Container Glass Forming in 2020/25
The dark factory

AFGM 2016, Hua Hin, Thailand
Container Glass Industry: market dynamics

Big challenges are facing the glass industry today

- Inefficiencies/waste (low pack to melt ratio: 85-90%)
- Resorting
- Quality to customer < 100%
- Low quality control in hot-end: no/slow feedback loop
- Hot end forming highly human dependent
- Labour is aging
- Flexibility is low (multi product, multi gob)
- Containers are too heavy (30-40%)
- Speed of production too low

Sustainability
- Environmental (waste/energy/carbon)
- Social (labour conditions)

Cost
- Energy
- Material
- Labour

Characteristics
- Inefficiencies/waste (low pack to melt ratio: 85-90%)
- Resorting
- Quality to customer < 100%
- Low quality control in hot-end: no/slow feedback loop
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Alternatives
- Plastic, Aluminium, PET
- Cheap, flexible, light

Glass manufacturers need to improve quality, reduce costs, increase flexibility
Container Glass Industry: market dynamics

Containers are (designed to be) too heavy

From the outside it looks ok, but……there is a structural imbalance between customer requirement and current (forming) process capability

Process stability is the key towards optimization

Example:

Beer bottle, customer spec. = min. thickness shoulder/body/heel 1 mm.

Beer bottle, design spec. = 1.8-1.9 mm thickness
Focus on hot end forming

Potential for improvement is huge: 20-25%!

Lighter and stronger containers, produced with zero defects at higher speed, with minimal human dependency
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

Quality to customer “secured” by CE investment and resorting
## Industry overview: sensors, feedback loops, robot

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<th></th>
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<th>Bottero</th>
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<th>MSC</th>
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- Excluding: handheld measurement tools, mechanical servo tools, cooling mechanism, lubricants
Hot end forming 2016

Hot end real time information: IR

- Bottle measurement: where forming process capability meets customer requirement → the only logical reference point

- Quality selection (inspection) – fast remedial action – learning – process improvement – (automatic) quality control (human dependency) – stability/predictability- less quality problems

- Chocked neck
- Bird swing
- Shark fin
- Local deformation
- Freak
- Leaner
- Wedged bottom
- Thin bottom/body/shoulder/neck
- Thin spot
- Spikes
- Surface flaws
- Inclusions
- Offset finish
- Stuck/fallen ware

- Gob temperature (difference between gobs, homogeneity of individual gobs)
- Weight
- Composition (redox)
- Loading variation
- Section performance
- Ware handling
- Cooling
- Speed
- Mould condition/design
- Job change
- Stop/start
- Swabbing
- Operator behaviour
Hot end real time information: other

- **Weight**: automatically constant gob weight
- **Loading**: faster identification and alignment at loading events (friction, coating, equipment change), avoid critical defects related to loading, less uncontrolled sections stops, less swabbing
- **Temperature**: automatically constant temperature
- Easy root cause analyses in case of bottle deviation
- Overall: use leads to improved quality, efficiency, safety, know how, reduced workload and less human dependency (replace opinions by facts!)

### Loading measurement
- Speed
- Position
- Length
- Time of arrival
- Diameter
- Shape

### Temperature measurement
- Blank
- Plunger
- Neckring
- Parison

### Loading related defects:
- Baffle seams
- Thin necks
- Bird swings
- Blisters
- Loading marks
- Finish defects

Amazing discoveries... part X
Hot end automated control loops

- Reduce influences of normal disturbances by automatic control (compensation)
- Enable stable and predictable process, less glass wall thickness variation, less weight, less (critical) defects, shorter ramp up time, minimal dependence on skills operator

“Defect-demons” do not exist
Defects are really preventable
Hot end forming 2016

Hot end robotized (blank) swabbing

• Constant swabbing
• Uniformity of swabbing into moulds
• Reduced graphite oil consumption
• Decrease defects due to swabbing
• Decrease operator exposure to smoke, noise and danger
• Reduce workload

“Defect-demons” do not exist
Defects are preventable
Focus on hot end forming

**Potential for improvement is huge: 20-25%!**

**Lighter and stronger containers, produced with zero defects at higher speed, with minimal human dependency**

Spot the difference...
Next steps

- More (good) sensors, automated control loops, robot functions
- Integration of systems
- Smart use of data
- Smart swabbing: reduce, strength

- Universal database platform for all (furnace, feeder, machine, hot end sensors/loops, cold end sensors)

- Sensors/controls (gob conditioning/forming, gob delivery/loading, cooling, conveying, inspection)
- Robot (swabbing blow, change materials, cleaning, adjustments, diagnose)
- Data → information (integration, smart use)
Hot end forming 2020/25

The power of (smart) vision systems

Montreal - GB-16619

- IS rejects
- XPAR rejects
- section 9

Graph showing % outside normal variation over dates from 30-03-2015 to 30-03-2015.
Hot end forming 2020/25

Ultimate goal: dark factory
Hot end forming 2020/25

**Ultimate goal: dark factory**

- Economical aspects
- Ecological aspects
- Human/labour aspects