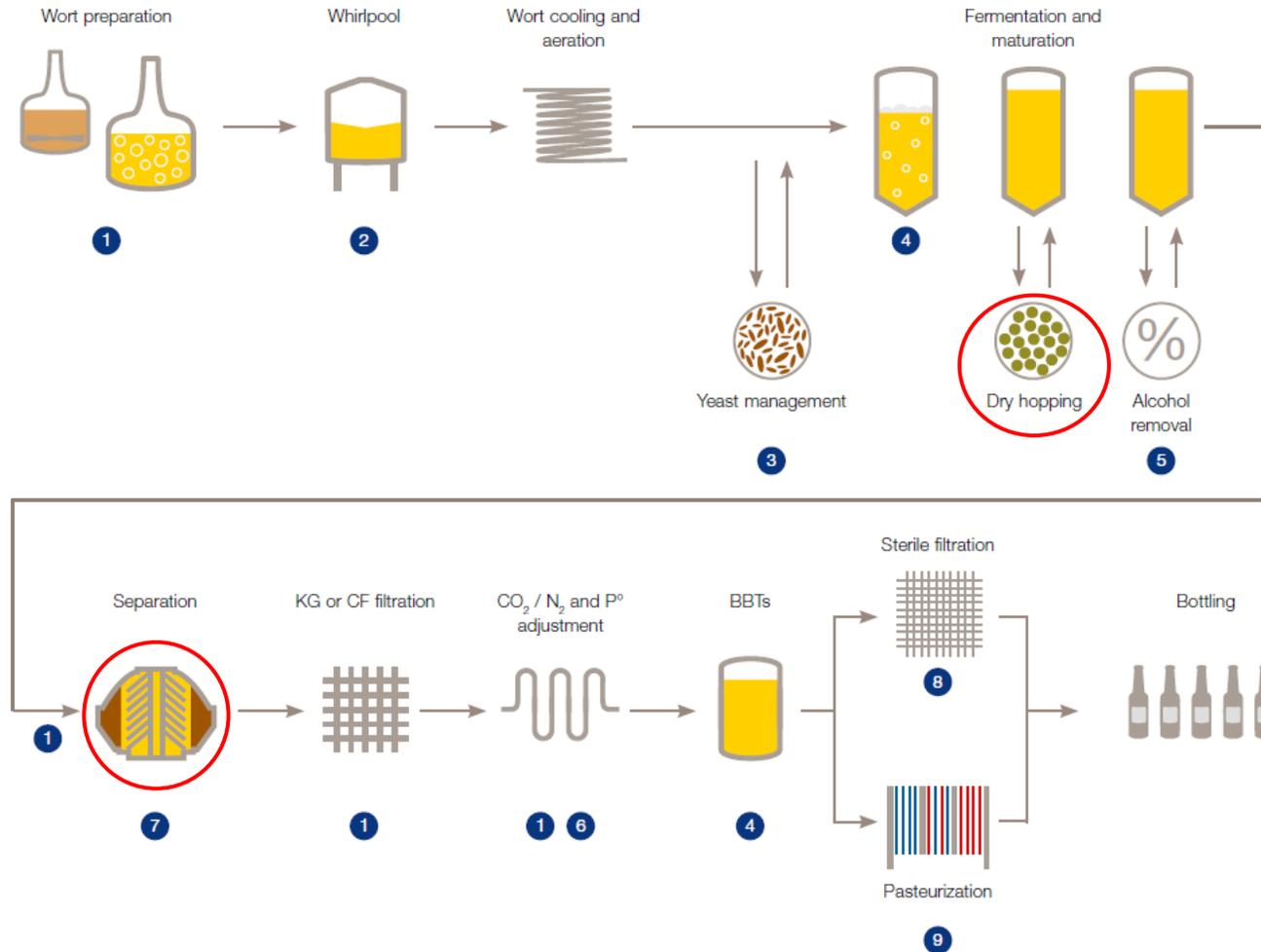


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## Maximizing Brew Yield and Efficiency: An Insight into Advanced Dry Hopping with Alfa Laval Innovations

# General brewing process



## Alfa Laval solutions for craft breweries

- |                                      |                                      |
|--------------------------------------|--------------------------------------|
| 1 Aldox Mini                         | 6 Carboset Mini                      |
| 2 IWS (Intelligent Whirlpool System) | 7 Centrifugal separators             |
| 3 3-in-1 Yeast Propagation Module    | 8 BSF Mini (Beer Sterile Filtration) |
| 4 Iso-Mix Mini                       | 9 Flexitherm Mini                    |
| 5 Lowal de-alcoholizer               |                                      |

