



# Structural Foam Technology

Processes - Applications



## Index

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

- Introduction
- Low Pressure Processes
- Gas Counter Pressure Process
- Multi - Component Injection Molding Process
- MuCell™ - Process
- Battenfeld Know How



## Index

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

- Introduction
- Low Pressure Processes
- Gas Counter Process
- Multi - Component Injection Molding Process
- MuCell™ - Process
- Battenfeld Know How

## ▶ Introduction

Introduction

Low Pressure

Gas Counter  
Pressure

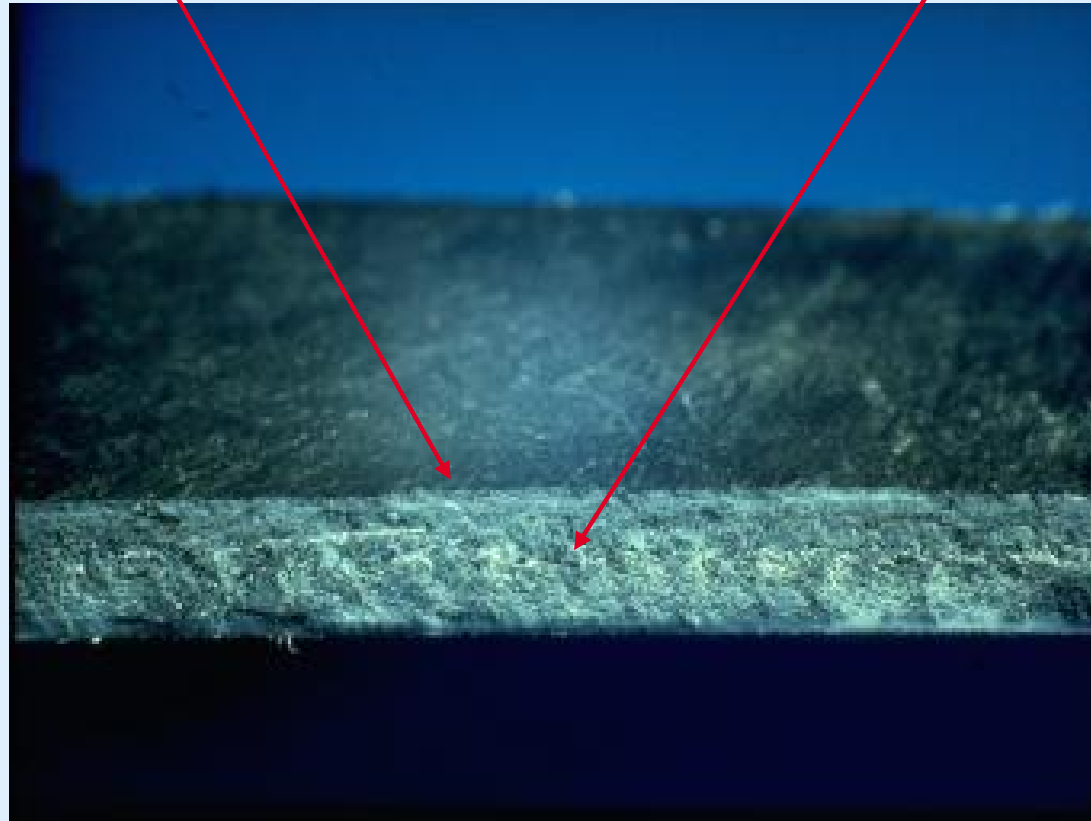
Multi-  
Component

MuCell™

Know How

Compact skin

Foamed core



scaled up cross section of a structural foam  
molding



## Introduction

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

Structural foam technology is used for about 40 years.

