Gas-assisted Injection Molding

- Airmould®
- Airmould Contour®

*Fields of application*
*Machines and equipment*
1. Why do you need gas-assisted injection molding?
   1.1 Airmould®
       1.1.1 Application
       1.1.2 Processes for gas injection
   1.2 Airmould Contour®

2. What equipment do we need for gas- and water-assisted injection molding?
Gas-assisted Injection Molding

Content

1. Why do you need gas-assisted injection molding?
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2. What equipment do we need for gas- and water-assisted injection molding?
Gas-assisted Injection Molding

Why do we need gas-assisted injection Molding?

- Fields of applicaton
- Advantages for the molder
- Typical moldings
- A process to resolve molding problems
Gas-assisted Injection Molding

Gas-assisted processes:

1. Gas distributed in melt to form a cell structure:
   Structural foam processes

2. Gas used to form hollow sections:
   Internal gas injection technology

3. Gas injected between melt and cavity:
   External gas injection technology
Gas-assisted injection molding

Why?

- Improvement of part quality
- No sink marks
- No or low warping
- Lower clamping forces
- Shorter cycle times
- Weight saving
Gas-assisted Injection Molding

Gas-assisted processes:

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   Structural foam processes

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Gas-assisted injection molding

Structural Foam Technology

Low pressure structural foam:
- compact skin
- foamed core
Gas-assisted injection molding

Structural Foam Technology

Telephone kiosk
Weight: 60 kg
Wall thickness: 6-8 mm
Plastic: PC with 5% glassfiber reinforcement
Multicomponent Injection Molding

Gas-assisted Injection Molding

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Application

Processes

Airmould Contour®

Modular system
### Gas-assisted Injection Molding

**Gas-assisted processes:**

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   External gas injection technology
Gas-assisted Injection Molding

Internal gas pressure:
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External gas pressure:
Airmould Contour®
Gas-assisted Injection Molding

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Gas-assisted Injection Molding

Internal gas pressure:
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Gas-assisted Injection Molding:
External gas pressure:
Airmould Contour®
Why Airmould®?

Some advantages:

- Improvement of surface quality
- No sink marks
- No or reduced warpage
- Reduction of clamping forces
- Reduction of cycle times
- Polymer and weight saving up to 50%
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Principle of mold cavity filling with Airmould®
Gas-assisted Injection Molding

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Thick wall grab handle, PA 12, Reduction of cycle time by 60% with Airmould®
Gas-assisted Injection Molding

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Gas-assisted Injection Molding

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Moldings suitable for Airmould®

Because of different polymer and gas viscosities, moldings for gas assist need to meet specific design criteria.

Therefore suitable products have been distinguished in 4 groups of differing designs:

- Rod shaped moldings
- Panel shaped moldings
- Panel shaped moldings with increased wall sections
- Problem moldings.
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1. Rod shaped moldings

- Weight reduction: 30 %
- No sink marks

Grab handle, ABS
Gas-assisted Injection Molding

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Rod shaped moldings

Handle for refrigerator, ABS,

One single production step with Airmould®
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Rod shaped moldings

Lawn maver handle, PP
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Rod shaped moldings

Seat adjustment lever for garden chair, PP- GF
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Rod shaped moldings

Steering wheel for pedal car, PP
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Rod shaped moldings

Gearshift lever for pedal car, PP
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Rod shaped moldings

Exterior door handle, PA 6 with 30 % GF

- Weight reduction 20 %,
- Cycle time reduction 50 %
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Rod shaped moldings

Exterior door handle unit for car, Handle: Airmould®, PA GF 20
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Rod shaped moldings

Door handle, ABS

- No sink marks
- No warpage
- Weight reduction
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2. Panel shaped moldings

Garden table top:
1500 x 900 mm

- High rigidity and low warping
- Clamping force reduction of 60 % to 10,000 kN by using Airmould®
Gas-assisted Injection Molding

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Panel shaped moldings

Rotating plate for kitchen furniture, PP

- High rigidity by means of gas channels with high ribs
3. Panel shaped moldings with increased wall sections

