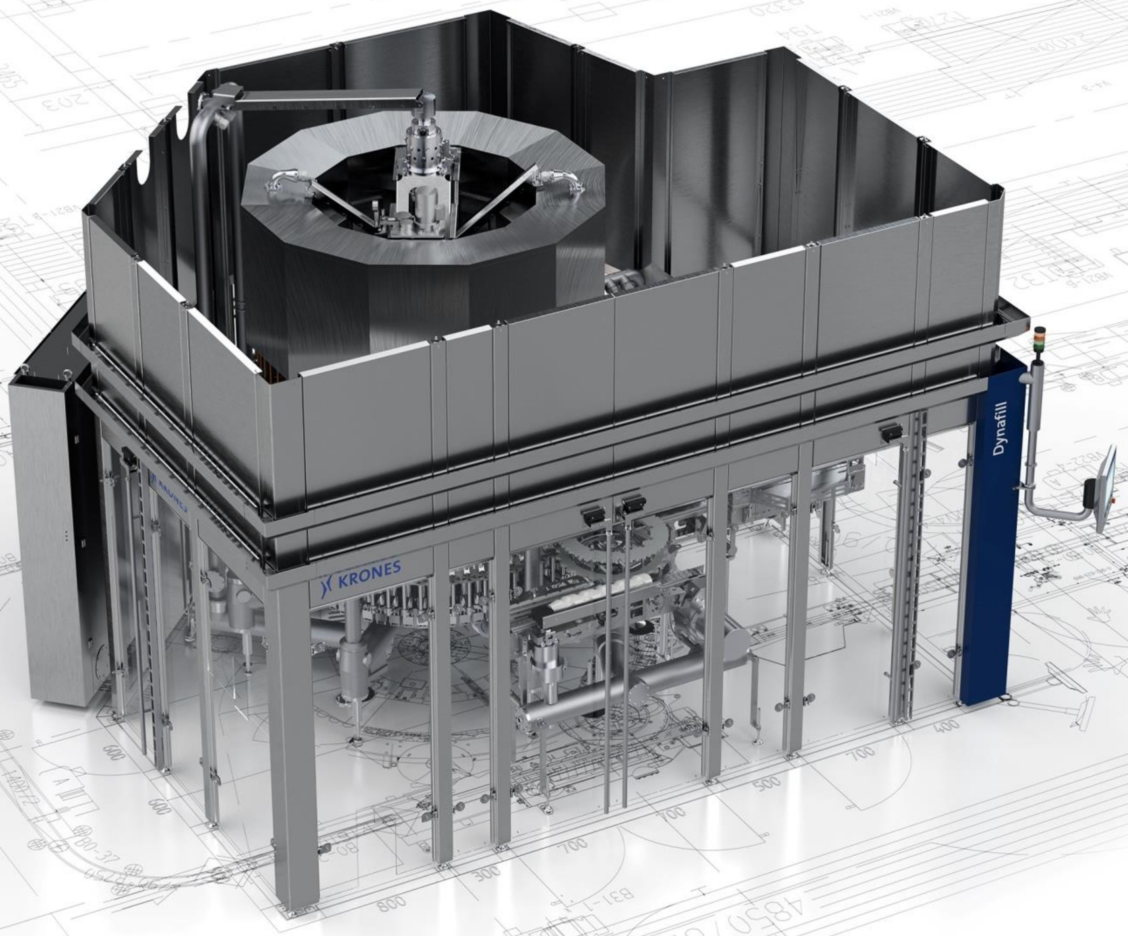


Dynafill

The innovative filling system
Redefining beer bottling for a better world

Study Day ARFB
11-10-2024
Hans Hellebaut – Filip Saelens

KRONES

ASSOCIATION ROYALE DES ANCIENS ETUDIANTS
DE L'INSTITUT DES INDUSTRIES
DE FERMENTATION DE BRUXELLES (CERIA) - ASBL

JOURNÉE D'ÉTUDE

DU VENDREDI 11 OCTOBRE 2024

Institut Meurice (bâtiment 10) – Auditoire Loncin -
Campus du CERIA

Avenue Emile Gryzon, 1 à 1070 - Bruxelles

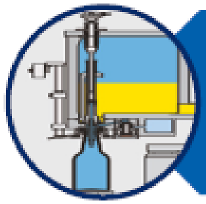
Saving Energy & Yield

A.R.F.B.

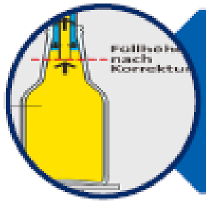
Challenge in filling beer – motivation for Krones

O_2-pickup

High pressure injection



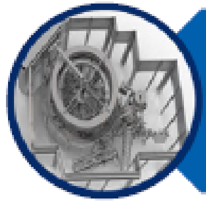
Return gas into the vessel



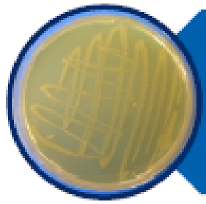
Parts inside the bottle

CO_2 consumption

Conveying open bottle



Speed / footprint



Hygiene

The filling process

Comparison of filling process

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Challenges - Questions

- Beer filling, how does it work
- How to manage the filling process, the filling height, and what are the parameters
- Does the procedure fit for beer filling in glass bottles?
- What with the product? Is there an impact on the beer quality?

