Container Glass Forming in 2020/25

The dark factory

AFGM 2016, Hua Hin, Thailand

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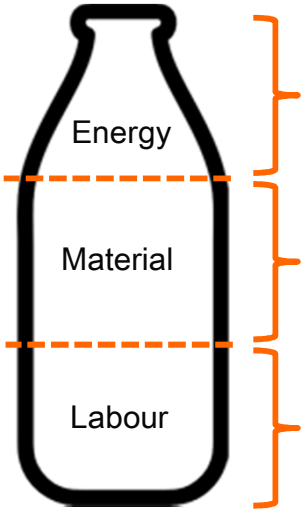
Container Glass Industry: market dynamics

Big challenges are facing the glass industry today

Sustainability

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

Cost



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
- 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

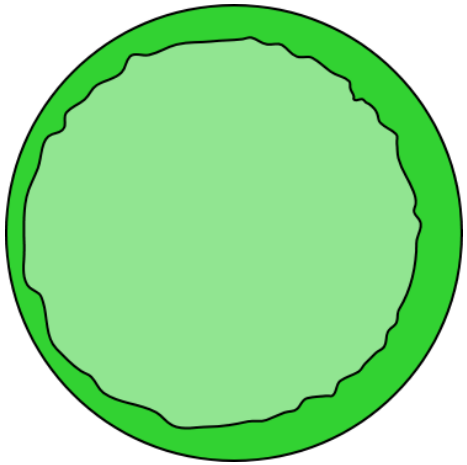
Alternatives

- 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



Example:

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

Beer bottle, design spec. = 1.8-1.9 mm thickness

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

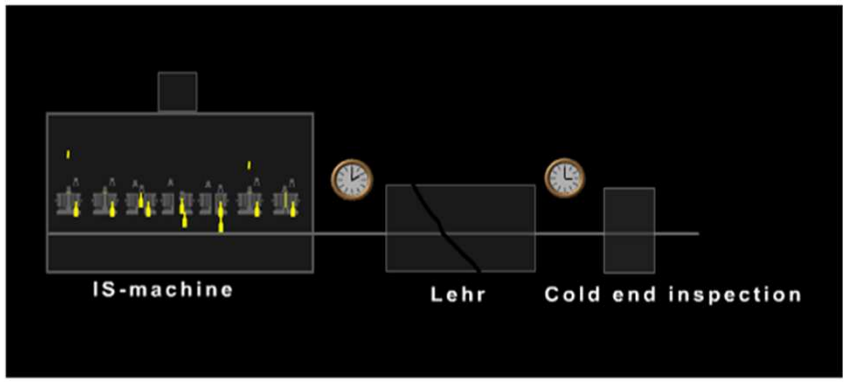
Focus on hot end forming

Potential for improvement is huge: 20-25%!

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

Focus on hot end forming

Historical perspective



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

Hot end forming 2016

Industry overview: sensors, feedback loops, robot

	BEG	Bottero	Heye	MSC	NY	XPAR	
Gob Temperature/shape				Hot Mass			Measurement
Gob weight NNPB/PB/BB				Hot Mass	GMC	IGC	Measurement/control
Plunger press process / Gob weight NNPB	PPC		HPC				Measurement/control
Temperature mould	TCS/BlankRadar				MTC	BTC	Measurement/control
Temperature Neckring/Plunger	TCS/BlankRadar					BTC	Measurement
Temperature Parison	TCS/BlankRadar					BTC	Measurement
Bottle/cavity deviations	FlexRadar			Hot Form		IR-D	Measurement
- inspection	FlexRadar			Hot Form		IR-D	Measurement
- container geometry	FlexRadar			Hot Form		IR-D	Measurement
- glass distribution	FlexRadar			Hot Form		IR-D	Measurement
- position on belt/stuckware/downware	FlexRadar/WHS	X	X	Hot Move		IR-D	Measurement
Gob Loading	BlankRadar					GA	Measurement
Plunger cooling control	TCS/BlankRadar						Control
Bottle spacing control	FlexRadar	BoX	X			BoX	Control
Vertical Glass Distribution Control		BoX				BoX	Control
Swabbing robot	Novaxion		HSR			Novaxion	Control

