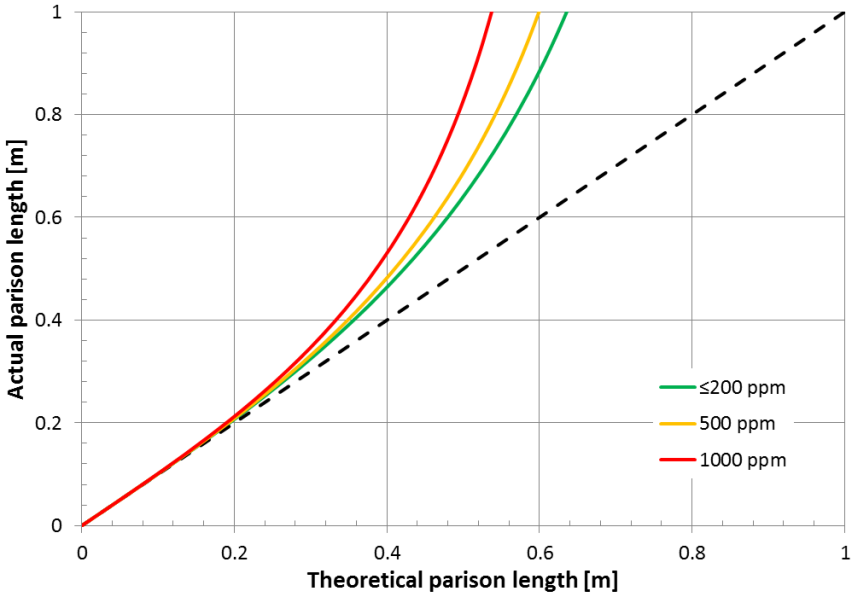


Figure 3. Loss of sagging performance in relation to moisture content of Arnitel processed at 230°C. The dashed line shows the parison extrusion without sagging.

Regrind

Regrind can be used taking into account that this regrind must be clean, low dust content, not thermally degraded, dry and of the same shape and size as the virgin material. Thermal degradation will occur to some extent. However, thermal degradation is expected to be minimal if the advised machine settings on screw speed (melt residence time) and temperature are used. Be aware that strong differences between regrind versus virgin granules (with respect to shape and size) will give problems at the screw feeding section. The maximum amount of regrind to be used is 30 wt%. Recommended feed of regrind material to the blow molding process is via a closed loop. If regrind material is used, additional drying should be performed in order to keep the moisture content within the required specification of ≤ 200 ppm. If the regrind material consists of similar granule dimensions as the virgin material, the drying conditions of virgin material also hold for regrind material. Bigger and more irregular granules require longer drying times.

Regrind behavior during processing might differ from virgin material since small differences in melt viscosity and die swell can occur. It is advised to run production at a fixed % regrind to allow the process to reach a steady situation. Changes to the % regrind might need other machine settings and take time to reach a new equilibrium.

Processing Guideline Arnitel® blow molding grades

Arnitel® HT

Print date: 2024-03-06

MACHINERY

Arnitel® HT grades can be processed on general blow molding machines. Conventional single screw extruders can be used for plasticizing of Arnitel® HT blow molding grades. Barrels with axial grooves and cooling of the intake zone as well as barrier screws are used to build up some pressure in the accumulator. This requires adaptation of the temperature settings, if there are any doubts; please consult a DSM specialist in such cases.

Screw geometry

A good melt quality can be obtained by a standard 3-zone screw with a minimal length of 24 L/D and a volumetric compression ratio of approximately 2.8 – 3.0. However, a well-designed barrier screw achieves the best result in terms of melt quality and absence of un-molten polymer. One can opt for an additional mixing element at the end of the metering section to enforce homogeneous temperature distribution of the melt. Please contact a DSM representative for detailed advice on screw design.

Steel type

Abrasive resistant tool steels which are normally used for glass and/or mineral reinforced materials are also to be used for Arnitel® HT polymers in tools, nozzles and screws.

TEMPERATURE SETTINGS

Mold temperature

Arnitel® can be used with a wide range of tool temperatures (15 – 60°C / 59 - 140°F). When wall thickness distribution is critical, it is recommended to apply a tooling temperature at the higher side (60°C / 140°F).
In case the molded part tends to stick to the mold, a lower mold temperature can contribute to a better part release.

Barrel temperature

The given temperature settings are general for Arnitel. Optimal settings are governed by barrel size and residence time. Additionally, a higher hardness and higher melting point of the Arnitel, requires a barrel temperature at the higher side.

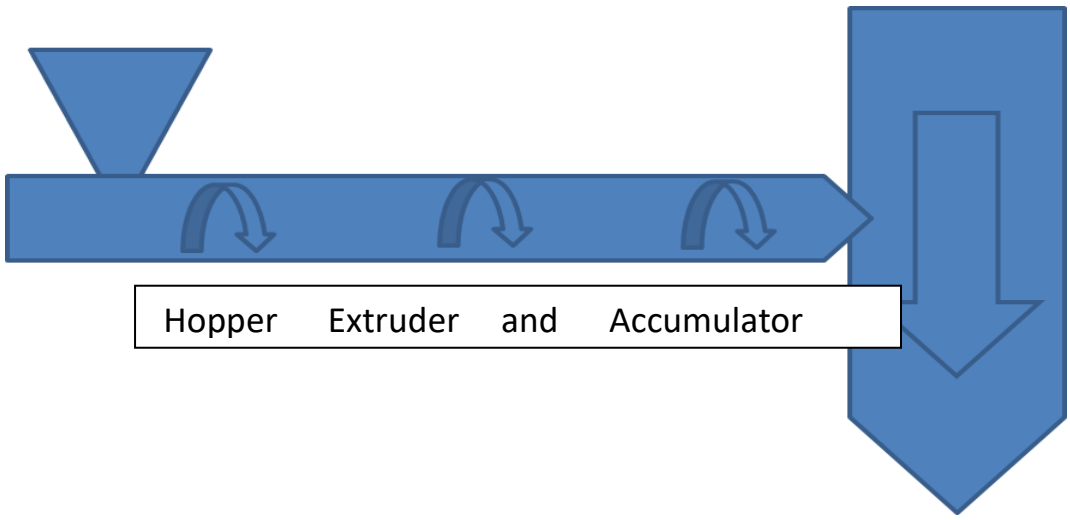
For both Arnitel® HT grades it is advised to have a grooved entrance and a slightly higher feed temperature. If higher machine power is observed, higher temperature settings at the inlet and compression zone can be used. The preferred temperature settings along the extruder have a decreasing or flat profile.

