Design & Manufacturing of Water Assisted Parts

a presentation by
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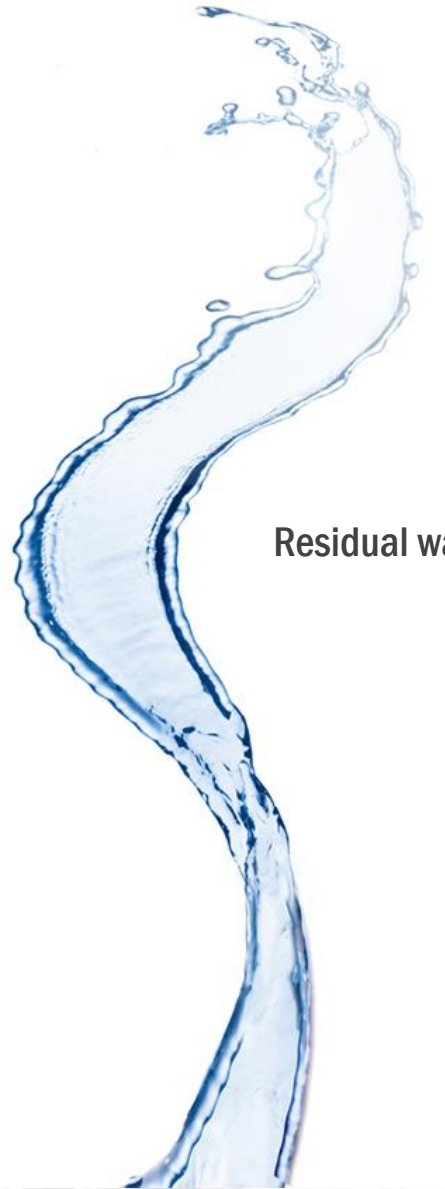
PMEfluidtec
FLUIDINJECTION IN PERFECTION

Contents

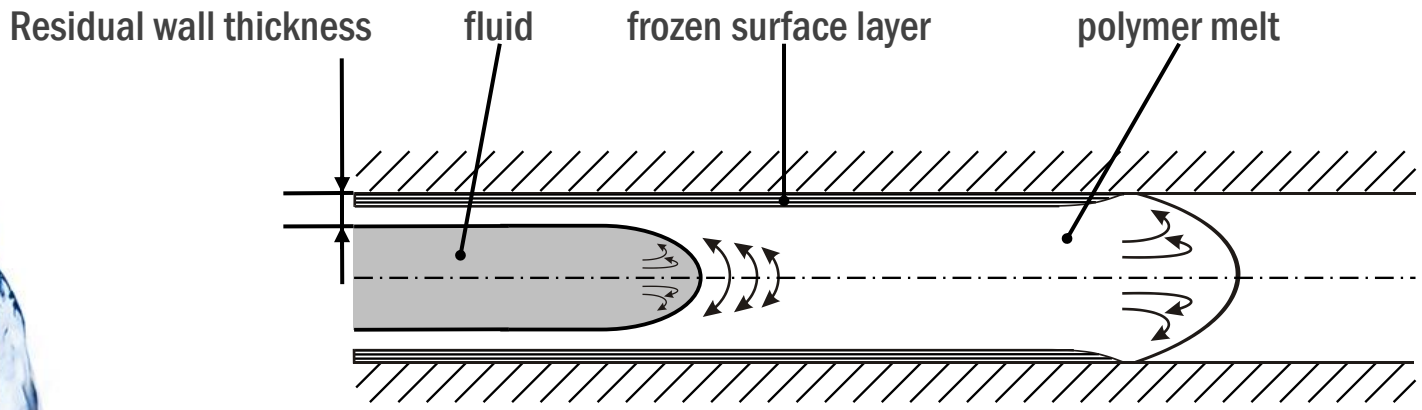
1. Company profile

- Founded in 2001, PME*fluidtec* is now a leading innovator in the filed of fluid assisted injection molding (FAIM).
- Core business is the development, process support and production of machine equipment for FAIM.
- Side business is the production of energy efficient nitrogen generators combined with high pressure compressors for PME GIT modules
- PME*fluidtec's* success is based on the extensive know-how of its employees , this forms the basis for:
  - engineering services
  - consultiting services
  - mold and product design
  - → implementation of a part from the drawing board into mass production