# Dry hopping

- Process issues

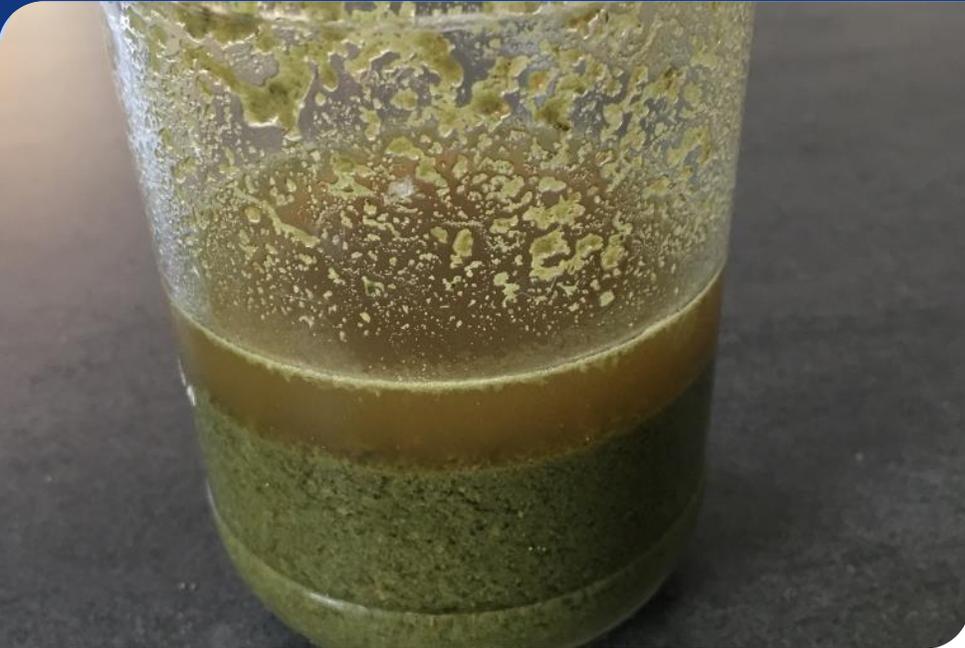


- Clogging, CIP
  - Pipes
  - Filters, heat exchangers
- Beer loss
  - Purging hops to drain



# Behaviour of hop solids during dry hopping

- Hop solids behaviour

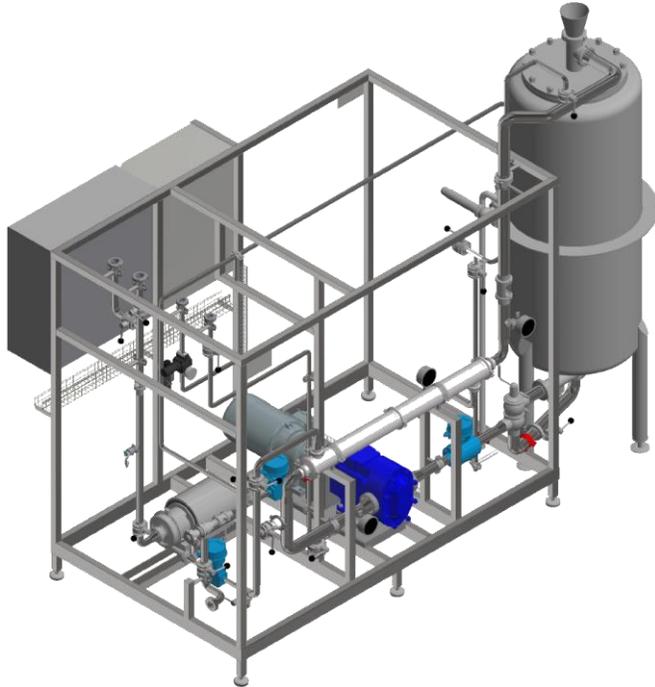


- Left picture: 10kg/hl
- Right side: 1kg/hl

A challenge for CIP and hops removal

# Dry hopping solutions

Alfa Laval IMXD and Alfa Laval Alhop



## Alfa Laval Alhop module

- \* Skid-mounted system
- \* Hops remain outside the main vessel
- \* For smaller volumes, 50-500kg pellets per batch, more on request.