Elimination of sink marks by adding a small amount of blowing agents (i.e. baking powder)

Foam structure in core when adding more blowing agent

The pressure of the blowing agent works as holding pressure

## Introduction

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

Advantages with structural foam:

- No sink marks
- Weight reduction
- No or low warping
- High rigidity
- Low internal stresses
- Viscosity reduction by blowing agent
- Reduced clamping forces

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

## Introduction

Types of blowing agents used:

chemical blowing agents

endothermic

exothermic

endo - exothermic

physical blowing agents (MuCell™)

$N_2$

$CO_2$



## Index

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

- Introduction
- Low Pressure Processes
- Gas Counter Process
- Multi - Component Injection Molding Process
- MuCell™ - Process
- Battenfeld Know How





## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

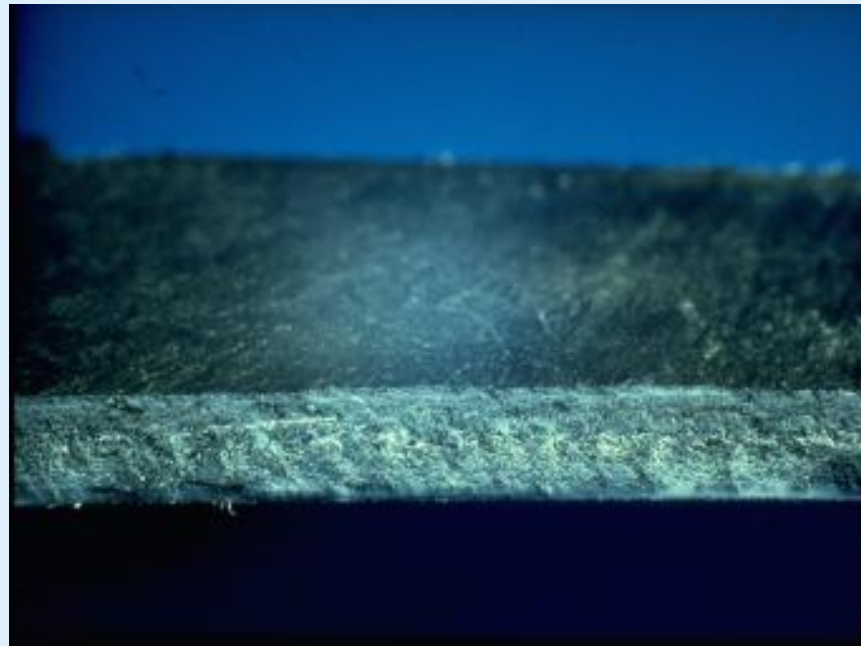
Know How

Injection into vented cavity

Short filling with plastic, complete filling by means of expansion of blowing agent