- No sink marks with Airmould®

Internal door handle, PP
Wall thickness from 2 to 12 mm
Gas-assisted Injection Molding

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Panel shaped moldings with increased wall sections

Door handle in PP,
wall thickness 2.5 mm,
wall thickness 20 mm in grab handle section

- No sink marks with Airmould®
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Panel shaped moldings with increased wall sections

Interior door cover, PP

- No sink marks
- No warping
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Panel shaped moldings with increased wall sections

Car side trims, ABS
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Panel shaped moldings with increased wall sections

End piece of side trim for car, ABS

- No sink marks
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Panel shaped moldings with increased wall sections

Exterior door handle unit with handle, PA-GF

- weight saving for handle
- no sink marks in housing because of gas injection, gas is injected at 3 different locations
Gas-assisted Injection molding

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Panel shaped moldings with increased wall sections

Rear view mirrors in ABS, painted

- No sink marks with Airmould®
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Panel shaped moldings with increased wall sections

Truck intake air filter housing,
PA with 30 % GF

- Increased rigidity by means of gas channels using Airmould®
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Panel shaped moldings with increased wall sections

Truck intake air filter housing,
PA with 30 % GF

- Increased rigidity by means of gas channels using Airmould®
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Panel shaped moldings with increased wall sections

Industrial vacuum cleaner housing in ABS

- increased rigidity with Airmould®
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Panel shaped moldings with increased wall sections

- No warpage
- No sink marks
- High rigidity

Frontend for truck, PC-PBT-blend
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Panel shaped moldings with increased wall sections

Interior door handle and handle unit for car,
Handle: Airmould®, PA GF 20 Metallised
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Panel shaped moldings with increased wall sections

Thin tube with ball, PP, tube diameter 2 mm

- Weight compact: 1.4 g,
- Weight with Airmould®: 0.6 g
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4. Problem moldings

Washing machine front cover in ABS

Right: Warpage with conventional injection molding

Left: no warpage with Airmould®
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Problem moldings

Front cover for washing machine, ABS

Left: gas injection at 2 locations by means of gas injection modules

Right: no sink marks even opposite mounting bosses
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Problem moldings

Monitor front, mod. PPE

No sink marks using gas injection in the 4 corners
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Problem moldings

U-shape border with ribs, PPE

Flatness ± 0.5 mm
was achieved by using Airmould®
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Problem moldings

Cover for car radio

No warping and better dimensional stability with Airmould®
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Problem moldings

Connector handle, PP

No sink marks opposite to mounting bosses using Airmould®
Gas-assisted Injection Molding

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1. Why do you need gas-assisted injection molding?
   1.1 Airmould®
      1.1.1 Application
      1.1.2 Processes for gas injection
   1.2 Airmould Contour®

2. What equipment do we need for gas- and water-assisted injection molding?
**Gas injection molding**

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1. Short-Shot Process
2. Full-Shot Process
3. Overflow Process
4. Back to Screw Process
5. Retractable Core Process
Gas-assisted Injection Molding

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Short-Shot Process

1. Gas-assisted Injection M.
2. Airmould®
3. Application
4. Processes
5. Airmould Contour®
6. Modular system

Short filling of the mold, complete filling by means of the gas
Gas-assisted Injection Molding

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Short-Shot Process

Handle, PP
Weight reduction 50 %
Gas-assisted Injection Molding

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Short-Shot Process

Lever, PA 6 with 20 % GF,

Weight reduction 15 %, Cycle time reduction 35 %
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Short-Shot Process

Grab handle for table barbecue, PA-GF

Weight reduction 25 %
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Short-Shot Process

Grab handle, ABS

Thick handle section, thin mounting section, no sink marks
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Short-Shot Process

Folding chairs for the Olympic Stadium in Sydney, consisting of seat, back and arm rests
Gas-assisted Injection Molding

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Short-Shot Process

Olympic Stadium in Sydney, equipped with Airmould® chairs
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Full-Shot Process