2. Fundamentals of fluid injection



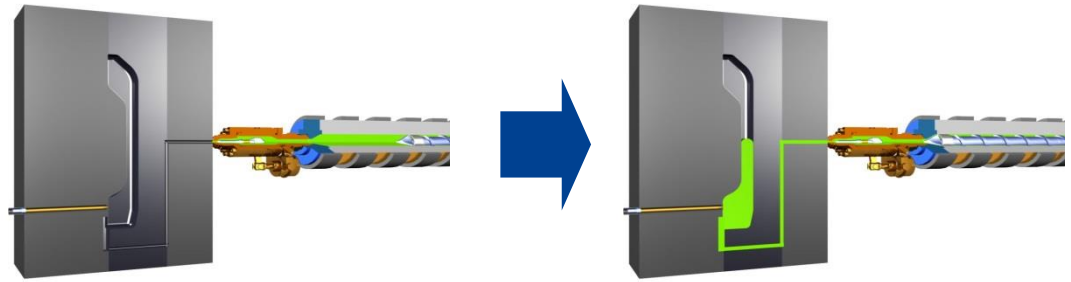
1. polymer melt is injected into the cavity
2. fluid is injected into the liquid core of the polymer melt
3. fluid removal (only water)
4. finished part with a hollow section



two component flow in a short shot process

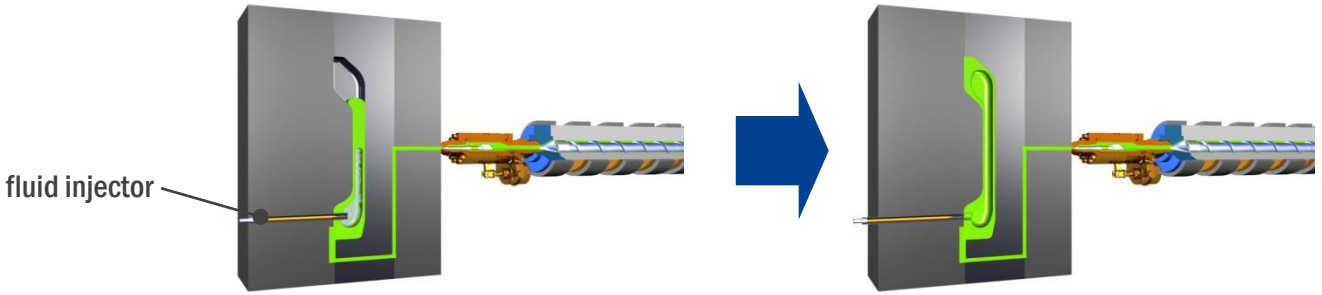
3. Process variations

1. short shot (partially filling)



mold before filling

partially filling cavity



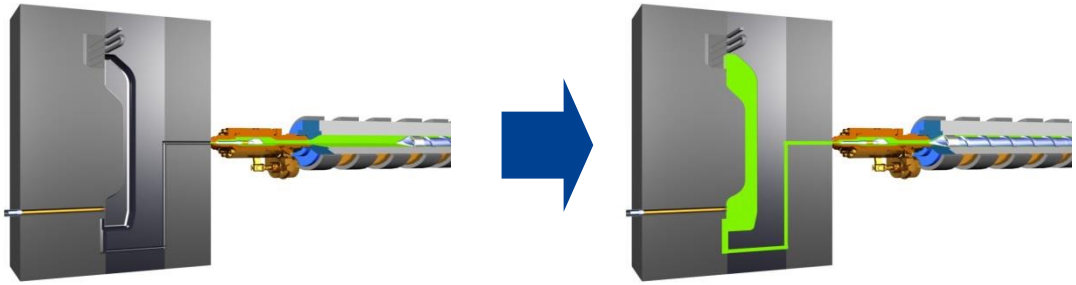
fluid injection

end of fluid injection

[pictures by ENGEL]