Blowing agent works as holding pressure

Very short filling times are mostly favorable



## ▶ Low Pressure Injection Molding Processes

Introduction

Low Pressure

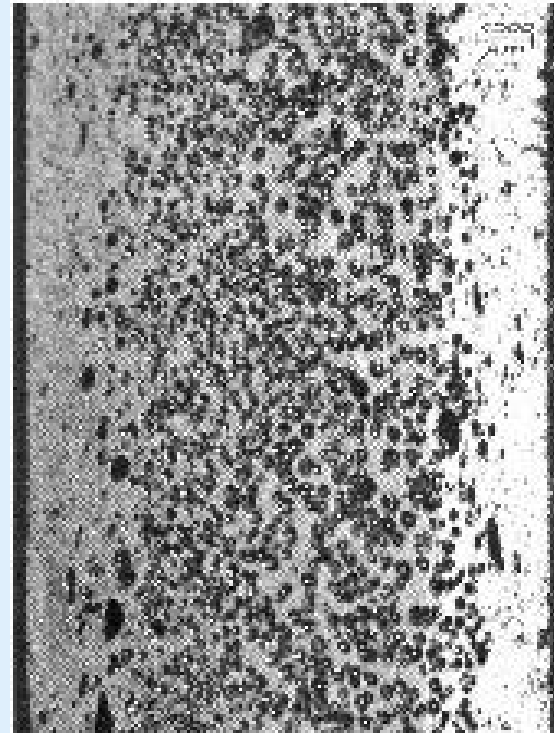
Gas Counter Pressure

Multi-Component

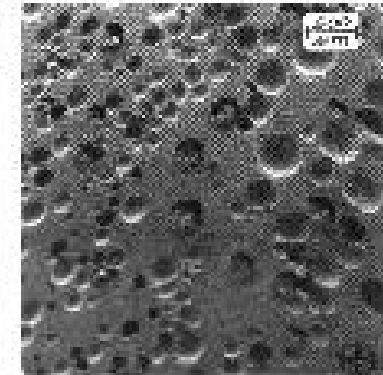
MuCell™

Know How

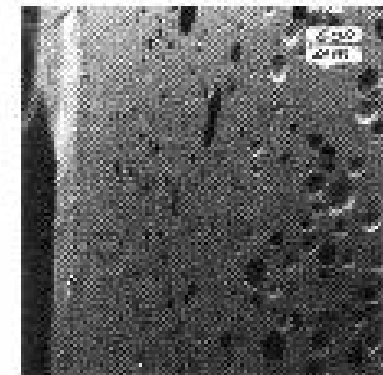
Cross section of a typical structural foam molding, PS



Cross section



Core



Skin



## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

What is preferable:

Fast Injection?

Slow Injection?

## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

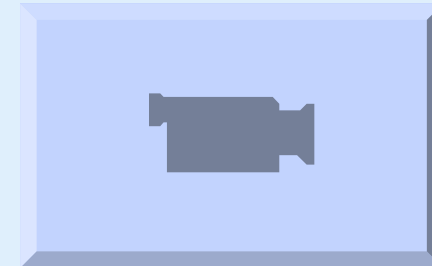
MuCell™

Know How

Cavity filling with a mold having  
a window

PS: Slow filling  
Slow motion 30 times

Big lost of blowing agent  
already when filling



## ▶ Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

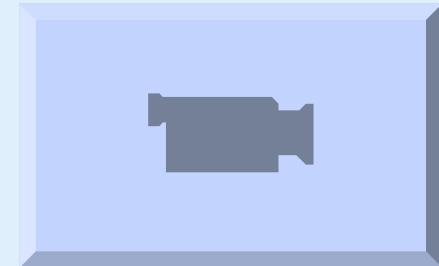
MuCell™

Know How

Cavity filling with a mold having  
a window

PS: Extremely fast filling  
Slow motion 30 times

Injection of melt is done after  
roughly 0,03 sec, die complete  
filling is done by foaming



## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

Foam structure

Very short filling times are mostly favorable

Influence of filling time to foam structure for PC moldings



Filling time a) = 0,3 sec

Filling time b) = 0,6 sec

Filling time c) = 1,2 sec

Filling time d) = 1,5 sec

## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

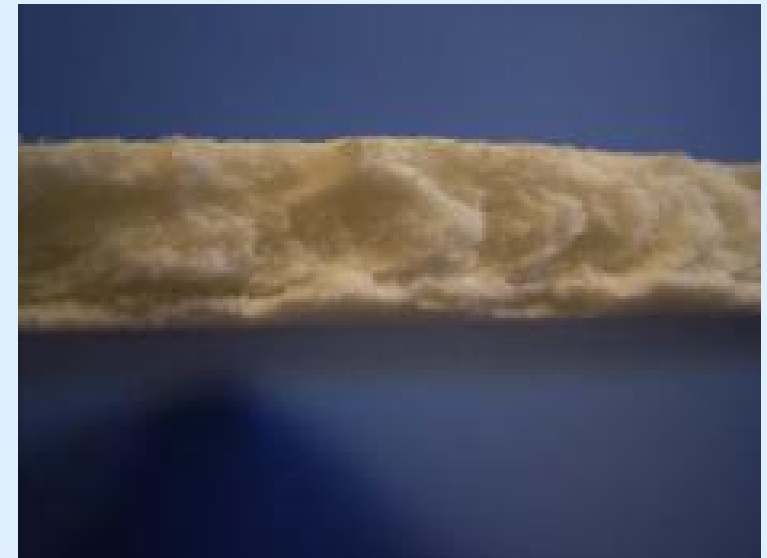
Know How

Use of chemical blowing agents



Very fine cell structure with  
chemical blowing agents:  
PS

Reinforced polymers:  
Very fine cell structure





## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

### Applications



Less warping with  
structural foam





## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

### Applications



Less warping and smaller tolerances with structural foam



## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

### Applications

Telephone kiosk  
Material PC-GF  
Weight 60 kg





## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

### Machine technology

Structural foam machine for production of telephone kiosks  
vertical clamping unit, clamping force 26.000 kN  
3 injection units with melt accumulators and nitrogen over oil  
accumulators for rapid injection





## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

### Machine technology



Structural foam machine for production of telephone kiosks  
vertical clamping unit, clamping force 26.000 kN  
3 injection units with melt accumulators and nitrogen over oil accumulators for rapid injection



## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

### Machine technology

Structural foam machine for production of telephone kiosks  
vertical clamping unit, clamping force 26.000 kN

3 injection units with melt accumulators and nitrogen over oil accumulators  
for rapid injection



## Low Pressure Injection Molding Processes

Introduction

Low Pressure

Gas Counter Pressure

Multi-Component

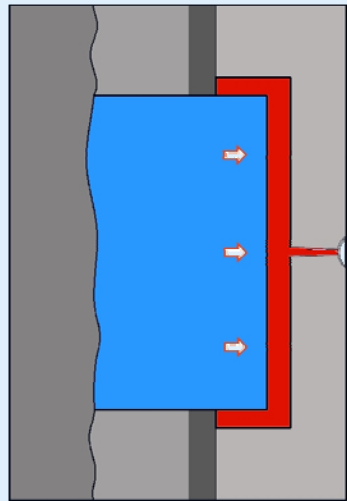
MuCell™

Know How

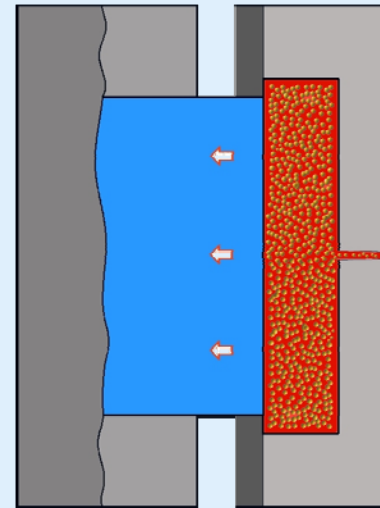
### Process

Molds with expanding cores

Better surface quality by injecting in lower wall thickness



Core in forward position  
Complete filling with melt



Core in backward position  
foaming of the melt in skin  
lower density in the core



## Index

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

- Introduction
- Low Pressure Processes
- Gas Counter Pressure Process
- Multi - Component Process
- MuCell™ - Process
- Battenfeld Know How



## Gas Counter Pressure Process

Introduction

Low Pressure

Gas Counter Pressure

Multi-Component

MuCell™

Know How



Battery housing, PP

Foam structure in the core is formed as compensation of volume shrinkage of the polymer







## Index

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

- Introduction
- Low Pressure Processes
- Gas Counter Pressure Process
- Multi - Component Process
- MuCell™ - Process
- Battenfeld Know How

