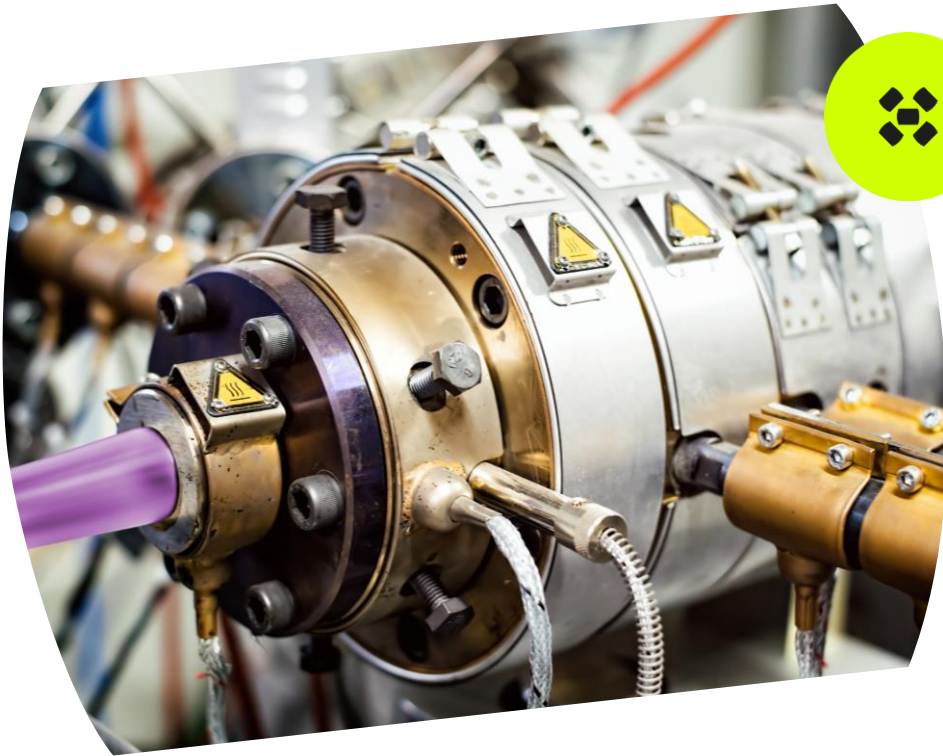




MOCOM

❖ Alfater XL[®] Processing Guide Extrusion

Alfater XL[®] is a thermoplastic vulcanizate elastomer (TPV) based on PP and cross-linked EPDM.

Especially the Alfater XL[®] E 2GP series is optimized for extrusion processes such as profile extrusion or extrusion blow molding. Other Alfater XL[®] series must be individually tested for suitability in extrusion.

Processing of TPV is generally different from conventional thermoplastics. The following processing guide aims to provide a first support, especially for customers with less experience in TPV processing.

Pre-drying

Alfater XL[®] is basically non-hygroscopic. However, pre-drying for 2 - 4 hours at 70 - 80 °C in dry-air (desiccant) dryers is recommended to ensure a stable extrusion process and good surface quality of the extruded parts. Open bags should not be stored over a long period of time.

Flowability

Harder Alfater XL[®] grades have basically higher viscosity than softer grades. Due to the cross-linked EPDM phase, the viscosity or flow behavior of Alfater XL[®] responds much more sensitively to shear than to temperature changes (Figure 1 and Figure 2 of the following page). In general, Alfater XL[®] E 2GP grades have a higher viscosity and melt strength level than Alfater XL[®] series, which are primarily intended for injection molding. For good flowability, homogeneity of the melt and good extrudate quality, high shear input during extrusion should be ensured. Thus, appropriate extrusion parameters and machine technology should be selected.