- Excluding: handheld measurement tools, mechanical servo tools, cooling mechanism, lubricants

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

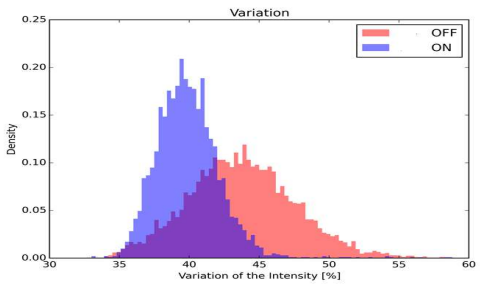
Amazing discoveries… part X

Hot end automated control loops

- Gob weight control
- Plunger press control
- Mould cooling/temperature control
- Plunger cooling/temperature control
- Bottle spacing control
- Vertical glass distribution control

- Reduce influences of normal disturbances by automatic control (compensation)

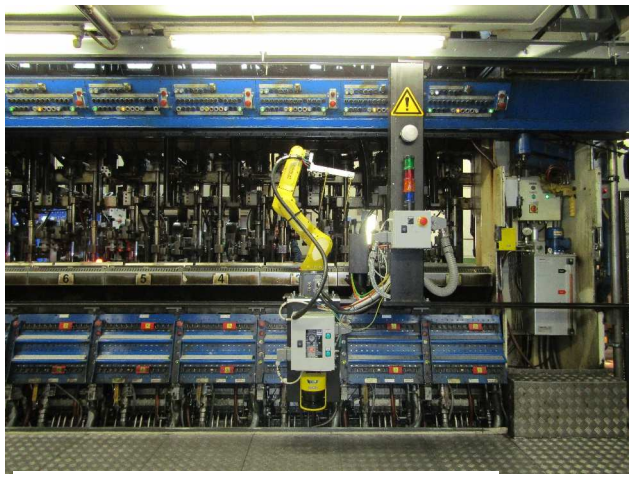
- Enable stable and predictable process, less glass wall thickness variation, less weight, less (critical) defects, shorter ramp up time, minimal dependence on skills operator

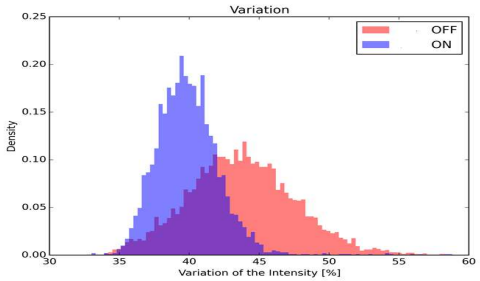


"Defect-demons" do not exist

Defects are really preventable

Hot end 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%!

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Spot the difference...