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How



## Multi - Component Process

Two - Component Injection Molding

Multi - Component Injection Molding

Sandwich - Molding

Co-Injection

Different names for the same process



## Multi - Component Process

Introduction

Low Pressure

Gas Counter  
Pressure

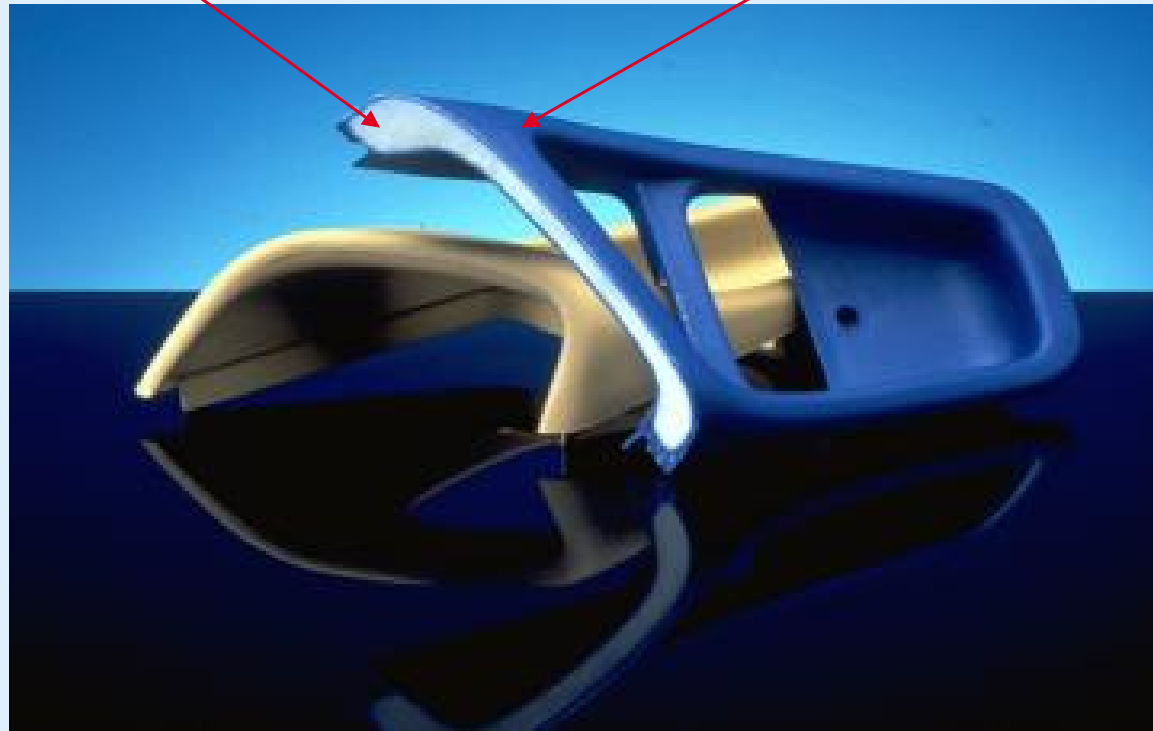
Multi-  
Component

MuCell™

Know How

Foamed core

Compact skin





## Index

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

- Introduction
- Low Pressure Processes
- Gas Counter Pressure Process
- Multi - Component Process
- **MuCell™ - Process**
- Battenfeld Know How



## MuCell™ - Process

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

MuCell- Process:

Micro cellular foam means fine regular cell structure:

Injection of a physical blowing agent into the barrel:  
The blowing agent is maintained under pressure and kept in solution.

