Back Molding Technology

Decorated parts in one process step
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2. Decoration processes - overview
3. Technology for decoration with films
4. Technology for decoration with textiles
5. Special processes for decoration
   5.1 Back Molding with foamed material
   5.2 Sequential injection molding
   5.3 Compression injection molding
6. In Mold Labeling (IML)
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6. In Mold Labeling (IML)
Motivation

Increasing of profitability by:

- Integrated functions
- Saving of the following process steps, e.g.
  - printing
  - painting
  - laminating
- high level of automation
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6. In Mold Labeling (IML)
Goal and way of solution

Completely decorated molding out of the injection molding machine

- Back Molding of preformed printed films
- Back Molding of printed carrier films
- In Mold Decoration (IMD)
- Back Molding of wood veneer
- Back Molding of textiles
- In Mold Labelling (IML)
Decoration processes

Films:
- **In Mold Decoration (IMD)** using embossing films
- **Film Insert Molding (FIM)** using flat or preformed films
- TPO Films

Textiles:
- Trimming as a separate process outside the mold
- **In Mold Cutting (IMC)** = textile cutting in the mold

Wood:
- Veneer
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Technology for Decoration with film

1. In Mold Decoration - IMD

2. Film Insert Molding - FIM
   - Flat film
   - Preformed film
   - TPO film

1. Backmolding of wood
In-Mold-Decoration (IMD)

Principle:

- Film feeding device transports decorated film in between two opened halves of the mould
- Back Molding of the film
- Decoration relieves from the carrier film and fixes on the molding
In-Mold-Decoration (IMD)

Film feeding device

Quelle/Source: Fa. Kurz
In-Mold-Decoration (IMD)

IMD-Films:

- single decorative film
- endless decorative film
In-Mold-Decoration (IMD)

Principle design of the embossing film

Direction of back molding

- Decorative layer
- Scratch resistant layer
- Separation layer
- Carrier layer

Transfer layer

Film
IMD
FIM
Flat Film
Preformed Film
TPO Film
Wood
In-Mold-Decoration (IMD)

Process variable

„normal“ construction

construction for depth effect

Decorative layer

Plastic

Visible site

Film

IMD

FIM

Flat Film

Preformed Film

TPO Film

Wood
In-Mold-Decoration (IMD)

Multiple designs and functions

- Metallic-pigments
- Metallized areas
- Brushed areas
- Colour changing with temperature
- Hologram
- Special scratch resistant
- Shielding effect
In-Mold-Decoration (IMD)

Applications:

- Automotive
- Telecommunication
- Household and electronic
- Cosmetics (Packaging)
- Hifi
- Leisure and sports
Back Molding Technology

In-Mold-Decoration (IMD)

Application: Automotive

Product code for cars

Quelle/Source: Fa. Kurz
In-Mold-Decoration (IMD)

Application: Automotive

Cover

Decorative molding

Quelle/Source: Fa. Kurz
In-Mold-Decoration (IMD)

Application: Automotive

Cover for heater control
In-Mold-Decoration (IMD)

Application: Telecommunication

Display for mobile phone
In-Mold-Decoration (IMD)

Application: Telecommunication

Housing for mobile phones

Quelle/Source: Fa. Kurz
In-Mold-Decoration (IMD)

Application: household / electronic

Household goods

Quelle/Source: Fa. Kurz
In-Mold-Decoration (IMD)

Application: household / electronic

Household goods
Back Molding Technology

In-Mold-Decoration (IMD)

Application: household / electronic

Electronic

Quelle/Source: Fa. Kurz
In-Mold-Decoration (IMD)

Application: household / electronic

Cover for loud speaker
In-Mold-Decoration (IMD)

Application: Cosmetic

Aesthetic packaging
In-Mold-Decoration (IMD)