Next steps

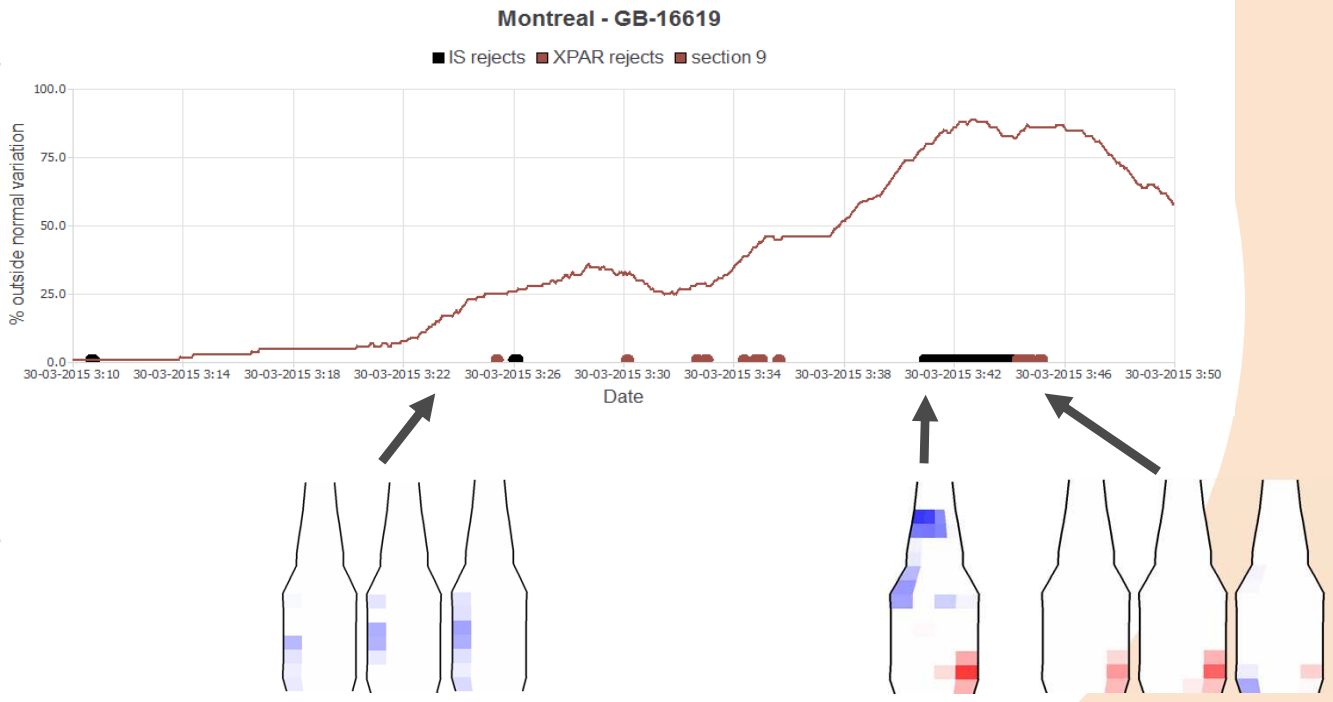
- More (good) sensors, automated control loops, robot functions
- Integration of systems
- Smart use of data
- Smart swabbing: reduce, strenght

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

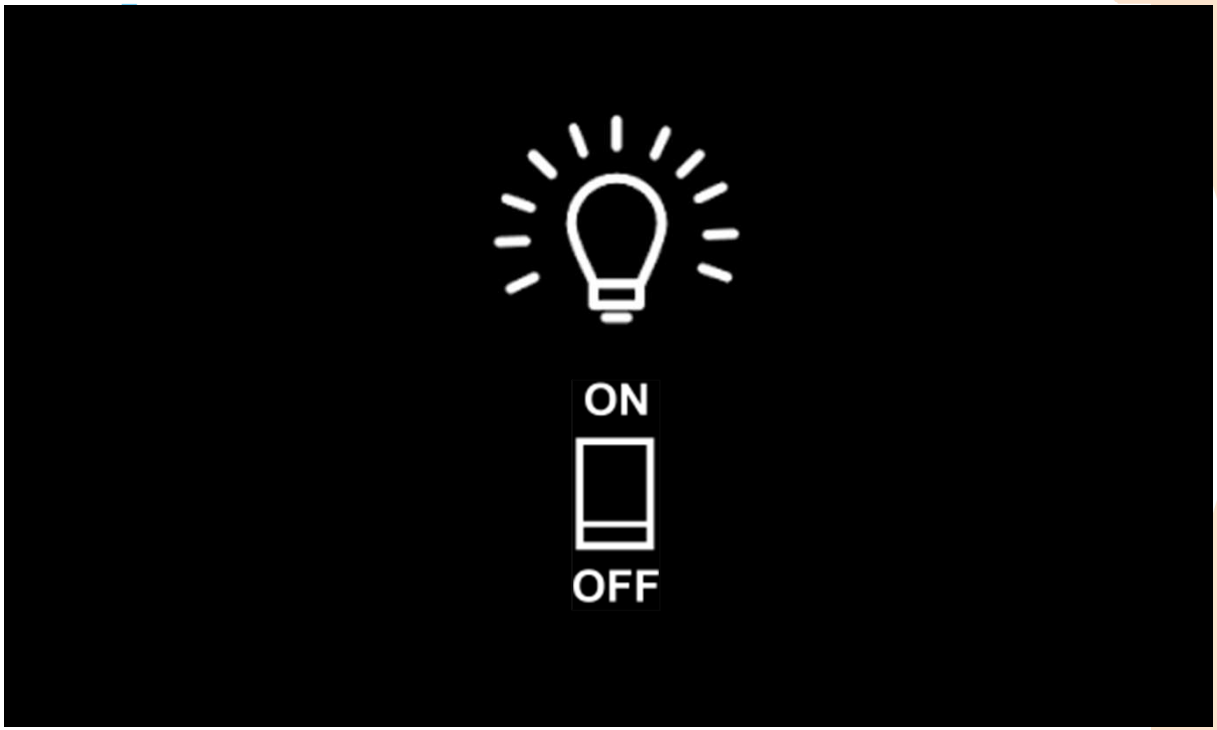
- Sensors/controls (gob conditioning/forming, gob delivery/loading, cooling, conveying, inspection
- Robot (swabbing blow, change materials, cleaning, adjustments, diagnose)
- Data → information (integration, smart use)

