



THE TPE SPECIALIST

THERMOPLASTIC ELASTOMERS

elastron

A vertical navigation menu on the left side of the slide, consisting of seven white circles connected by a dark blue line. Each circle is positioned to the left of a corresponding dark blue horizontal bar that contains white text. The top circle is the largest and is partially filled with dark blue, indicating it is the current page.

TPE Foaming

Definiton of foaming

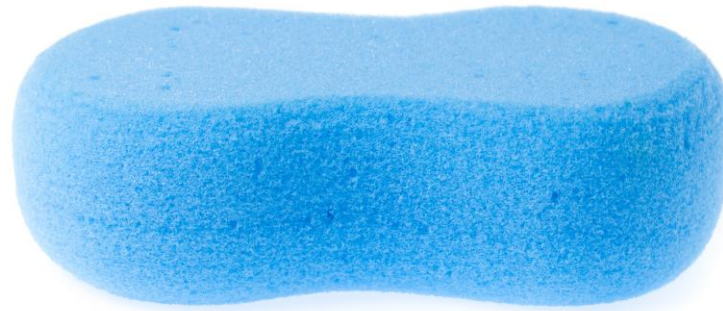
Advantages of foaming

Different foaming types

Parameters affecting foaming

Foaming grades and properties

Problems affecting process

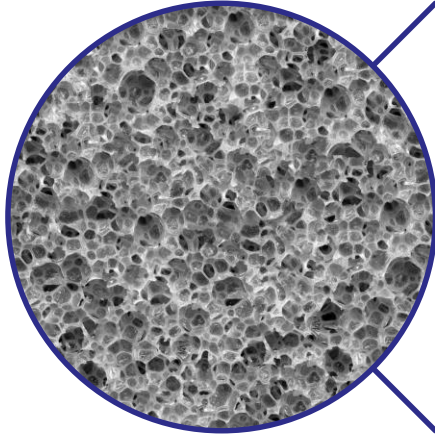


Definition of Foam

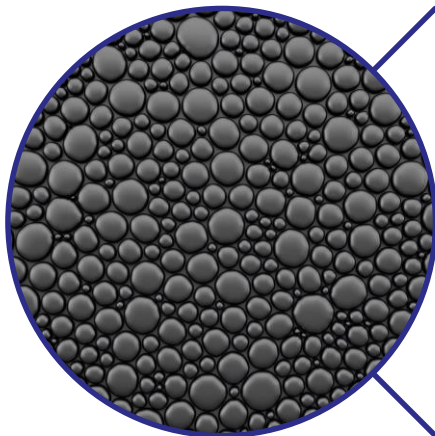
Foam is a material, liquid or solid, with gaseous pockets or voids surrounded with material.

There are many polymeric foams that is used in everyday life. Polyurethane, polystyrene, PVC foams are examples to polymeric foams.

Types of Foam Structure



Open-cell foam contains voids that are connected with each other all the way to the surface and air fills all these voids. Open-cell foams are used as sound barrier for normal frequency ranges and a good air barrier.



In **closed-cell foam**, each void is discrete and surrounded by matrix. It has high rigidity and strength and is a good insulator with high R-value (resistance to heat flow). Closed-cell foam applications include roof, mat and sealant.