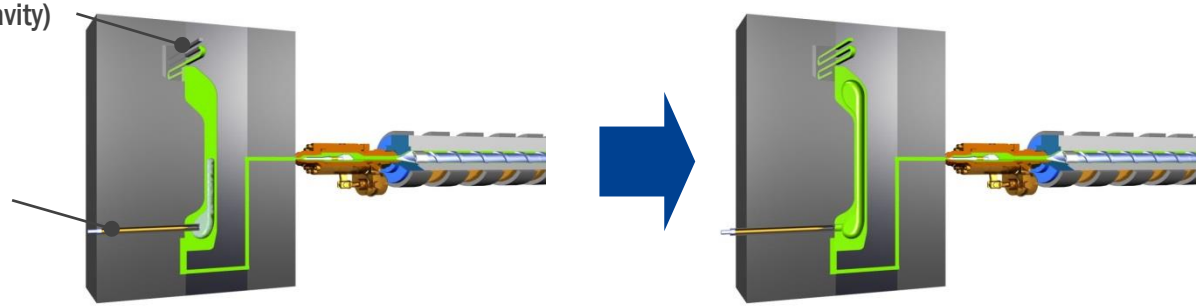
3. Process variations

2. overflow (side cavity)



mold before filling

end of polymer injection



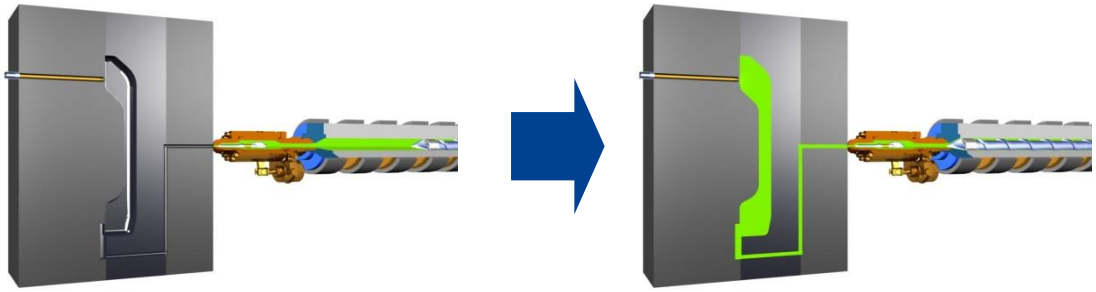
fluid injection during opened side cavity

end of fluid injection

[pictures by ENGEL]

3. Process variations

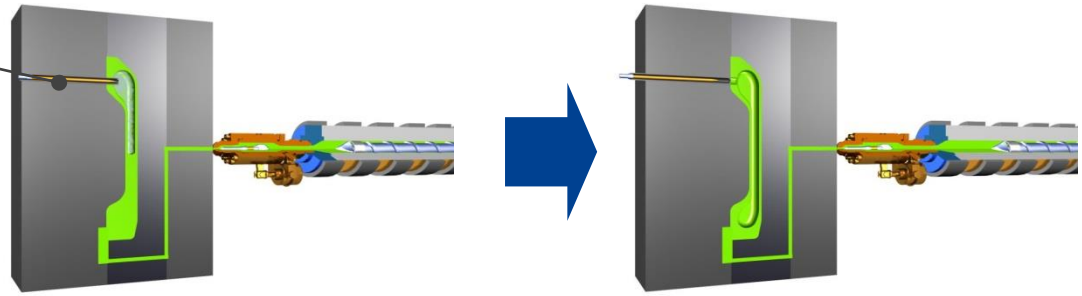
3. melt pushback



mold before filling

end of polymer injection

fluid injector



fluid injection pushes
melt back into the barrel

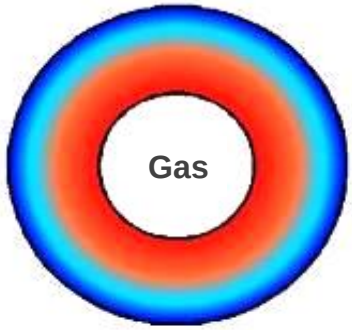
end of fluid injection

[pictures by ENGEL]