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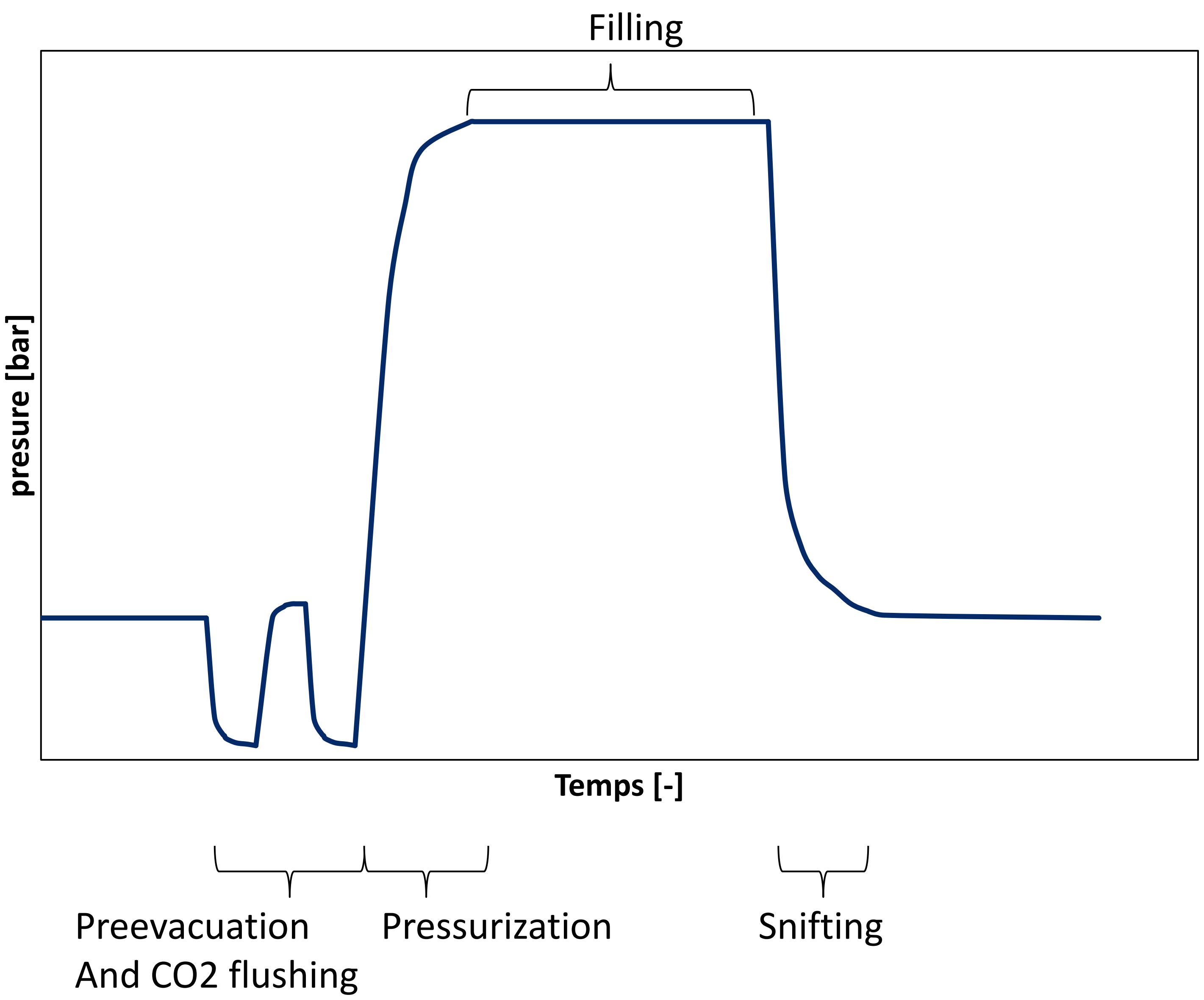
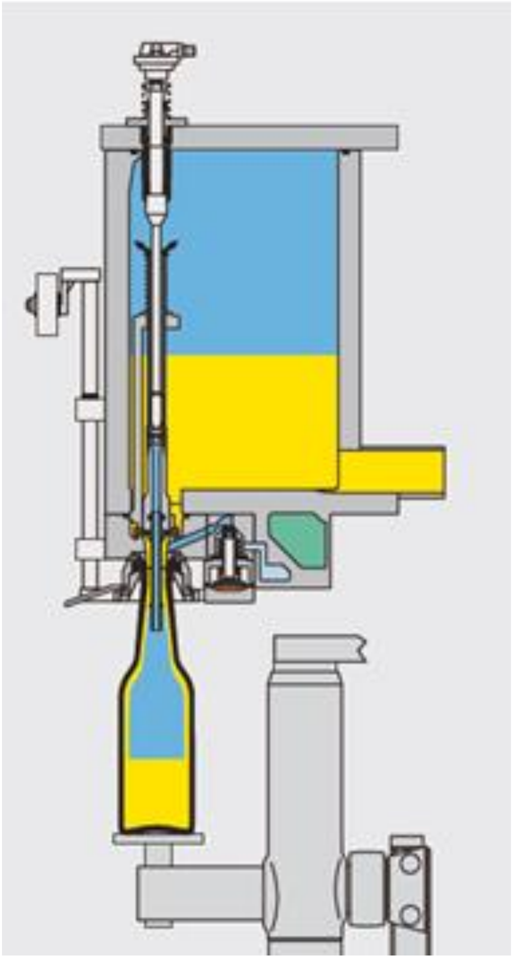
Counterpressure beer filler





Counterpressure filler:
isobarometric filling

The pressure in the ring bowl and the bottle are equal

The beer (yellow) flows gravitational in the bottle

The saturation gaz flows into the ring bowl

➔ Both beer and gaz flow through the bottle neck

➔ Mutal impact on filling speed

The Solution : split up the filling process

- Classic filling:
- *The Dynafill procedure*: 2 steps

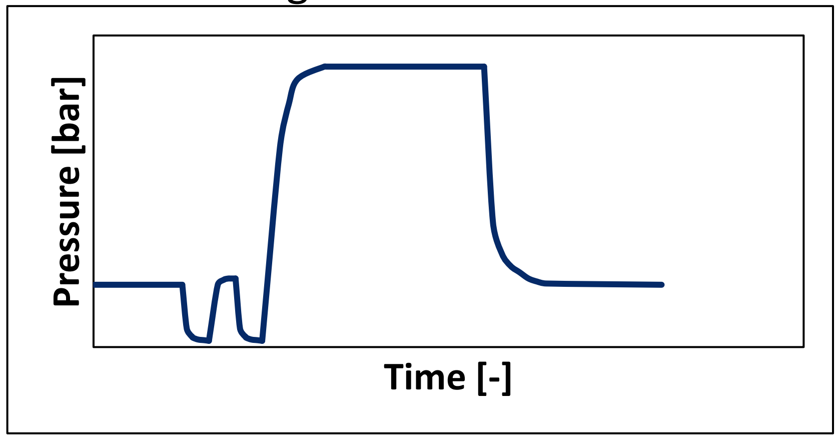
1 step

2 steps

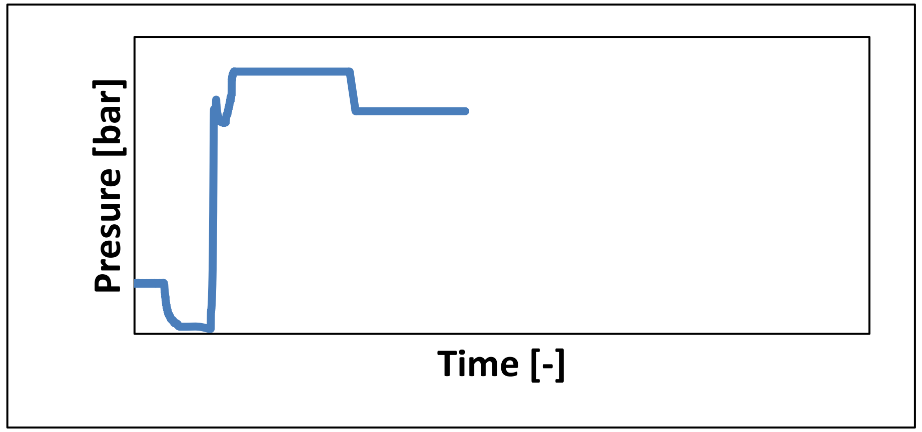
→ The pressure is in the bottle is, <u>at filling start</u>, below saturation pressure!

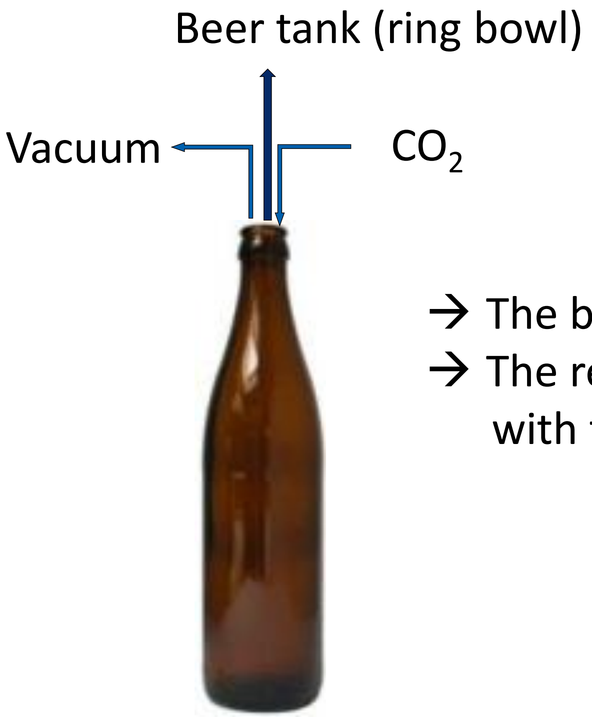
Pre-evacuation and vacuum creation

Classical filling

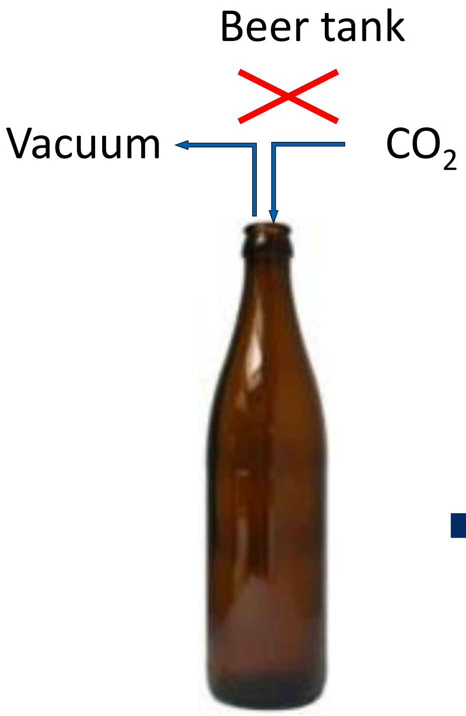


Filling with Dynafill





→ The bottle is flushed with CO2,
→ The remaining oxygen flows with the CO2 in the ring bowl