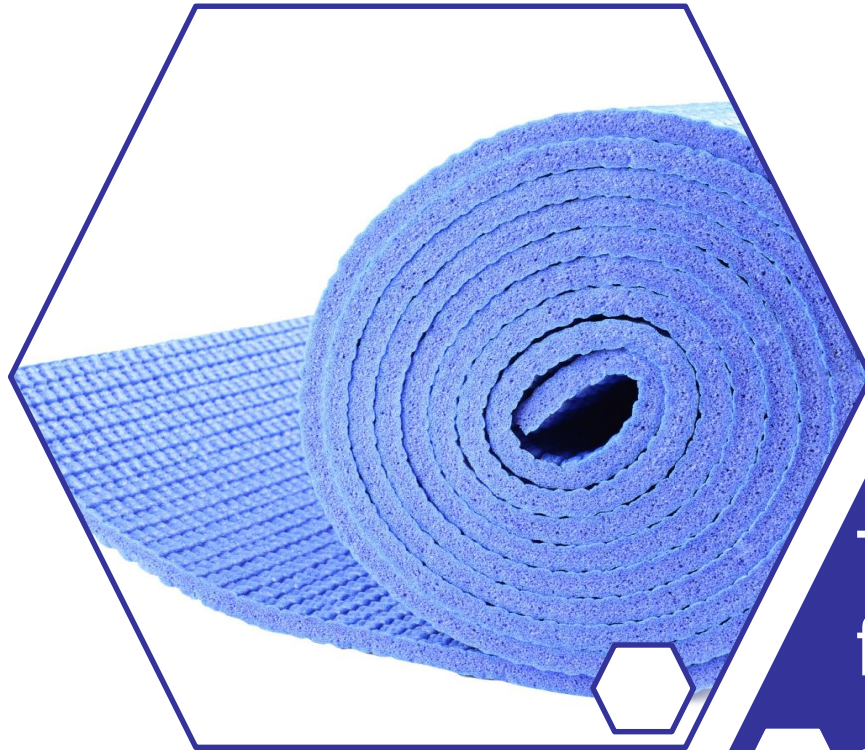


Advantages of Foamed Materials

- The void inside the material containing gases acts as a barrier for heat and sound; foamed materials can act as either heat or sound insulators.
- Polymeric foams are very light materials, with densities ranging from $0,025 \text{ g/cm}^3$ to $0,75 \text{ g/cm}^3$. This will also decrease the material used, leading to increased savings of materials.

Disadvantages of Foamed Materials

- Especially in open-cell foam, water absorption is a problem as water can get inside the polymer matrix through voids.
- Another disadvantage is that due to voids reaching the surface of the polymer, foamed polymer does not have smooth surface.



Types of foaming agents

- Physical foaming agents
- Chemical foaming agents



Physical foaming agents

- Physical foaming agents are materials that are injected into the process as either liquids or gasses. They change into vapor and form voids in the polymer melt by either reducing pressure (for liquids) or injected as vapor (for gasses). Examples include water, nitrogen, pentane.



Chemical foaming agents are materials that decompose and produce gasses. Two types of chemical foaming agents exist:

- Exothermic foaming agents
- Endothermic foaming agents

Exothermic foaming agents

- Release gas more explosively; harder to control the process
- Larger cell
- Higher density reduction
- Discoloration due to agent

Endothermic foaming agents

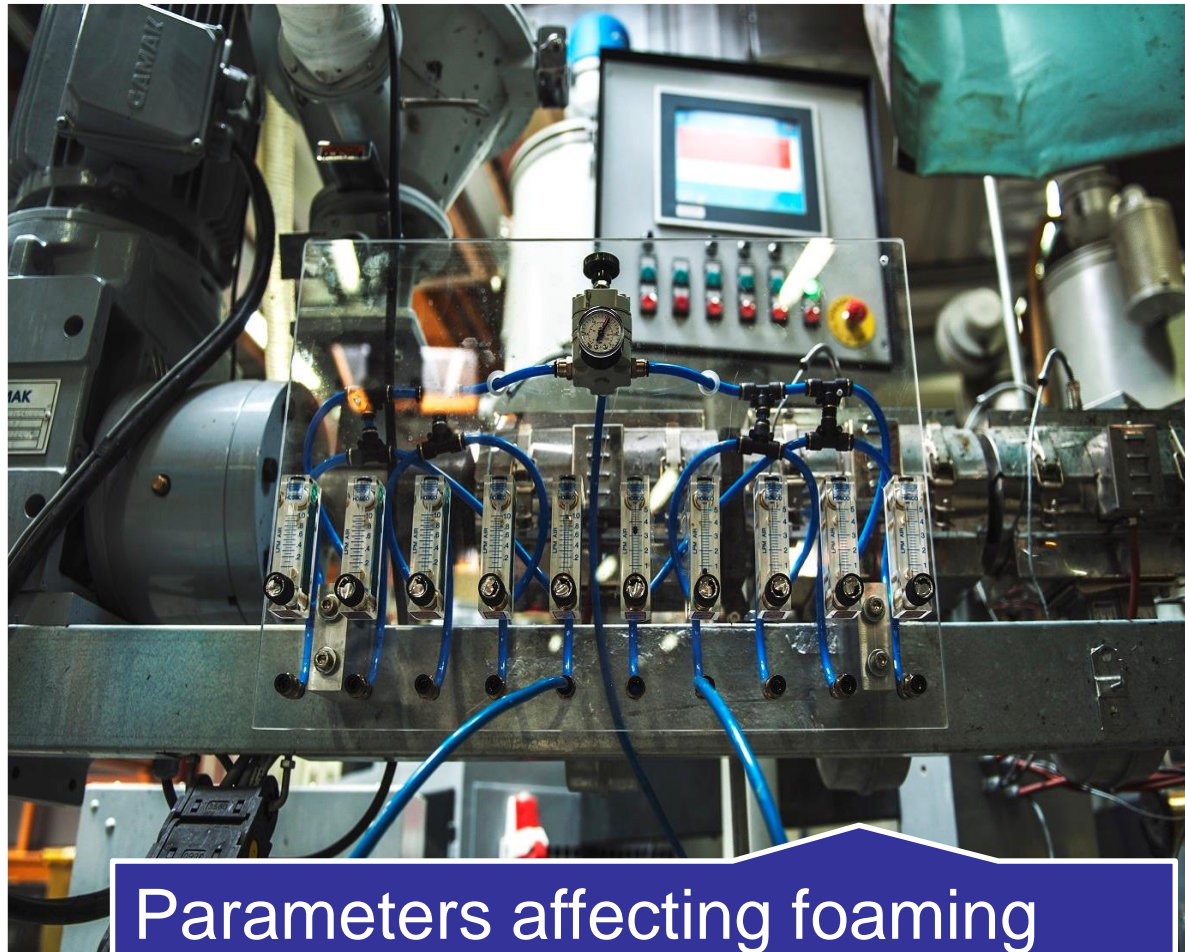
- Reaction is more stable
- Smoother surface
- Small cells
- No discoloration due to agent