Processing Guideline Arnitel® blow molding grades

Arnitel® HT

Print date: 2024-03-06

	Extrusion Zones			Accumulator	Resin	Mold
	Feed	Compression	Metering	Storage	Melt	Temperature
°C	210 – 240	210 – 230	200 – 230	220 – 220		
°F	*410 - 464*	*410 – 446*	*392 - 446*	*428 - 4*		



Melt temperature

A melt temperature of 225±5°C (437±11°F) is preferred to achieve a good homogenous melt and the optimum viscosity for parison stability during blow molding.

Lower melt temperatures might induce improper surface quality. Higher melt temperatures will decrease parison stability.

It is advised to frequently measure the melt temperature by inserting a thermocouple into the melt (handheld) to avoid that only the temperature of the extruder will be measured via the installed device. This temperature is strongly influenced by the set barrel temperature.

Be aware that optimizing parison stability might conflict with other quality parameters during blow molding. In all cases an optimum balance between all parameters for the specific set-up should be aimed at. Contact our AD/TS support desk whenever help is needed.

Arnitel® HT

Print date: 2024-03-06

Die swell

The typical die swell values of both Arnitel grades is between 2.0 and 2.3. Keep in mind that die swell values are strongly dependent on following parameters:

- melt viscosity of material
- melt temperature
- injection speed
- die-pin geometry
- gap height

The above die swell values should act as guideline in selecting the appropriate die-pin diameter in advance of fine-tuning the blow molding process.

GENERAL PROCESSING SETTINGS

Screw rotation speed

To realize a good and homogeneous melt, it is advised to set a screw rotation speed resulting in a plasticizing time that is just within the cooling time. Please realize that a too high rotation speed can generate slippage, inhomogeneous melt and too high melt temperature resulting in unbalanced parison stability. The lowest screw speed is limited by the melt residence time; being at maximum 4 minutes.

Injection speed

Appropriate injection speeds are selected based on required part dimension (length) and observed parison behavior. Typically moderate to high injection speeds are required in order to prevent premature crystallization in the mold during injection phase and to obtain a good wall thickness distribution. At high injection speeds surface quality might become worse. Be aware that melt compressibility reduces the effective shot volume during the injection stage.

Blow up pressure

To get an optimal part it is preferred to blow up quick, with minimal 8 bar of air pressure, injected via a big hole. A pressure of 10 bar improves the copy of the mold print/profiles onto the part even more.

Cooling Time

Actual cooling time will depend on part geometry and dimensional quality requirements.

Ejection of the part

If an appropriate cooling time is used to allow for adequate solidification of the product no specific issues are expected during ejection of the part.

Arnitel® HT

Print date: 2024-03-06

RESIDENCE TIME

Melt residence time (MRT) for Arnitel in general should not exceed 4 minutes with preferably at least 50% of the maximal shot volume used. A formula to estimate this MRT is described below. Optimal melt residence time for Arnitel is ≤ 3 minutes.

$$MRT = V_{melt,total}\frac{\rho_{melt}}{m_{shot}}t_{cycle}$$

$$\text{with } V_{melt,total} = V_{metering} + V_{accumulator} + V_{die}$$

$$\text{with } V_{metering} = \pi D_{screw} h_{metering} L_{metering}$$

Term	Description	Unit	Value
MRT	Melt Residence Time	s	
D	Screw Diameter	cm	
ρ	Melt Density	g/cm^3	1.100
M	Shot Weight	g	
t	Cycle Time	S	
$H_{metering}$	Flight height metering section	cm	
$L_{metering}$	Length metering section	cm	

Remark:
According to the head design, most of the heads work according the principle first in first out, but cushion should remain as small as possible

SAFETY

For the safety properties of the material, we refer to our MSDS which can be ordered at our sales offices. During practical operation we advise to wear personal safety protections for hand/eye/body.

STARTUP/SHUT DOWN/CLEANING

Production has to be started and stopped with a clean machine. Cleaning can be done with material itself, applicable cleaning agents or HDPE (high viscosity).

PRODUCTION BREAKS

During production breaks longer than a few minutes, we advise purging the accumulator head prior to production restart. After longer production breaks the temperature of the barrel and the accumulator should be reduced to a level far enough below the melting point of the compound in order to stop decomposition of the compound. Due to longer hold up times, the material will become lower viscous and material could start drooling from the nozzle. When the nozzle, or even the screw is blocked, be aware that under these conditions a sudden outburst of molten material can take place. Always wear personal safety protections for hand/eye/body..

TROUBLESHOOTING

Contact Envalior in case more information is required from the aspect of material or processing.