- The CO2 and oxygen are sucked out of the bottle
- There is no pressurization step

➡ **No CO2 diluted with air in the beer tank**

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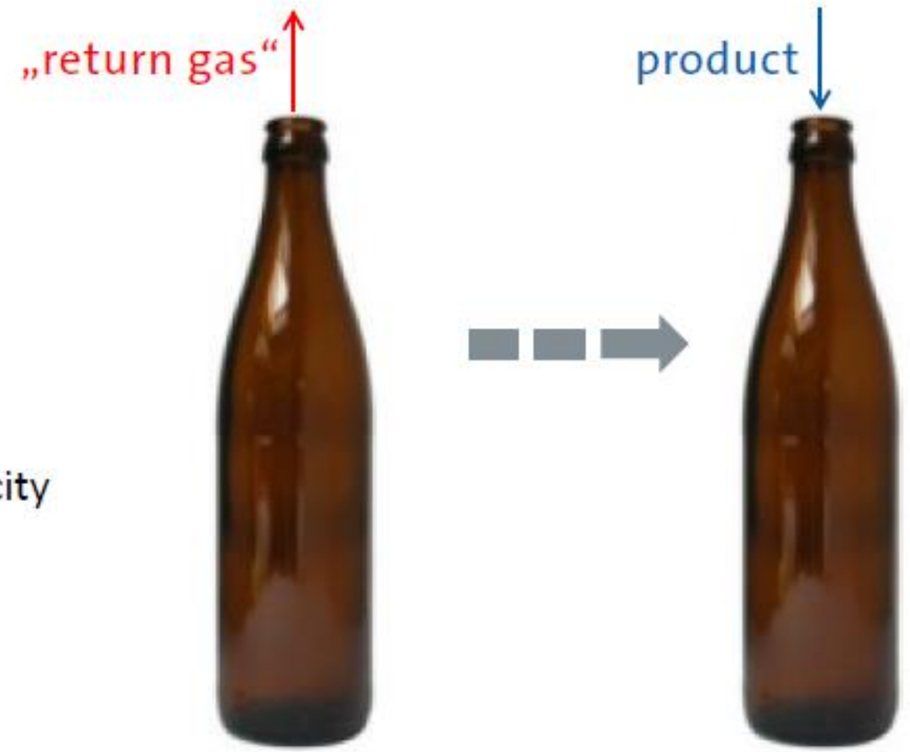
Differences of the filling process

- Conventional filling

Isobarometric filling:

- Filling velocity is limited by gravimetric height
- counteraction of return gas and product flow regarding filling velocity

- *Dynafill* filling:

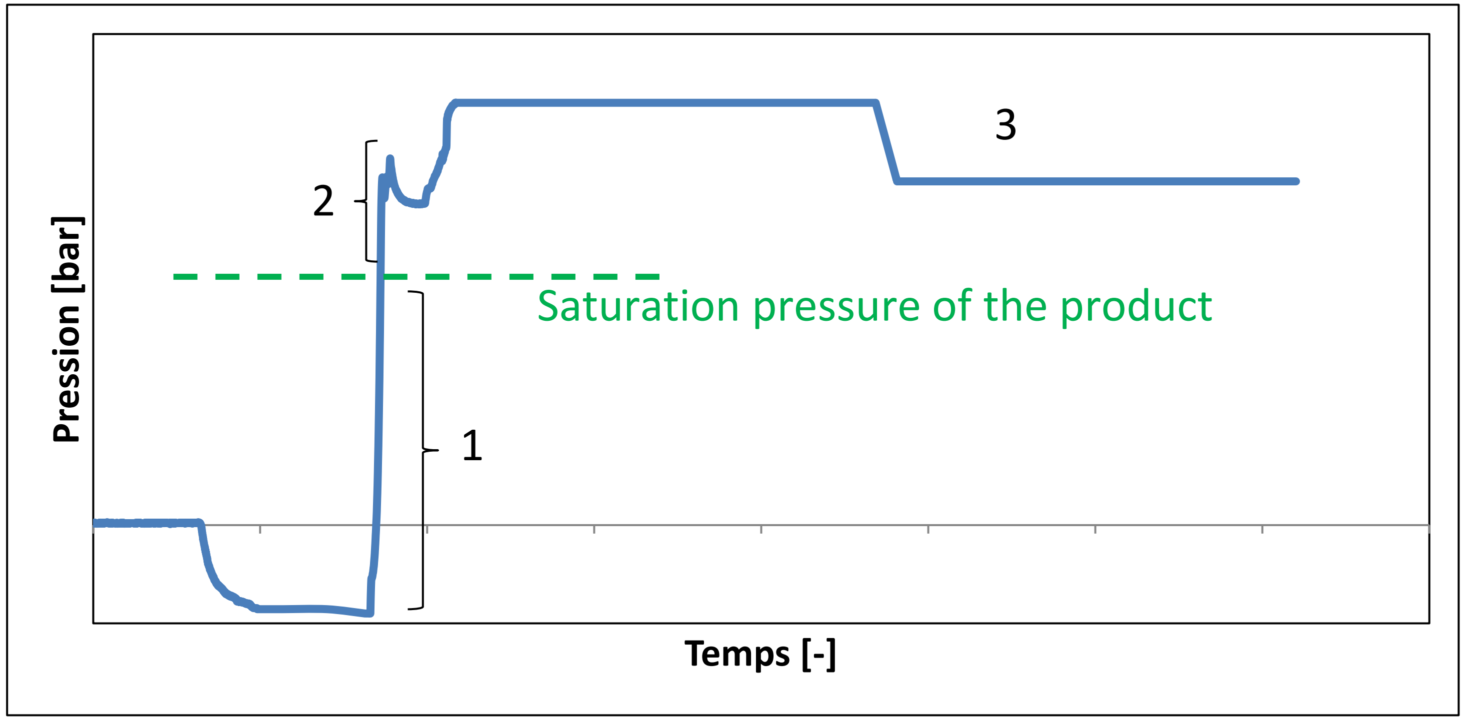


Vacuum filling

- High pressure difference of product and bottle results in very high filling velocity
- No hydrodynamic resistance of return gas

→ No oxygen containing return gas in the product vessel

Pressure curve during the different filling steps



- Phase 1: Bottle pressure < Saturation pressure → the beer is foaming
- Phase 2: Bottle pressure > Saturation pressure →CO2 is dissolved
- Phase 3: Bottle pressure > Saturation pressure → the bottle is closed