Chemical blowing agents

- Easier to use
- Storage stability
- No extra cost for process

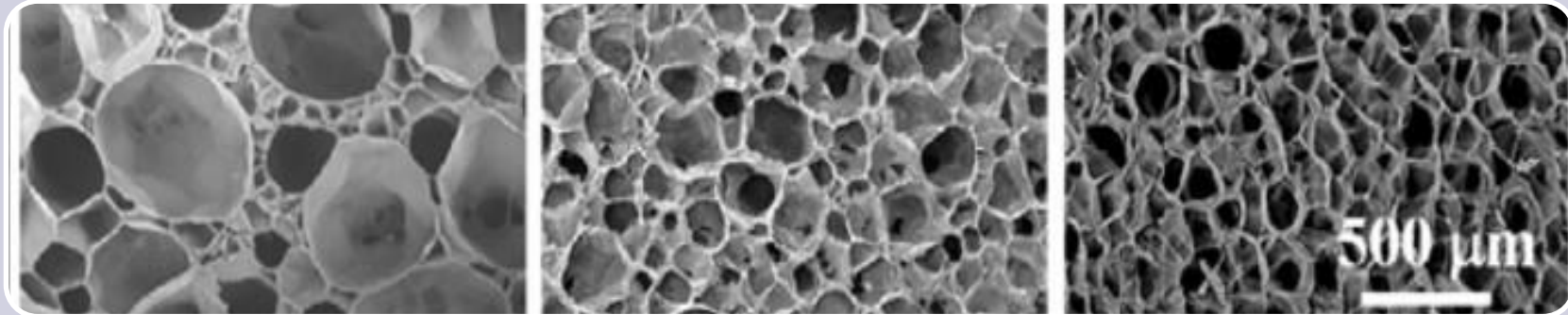
Physical blowing agents

- Lower density foam
- Cheaper than CBAs



Parameters affecting foaming

- Pressure
- Temperature
- Die and screw design



PRESSURE

- The pressure on the melt during processing must be high enough so that the gas is dissolved in the matrix. If pressure is low, foaming starts in the barrel and this leads to uneven surface. Sharp pressure drop in the die also increases the nucleation sites for gases.
- In the figure, as the pressure drop increases from left to right, size of the cells decreases while cell density increases.