Mold technology and accessories

- 2- and 4- cavity molds possible
- Direct gating with hotrunner
- Positioning with printed brands
- Tolerances at the molded part up to \( \pm 0.02 \) mm
- Closed loop control between film feeding device and optical sensor
- Communication between film feeding device and IMM via interface
In-Mold-Decoration (IMD)

Advantage

- high automation level
- flexible in design and fast changing of decorative surface
- no pre-treatment
- no solvents
- good adhesion on the substrate
- decorative surface is able to cover welding lines
In-Mold-Decoration (IMD)

Boundary conditions

- special moulds
- heat resistance of the film must be higher than melt temperature
- minimal number of pieces and timing for the production of the film
- depth of the decorated surface is limited
- radius are limited
- cleaning of the parts might be necessary
Film Insert Molding (FIM)

Principle:

- more thicker and rigid film (painted or printed) is inserted in the mould
- films are preformed or not and cutted
- flat and 3 dimensional parts can be molded
- film is part of the molded article
## Film Insert Molding (FIM)

### Main applications:
- automotive
- telecommunication
- medical technology
- white goods
- ...
Film Insert Molding (FIM) – flat films

Application: production of a tray
Film Insert Molding (FIM) – flat films

System technology

- Film magazin
- Separation of films
- Double gripper
- Buffer
- Mold
- Hot stamping of the rim
- Transport of finished parts
Film Insert Molding (FIM) – flat films

System solution for back molding of films
Film Insert Molding (FIM) – flat films

cover for washing machine

Material: PMMA
Film Insert Molding (FIM) – preformed films

- printed film
- preformed film
- precutted film

Final part

Quelle/Source: Fa. Kurz
Film Insert Molding (FIM) – preformed film

Decoration of the film

- silk screen printing
- Off- set printing
- colouring of the film
- vacuum coating
- scratch proof coated
- PVD coated
Film Insert Molding (FIM) – preformed film

Preforming if the film

- mechanical
- hydraulic
- thermoforming
- preforming during back molding
- high Pressure Forming (HPF)

High Pressure Forming

Quelle/Source: Fa. Bayer
Film Insert Molding (FIM) – preformed film

Cutting

- cutting with knife
  - for single samples
- steel rule cutting die
  - depends on geometry
  - for pilot plant production
- cutting die
  - for mass production

Quelle/Source: Fa. Bayer
Film Insert Molding (FIM) – preformed film

Insert and setting

- insert
  - manual
  - with robot

- setting
  - cores in the mold
  - ejector systems
  - slide (clamp)
  - pins out site the cavity
  - vacuum
  - electrostatic loading
Film Insert Molding (FIM) – preformed film

Requirements for robot

- high precision with servo axes
- suitable gripper
  - cross head gripper
  - turning double gripper
- assembling of charging element
Film Insert Molding (FIM) – preformed film

Insert of preformed films

- double gripper with 3 triods
- charging generator
- triode
- filmmagazin
- Transport of finished parts

Quelle/Source: Fa. HAUG
Film Insert Molding (FIM) – preformed film

Application: cover for heater controls

Material: PC

Quelle/Source: Fa. Bayer
**Back Molding Technology**

Film Insert Molding (FIM) – preformed film

Application: cover for a car

Material: ABS + PC/ABS

Quelle/Source: Fa. Bayer
Film Insert Molding (FIM) – preformed film

Application: cover for a car

Material: ABS + PC/ABS

Quelle/Source: Fa. Bayer
Film Insert Molding (FIM) – preformed film

Application: side protector trim
Film Insert Molding (FIM) – preformed film

Application: side protector trim

production cell with HM 3500 / 2280 and KUKA KR 30
Film Insert Molding (FIM) – preformed film

Application: side protector trim

- Clean room conditions
- Precentering of film
- Remove final part
- Insert of film

KUKA KR30/3
Film Insert Molding (FIM) – preformed film

Requirements for the film

- transparency
- suitable for printing
- elasticity for preforming
- load-bearing capacity for cutting process
- heat resistance
- shrinkage behaviour
- high surface quality
Film Insert Molding (FIM) – preformed film