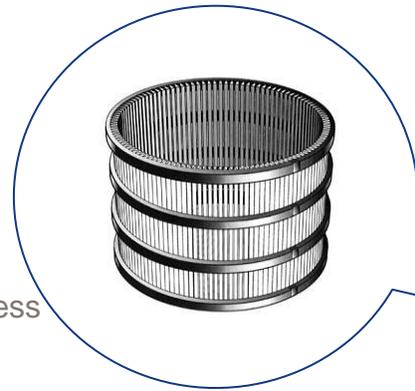


## Alfa Laval IMXD integrated system

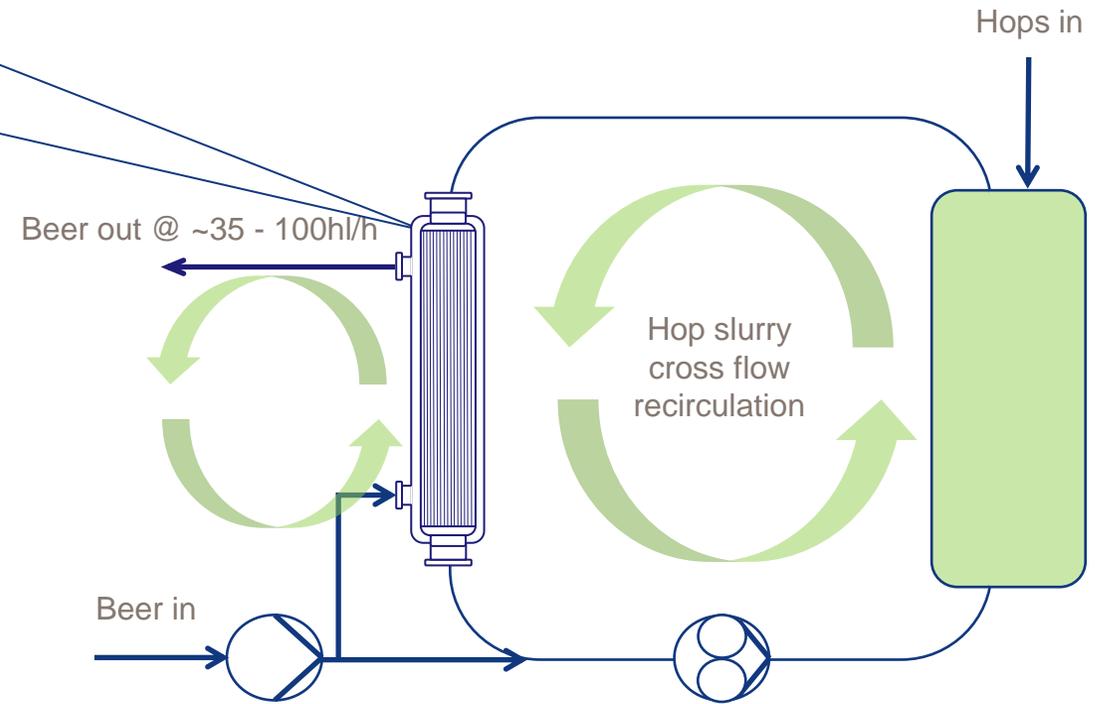
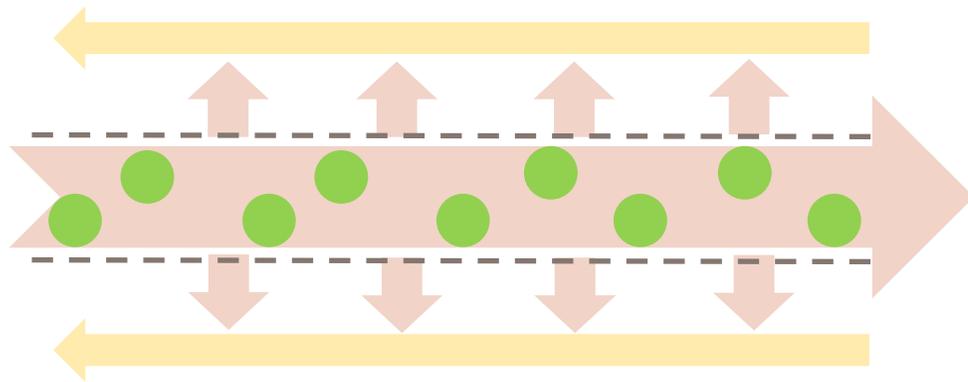
- \* Integrated in the fermentation/maturation vessels
- \* Hops are mixed within the main vessel
- \* For larger volumes (200–5,000 hl tanks)