TEMPERATURE

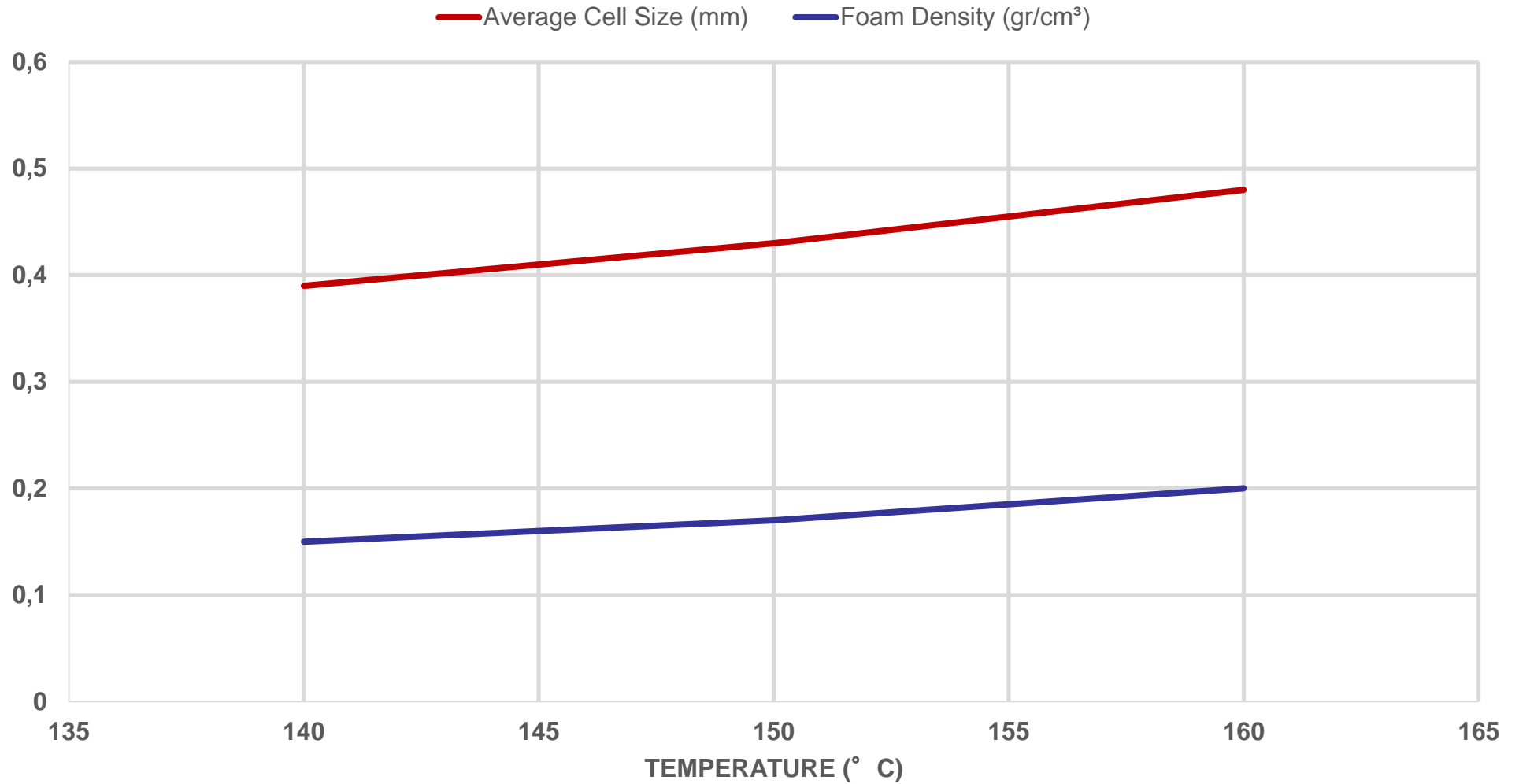
Too high temperature

Melt strength decreases, leading to collapsed foam structure.

Decomposition of agent does not start.

Too low temperature

EFFECT OF TEMPERATURE ON FOAM PROPERTIES





Die and screw design

- No barrier screws or fine screen packs. Barrier screws forms decompression zone, resulting in early foaming. Screen packs also interferes with foaming formation.
- Die design is another important factor in foaming. The cross-sectional area leading to the die should decrease linearly and die land length should be kept low enough to increase the pressure drop across the die.