1. Complete filling of the mold, gas injection for shrinkage compensation.

**Gas**, **Plastic**, **Mold**, **Gas injection**
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Full-Shot Process

Car speaker housing
No sink marks in thick sections
Gas-assisted Injection Molding

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Short-Shot Process

Tray
No sink marks at thick sections
Gas-assisted Injection molding

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Overflow Process

1. Complete filling of the mold, expelling plastic into overflow cavity by means of the gas.

Gas
Plastic
Mold
Gas injection
Gas-assisted Injection Molding

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Overflow Process

Exterior door handle,
PA 6 with 30% GF
Gas-assisted Injection molding

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Back to Screw Process

1. Gas injection
2. Complete filling of the mold
3. Pushing plastic back to screw by means of the gas

Gas
Plastic
Mold
Gas injection

Application
Processes
Airmould Contour®
Modular system
Gas-assisted Injection Molding

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Retractable Core Process

1. Core forward: complete filling with plastic
2. Core retraction and gas injection

Gas
Plastic
Mold

Gas injection
Retractable core
Hydraulics

Core forward: complete filling with plastic
Core retraction and gas injection
Gas-assisted Injection Molding

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Retractable Core Process

Bottle crate
Thick wall hollow handle sections
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Multifoam Process

Multifoam = Co-injection and Airmould®

Start with skin material, then core material mold filling with gas.
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Multifoam Process

Cross section of molding

Skin: TPE
Core: PP
Hollow section using Airmould®
Gas-assisted Injection Molding

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Multifoam Process

Time sequence of mold filling:
Co-injection:

A
B

MULTIFOAM:

A
B
Gas
Gas-assisted Injection Molding

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Multifoam Process

Arm rest for office chair,

Skin: PA
Core: PA- GF
Hollow section using Airmould®
Gas-assisted Injection Molding

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Multifoam Process

Cross section of door handle

Skin: PP
Core: PP foamed
Hollow section with Airmould®
Gas-assisted Injection Molding

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Multifoam Process

Cross section of media duct

Skin: Polymer 1, i.e. resistant against chemicals

Core: Polymer 2, i.e. resistant against transport media

Hollow section with gas

Reference: IKV Aachen
Gas-assisted Injection Molding

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Gas-assisted Injection Molding

Gas-assisted processes:

1. Gas distributed in melt to form a cell structure: Structural foam processes

2. Gas used to form hollow sections: Internal gas injection technology

3. Gas injected between melt and cavity: External gas injection technology
Gas-assisted Injection Molding

Internal gas pressure:
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Gas-assisted Injection Molding:
External gas pressure:
Airmould Contour®
Gas-assisted Injection Molding

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Conventional injection molding

AIRMOULD CONTOUR®
Gas-assisted Injection Molding

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The Process

1. Complete filling with melt
2. Injection of the gas between the melt and the mold cavity
3. The gas acts as holding pressure and pushes the melt against the opposite cavity wall.
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The Process

1. Complete filling with plastic - Application of holding pressure
2. Injection of gas between melt and cavity surface
3. Gas pressure is active during cooling phase and compensates for shrinkage during cooling

Gas (nitrogen) Gas injection
Plastic
Mold
Gas-assisted injection molding

Fields of application for Airmould Contour®

- Panel shaped moldings
- Panel shaped moldings with increased wall sections
- Problem moldings
- Combination of processes Airmould® und Airmould Contour®
Gas-assisted Injection Molding

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Panel shaped moldings with increased wall sections

Keys, PMMA
Gas-assisted Injection Molding

Airmould Contour®

Panel shaped moldings with increased wall sections

Cover for cosmetic box, with thick ribs,

Left: compact molding
Right: Airmould Contour®
Gas-assisted Injection Molding

Airmould Contour®

Panel shaped moldings with increased wall sections

molding with ribs

Left: sink marks with conventional injection molding

Right: no sink marks using Airmould Contour®

Polymer injection
Gas-assisted Injection Molding

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Panel shaped moldings with increased wall sections

