Physical Foaming of Thermoplastics at Pollmann International
Physical foaming of thermoplastics at Pollmann

- Pollmann Austria has been using the physical foaming technology MuCell® in production since 2005
- Pollmann CZ s.r.o. since 2013
- A few production parts manufactured with physical foaming (MuCell®) at Pollmann:
MuCell® characteristics

- Can be used with basically any machine
- Requires special metering unit ➔ additional mixing and shear zone (see figure)
- Injection molding machine has to be adapted
- Shot weight limited to about 1kg

01…Hot-runner needle valve nozzle
02…Gas injector
03…MuCell – plasticizing unit
04…Shear/mixing zone
05…Conventional plastics granulate
Explanation of super-critical state - SCF

- The phase between liquid and gaseous is called the super-critical state.
- The SCF is created under a specific pressure in combination with a specific temperature.
- Advantages of the super-critical state:
  - Excellent dissolving capacity (diffusion)
  - Lower melt viscosity

![Diagram showing phase transitions with pressure and temperature axes]

Parameter for N₂:

- \( p_c = 34 \text{ bar} \)
- \( T_c = -147 ^\circ \text{C} \)
Schematic of the physical foaming process using MuCell®

- The plastics melt in the plasticizing unit is supplied with gas (Pollmann uses N₂) – or more specifically, with super-critical fluid.
- The SCF/plastics mixture is then homogenized in a special plasticizing unit.
- Cooling the melt results in a compact edge layer with a foamed core.
- The size of the foam pores is 10 - 50µm.
Materials that can be foamed with MuCell®

- Basically all thermoplastics

- Excellent candidates: PBT, PA, PP und PS

- Pollmann currently uses MuCell® to produce parts made of PBT and PP

- These materials are more difficult to work with: TPU, ABS, PC und POM

- Every particle-shaped filler such as fiberglass, talc or carbon fiber supports the material property.
Success factors for forming the best possible foamed structure

- Selection of raw materials
- Part design
- Special tooling for MuCell®
  - Angus system
  - Hot or cold channel systems
  - Vents
  - Tool annealing
- Suitable process conditions
  - Proper balancing of cavities
  - Optimum coordination of parameters
Advantages of physical foaming

- **Up to 25% reduction** in *cycle time* by expanding nitrogen during injection process → shorter cooling time since no holding pressure necessary
- **Up to 10% material savings** due to foam pores
- **Up to 50% lower closing forces** due to lower internal pressures and low-viscosity melt
- Fewer sink marks
- Less shrinkage and distortion
- Thinner wall thicknesses possible than with compact injection molding
- Better flow properties due to low-viscosity melt
Appendix
Foaming requires lower internal tool pressures

Cavity pressures for door latch housing
- Compact: up to 650 bar
- Foamed: up to 120 bar
Eliminates sink marks on end product

compact  foamed
Reduced shrinkage and distortion

compact:

foamed:

door latch housing
Foamed cover for door latch housing

material: PBT/GF20
blowing agent: N₂

end customer: FIAT GM
Foamed cover and housing for closing aid in tailgate

material: PBT/GF20
blowing agent: N$_2$
with overmolded axles!

end customer:
Various covers for door latch housings

end customer:

material: PBT/GF20
blowing agent: N₂