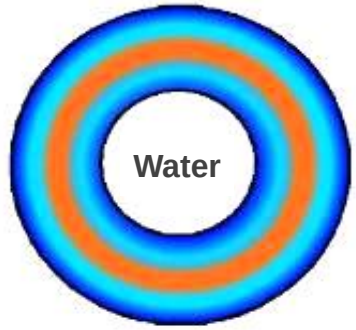
4. Differences between gas and water injection

It is often not obvious whether a part should be produced with gas or water. The main reason to use WIT are the advantages of water as a medium.

- water has a substantially higher cooling effect than gas
- water is incompressible
- water is almost everywhere available and lower-priced than N2



cooling from outside

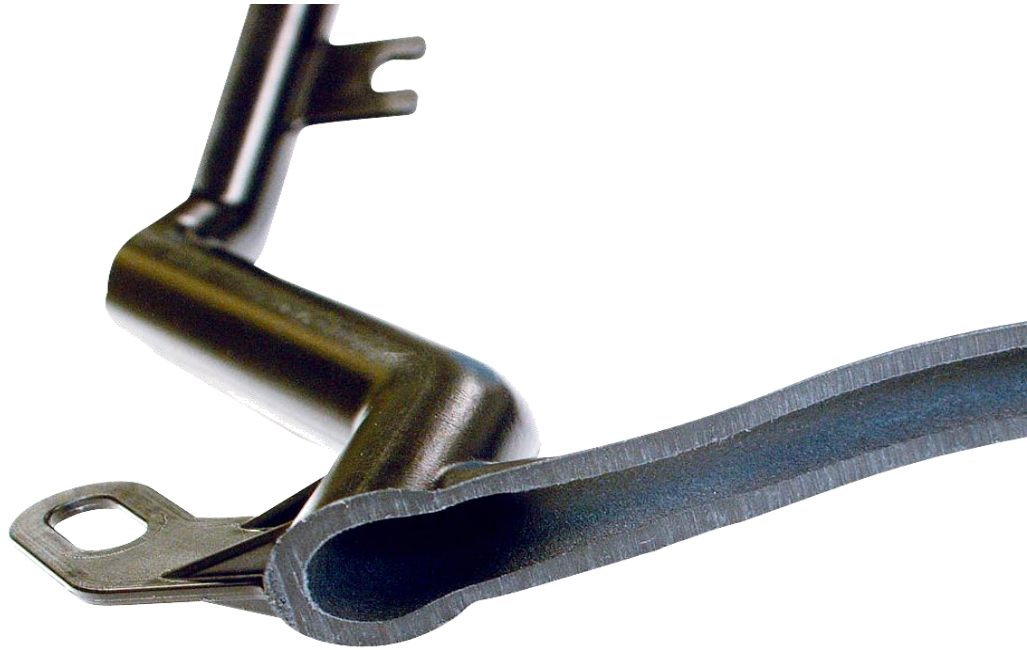


cooling from both sides

[pictures by ENGEL]

5. Advantages of water injection technology

- Water lets the inside wall solidify very fast which leads to a smooth channel.
- Additionally the cooling time gets reduced considerably up to 60%.