ELASTRON GRADES AND FOAMING PROPERTIES

Grades	Density Before (g/cm ³)	Density after (g/cm ³)	Density reduction (%)	Expansion ratio (%)*	Water Uptake (%) 24h
G341.A50.N	1,05	0,57-0,63	40-45	60-100	%0.15
G341.A60.N	1,05	0,58-0,63	41-45	60-100	%0.15
G341.A70.N	1,05	0,58-0,63	41-45	60-100	%0.15

*Expansion ratio is calculated from cross-sectional area of a foamed strip and original dimensions of the die.

$$\text{Expansion ratio} = \frac{\text{Cross – sectional area of foam} - \text{original dimension of die}}{\text{original dimension of die}} * 100$$

EXTRUSION TEMPERATURE PROFILE

Zone	Feeding	Compression	Metering	Neck Head Die
Temp. Set° C	140° C	150° C	160-170° C	180° C



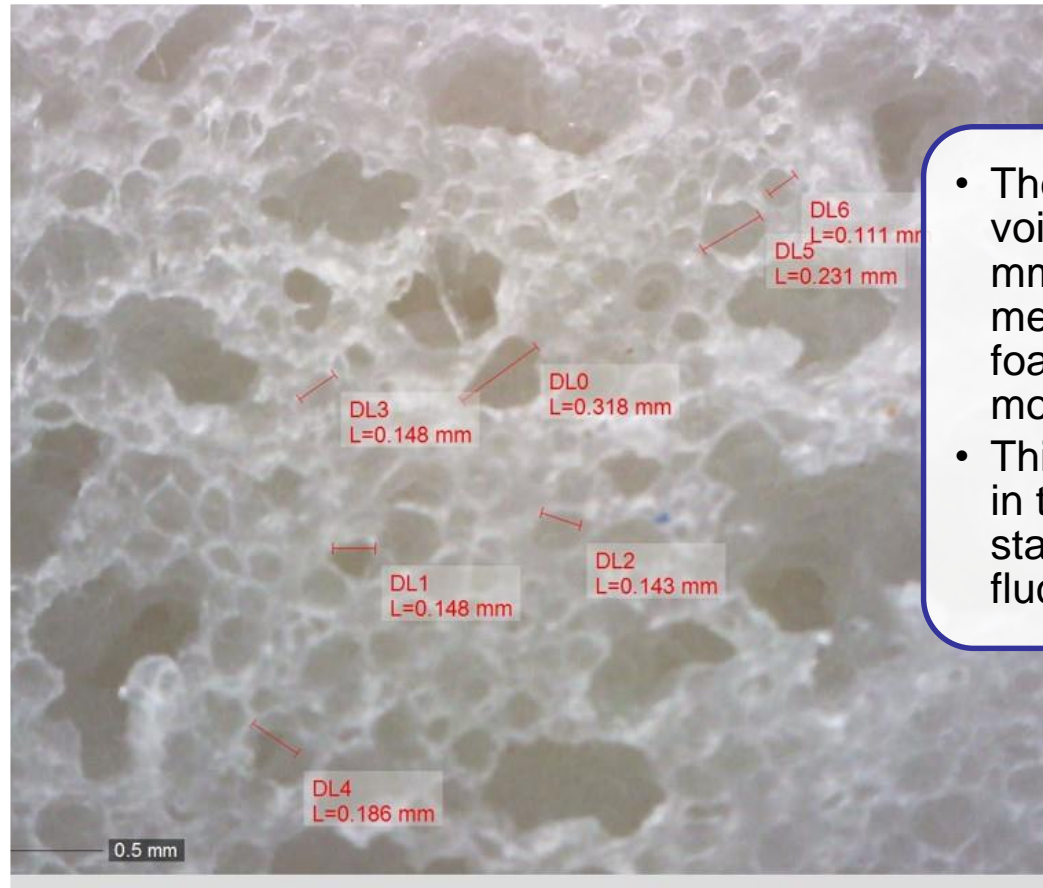


A round extruded surface
made of foamed
G341.A70.N



A thin strip surface made
of foamed G341.A70.N

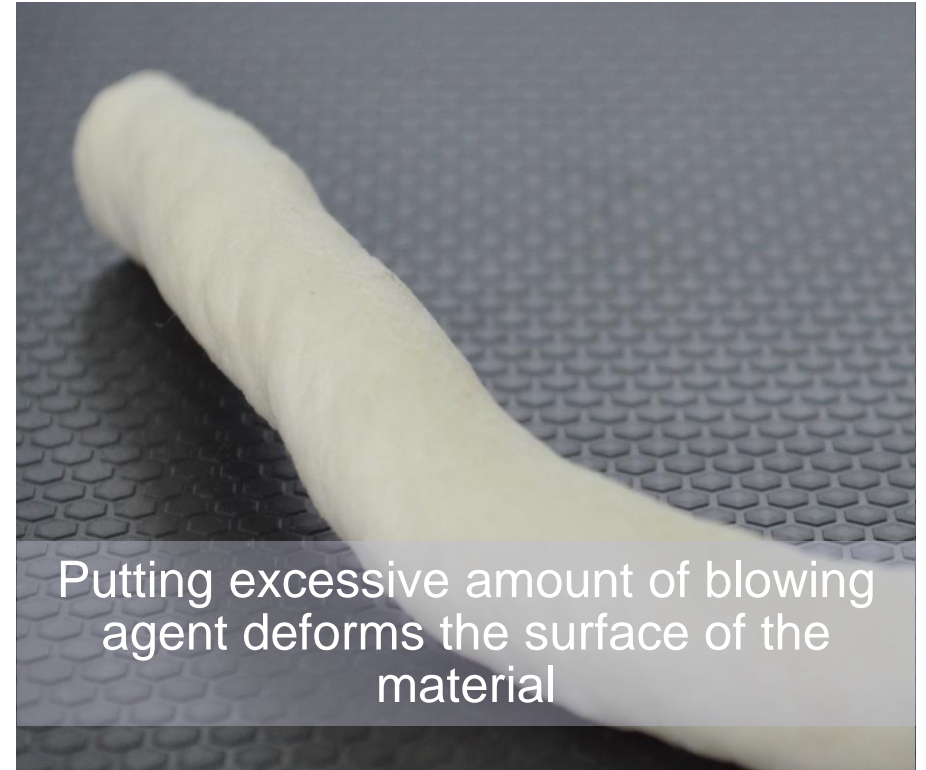
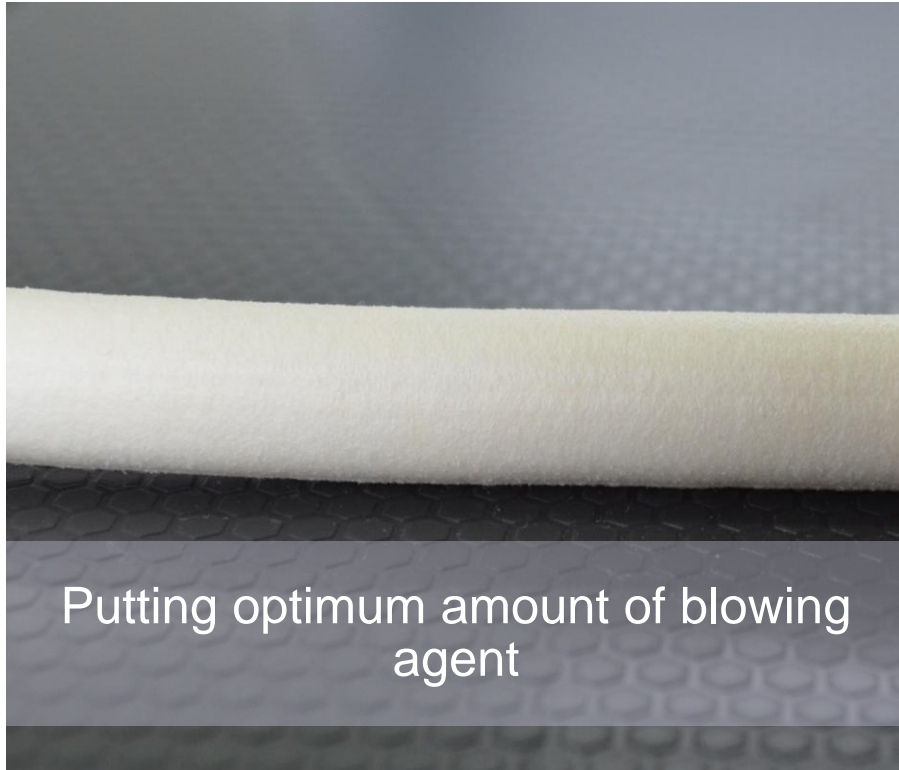
Microscopic Image

