Numerical simulation for glass containers forming process

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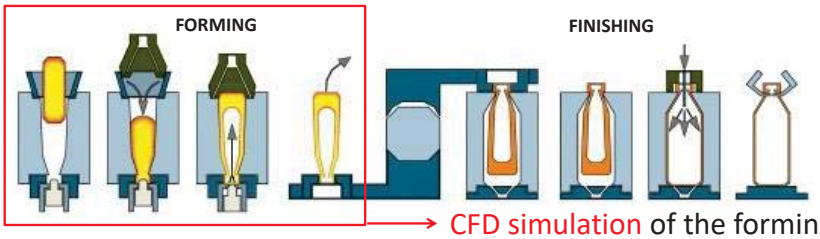
Industrial process for glass containers production



The **blow and blow forming** process is divided into:

- Filling phase of the glass
- Rest phase
- First compression phase
- Counter-step stage

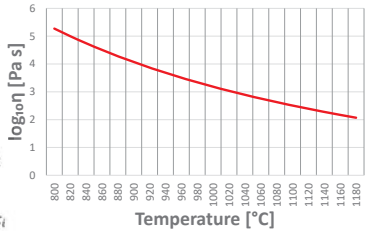
→ CFD simulation of the forming process in present application

CFD model

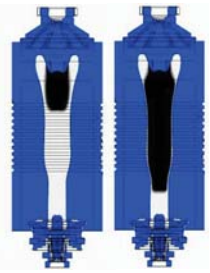
- **Unsteady** simulation of the two phase (air and glass) with a **VOF omogeneous** model and a **conjugate heat transfer** between the fluid (1,3 Mcells) and the solid domain (1,05 Mcells)
- The **glass viscosity** has been modelled with the VFT Equation, as a function of temperature and based on the chemical composition of the glass
- **numerical of convergence** issues due to different physical lenght scale
- SST turbulence model and thermal energy set up
- Buoyancy model: Density difference
- Surface tension model (air-glass)

$$\log_{10}\eta = A + \frac{B}{T - T_0}$$

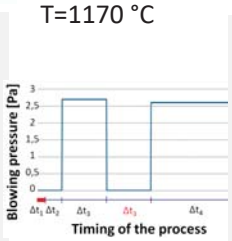
$$A = \sum_{i=1}^{N} A_i x_i \qquad B = \sum_{i=1}^{N} B_i x_i \qquad T_0 = \sum_{i=1}^{N} T_{0_i} x_i$$



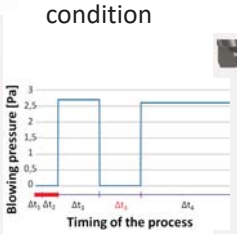
Snapshots of the simulated steps : the black colour represents the VOF contours, while the colour distribution the Temperature contours



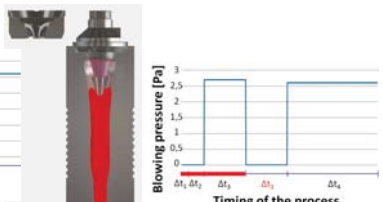
Filling phase:
Glass inlet
V=7 m/s
T=1170 °C

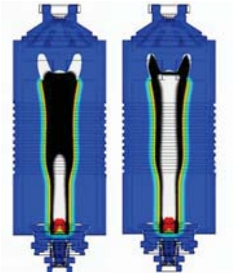


Rest phase:
Opening of
Air at ambient condition

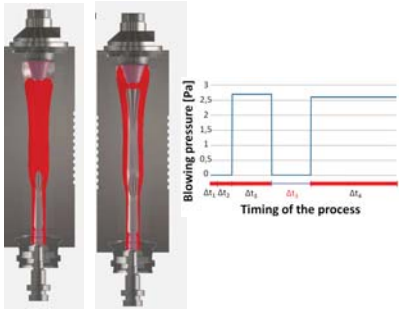


First compression:
Air
p_t=2,7 bar



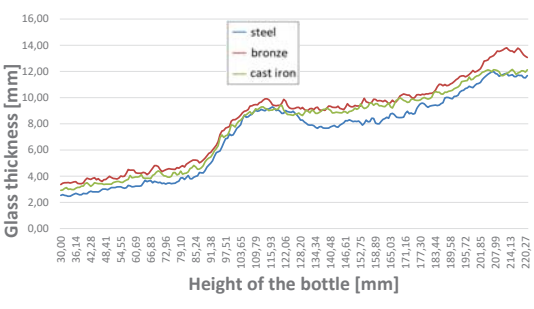


Counter step:
Air
p_t=1,6 bar

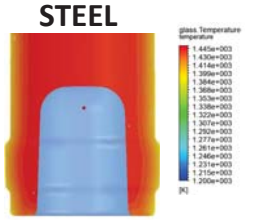


Applications: effects of mold material

Parison thickness comparison from forming phase



STEEL



CAST IRON

BRONZE

Conclusions:

- A complex CFD model has been developed in order to simulate the glass container forming process;
- The model can be used to test the influence on the parison thickness of the main process parameters (Inlet glass temeprature, timing, mold material, blowing pressure, etc,);
- This activity will continue with the second phase of the forming

Video of the simulations:

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