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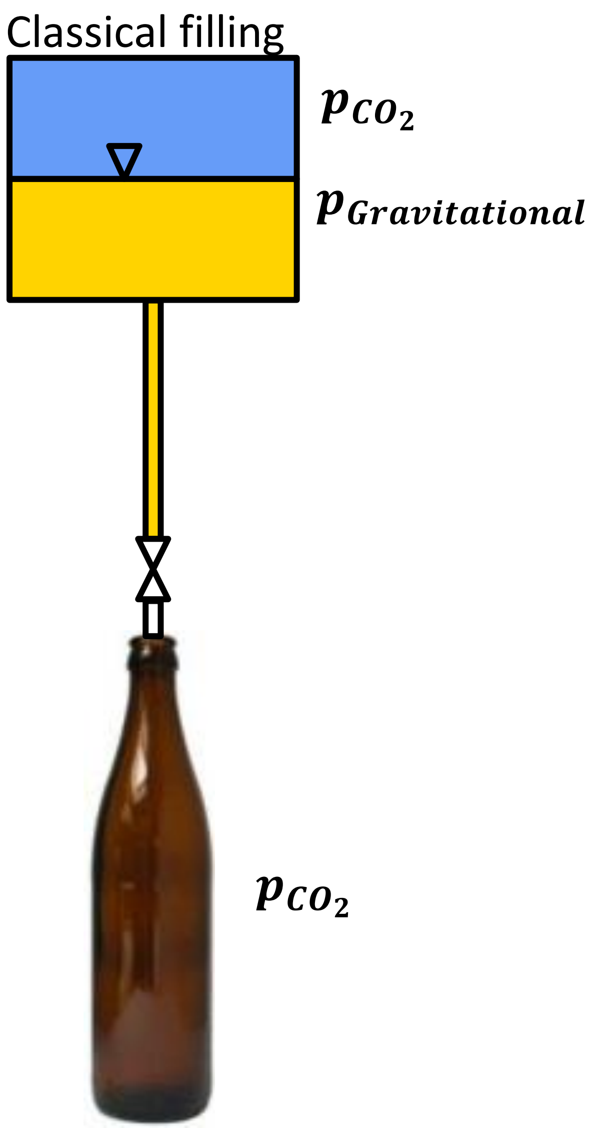
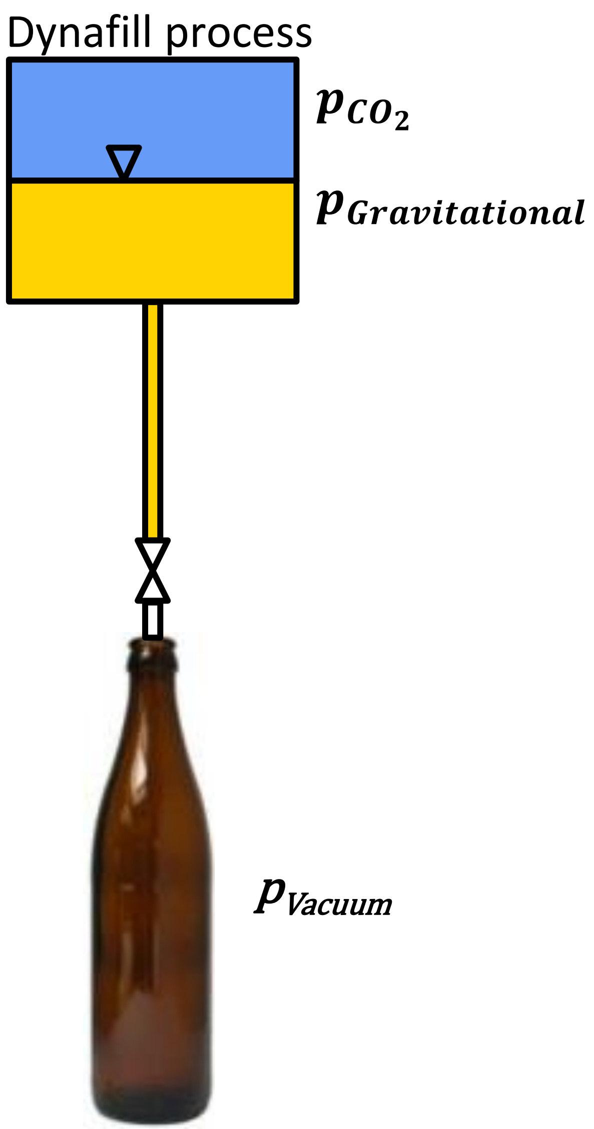
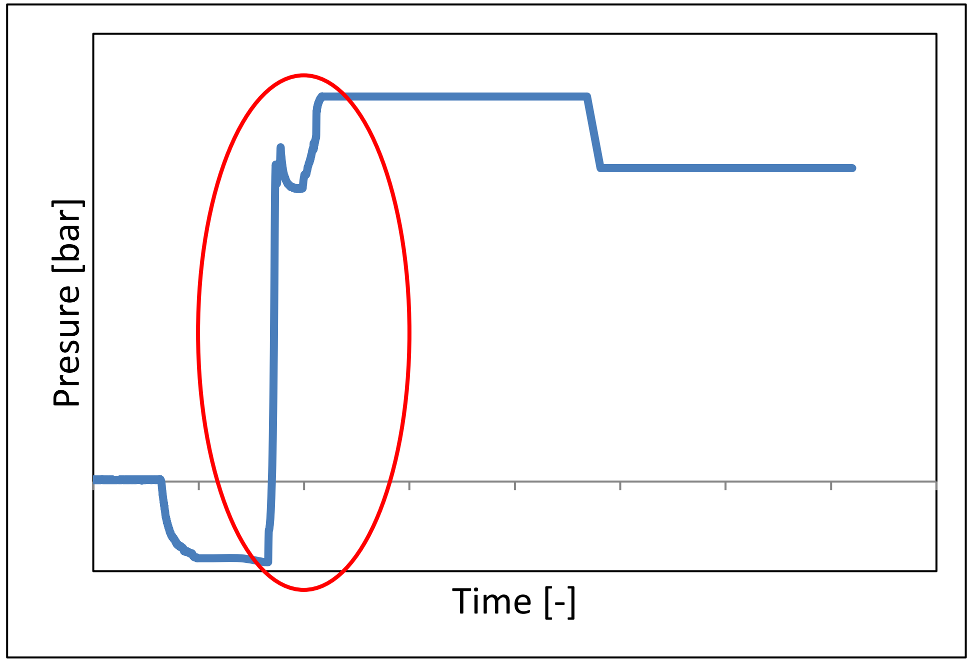
Filling with active differential pressure







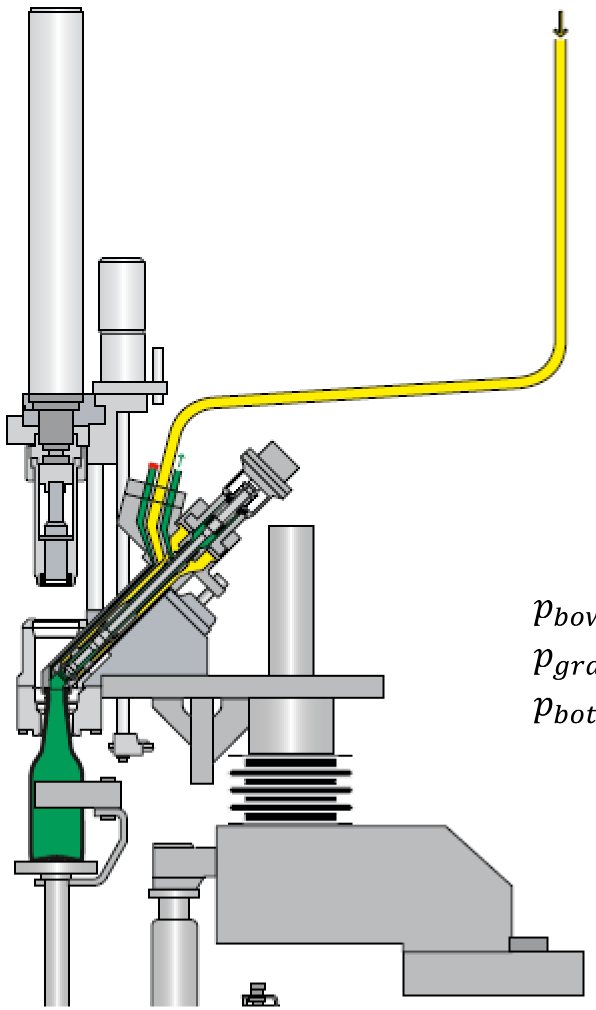
- The Dynafill process not only uses gravitational pressure
- The CO2 overpressure vs. the vacuum pressure in the bottle is added