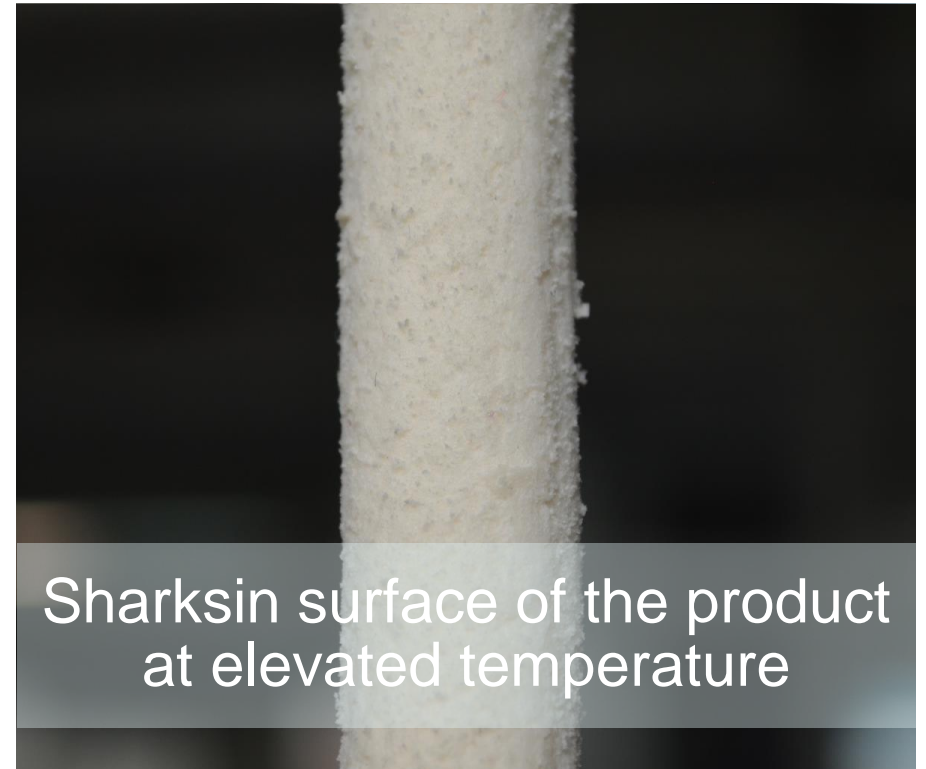
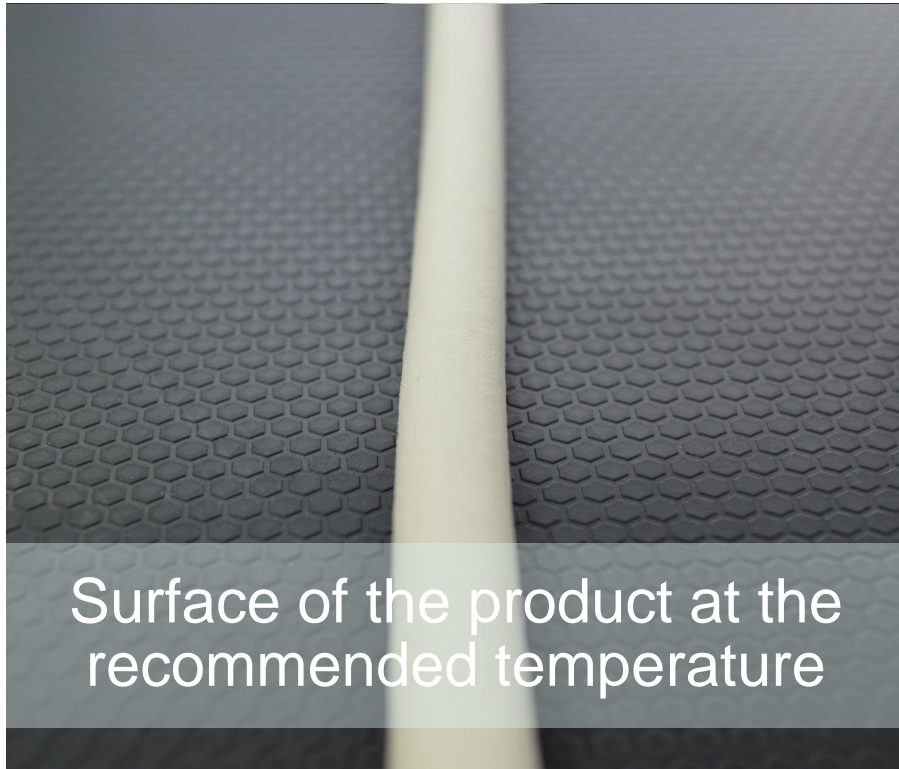


- The sizes of the voids range from 0.1 mm to 0.3 mm, meaning that the foaming process is mostly homogenous.
- This is advantageous in that the surface stability will not fluctuate greatly.



Problems affecting foaming process





Any Questions?