# Alfa Laval Alhop Dry Hopping System

How it works



100 micron stainless steel strainer



# Alfa Laval Alhop Dry Hopping System

- Production steps

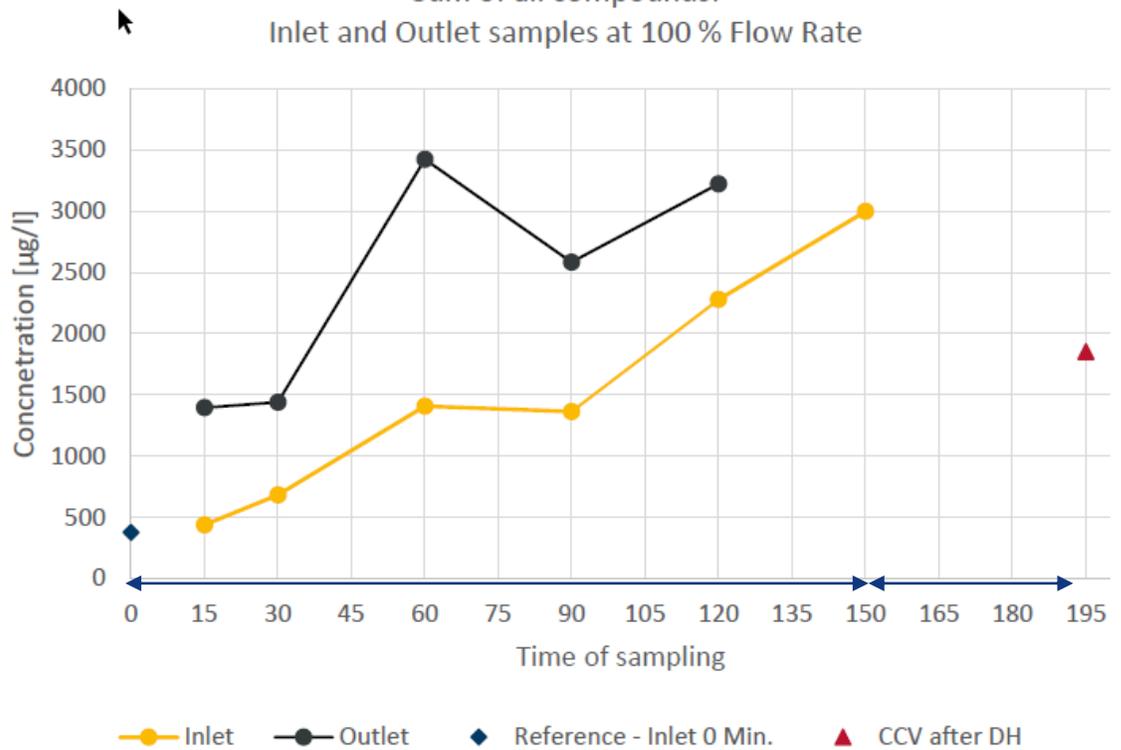


# Alfa Laval Ahop Dry Hopping System

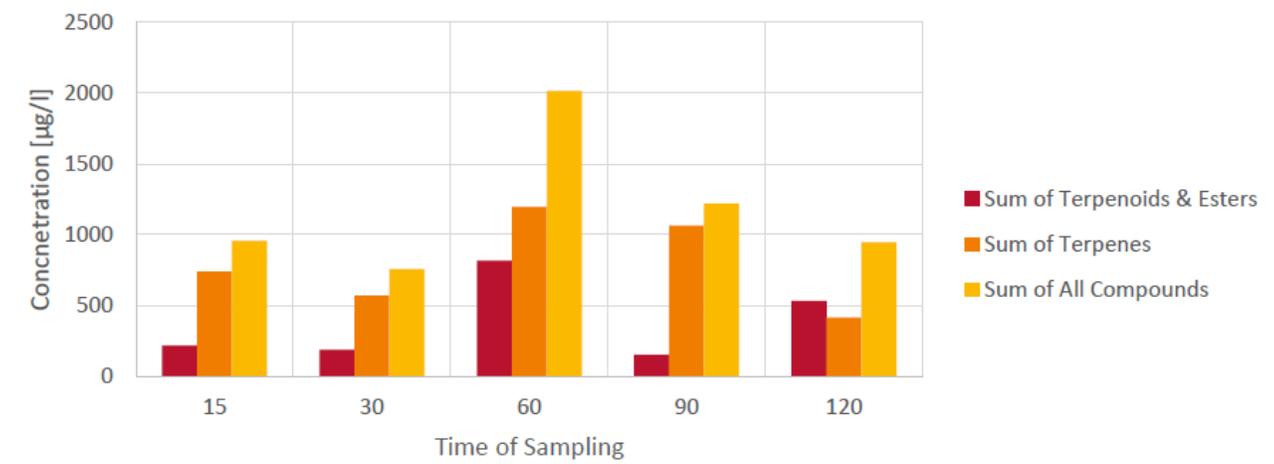
- 120hl ale, 22 degrees C, 30kg hop pellets



Sum of all compounds:  
Inlet and Outlet samples at 100 % Flow Rate



Δ Inlet vs. Outlet at 100 % Flow Rate



Recirculation time: 150 min @ 80hl/h  
Beer recovery time: 40min



# Alfa Laval Alhop Dry Hopping System

EU pilot – Second EU runs: Inlet vs outlet



Beer inlet

Beer outlet

# Alfa Laval Aihop Dry Hopping System

- VLB results – BRLO brewery, Germany



1,2% beer losses (Without DAW recovery step)

- 1,45hl out of 120hl
- 5l/kg of hop pellets

Improve yield even further with diafiltration step, using DAW.