higher differential pressure
➡ faster filling

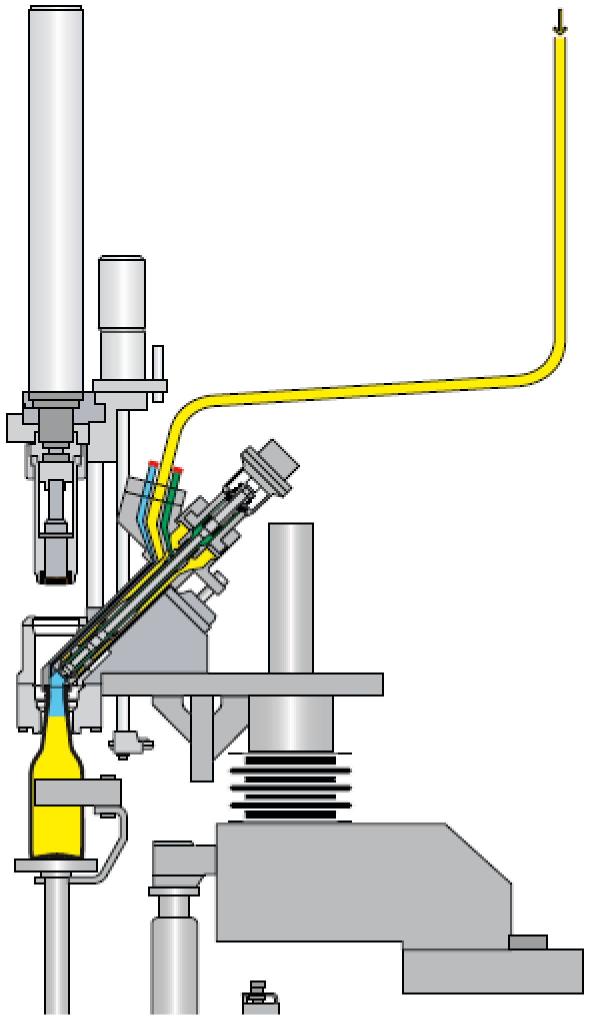
Filling until balanced pressures

$$p_{bowl_s} + p_{grav_s} \gg p_{bottle_s}$$

$$p_{bowl_e} + p_{grav_e} = p_{bottle_e}$$



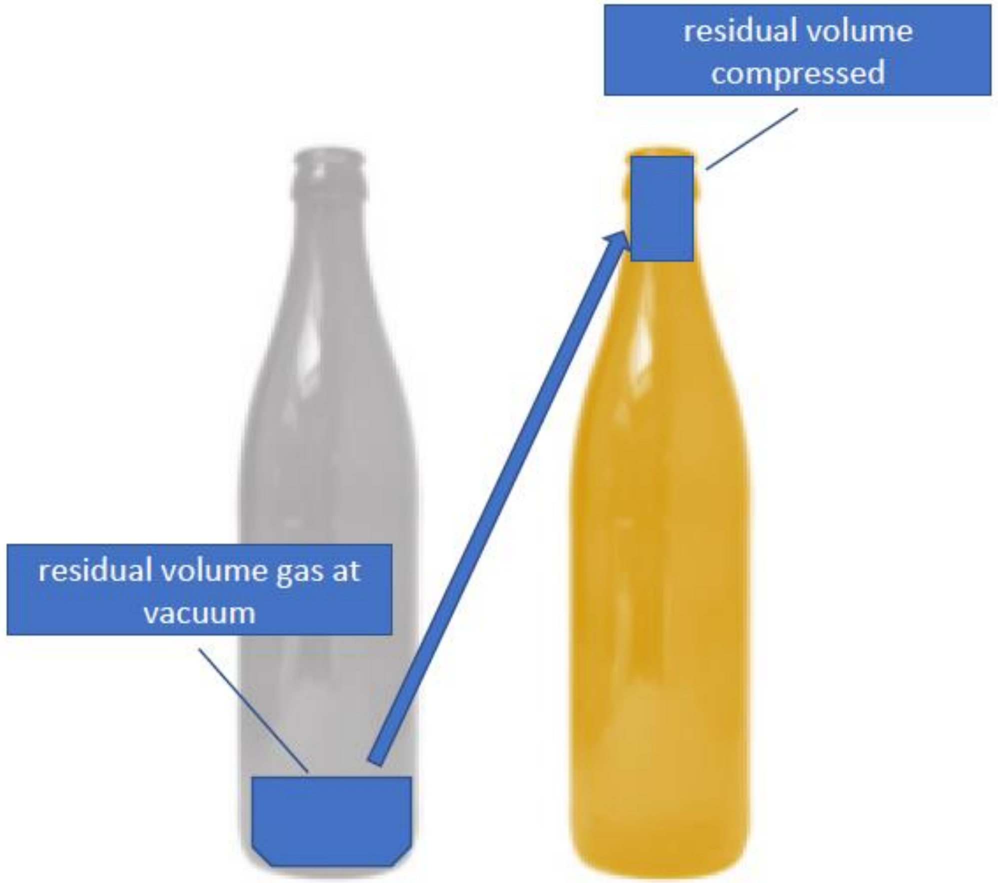
p_{bowl_s}: Pressure in ringbowl at start[bar]
p_{grav_s}: Hydrostatic pressure at start [bar]
p_{bottle_s}: Pression in the bottle at start[bar]



p_{bowl_e}: Pressure in ringbowl at end [bar]
p_{grav_e}: Hydrostatic pressure at end [bar]
p_{bottle_e}: Pression in the bottle at end[bar]

How to set up the filling height

- Filling to equal pressure of bottle to vessel
- Product works as pressure initiator in the bottle



- Trials with prepared bottles show that differences in bottle volume does not influence filling accuracy

