Container Glass Forming in 2020/2025

The dark factory

Weimar, May 2017
XPAR Vision foundation and focus

> 20 years track record of innovating the glass production process

- 1994 JD / CTI / RUG / Glass
- 1999 Foundation XPAR Vision
- Focus on container glass industry
- Focus on hot end production process
  - Inspection, process monitoring
  - Sensors, automation, robots → process improvement & quality control
The dark factory

- A dark factory is a fully automated shop floor
- Smart Manufacturing / Industry 4.0
The dark factory

Main drivers: cost, quality, labour

Cost

- Efficiency low: 85-90%
- Quality to customer < 100%
- Many unknown variables
- No/slow (quality) feedback loop
- Forming highly human dependent
- Labour is aging
- Flexibility is low
- Containers are too heavy (40%)
- Speed of production too low

Characteristics

Alternatives
- Plastic, Aluminium, PET
- Cheap, flexible, light

Sustainability
- Environmental (waste/energy/carbon)
- Social (labour conditions)
Main drivers: cost, quality, labour

Containers are (designed to be) too heavy

Example:
Beer bottle, customer spec. = min. thickness shoulder/body/heel 1 mm.
Beer bottle, design spec. = 1.8-1.9 mm thickness

The level of (forming) process control is (very) low: efficiency and weight!!

Process stability is the key towards optimization
Process stability is the key

- Cullet
- Batch/homogeneity
- Viscosity/temperature/homogenity
- Feeder pull
- Ambient temperature
- Gob condition (weight/shape/temperature) variation
- Loading variation
- Temperature variation
- Bottle variation/defects
- Deterioration/wear
- Material change
- Operator change
- Stop/start
- Swabbing
Focus on hot end forming

**Process stability requires automation (and thus sensors)**

1927....2000: No real time factual information on forming process and bottle quality in hot end

More focus on HE pack than on HE quality
Focus on hot end forming

Huge savings potential!

Lighter and stronger containers.....
produced with (almost) zero defects.....
at higher speed....
with minimal human dependency.
Deflector

- Normally a coating is used in the deflector
- This coating wears out after a while and more and more friction will appear in this area
- When the gob meets more friction it will start to deform:
  - Shorter length
  - Increased diameter
  - Shape deviation (from cylindrical)
  - Decreased speed
- More defects are the result
Example process variation: deterioration and wear

Gob Assist: cavity 3 M, 15-07 00:15

Due to higher friction in delivery
Example process variation: deterioration and wear

**Deflector: gob changes**

At gob cut shape of gobs might look equal...

...but length, shape and diameter can be different when loading into the blank...

...due to friction in the delivery system
Example process variation: deterioration and wear

IR-D: cavity 3 M, 15-07 00:15

Due to the shorter length the glass distribution changes.

The sensor GA sees the gob condition changing.
An automated lubrication of deflector would prevent this from happening.
More consistency/predictability would be the result.
Automation: Vertical Glass Distribution

From uncontrolled to controlled glass distribution

The sensor IR sees the glass distribution changing. Operator will not act upon it as the bottle still within customer specification.

With an automated algorithm it is very easy to optimize/control the glass distribution. The bottle will be stronger and potential for weight decrease is huge.
Automation: Vertical Glass Distribution

The impact of automation is huge
Automation: impact

The variation of glass thickness (glass distribution) reduces!
What is available today?

**Sensors**
- Bottle/cavity variations
  - Inspection
  - Container geometry
  - Glass distribution
  - Position on belt/stuckware/downware
- Gob loading variations
  - Speed/Lenght
  - Time of arrival
  - Position
  - Orientation/shape/falling angle
- Temperature variations
  - Mould
  - Plunger/neckring
  - Parison
- Gob Forming
  - Temperature/shape
  - Weight

**Automation**
- Gob weight control
- Ware spacing control
- Mould temperature control
- (Plunger) process control
- Vertical glass distribution control
Reduce human dependency

Besides sensors and automation robotics is critical step towards the dark factory

- Sensors, automation and robotics will replace (most) functions of the hot end operator
- Leading to much better output
- Reducing the operational costs (TCO)

Time distribution tasks hot end operator

Swab blank side 30%
Swab blow side 20%
Quality control 13%
Defect correction / adjust machine 11%
Mold change 6%
Measurement weight 5%
Fill swab oil 1%
Make swab 1%
Make spare swab 2%
No spare swab 1%
Focus on hot end forming

Huge savings potential!

Lighter and stronger containers.....
produced with (almost) zero defects.....
at higher speed.....
with minimal human dependency.
Next steps

- More / better sensors, automated control loops, robot functions
- Integration of systems (=data)
- Smart use of data
Hot end forming 2020/2025: Smart Manufacturing / Industry 4.0

The dark factory

- Economical aspects
- Human/labour/safety
- Cooperation within the industry
Join us

Bright ideas. Better glass.
Thank you for your attention

Bright ideas. Better glass.