Hop slurry sample during trials not conducted with VLB



# Alfa Laval AIHop Dry Hopping System



## Advantages

- Self-contained skid-mounted system
  - HMI/PLC Automation for reduced labor costs & safety
- Improve time and utilization rates
  - Reduce dry-hopping from 3-7 days to hours
- Improve yield from FV to BBT
  - Hops stay in AIHop from start to finish
- Allows biotransformation during fermentation
- Reduce/Eliminate hop creep





How craft brewers can improve yield and profits with centrifugation technology ?

# Challenges of filtration



- Clogging
- Pressure loss
- Health risks
- Consumable costs
- Disposal costs
- DO pick up

# Centrifuges in the brewery process

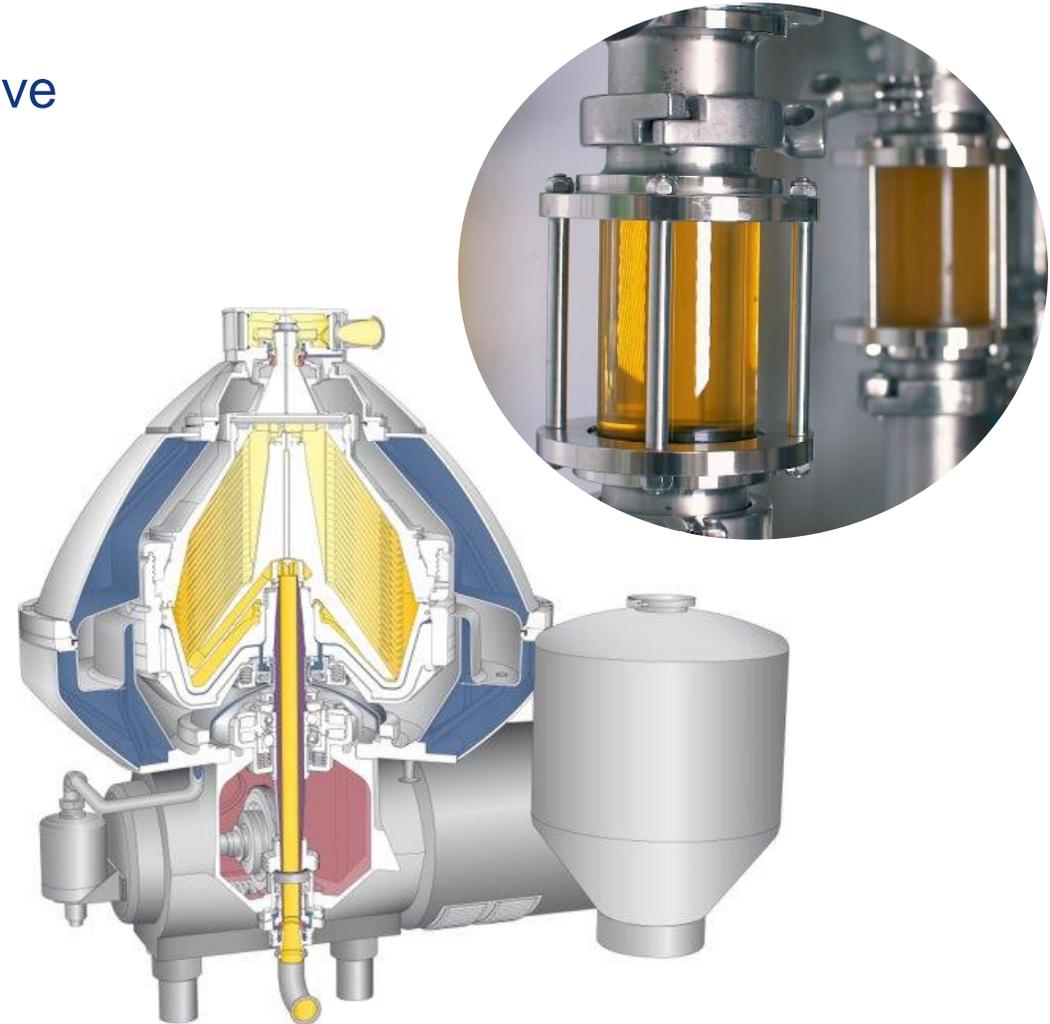


# Centrifuges - a great tool for brewers

- Reasons to install a centrifuge



- Clarify beer – remove coarse solids and improve **quality**
- Reduce beer losses – increase **yield**
- Control the contact **time** of ingredients in beer
- Increase production capacity - **reduce** sedimentation time
- Replace or combine with a filter
- Continuous operation, no intermediate CIP to finalize a tank
- “Classifier” rather than filter