→ Dynafill is a height filling system

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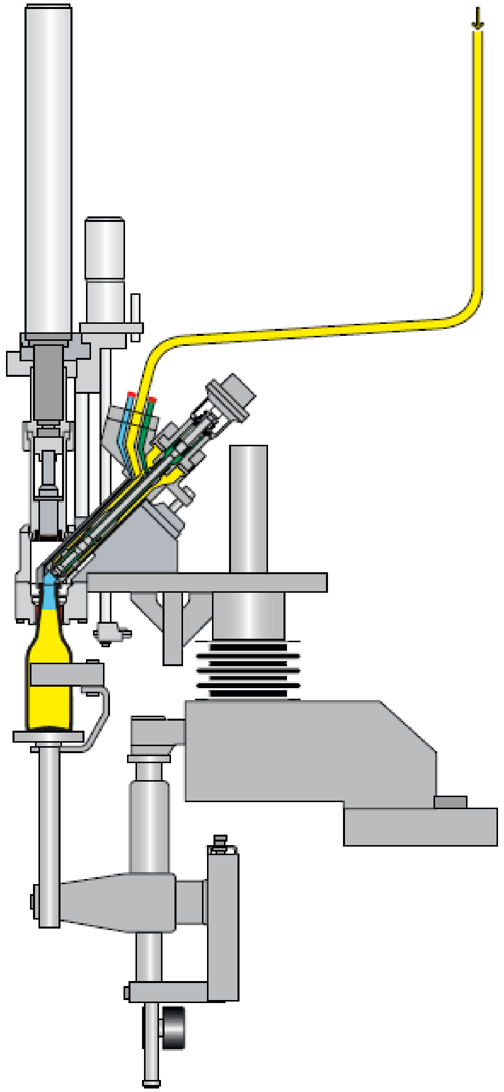
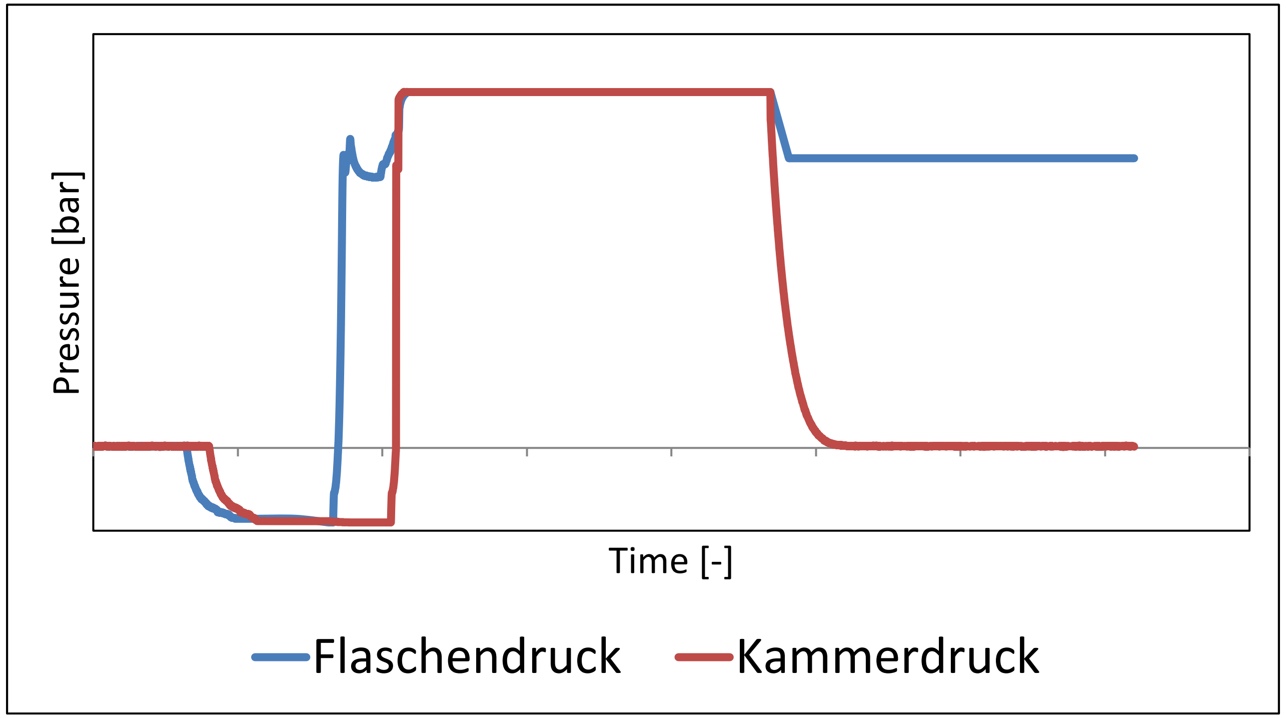
Capping under CO2 pressure





- Parallel to the filling process, the pressure chamber is evacuated and pressurized with CO2

➡ Capping in the sealed pressure chamber
The chamber is fully CIP-able

➡ No need for high pressure injection

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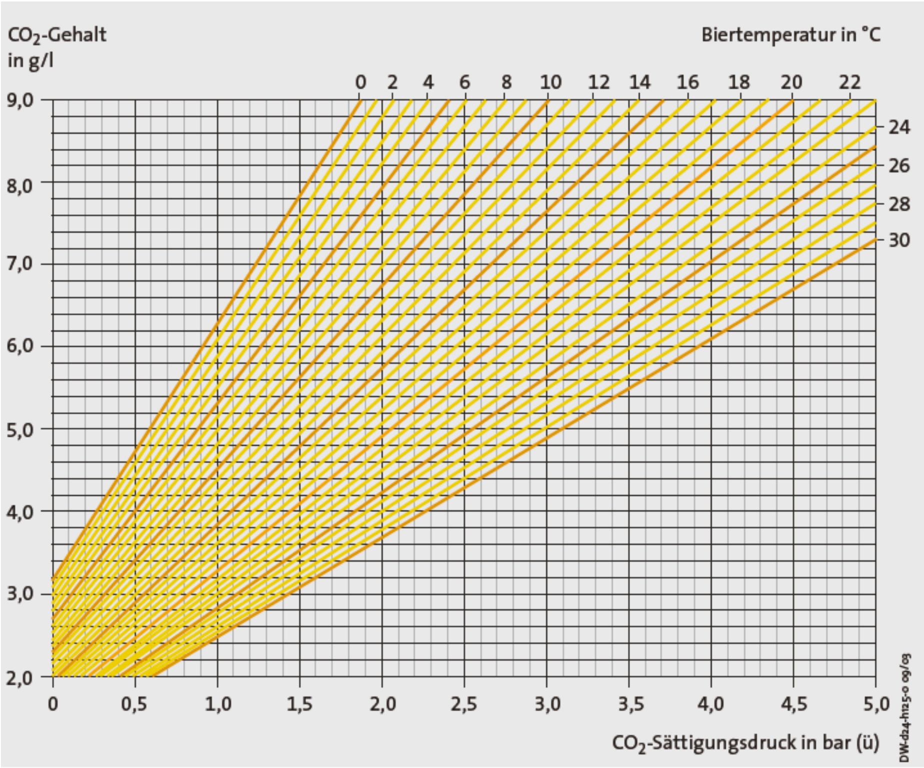
Capping under CO2 or N2 atmosphere



- Bottle pressure and chamber pressure are higher than the saturation pressure

  → no foaming product

  → no snifting needed

- The pressure is function the product saturation and the temperature

$$p_{Sätt} = \frac{c_{CO_2}}{\xi_{Temp}}$$

]

➡ "Warm" filling is possible

➡ The *Dynafill* is part of the brewery of the future

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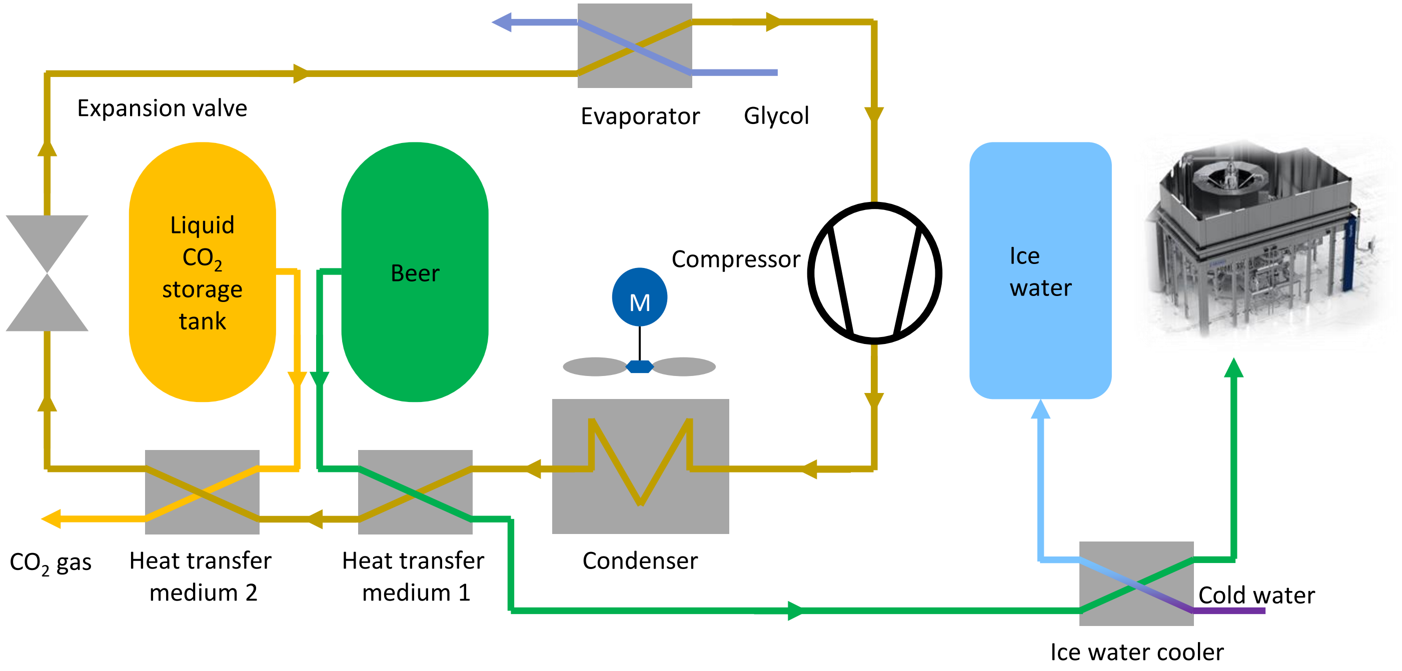
Warm filling is possible

