

Akulon[®]

Processing of Akulon[®] film grades

Material handling

Akulon film grades are supplied dry and ready-to-process. Material taken from original containers will have a moisture content <0.07%. This should also be the value once the material has been re-dried. During processing, the inner liner of (large) containers has to be closed tightly. If the material is transported using pneumatic suction conveyors, the liner should be secured tightly around the suction pipe to limit moisture absorption from ambient air. Material from opened or damaged containers, as well as recycled waste such as edge trim, must be dried in a dehumidified hopper dryer at approximately 75°C before processing. The dryer should be a regenerative, desiccant-bed type with an exit air dew point monitor. Recommended dewpoint is -25 to -40°C. Experience has shown that a drying time of 8 to 10 hours will usually be enough to give an acceptable moisture level. Avoid drying temperatures above 80°C because of possible oxidative damage (for example, yellowing). Compacted edge trim should be dried before reprocessing. Possible defects from material containing too much moisture include holes, bubbles, fluctuations in film thickness, foaming and hydrolytic degradation.

Table 1 shows standard temperature settings. However, in many cases, a reversed temperature profile may be favorable. For instance, from hopper to die starting at 275 - 265 - 255 - 245 - 235°C. Screen, adapter and die can be set at 240°C. This profile puts the energy exactly where it is needed: in the feeding zone where the polymer has to melt; the remaining part of the machine is needed to homogenize the melt and feed it into the die. In blown film, this setting contributes to bubble stability.

Cast film extrusion

Flat (chill-roll or cast) film is primarily extruded from Akulon F132-E1 and F136-E2 (nucleated grades). In practice, the gauge varies from 18 to 150 µm and the film die may be as wide as 3 m. The die gap should be 0.5 to 1.2 mm; the rate of haul off 25 to 150 m/min. Film quality is determined by sticking to tolerances, dimensional stability, clarity, and thermoformability. These properties depend on the Akulon resin selected, and the thermal and rheological history of the material in the extruder and downstream equipment including the chill-roll. If the melt is cooled too abruptly (i.e. if the chill-roll temperature is too low) the film may post-crystallize, and therefore shrink and corrugate. The chill-roll temperature depends on the film gauge, and lies between 90 and 130°C for mono layer film. The best setting is determined by the layout of the equipment, and the properties desired. Temperatures below 80°C will cause films to post-crystallize. Postcrystallization causes the film to shrink, and sometimes to wrinkle.

Akulon film secondary treatment

Akulon film can be printed and metallized with no pre-treatment. A "Corona" treatment can, however, have a beneficial (cleaning) effect.

Safety

Akulon will not decompose under recommended processing conditions. However, like all thermoplastic polymers, Akulon polyamides will decompose if exposed to temperatures that are too high. These can occur if the melt is overheated, if machine parts are cleaned by burning off, or if extrusion is interrupted while maintaining high barrel temperatures. More detailed information can be found in separate material safety data sheets.

Table 1. Typical temperature settings for co-extrusion of Akulon film grades (°C)

Akulon grade	feed zone	compression zone	metering zone	adapter zone	die zone
F126	245	250	250	250	250
F132/XP32	250	255	255	255	255
F136/XP36	255	260	260	260	260

Blown film extrusion

Although bottom-fed die designs have been used to extrude Akulon blown monofilm, spiral mandrel designs are preferable. Conventional equipment such as that used for PE film extrusion can also be used, but avoid sharply grooved feed zones as these may lead to unacceptable high temperature or blocking of the screw. For monolayer blown film extrusion, the distance between the die and the nip rolls should not be too long (the actual length depends on the bubble diameter). "Lay-flat" should start at a point as close as possible to the die, so in the vicinity of the frost line, to ensure the film remains warm. This will prevent stiffening of the film causing wrinkling in the "lay-flat" section. The distance between the die and the nip rolls should be adjustable to ensure that the length of the lay-flat section can be easily varied to suit other process variables (haul-off speed, film thickness, cooling conditions);

- the die gap should be 0.5 to 1.2 mm - the bubble may be inflated upwards or downwards. It should be cooled with air or with cold water for the production of thermoform films.
- the blow-up ratio can be between 1 up to and bigger than 3.

Co-extrusion

Depending on the co-extrusion process, melt flow properties of adjacent layers should be similar in order to prevent interfacial disturbances. Important parameters are melt viscosity and melt elasticity. Co-extrusion of PA6 with polyolefins requires the use of a tie layer material; DSM recommends the application of Yparex®. Yparex is an adhesive material with rheological properties that makes it very suitable as a tie layer between Akulon and polyethylene's or polypropylenes.

Screw design

Single-flight, three-section or barrier screws can be used for Akulon film grades. For best results use high- performance screws equipped with shearing and mixing sections. The screw length should be at least 24 D, and preferably 28 to 33 D. This guarantees best plasticizing and conveying with the high through-put rates of film extrusion (D-screw diameter). A three-section screw should have a flight depth ratio of 2.9 : 4 (feed section to metering section). See Table 2 for some general recommendations.

Contact

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Figure 1. Recommended flight depth metering section for Akulon film grade extrusion

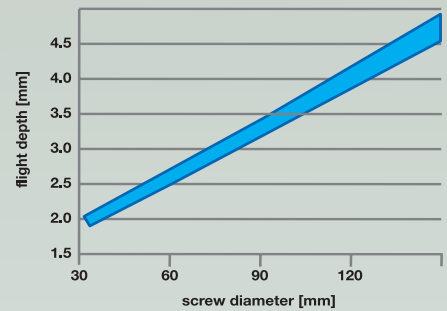


Figure 2. Indication of maximum extruder output with Akulon F132-E1

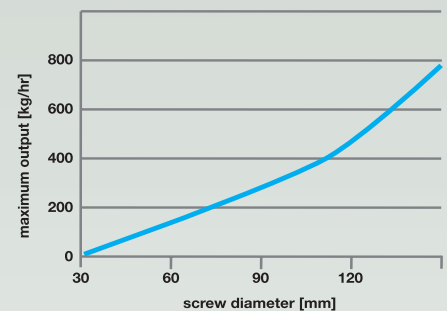


Table 2. Recommended plasticizing (screw) parameters

L/D ratio	>24
Length of screw sections:	
Insulation resistance	25-30%
Insulation resistance	15-25%
Dielectric strength	40-55%
Length of screw sections:	2.9:1 / 4.0:1
Length of screw sections:	recommended

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