Hot end forming 2020/25

The power of (smart) vision systems



Ultimate goal: dark factory



Hot end forming 2020/25

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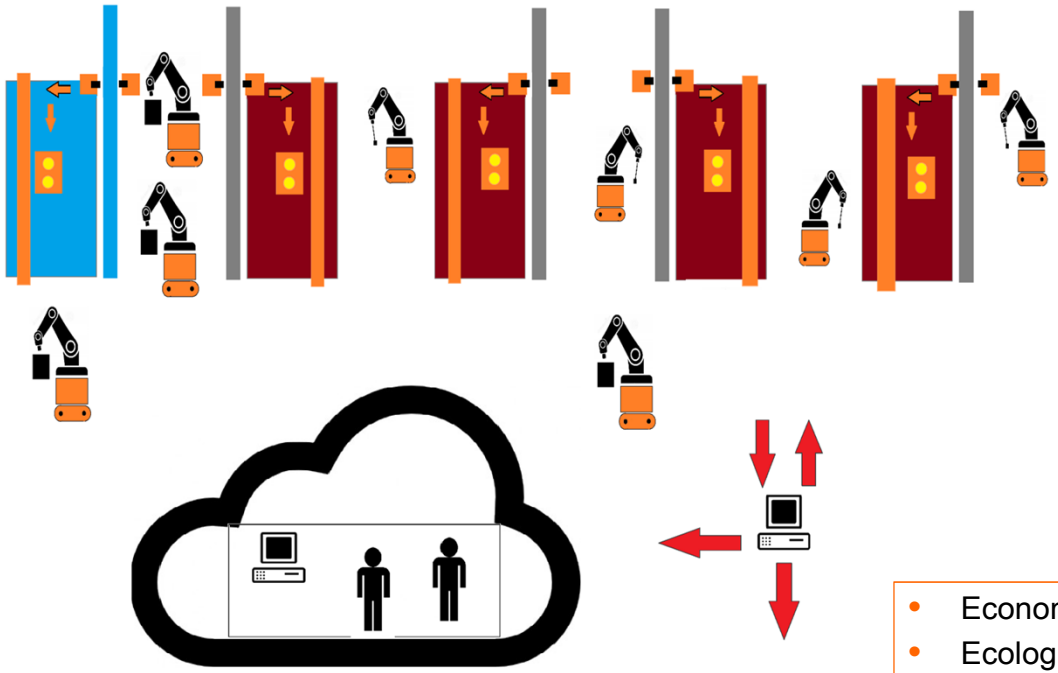

- Economical aspects
- Ecological aspects
- Human/labour aspects

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