5. Advantages of water injection technology

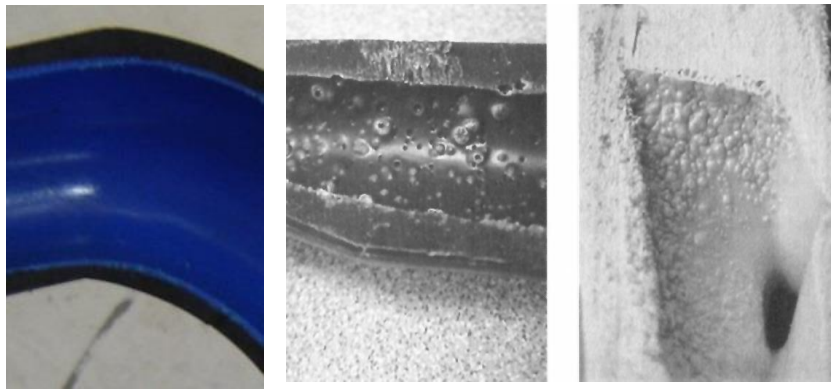
Media leading parts

- With media leading parts it is essential that the channel is even and that the channel surface is closed.
- Using WIT, significantly bigger cross-sections can be achieved as with GIT
- With GIT it happens often that not solified material flows downwards in the channel. This doesn‘t happens with WIT.

5. Advantages of water injection technology

- In contrast to gas water doesn‘t diffuse into the melt. There is no risk of foaming at the channel surface.

- Cycle time reductions of up to 60% are attainable for media leading parts in WIT at same part size as in GIT.

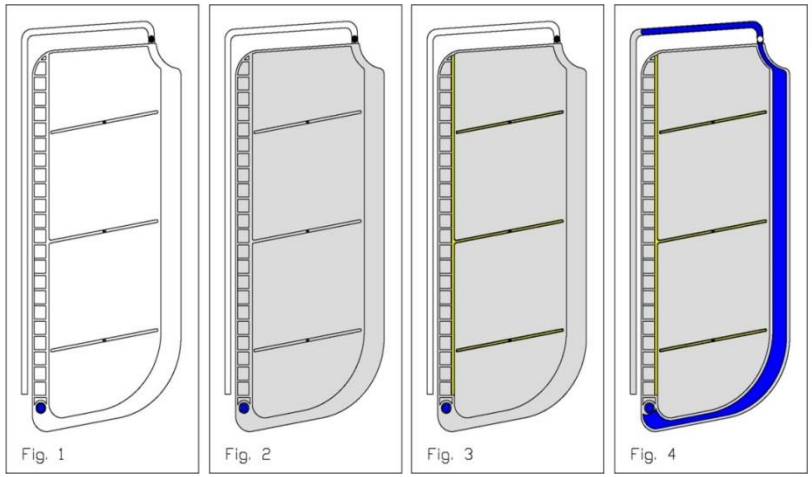


WIT GIT

5. Advantages of water injection technology

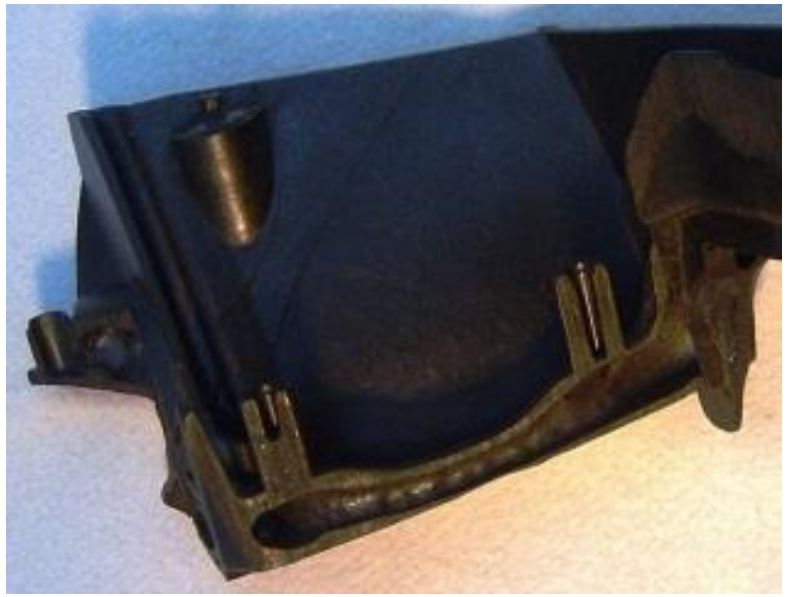
CIT – WIT and GIT used for one part

- Combined Injection Technology, GIT and WIT in one part, for parts which have big channel cross sections as well as areas with shrinkage compensation such as ribs.
- Water is injected into the big channel cross sections while gas is used at the other areas.
- CIT is possible with any PME-controller.



