Dry hopping solutions

Streamline and optimize the dry hopping process






Agenda

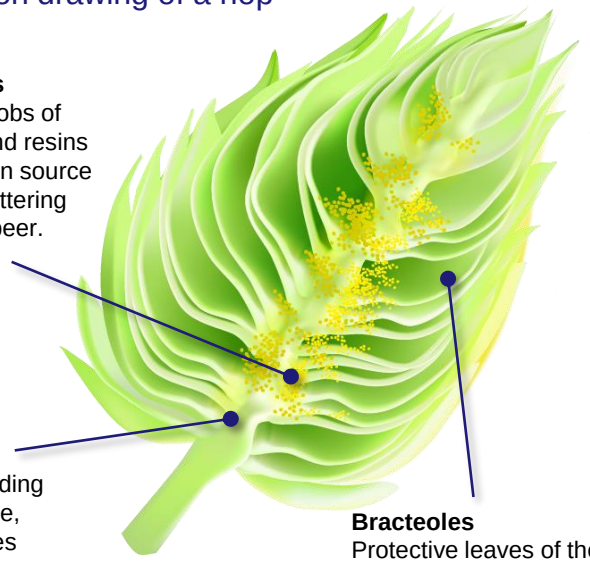
- Introduction to dry hopping (Alyce Hartvigsen)
- Alfa Laval solution 1: Iso-Mix External Drive (IMXD) (Alyce Hartvigsen)
- Alfa Laval solution 2: Alhop (Denis Martin)
- Q&A (All)

Recording of the webinar is available.

A bit about hops

- Hop cones from female plant
- Grown in temperate regions
- Used for bittering and aroma
- Bract: the leaves provide astringency (tannins, dd)
- Lupulin: the yellow resin provide aroma and bitterness (essential oils and resins)

Cross-section drawing of a hop



Lupulin glands
Yellow sticky globs of essential oils and resins that are the main source of aroma and bittering compounds in beer.

Strig
The stem extending through the cone, where bracteoles originate.

Bracteoles
Protective leaves of the hop cone that yield more oil and resin in addition to tannins and polyphenols.

Dry hopping process

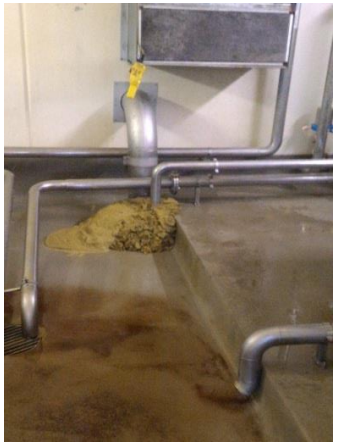
The addition of hops to the fermentation or maturation vessel during or after main fermentation in order to extract the hop flavours into the beer

Hop pellets

- Hop pellets are hops that have been dried, ground into powder and then recompressed into pellets
- Most frequently used type: T-90 pellets (whole hops pelletized)
- T-90: 1 kg whole hop flowers yields 0.9 kg hop pellets
- Pellets are most frequently used because:
  - Easier to handle
  - Less costly to store and ship
  - Better storage properties
  - Higher hop utilization
  - Easier to remove from wort/beer

Dry hopping process

- Main process steps



Hop addition → Dis-aggregation → Extraction → Hop removal

Scaling up of dry hopping process

Hop addition | Dis-aggregation | Extraction | Hop removal

Large-scale brewing of dry hopped brands presents some issues for brewing at scale:

5,000 hl x 200 g/hl = 1,000 kg of hop pellets

A 5,000 hl fermentation tank is five stories high!

Increasing hopping rates + Growth of dry hopped brands =

Hop disaggregation – the tricky part

Hop addition | Dis-aggregation | Extraction | Hop removal

10 g T90
dry pellets

10 g T90
pellets in
100 ml liquid

Hop disaggregation “live” – 20% solids

Mixing in warm water
(approximately 40° C)

After 2–3 minutes mixing

Hop slurry tank: agitator design is important!

Wrong: Lower of two impellers is positioned too high; no mixing occurs in the lower part of tank. Solids accumulate here, causing plugging.

