# Akulon® Fuel Lock

**Recommendations for Blowmoulding**
*A practical guide for processing Akulon® Fuel Lock*

Akulon® Fuel Lock is a new generation of polyamides (nylon polymers), which are very effective in reducing the release of hydrocarbons via permeation and therefore meet US Environmental Protection Agency regulations for small engine fuel tanks. Akulon Fuel Lock FL40-HP is the polyamide blow molding grade with a broad operating window and acts as a superior permeation barrier for fuel CE10.

Blow moulding requires specific knowledge regarding balancing the process window, product properties and the equipment capabilities. This practical guide aims at explaining how to successfully use Fuel Lock in the blow moulding process and how this differentiates from processing HDPE.

## MATERIAL HANDLING

### Pre-drying conditions

While processing polymers that absorb moisture, such as nylons, care must be taken to assure that the moisture content of Fuel Lock resin, as well its regrind, is maintained at a maximum level of 0.10% or lower. Processing at moisture level higher than the recommended level may lead to a decrease in mechanical and physical properties. A modern, closed loop, desiccant bed dryer sized for proper throughput should be utilized. It is also advisable to regularly check the moisture content of the molding resin plus regrind using a commercially available moisture analyzer.
Drying conditions:

| **Drying time** [hr] | **Temperature** [°C] | **Remarks** |
|---|---|---|
| 4-8 | 80°C (175°F) | Maximum moisture content will be 0.10% |

### Regrind

Since the blow molding process generates scrap at up to a 50% by weight level, the reuse of this material is required due to process economics. Evaluations of the use of Fuel Lock regrind has shown that levels up to 100% have been successful in maintaining the physical and mechanical properties of the virgin material. The successful use of Fuel Lock regrind in the blow molding process requires good initial care of the molded material, like proper initial drying.

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## PROCESSING

**Melt temperature**

The melt temperature mainly affects processing behavior via the viscosity and the color. A too high processing temperature results in a decreased melt strength and can result in discoloration (yellowness). Recycle of material that was processed at a too high temperature is not recommended.

**Mould temperature**

No/limited impact of the mould temperature can be expected on the pinch line or the part surface when processing Akulon® Fuel Lock. The mould temperature can be optimized to tune the result in surface quality and/or should be taken into account considering the design.

| | Extrusion Zones | | | Resin | Mold |
|---|---|---|---|---|---|
| | Feed | Compression | Metering | Melt | Temperature |
| °C | 220 - 235 | 240 - 260 | 260 | 250 - 260 | 30 - 50 |
| °F | 430 - 455 | 465 - 500 | 500 | 480 - 500 | 85 - 125 |

The intake of material can be restricted by limitations of the equipment, like the power of the motor, which can be overcome by increasing the feed zone temperature. The preferred melt temperature at the die head is around 250 °C. The die head temperature can be increased if surface roughness (sharkskin) is experienced.

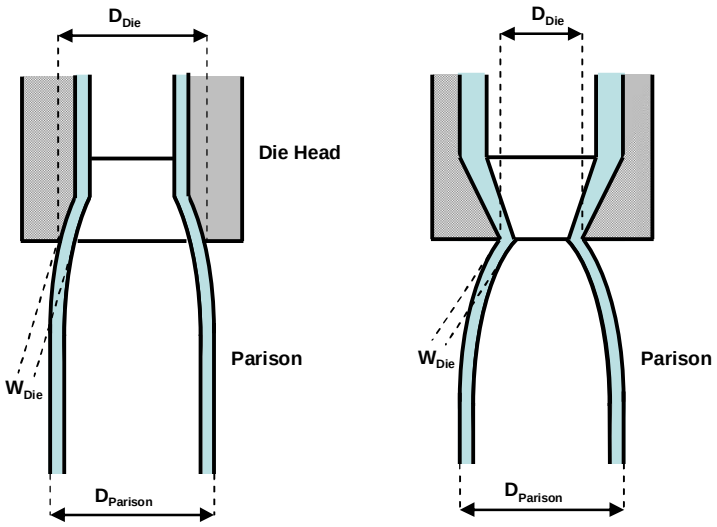
**Residence time**

Downtime of the equipment or production stops may result in a relatively long residence time of the material at high temperature. Expect a reduction of the melt strength during extrusion when restarting. The impact on melt strength is higher for polyamides compared to HDPE. Akulon® Fuel Lock is designed to withstand process interruptions of ~1 hour without concessions to the quality of the performance.