6. Part Design for fluid assisted injection

- Transitions of channels to flat areas (flat parts with thick spots) must be designed so that it doesn‘t come to any melt accumulations.

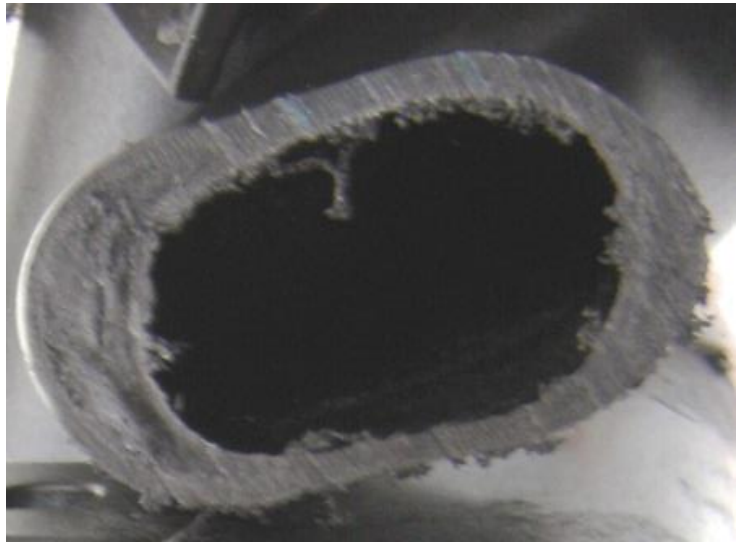


6. Part design for fluid assisted injection

- If possible, the ratio of width to height should not be too dissimilar at flat or oval parts. The channel attempts to be circular.

  →accumulations on the side walls.

- Whether this effect is disturbing for the respective part depends strongly on every individual case and also to the material.

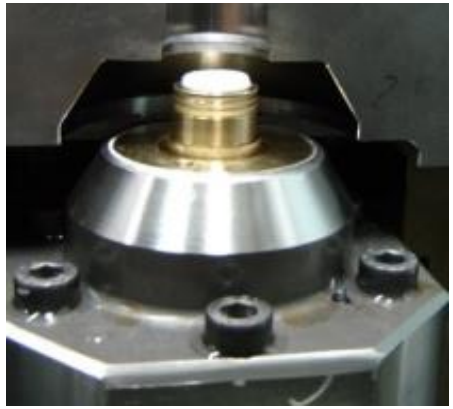


6. Part Design for fluid assisted injection

- Too small radii or sharp-edged changes of direction in the fluid channel should be avoided.
- The channel moves to the inside and is not centered
- This leads to a increased warping and to greater wall thickness on the outside.

7. Mold design, injector position in the mold

- Compared with gas, water always flows downwards
- One can economically remove the process water from the part only from the bottom side of the part.
- With all processes (partial filling/over flow) where only one injector is used, the injector has to be placed at the deepest point of the channel.



7. Mold design, injector position in the mold

- When a flush injector is used additionally, it makes sense to place it on the bottom and the injection injector should be placed above.
- A WIT-injector has usually a bigger diameter than a GIT-injector.
  It is crucial to consider the position of the injector already at the part design.
- The decision whether the injector shall be placed directly at the part or connected via a channel should be considered already during the part design.

7. Mold design, pre-filling with the melt

- A decisive factor in the mold design is a laminar flow at the pre-filling of the cavity, without a jet and with as few weld lines as possible.
- Here the part designer is most required because the mold maker can only do the fine tuning via the gate
- A 3D simulation is a decisive advantage here!