The Dynafill enables warm filling up to 30 °C.*

Advantages:

- The temperature does not affect the filler size and the number of filling valves, which means: there are also 66 filling valves like in the cold filling process (instead of 120 filling valves with conventional fillers) – with an unchanging output of 36,000 containers per hour
- No condensation on the bottles
- No tunnel heater required
- Cooling energy can be recycled at other positions in the brewing or filling process

** With a maximum filling pressure of 5 bar*



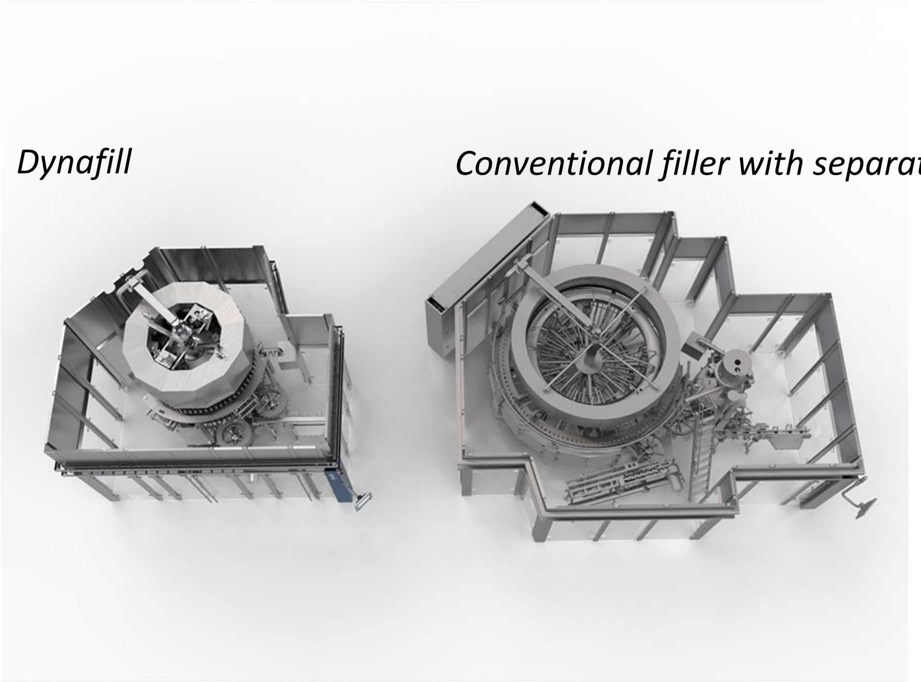
Dynafill as part of the STEINECKER Brewnomic concept

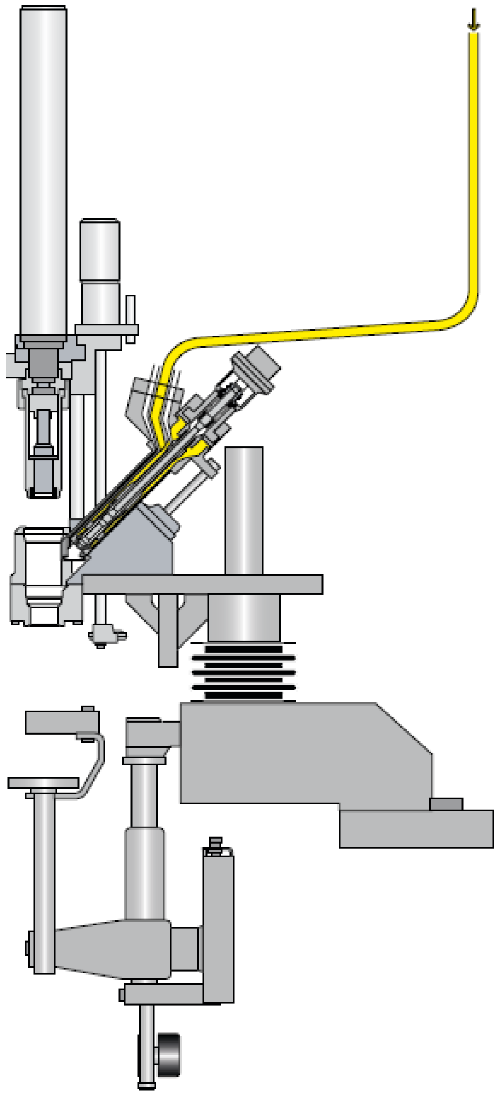
Brewnomic is energetically self-sufficient – as this brewery of the future supplies itself by utilising the residual materials accumulated during the brewing and filling process. The excessive thermal and electrical energy can be sold. Compared to a standard brewery, approximately 60 percent* of the thermal energy can be saved.

** With an output of 2.6 million hectolitres*

Speed and footprint: filling and capping in 1 unit

Compared to conventional systems, the Dynafill reduces
- the **time between filling and capping process** by 50 percent to approximately 5 seconds.
- the **duration of the filling process** to approximately **0.5 seconds.**
- the **number of filling valves** from 100 to **66** with the same output of 36,000 containers per hour.
- the **installation surface** by **50 percent**, as no capper nor the appropriate transfer starwheels are required.



