Container Glass Forming in 2020/25
The dark factory
Dark Factory

- A Dark Factory is fully automated shop floor.
- It is dark, because there are no human beings.
What are the drivers for a Dark Factory?
DRIVERS: REDUCE COST & INCREASE QUALITY

Glass manufacturers need to improve quality, reduce costs, increase flexibility

COST OF MAKING OF A BOTTLE

- Energy: 1/3
- Material: 1/3
- Labour: 1/3

Alternatives
- Plastic, Aluminium, PET
- Cheap, flexible, light
Energy and Material costs are 50% related to the weight of bottle.
COST: Energy & Material

Bottles are nowadays 50 .. 100% too heavy

- Relative glass thickness fluctuations in the same section plane of different, randomly taken glass bottles

- Prof. Dr.-Ing. H. Hessenkemper, Glas- und Emailtechnik (TU Bergakademie Freiberg)
COST: Energy, Material

• Glass forming process efficiency is low:
  80 .. 90 %

• Glass forming is of low quality:

  Many defects, which are mostly process related
COST: Hot End Labor

- Glass forming process is not stable:
  - Complex, very dependent on know-how people
  - Many unknown variables (cullet, ambient temperature, redox, viscosity,………)
  - Needs lot of attention (repeatability, instability)
  - Wear and deterioration
  - Material change
  - Manual Swabbing
Dark Factory: huge cost reduction

• Example

• increasing efficiency 10%=>reducing energy cost 5%

• Lower cost HE labor by 60 %

• Reducing weight 30% -> reducing energy 15%
• And reducing material cost by 15%
Is a Dark Factory feasible?

- What is needed?
- Stable process with a predictable quality
Instability glass process

• Main reasons for instability of glass forming process: wear and deterioration of the material:

• Examples:
  • Gob forming (tube, orifice, shears, .. )
  • Gob loading (alignment, through, deflector)
  • Blank/Blow Molds Coating
  • Conveyor belt
Wear and deterioration example:

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:
  - Length shorter
  - Increased diameter
  - Shape will deviate more from a cylindrical gob
  - Speed decreases
  - Cause of many defects
Gob Assist: Cavity 3M 15-07 00:15

Due to higher friction in delivery
Gobs gets shorter and the diameters increases

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
Due to the shorter length the glass distribution changes.
How to stabilize the glass forming process?

- Sensors
- Automated control loops
Example of an automated control loop
The BoX has two automated control loops

Automatic Ware Spacing control

Automatic Vertical Glass Distribution control
Ware Spacing Control Module

Goal: achieve optimal and stable spacing between all bottles
Goals of VGD control

Vertical Distribution Control Module

The BoX controls and maintains the vertical glass distribution under continuously changing operational conditions such as environment and production process fluctuations:

- Feeder temperature & pull changes
- Glass conditions changes
- Ambient temperature changes
- Blank heat transfer changes (new Blank)
- Blank swabbing
- Section stop/start
Section 2
Is a Dark Factory feasible?

What is needed?

- Automated loops:
  - Ware spacing
  - Glass distribution
  - Gob Forming
  - Gob loading
Is a Dark Factory feasible?

What is needed?

• Automated loops
• Robots:
  • Swabbing
  • Materials change
  • Job Change
Time distribution operator

- Robots and smart sensors will replace (most) functions of the hot end operator
- Leading to better output
- Reducing the operational costs (TCO)

Critical step towards the Dark Factory
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
Next steps

- More (good) sensors, automated control loops, robot functions
- Integration of systems
- Smart use of data: more know how forming process
- Smart swabbing: use available sensor data
- Universal database platform for all (furnace, feeder, machine, hot end sensors/loops, cold end sensors)
- Robot friendly IS-machine!
Hot end forming 2020/25

Ultimate goal: dark factory
Thank you for your attention
Bright ideas. Better glass.