## MACHINERY

**Swell and blow-up rate**

Die swell can be defined as the ratio between the outer parison diameter and the outer diameter of the die. The die swell of Fuel Lock is less than for HDPE. Typically a die is used for Fuel Lock that is about twice the size than when processing HDPE. Besides the material, flow rate, viscosity, melt strength and die width, the die swell depends on the design of the die.




A die swell of around 10 to 50% can be expected with Akulon® Fuel Lock. In general, Fuel Lock has a lower die swell than HDPE. Blow-up ratios of a factor 2 to 5 can be achieved, depending on the mould design.

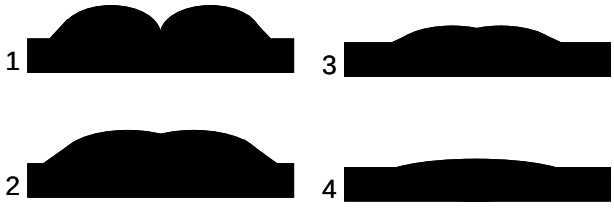
The blow-up pressure and speed have impact on the polymer distribution in the shape (wall thickness, etc.) and the final color (in case oxygen is used as blow-up medium). Preferably, the blow-up speed is optimized with a profile.

**Closing speed**

The closing speed of the mould has an impact on the pinch line (depending on the design of the mould). The closing speed has an optimum, which means in practice that closure of the final few mm should be done at reduced pace to allow material to flow into the pinch.

**Mould design**

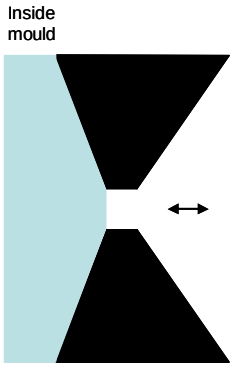
The mould design should be considered to improve the pinch of the application. Below an overview of pinch profiles that could be encountered:



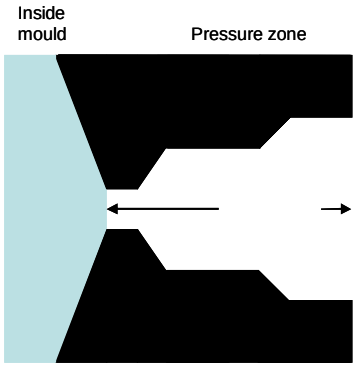

*Pinch lines*

Typically category 1 pinches should be avoided by using the correct mould design in combination with a proper processing window (temperature, pre-drying, recycle, heat stabilization, air/nitrogen, closing speed, etc.) and closing speed profile.

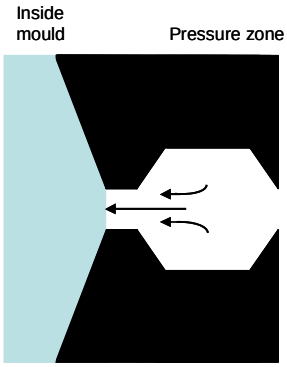
A pressure zone is recommended in the mould design to process Fuel Lock. Below three examples of how a mould designs could look like:




*Regular mould type 1*




*Pressure zone mould type 2*




*Pressure zone mould type 3*

## 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.

## CLEANING

Production has to be started and stopped with a clean machine. Cleaning can be done with PA6-GF, applicable cleaning agents or HDPE.

## CONCLUSION

Akulon® Fuel Lock is a polyamide, which can be processed via blowmoulding in a broad operating window with similar equipment as used for HDPE. Akulon® Fuel Lock is an intrinsic robust solution for reduced permeation of hydrocarbons through tank walls.