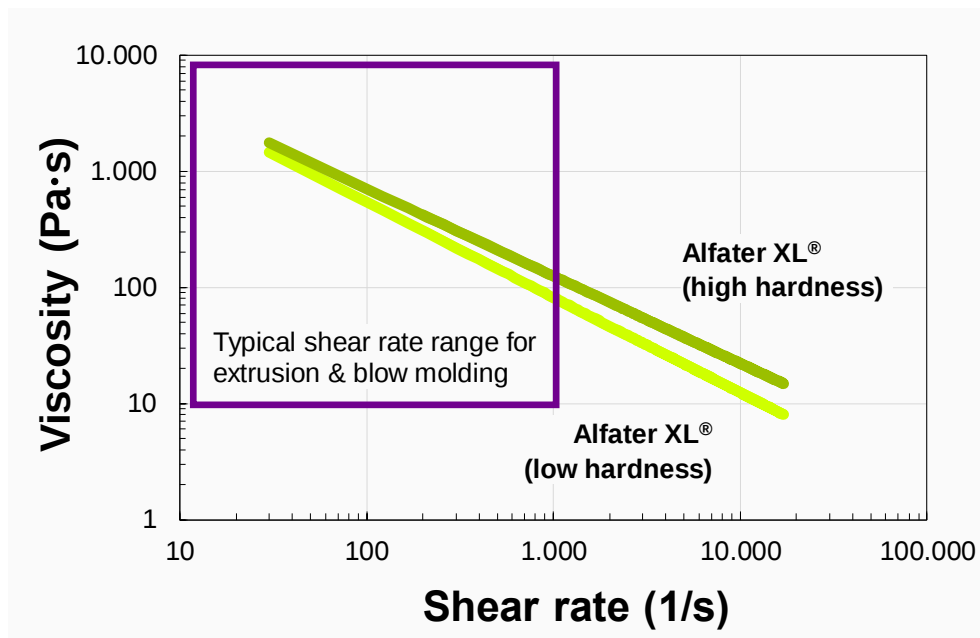


Figure 1: Influence of shearing on the flow behavior (viscosity) of Alfater XL® melt.

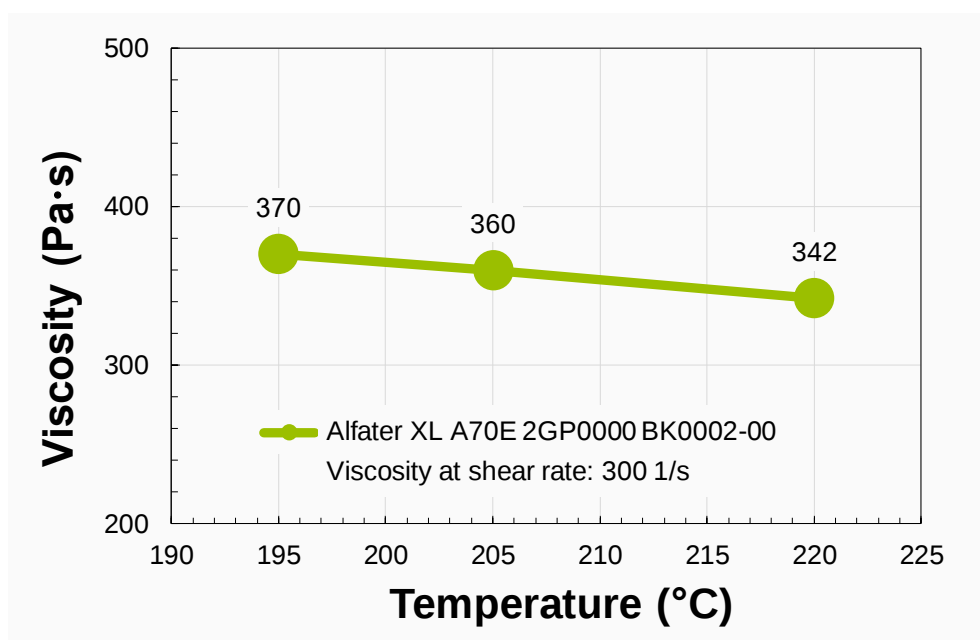


Figure 2: Influence of temperature on the flow behavior (viscosity) of Alfater XL® melt.

Machinery and screw design

Single-screw extruders with three-zone polyolefin screws are recommended for the extrusion of Alfater XL® grades. Special degassing extruders or screws are generally less suitable, as they can reduce throughput and throughput stability. The screw length L should range between $20D$ to $30D$. Very short screws ($L < 20D$) should be avoided. A recommendation for a possible layout of the three-zone polyolefin screw is shown in Figure 3 on the following page and could be as follows:

The feeding section should be rather short (approx. 25 % of the screw length) and designed with deeper flights to achieve efficient transportation and compaction of the material. The melting or transition zone should also be around 25 % of the screw length. The remaining 50 % of the screw length should cover the metering zone to ensure sufficient shearing, homogenization and mixing performance.