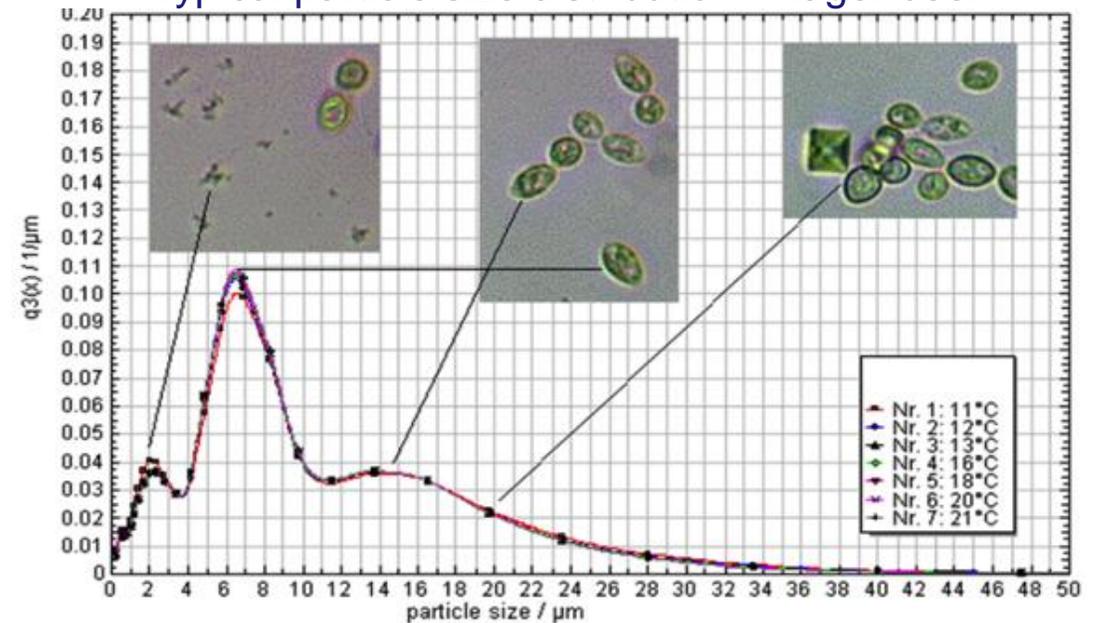
# Clarify or polish with same tool, different flowrates

It's not a filter  
is it a clarifier or polisher ?  
in fact, it is a "classifier"

Following *Stokes law*,  $V_c = \frac{d^2(\rho_w - \rho_o)}{18\eta} r\omega^2$   
the larger the particules, the easier to separate:

- Reduced flow
  - less particles in the clarified beer
- Increased flow
  - more particles in the clarified beer

Typical particle size distribution in lager beer



# Flow rate

- Altering the flow rate has the largest effect on clarity



Flow rate  
15 hL/hr



Flow rate  
10 hL/hr



Flow rate  
5 hL/hr



Brew 20  
4-15 h/h

## Note

Inlet beer, left glass, has been clearing naturally in a tank for 1 month prior to centrifugation. Something that is uncommon for most breweries