Advantages

- fast changing of decorating
- multiple possibilities for decorating
- 3-D geometry possible
- no pre treatment
- welding lines can be covered
- protected printing
Back Molding Technology

Film Insert Molding (FIM) – preformed film

Boundary conditions

- additional process for production of film
- additional investment
- automation
- smaller process window
- cleanness (clean room conditions)
TPO - film

characteristics

- very often surfaces like leather
- multi layer
  - barrier for flow
  - with and without foamed backing
- lay-up in the mold preheated
- application for interior covers automotive
- limitation in regard of small radius
  (otherwise surface defects)
TPO - film

Interior cladding part with TPO-film Daimler Chrysler Vito

Quelle/Source: Fa. Müller, Wallau
TPO - film

Interior cladding part with TPO-film Daimler Chrysler Vito

Quelle/Source: Fa. Müller, Wallau
TPO - film

Different applications

Quelle/Source: Fa. Müller, Wallau
Back Molding Technology

Backmolding of decorative wood

Quelle/Source: Fa. Summerer
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Back Molding Technology

Back Molding of textile

Process: without In Mold Cutting (conventional process)

1. Precutting of textile
2. Gripper takes the precutted textile
3. Hand over to the mould
4. Mold is closed
5. Back Molding with plastic material
6. Mold opens
7. Molded part with excess length of textile is taken out
8. Cutting of textile
Back Molding of textile – without In Mold Cutting

Precutting of textile from a coil
Back Molding of textile – without In Mold Cutting

Precutting of textile

6-axis robot with CO₂ laser head

Quelle/Source: Fa. Robot Technology
Back Molding of textile – without In Mold Cutting

Cover for C-column with excess length of textile

Insert excess length of textile

Quelle/Source: Fa. Müller, Wallau
Back Molding Technology

Back Molding of textile – without In Mold Cutting

Covers for columns VW T5
Back Molding Technology

Back Molding of textile – without In Mold Cutting

Covers for columns VW T5

Introduction

Film

Textile

Special Processes

IML

Laser cutting with ABB 6-axis robot

Edge wrapping device

Central ABB 6-axis robot

HM 13000 2P / 7700
Back Molding Technology

Back Molding of textile – without In Mold Cutting

Interior door panel VW

Quelle/Source: Fa. Müller, Wallau
Back Molding Technology

Back Molding of textile

Process: In Mold Cutting (IMC))

- Precutting of textile
- Gripper takes the precutted textile
- Hand over to the mold
- Mold is closed
- Back Molding with plastic material
- Mold is opened
- Part ready to assemble is taken out
- Textile cutting
Back Molding of textile – with In Mold Cutting

Production cell (UNIROB R15 with gripper)

HM 3500/1900 + 130 L

Hand over of textile
Mould with IMCmore technology
Textile cutting with laser
Parts ready to assemble
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Process: In Mold Cutting with more material technology

- Precutting of textile
- Gripper takes the precutted textile
- Hand over to the mold
- Mold is closed
- Back Molding with plastic material
- Cutting of textile in the mold
- Injection of TPE sealing
- Mold is closed
- Part ready to assemble is taken out
Back Molding of textile – with In Mold Cutting

Process

1. Precutting of textile
2. Gripper takes the precutted textile
3. Hand over to the mold
4. Mold is closed
5. Back Molding with plastic material
6. Cutting of textile in the mold
7. Injection of TPE sealing
8. Mold is closed
9. Part ready to assemble is taken out
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Precutting with laser system

- high flexibility
- less waste
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Process

1. Precutting of textile
2. Gripper takes the precutted textile
3. Hand over to the mold
4. Mold is closed
5. Back Molding with plastic material
6. Cutting of textile in the mold
7. Injection of TPE sealing
8. Mold is closed
9. Part ready to assemble is taken out
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Hand over of the precutted textile to the mold
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Process