Key, PMMA
Gas-assisted Injection Molding

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Applications

Closure, PP

Cover, PC-PBTP
Gas-assisted Injection Molding

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Gas-assisted Injection Molding

Airmould® The modular system
Gas-assisted Injection Molding

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The Airmould® modular system:
1. Nitrogen generators
2. Pressure generators
3. Gas pressure control
4. Gas injection
Gas-assisted Injection Molding

1. Nitrogen generators

- Nitrogen generation with membrane filtration
- Specification from 130 up to 500 Nl/min
- Minimum nitrogen purity 98%
- Chill dryer to reduce residual moisture
- Large nitrogen storage accumulator
- Low noise
- Mobile, compact design
- Integrated air compressor
- Easy maintenance
Airmould®

2. Pressure generating units

Compresses the nitrogen supplied by:

- Nitrogen generator unit type SE
- Nitrogen bottles
- Liquid nitrogen

One pressure generator is capable of supplying gas simultaneously to several injection molding machines.
Gas-assisted Injection Molding

**Airmould®**

Pressure generating units series DE

- Specification from 130 up to 500 Nl/min
- Max. working pressure 300 bar
- Low noise
- Mobile, compact design
- Large nitrogen storage accumulator
- One pressure generator is capable of supplying gas simultaneously to several injection molding machines
Gas-assisted Injection molding

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Pressure control - two versions:

- Stationary, integrated in the machine control UNILOG B4
- Mobile via Airmould® interface
Gas-assisted Injection Molding

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Pressure control

- Integrated in the machine control UNILOG B4
- Up to 4 pressure control modules
- For all gas injection processes
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Pressure control

Mobile Airmould® control via Airmould® interface

- One Monomodule
- Two Monomodules via Duplex
- Mobile control unit B4 AC

Airmould® interface for all types of injection molding machines
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Pressure control

Monomodule with integrated control
with manual programming device with all standard functions for ex.
- Impulse program
- Manual operation
- Diagnostic

for up to 2 Monomodules (Duplex)

Modules can be placed close to mold to minimize gas consumption
Gas-assisted Injection Molding

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Pressure control

Mobile control unit B4 AC

Control UNILOG B4

Easy data saving
- internally 99 sets of data
- externally on floppy disc

Languages:
- German and English as Standard

bar or psi
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Pressure control

Mobile control unit  B4 AC

- Up to 4 pressure control modules
- Up to 4 Monomodules
- For retractable gas needles
- Suitable for all gas injection processes
- Option: Hardware core pull program
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Pressure control
Mobile control unit B4 AC

User friendly setting
With all standard functions e.g.
- Impulse program
- Manual operation
- Diagnostic
Quality control
- Set- & Actual value graphics
- Pressure control

also for Aquamould®
Gas-assisted Injection Molding

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Pressure control

Pressure control module

together with stationary control

together with mobile control unit B4 AC

Modules can be placed close to mold to minimize gas consumption
Gas-assisted Injection Molding

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Pressure control

Quick gas pressure release valve

Recommended for:
- Reinforced materials
- Flame retardant materials
- Parts with large gas volume

Reduction of:
- Plate-outs
- Gas release time
4. Gas injection

Machine nozzle for Airmould®:
- Open nozzle
- Shut-off nozzle

Gas injection modules for Airmould®:
- Stationary needles
- Retractable needles
Gas-assisted Injection Molding

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Gas injection

Airmould® machine nozzle
- Easy mold design
- Sealing is possible
Gas-assisted Injection Molding

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Gas injection

Airmould® injection module

- Three diameters: 3, 5 & 8 mm
- Standardized length
- Small dimensions
- Compact and small design
- Entry depth adjustable
- Cleaning without disassembling
Gas-assisted Injection Molding

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The Airmould® modular system:

1. Nitrogen generators
2. Pressure generators
3. Gas pressure control
4. Gas injection

Video: Production cell
Many thanks for your attention

More information on www.battenfeld.ru