# Flow rate

- Altering the flow rate has the largest effect on clarity



Feed inlet

Flow rate  
18 hL/hr

Flow rate  
22 hL/hr

Flow rate  
28 hL/hr



Brew 80  
10-50 hL/h

# Polished beer & Hazy beer

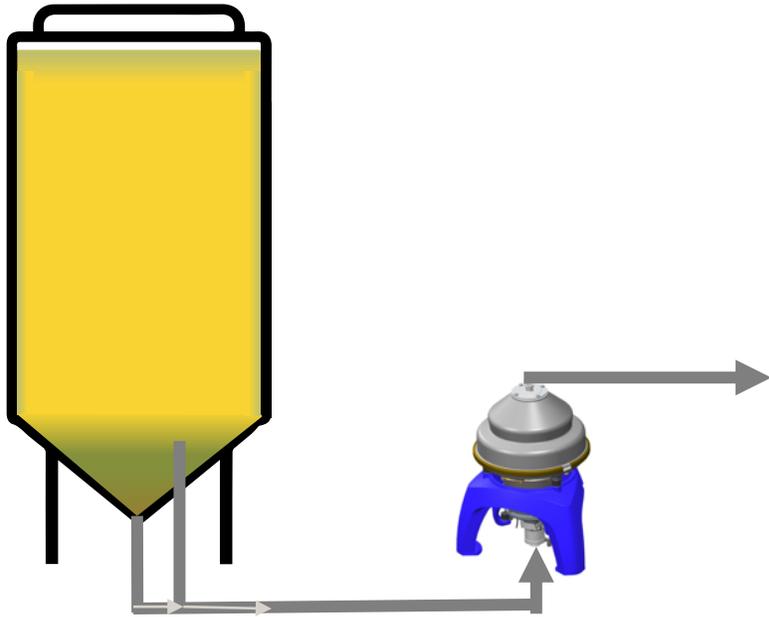
- Bright to near bright beer styles without filtering
- Possibility to adjust desired final haze
- Reduces/remove the consumption of consumables such as filter aids



# Process improvements for more yield

- Racking cane or Stand pipe feed

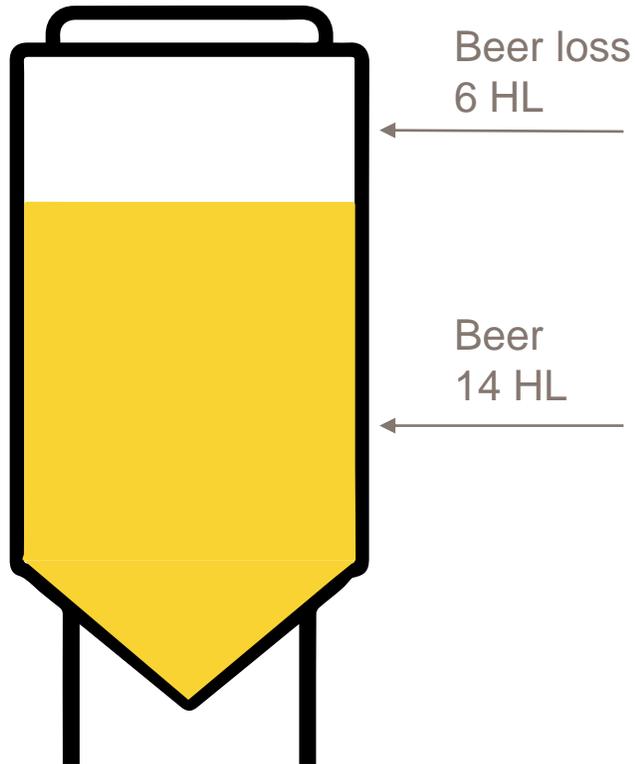
- Transfer prior to cooling
- Feed from racking pipe/stand pipe
  - Blending with tank bottoms



# More yield with the centrifuge

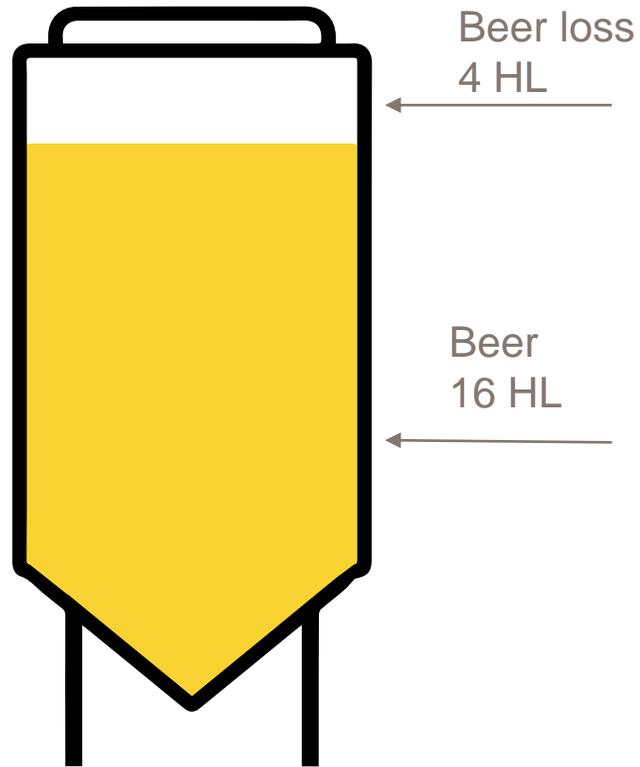
- Example from a customer brewing Hazy IPA styles with a high solids content (22g hops/L)