1. Precutting of textile
2. Gripper takes the precutted textile
3. Hand over to the mold
4. Mold is closed
5. Back Molding with plastic material
6. Cutting of textile in the mold
7. Injection of TPE sealing
8. Mold is closed
9. Part ready to assemble is taken out
Back Molding of textile – with In Mold Cutting

Integration of functions

sealing of TPE
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Process

1. Precutting of textile
2. Gripper takes the precutted textile
3. Hand over to the mold
4. Mold is closed
5. Back Molding with plastic material
6. Cutting of textile in the mold
7. Injection of TPE sealing
8. Mold is closed
9. Part ready to assemble is taken out
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Demolding
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Production cell

solution 1

solution 2
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Additional functions with 6-axis robot
Back Molding Technology

Back Molding of textile – with In Mold Cutting

System solution

Video: System solution
Back Molding of textile – with In Mold Cutting

System solutions with partners
Back Molding of textile – with In Mold Cutting

In Mold Cutting

= advantages for the moulder

- saving of space
- safe process
- profitable
Back Molding Technology

Back Molding of textile – with In Mold Cutting

Future

Using of monolayer

- special optical effects
- cost advantages
Future

- Cutting of edges in the mold
- Laser technology for flexible cutting and additional operations
- Back molding with foamed material
- Fully automation of the production
- Machine supplier is more and more responsible for the whole system
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Special process: Back molding with foamed material

Motivation:

- Increasing of the free flowing of the plastic material
- Reduction of wall thickness
- Reduction of weight (at the same wall thickness)
- Reduction of warpage
- Reduction of costs
Special process: Back molding with foamed material

Cross section of a part molded with structural foam material

Closed cell structure
Compact surface
Special process: Back molding with foamed material

Process characteristics for chemical foaming

- feeding of chemical blowing agent
- nucleation process for gas bubble production
- maximum foaming pressure less than 10 bar
- application for bigger wall thickness
- processing without problems and that which can be retrofitted easily
Special process: Back molding with foamed material

Process characteristics with phys. foaming (MuCell ®-process)

- generating of with direct injection of gas \( (\text{N}_2, \text{CO}_2) \)
- higher foaming pressure and foaming level
- suitable also for thinner wall thickness
- additional equipment necessary
- license fee necessary
Special process: Back molding with foamed material

Machine equipment for injection molding of foam:

- shut off nozzle
- increased injection speed
- clamping of injection piston
- increased platen or Battenfeld 2 platen-IMM

MuCell®-process requires in addition:

- SCF-System
- special screw
- fans for heater bands (similar to PVC-equipment)
- gasinjector
- additional software

New: Equipment for MuCell™-process that which can be retrofitted!
Special process: Sequential injection molding

- Both nozzles are closed
- One nozzle is open, one nozzle is closed
- Both nozzles are opened
Special process: Sequential injection molding

Advantages:

- shorter flow distance
- less filling pressure
- less warpage
- textile gently
- no welding lines

Disadvantages:

- more complex mold technology (hot runner with shut off needles)
Special process: injection compression molding

Quelle/Source: Georg Kaufmann
**Special process: injection compression molding**

Advantages:
- less filling pressure
- less warpage
- textile gently

Disadvantage:
- more complex mold technology (vertical flash face)
- not for all geometry suitable
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In-Mold-Labeling (IML)

Mainly used for packaging parts (Thin wall)

Process:
- Insert of the label
- Back Molding
- Demolding

Alternative process:
- Thermoforming and printing
In-Mold-Labeling (IML)

Label (Film)
In-Mold-Labeling (IML)

Container 250 g
In-Mold-Labeling (IML)

Container with film
In-Mold-Labeling (IML)

Advantages:

- flexible in changing of decoration, suitable for small numbers
- advantages in regard of hygienic requirements
- very short cycle times
- up to 16 cavities possible
- automatic changing of decoration
- full automatic stacker
Thank you for your attention

more information : http://www.battenfeld.ru