8. Mold, Injector, Machine Equipment, Material: the complete package makes the difference!

- WIT offers a wide processing window, granted you adhere to the basic rules and guidelines
- Unstable processes happen easily if basic faults are made or the compromises are too big for some parameters
- The WIT-Process behaves in black and white.
  Complex parts are either good or bad (but repeatable).

8. Mold, Injector, Machine Equipment, Material: the complete package makes the difference!

- For the complete process chain up to the series part the whole package must be right. Mold, injector, WIT machine, material and process – all these items have to be taken into account with the same care.

  Only then, all advantages of fluid injection can be used in the right way.

9. Application examples

- Customer BATZ
- OEM BMW
- Cycle time 45 sek.
- Material PA66 GF30
- Part weight 300 gr.
- Application WIT push back

9. Application examples

HANDLE, TRANSPORT CART

- Manufacturer Mouldtec / Wanzl
- Production since 2007
- Material PP
- Application WIT full shot with over flow and flush

9. Application examples

Sulo Container Lid

- Production since 2001
- Material PE
- Shot weight 15 kg
- Application Full shot with over flow

9. Application examples

Maxi Cosi Carrying Handle

- Production since 02/2002
- Material PP
- Weight ca. 800 gr.
- Application WIT partial filling

9. Application examples

LASHER Wheel Barrow

- Manufacturer LASHER Tools Pty Ltd, SA
- Production since 11/2011
- Material PP GF 50, alt. PPA GF50
- Cycle time 62 sec
- Application 2-times back to spill process

9. Application examples

Comfort-Mono-Handlebar [Lawn-mower]

- Manufacturer Viking GmbH
- Production 05/2011
- Material PPA GF 50
- Cycle time 48 sec
- Application Back to spill process

universal design award 2011

9. Application examples

BSH Fridge Handle

- Production since 08/ 2002
- Cycle time 34 sec
- Material PA 6 GF 30
- Weight 180 gr.
- Application WIT partial filling, 2-parts, switch in between handles

9. Application examples

Fork Lift Handle Jungheinrich

- Production since 04/ 2002
- Cycle time 39 sec
- Material PA 6 GF 30
- Weight 740 gr.
- Application Full shot with over flow

9. Application examples

Fork Lift Handle Jungheinrich

- Production since 08/ 2002
- Cycle time 38 sec
- Material PA 6 GF 30
- Weight 650 gr
- Application Full shot
  with over flow

9. Application examples

Chain Saw Handle

- Production seit 01/ 2004
- Cycle time ca.45 sec
- Material PA 6 GF 30
- Weight ca. 250 gr.
- Application Partial filling

9. Application examples

Upper Handle Vorwerk

- Production seit 2004
- Material PA 6 GF 30
- Cycle time ca.43 sec
- Shot weight 135 gr
- Application Full shot with over flow; auto-matic production with degating and welding the opening shot

9. Application examples

Pot Handle Vorwerk

The production of the pot handle with the current design was only possible by using the water injection technology of PME fluidtec. The high requirements on the handle like no flash on the surface, no sinkmarks, an even appearance, almost free of warpage and a high process reliability wouldn't have been able to be fulfilled in another way.

9. Application examples

Pot handle Vorwerk

The handle runs now on two fully automatic production cells since the middle of 2004. At the beginning the production was in the mold department of a mold builder.

The close cooperation between the mold company and PME fluidtec and VorwerkSemco made it possible to achieve a dry and successful production in a short time.