Without a centrifuge



FV – 20 HL

With a centrifuge



FV – 20 HL

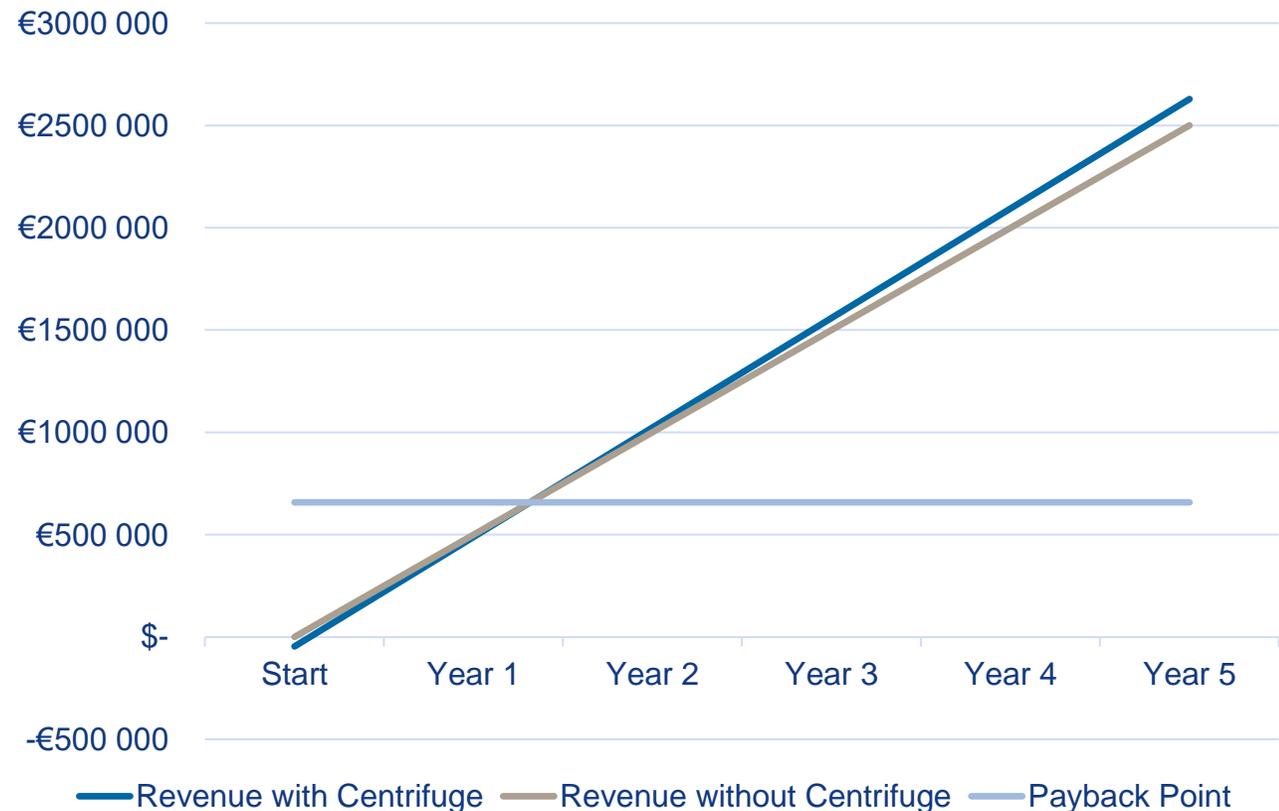
**~10%**  
more yield if using  
a centrifuge

# Return of investment example

- Based on yield increase only

- Fermentation vessel: 20 hL
- Yearly production: 2000 hL
- Suggested flow rate: 5-10 hL/hr  
 → **Brew 20**
- Recovery rate for IPAs –  
 Yield increase ~ 8%
- Beer sales: €2,5/L
- Return of investment:  
 → **Less than 1,5 years**

## Payback point ROI (Capex)



# Centrifuges in breweries

- Summary



A centrifuge will contribute to:

- Clear beer with little or no filtering
- Quicker tank turn-over
- Beer recovery & reduced product loss
- Improved quality & consistency
- Improved filter performance
- Control haze in the beer



# Secure performances and profitability in the long run



– Top performance - now and in the future

- **A Tailored Solution for Maximum Reliability and Uptime**
  - Optimized Service Intervals, with predictable costs
- **Choose Alfa Laval for a Comprehensive Separator Maintenance Solution**
  - Training support
  - Service Videos at your disposal
  - On site services by Field Service Engineers
  - Remote Support
- **Life cycle support**
  - 30-year Spare Parts ambition



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