Blowing agents:  
Nitrogen or CO<sub>2</sub>



## MuCell™ - Process

Introduction

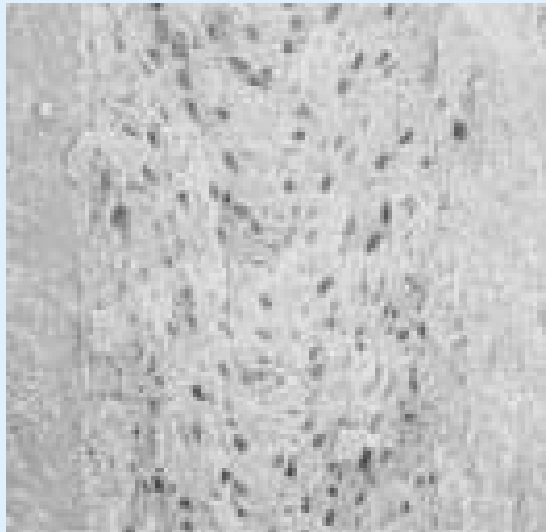
Low Pressure

Gas Counter  
Pressure

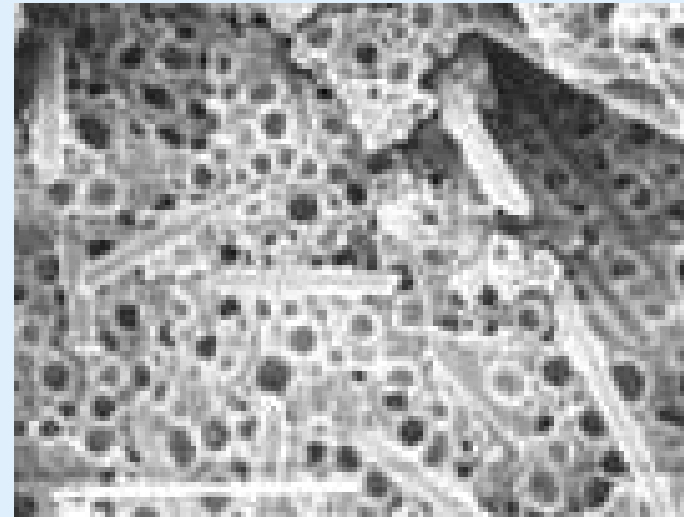
Multi-  
Component

MuCell™

Know How



Foam Structure



Foam Structure of glass fiber  
reinforced plastic



## MuCell™ - Process

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

Applications

Advantages with MuCell™  
Weight reduction 22%



Bowl, PP  
Wall thickness 2 mm

## ▶ MuCell™ - Process

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

### Applications

### Advantages with MuCell™

Weight reduction 6 %

Reduction of clamping force from 9500 kN to 6500 kN

Reduction of warping



Traverse  
ABS, 900 g



Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

## ▶ MuCell™ - Process

Applications

Advantages with MuCell™

Weight reduction

Reduction of warping



Housing  
PS



## MuCell™ - Process

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

Machine technology

Injection molding machine equipped for MuCell™

- Screw length 22 D with special design
- Barrier screw with mixing elements
- Hydraulically operated shut-off nozzle
- Nitrogen over oil accumulator for rapid injection
- Software for MuCell™

## ▶ MuCell™ - Process

Machine technology

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How



Pressure generation unit for N<sub>2</sub> and CO<sub>2</sub>

## ▶ MuCell™ - Process

Machine technology

Introduction

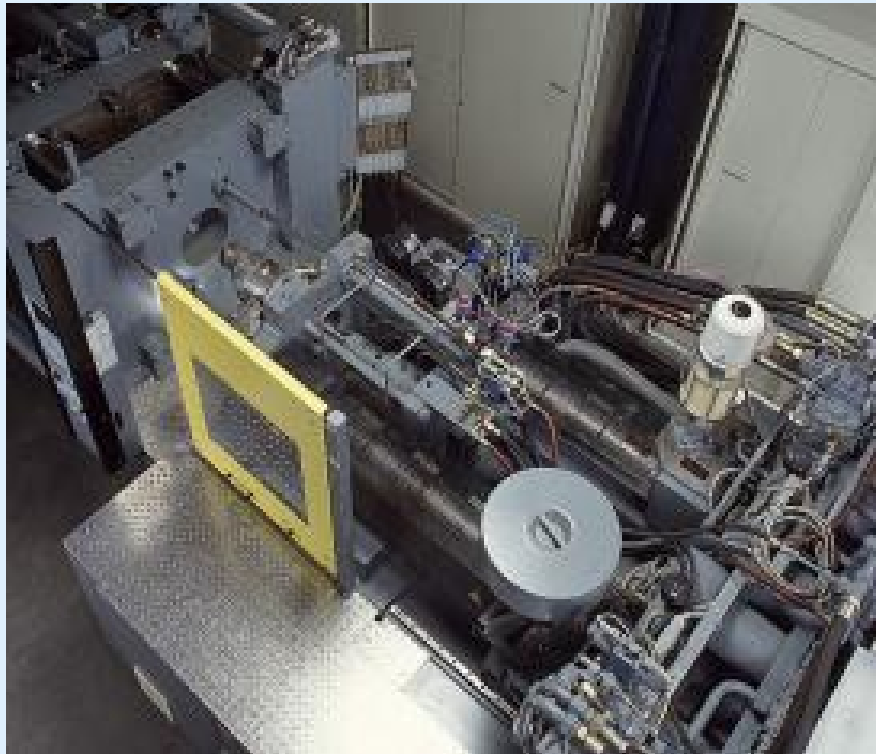
Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How