9. Application examples

Audi/VW Cooling Manifold Common-Rail Diesel

- Manufacturer — Polytec Automotive
- Production — since 09/ 2007
- Cycle time — ca. 35 sec.
  because of insert bushings
- Material — PA 66 GF 30 HR
- Weight — Shot ca. 1000 gr.
  Part 550 gr.
- Application — WIT push back partial PIT

9. Application examples

VDA Coolant Coupler

- Manufacturer AKsys
- Production 2007
- Cycle time 19 sec
- Material PA 66 GF 30 WIT
- Part weight 43 gr
- Mold 2-cavity
- Application WIT full shot with over flow and push back

9. Application examples

Cable Routing (Rear door)

- Manufacturer — ETG, AIF funded project with PME fluidtec
- Production — 2007
- Cycle time — 45 sec
- Material — TPE 2-K (ends hard, inbetween flexible)
- Part weight — 43 gr.
- Mold — 1-cavity
- Application — Full shot with over flow

9. Application examples

Cover VW T5

- Manufacturer — ETG, AIF funded project with PME fluidtec
- Production — 2007
- Cycle time — 45 sec
- Material — PP/TPE Monosandwich
- Mold — 1-cavity
- Application — Full shot with over flow

9. Application examples

Golf Plus Rear door

Polytec manufactures the frame for the Golf Plus rear (hatch) door in a fully automatic cell.
The dry side cavities will be re-ground right at the machine and reused.

9. Application examples

Golf Plus Rear Door

- Manufacturer — Polytec Hodenhagen
- Production — since 2004 – ca. 2009
- Material — PP
- Weight — 850 GR
- Application — Full shot
  with over flow and flushing

9. Application examples

VW Passat Roof Rail

- Customer Decoma/Magna
- Manufacturer Hoffmann Werkzeugbau GmbH
- Production Development
- Material PA 6 GF 50
- Cycle time 60 sec
- Application WIT push back

9. Application examples

Door handle PKW

- Material PP
- Cycle time ca. 40 sec
- Application Full shot
  with over flow and flushing

PME fluidtec portfolio

PME WIT
POWER MODULE 15/210

PME WIT
POWER MODULE 15/210-4

PME WIT
EXT. WASSERTANK

PME*wirelessvalve*N$_2$

PME*cube*
BASIC MODULE
15/210

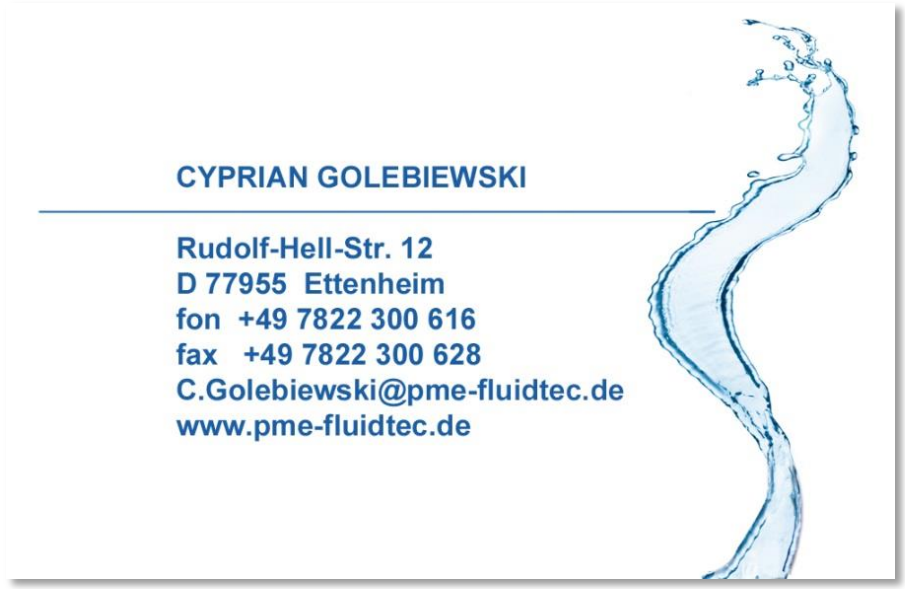
PME*cuboid*
BASIC MODULE
4/10/160

PME*cube*N$_2$
GAS-INJECTION
BASIC MODULE
4-400/20500

PME*domino*N$_2$
GAS-INJECTION
MINI MODULE

Many thanks for your attention.

Questions?



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