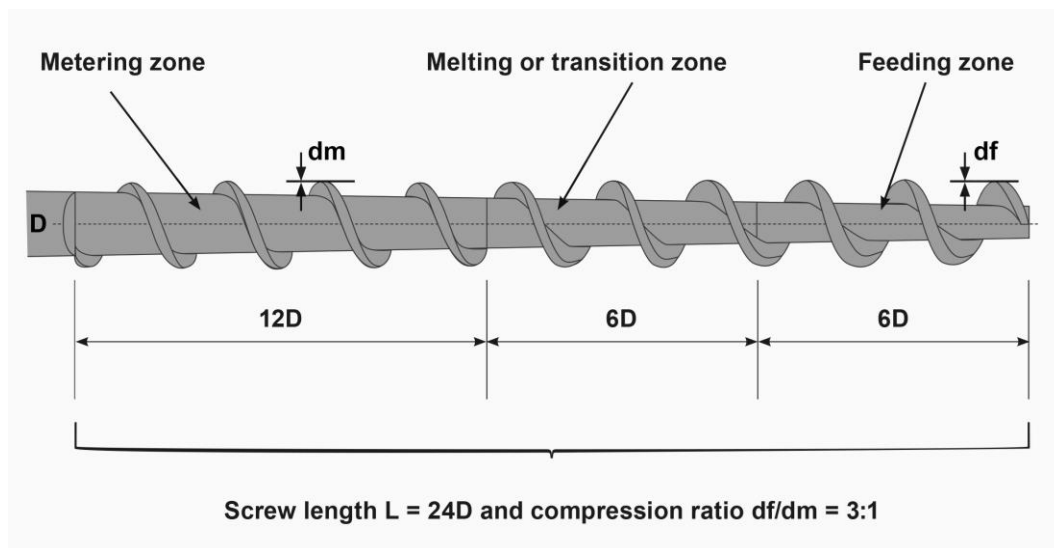


Figure 3: Example for a suitable screw design for extrusion of Alfater XL® (df = feeding depth; dm = metering depth).

The compression ratio df/dm of the screw should be 2.5:1 to 3.5:1 (maximum 4:1). Very short or low-shear screws, such as those used for PVC processing, are not recommended. Special mixing and shear elements in the metering zone, e.g., barrier element, Maddock or Egan mixing element, can additionally improve the mixing effect and homogenization of the Alfater XL® melt. Furthermore, a breaker plate with a mesh screen pack at the screw tip can further improve the melt homogeneity. Screen packs should be designed towards the die from fine to coarse or as sandwich coarse / fine / coarse. A coarse screen should always be placed towards the die in order to support the finer screens. Typical mesh sizes for recommended screen packs are in the range of ca. 170 - 840 μm .

Grooved feeding zones will improve axial solid conveying and melting capacity and can also be used for Alfater XL®. However, proper temperature control or cooling of the grooved feeding section is recommended to avoid bridging.

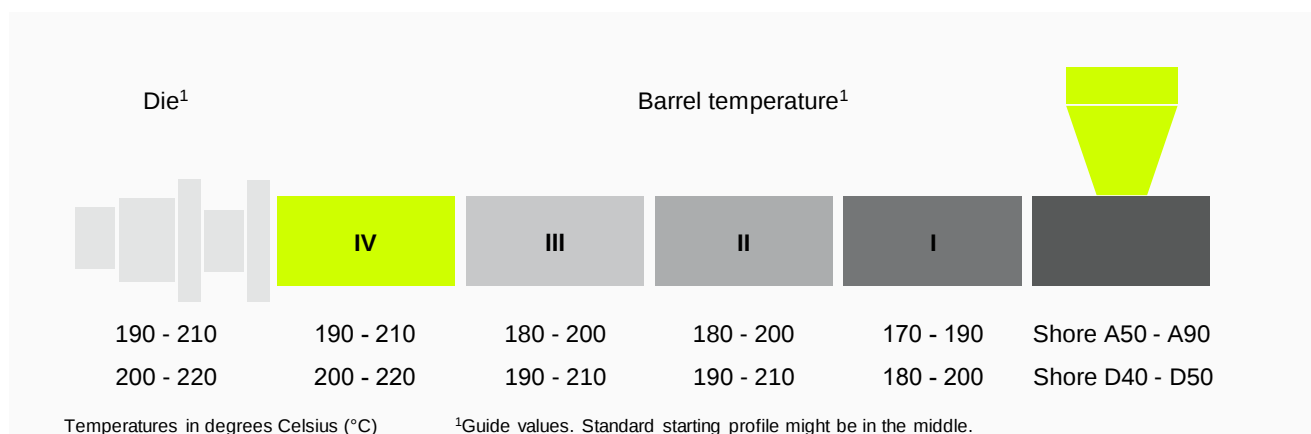
The use of a melt pump can be useful in cases of high requirements on process stability and extrudate quality (e.g., narrow production or dimensional tolerances of the extrudate).