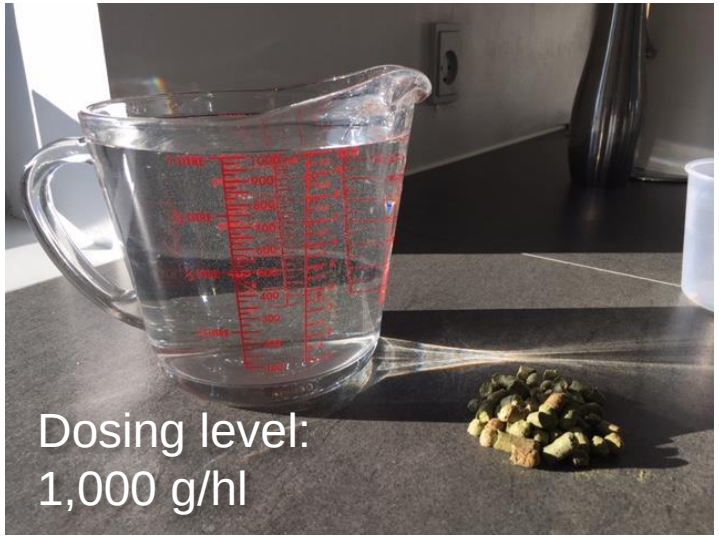
Right: Third impeller blade has been added close to the tank bottom. Mixing is now effective until the tank is emptied.

Aroma/flavour extraction rates

- Hop aroma/flavour extraction is like making tea in cold water in a very large cup
- Extraction occurs at the boundary layer between the hops (tea) and beer (water)
- Saturation occurs at the boundary layer and inhibits further extraction in a stationary medium
- Extraction rates can be greatly accelerated by introducing forced convection (e.g., stirring the liquid)

Hop settling patterns in large tanks

Hop addition | Dis-aggregation | Extraction | Hop removal



Hop solids can settle to the tank bottom or float to the top – or both!

Process issues

Hop addition | Dis-aggregation | Extraction | Hop removal

- Slugs of hop solids
- Blockages of lines, HEX, filters
- Carryover of solids
- Product losses
- Unplanned downtime/ outages
- Increased waste streams

Maturation beer during filtration after 3–5 days settling time and cropping

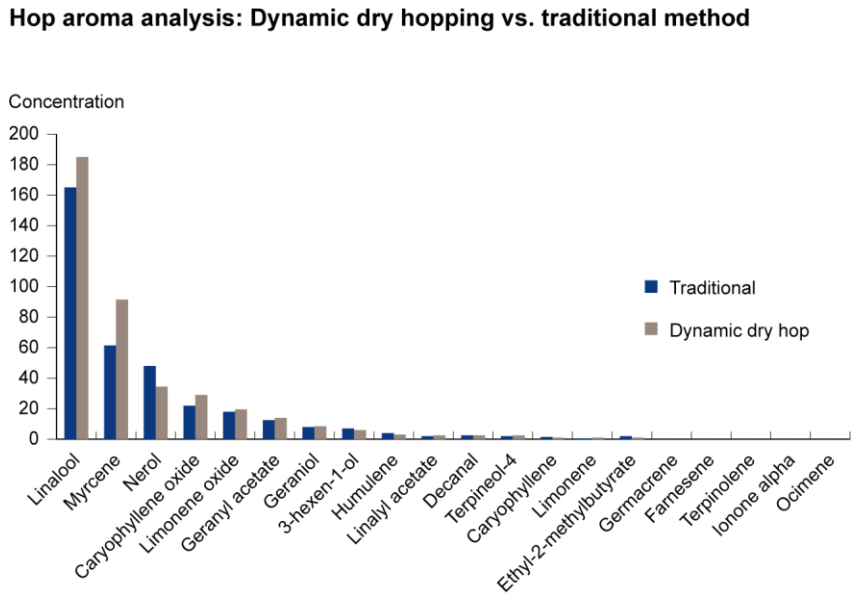
Near end of filtration ~2–3%

Ending filtration → blockage

Significant hop material

Solution: “Dynamic” dry hopping

- More effective hops dispersion
- Faster and more efficient aroma/flavour extraction
- Shorter hop residence times
- Homogenization of hop particles during transfer
- Efficient separation of hops from beer
- Reduction of beer losses
- Reduction of process times