Multi - component injection molding machine  
B side provided for MuCell™



## MuCell™ - Process

Machine technology

Introduction

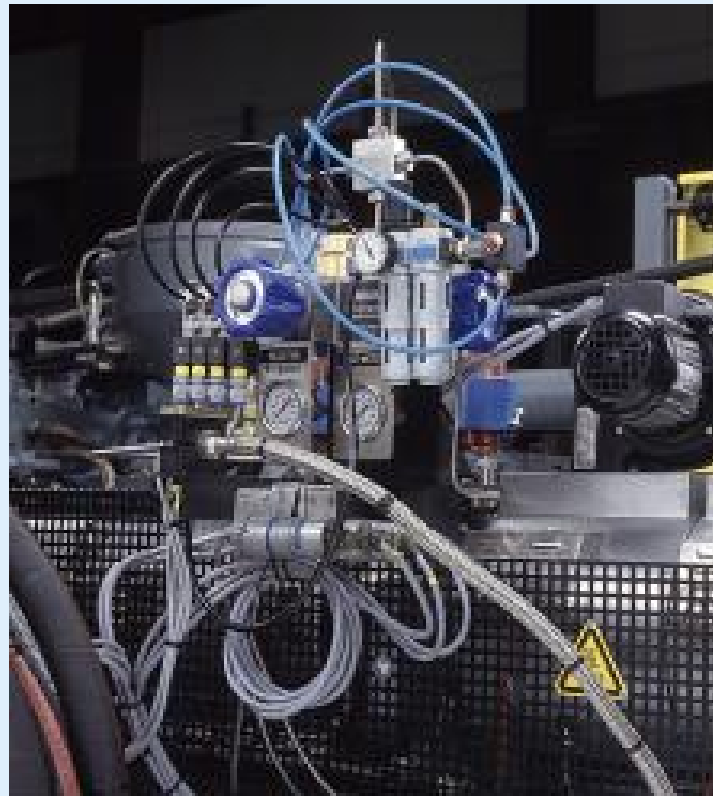
Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How



Gas injection valves

## ▶ MuCell™ - Process

### Machine technology

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How



Nitrogen over oil accumulator for  
rapid injection:  
350 mm/sec



## MuCell™ - Process

Introduction

Low Pressure

Gas Counter Pressure

Multi-Component

MuCell™

Know How

For perfect surface quality:

Combination of Mucell™ with gas counter pressure process

Combination of MuCell™ with multi - component injection molding

## MuCell™ - Process

Multi - Component Injection Molding with MuCell™

Advantages with MuCell™

No Warping

Weight reduction 10 to 15 %

Lower clamping forces

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How



Panel: 520 x 520 x 2 mm, PP  
Skin - core - ratio 50 to 50 %





## Index

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

- Introduction
- Low Pressure Processes
- Gas Counter Pressure Process
- Multi - Component Process
- MuCell™ - Process
- Battenfeld Know How



## Battenfeld Know How

Introduction

Low Pressure

Gas Counter  
Pressure

Multi-  
Component

MuCell™

Know How

Battenfeld has more than 30 years practical experience with structural foam with chemical and physical blowing agents

▶ **Many thanks for your attention**

more information under [www.battenfeld.ru](http://www.battenfeld.ru)