Temperature profile

A gradually increasing temperature profile is recommended. The temperature profile below is a guideline and a starting point for process optimization.

Temperature adjustments may be necessary depending on the extrusion process applied, the extrudate design, and the Alfater XL® grade used. Higher temperatures are recommended for the harder grades whereas softer grades can be processed at somewhat lower temperatures. Proper cooling is necessary when a grooved feeding section is used to avoid bridging during feeding the material.

Optimal mass temperature of the Alfater XL® melt should range from 200 - 230 °C. Too low mass temperatures can cause extrusion problems such as poor surface quality or inhomogeneity. Too high mass temperatures can also lead to extrusion problems such as low melt stability, dimensional instabilities, material degradation or evaporation of additives. Therefore, it is recommended to avoid mass temperatures of Alfater XL® significantly higher than 230 °C, especially for long residence times in the extruder.



Screw speed

The screw speed should rather be in the lower to medium range at about 25 - 80 min⁻¹. Too low screw speed can lead to insufficient melting and mixing quality as well as inadequate homogenization of the Alfater XL®. Very high screw speed results in good mixing but can cause quality issues such as excessive shear heating or mechanical degradation of the melt. For good melt homogeneity it is preferred to use a sufficiently long extruder with moderate to medium screw speed instead of very short extruders with very high screw speed.

Cleaning

It is recommended to clean the machine before and after processing of Alfater XL®. PP or PE with a low melt flow rate (e.g., MFR < 5 g/10min) should be used for purging. It is important to remove all PVC and acetal products (e.g., POM) from the machine before processing Alfater XL®. If necessary, the machine has to be cleaned mechanically.

Use of regrind

In principle, production waste from Alfater XL® can be easily recycled and can be used as regrind in a new production in the sense of zero-waste production. The maximum amount of regrind that can be added depends on many factors, e.g., the extrudate design and application. Therefore, the optimal dosage should be defined individually for each process and each part. As a general rule, we would recommend to limit the regrind amount to 20 %. It is essential that the regrind is clean and free from any impurities. Grinding or regranulation of the scrap to a particle size comparable to the granule size of the virgin material is recommended. This can minimize separation problems between the regrind and the virgin material. Pre-drying of the recycled material is also recommended. Pre-drying conditions are similar to prime quality, 2 - 4 hours at 70 - 80 °C in a dry-air (desiccant) dryer.

Coloring

Natural-colored Alfater XL® grades can be easily colored. However, the best choice would be a colored Alfater XL® compound as this ensures the highest color consistency and batch-to-batch repeatability. For requests on a colored Alfater XL®, please contact the Technical Service Center of MOCOM Compounds GmbH & Co. KG or your contact person at our distribution partners.

As an alternative to a directly colored TPV compound, PP-based color masterbatches can also be used. They usually have good compatibility with the Alfater XL®. When using a color masterbatch, it is important to ensure that its flowability is suitable for use in extrusion. Typical feeding level of such a batch is 1 - 5 %. However, the optimal dosage can vary depending on the extruded product or application. It is therefore highly recommended to discuss the best feeding level either with the color masterbatch producer or with your local technical contact at MOCOM or your responsible distribution partner.

Sufficient mixing of the Alfater XL® melt with the color masterbatch is necessary to achieve high quality colored products. Mixing can be improved using appropriate extrusion parameters such as screw filling level or increased back pressure level. In addition, proper mixing elements, e.g., mixing head and / or mesh screen packs at the screw tip further improves the dispersion of the color masterbatch.

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