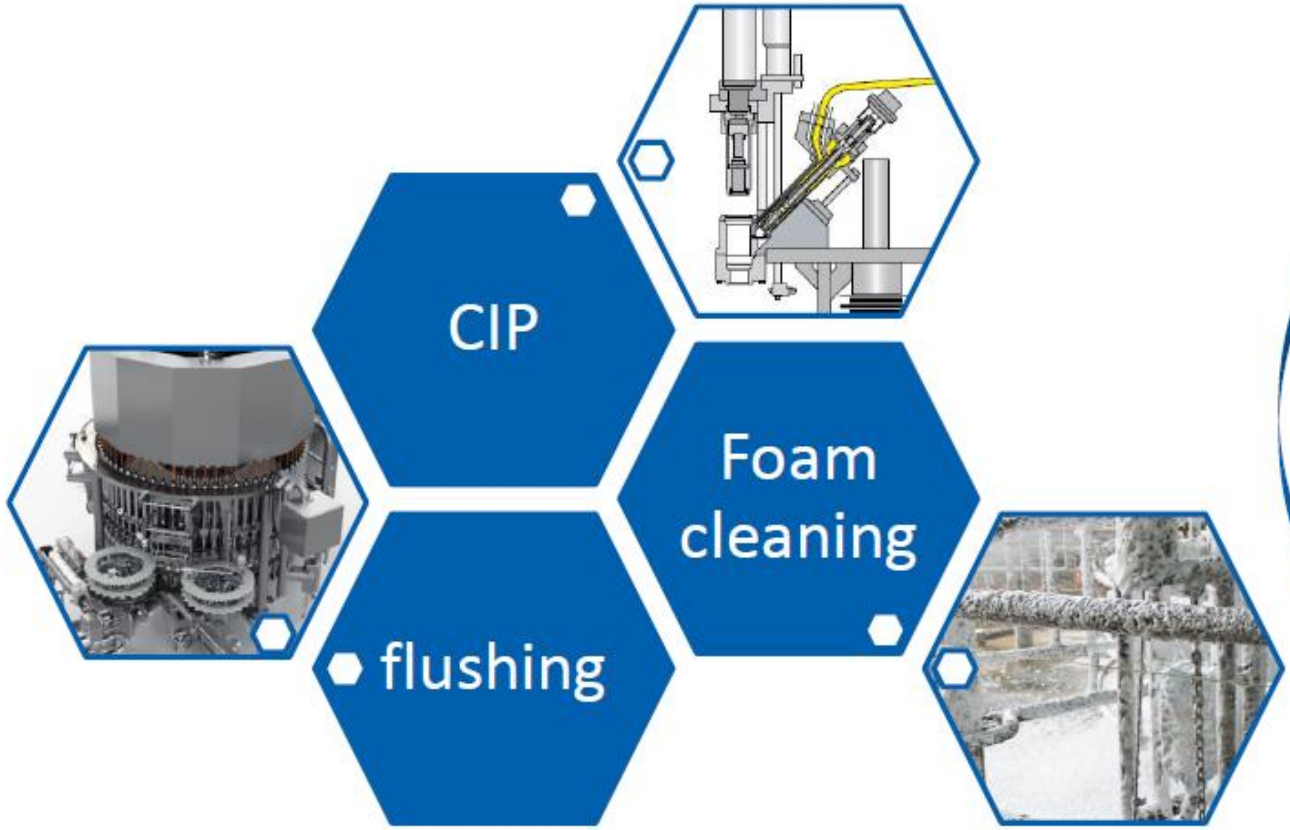


Filling quality – beer quality

- The closed hygienic filling and capping area ensures optimum product purity.
  - No entry of foreign matter into the product
- The new filling process enables a low total oxygen uptake with low consumption of CO_2.
  - No multiple flushing phases required: 20 percent lower CO_2 consumption for flushing
  - 100 % control of the oxygen uptake by capping immediately after filling
  - Filling with N_2 possible
- No return gas must be returned.
  - 100 % CO_2 concentration in the product tank
- No high-pressure injection is required.
  - No oxygen uptake in the bottle neck area
  - No product loss due to overfoaming
  - No water input into the product

The Weihenstephan Research Centre for Brewing and Food Quality and the Chair in Brewing and Beverage Technology at Munich Technical University confirm that all analytic and sensory quality parameters for beer are met.

Microbiological tests and cleaning



Different smears

- Inside the filling valve
- At capper
- Outside the filling valve

Membrane filtration of filled bottles

Incubation at
NBB Agar/Bouillon

→ All trials negative

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Benefits

Reduced space requirement
Thanks to the 2-in-1 principle, the Dynafill requires substantially less space than comparable combined filler-capper units. As the filler is not to be emptied in the case of a malfunction in the filling line, the buffer section to the labeller can be reduced. The labeller can also be directly block-synchronised to the filler.

Increased outputs
In future, the Dynafill enables a higher total line output than conventional systems: A total of 80,000 containers per hour can be processed.

Increased filling quality
The closed hygienic filling and capping area ensures optimum product purity, as return gas feed back into the product bowl is no longer required. High-pressure injection is no longer required and no product is lost during filling.

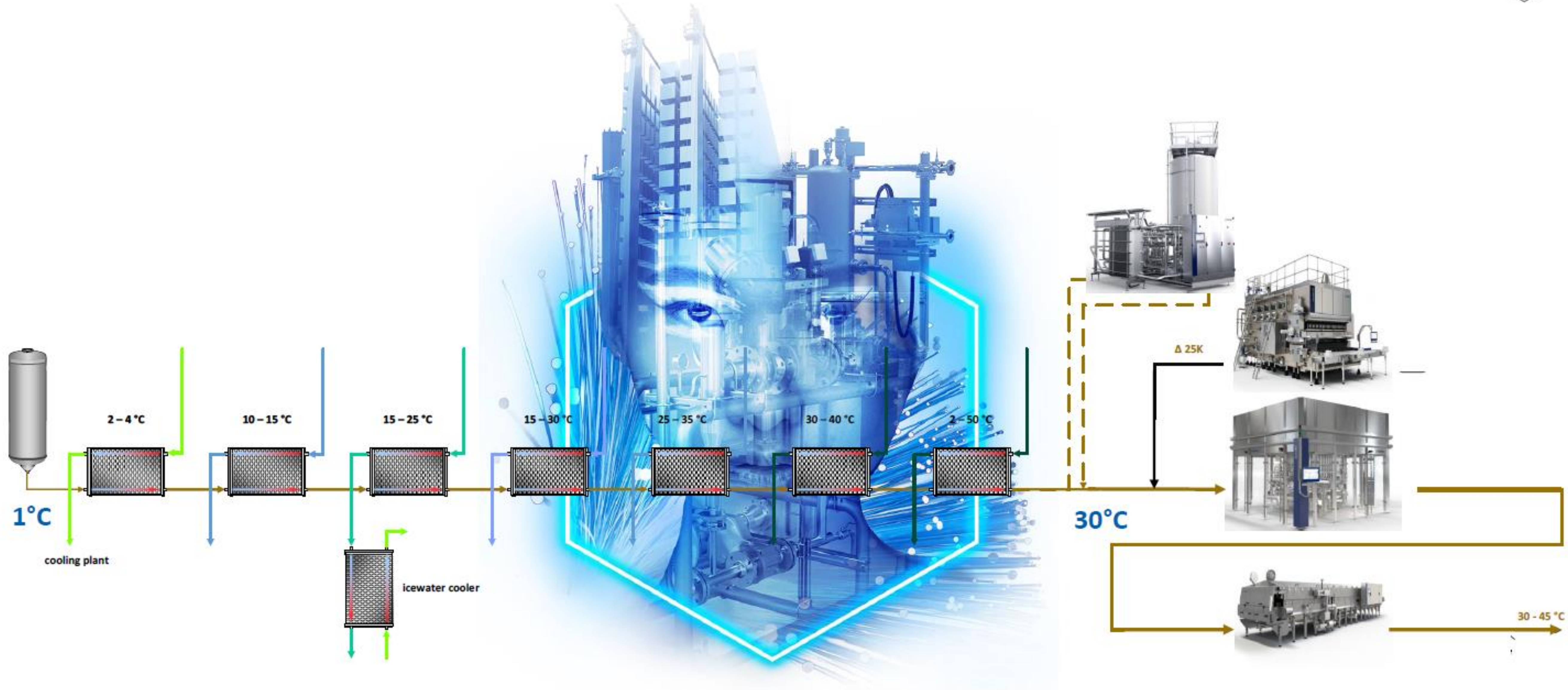
Reduced CO_2 consumption
The CO_2 consumption is 20 percent lower than that of conventional systems.

Stable filling process
The Dynafill enables not only cold but also warm filling of beverages (temperatures up to 30 °C) – the process duration will not exceed five seconds in both cases. The filling process remains always stable.

Ideal cleaning conditions
The Dynafill is a closed system. The filling valve and the capper unit are integrated in the CIP circuit.

Easy accessibility
The individual components, such as the filling valve, the media hoses and the capper drive can be individually dismantled.

The future starts in our heads
Break with existing concepts and run your brewery with free energy thanks to the Dynafill



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Digitalisierung

Prozess-
technik

Abfüll- und
Verpackungs-
technik

Intralogistik

Lifecycle
Service

We do more.

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