Dry hopping solutions

Alfa Laval IMXD and Alfa Laval Alhop

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 module

- Skid-mounted system
- Hops remain outside the main vessel
- For smaller volumes (20–50 kg of pellets per batch)

Solution 1: Alfa Laval Iso-Mix External Drive (IMXD)

- Motor-driven Alfa Laval rotary jet mixer
- Tolerates high particulate loads
- Flexible hops introduction method
- Fast dispersion and flavour extraction
- Homogenization of feed to centrifuge
- Reduced hop residence time
- Reduced beer losses
- More efficient aroma/flavour extraction

Hop dispersion lab demo

Addition of 5 kg hop pellets to 625 litres of water

- Fast disaggregation (swelling and slurrying) of the pellets
- Mixing in the liquid and extraction of the hop compounds

Water test conditions

- Recirculation at 200 hl/h and addition of hop pellets to reach a concentration of 800 g/hl

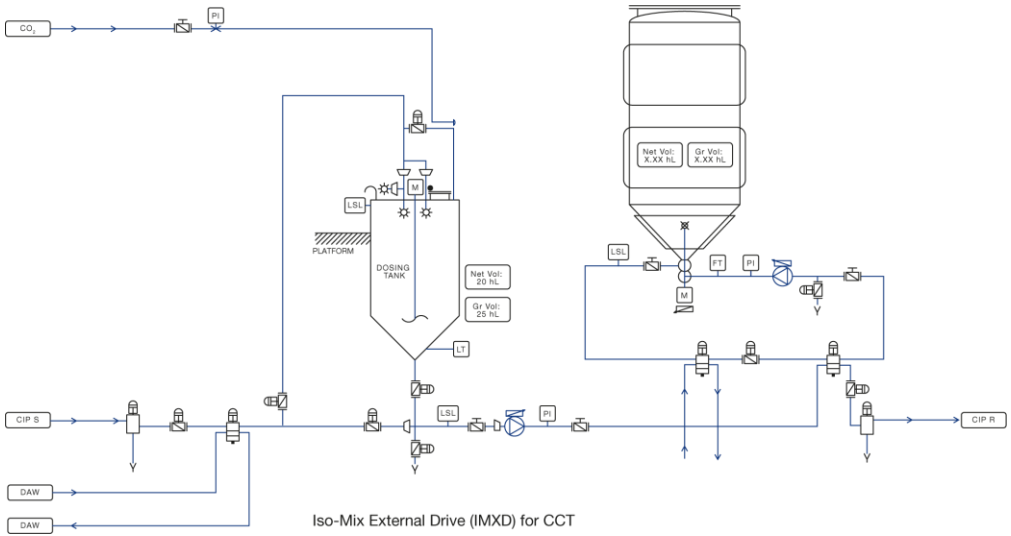
½ minute

1 minute

1½ minutes

2 minutes

Alfa Laval IMXD system with hop slurry system



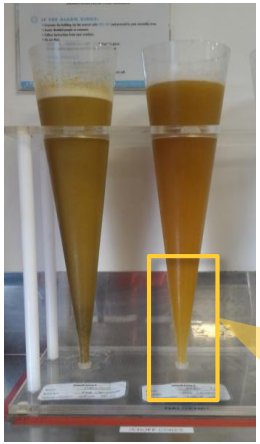
Iso-Mix External Drive (IMXD) for CCT

Prepared hop slurry dosed into the tanks through the Alfa Laval IMXD loops during circulation

Efficient hop removal and reduced losses

- Homogeneous solids loading to the centrifuge inlet
- Complete removal of hops solids and regular discharge intervals
- Reduced losses means less waste streams

Sample of solids discharge



Pre-centrifuge
→ post centrifuge

Homogeneous solids loading to the centrifuge

Samples taken at the centrifuge inlet throughout the transfer.
All samples have consistent solid concentrations.

Discharge of hop solids from the centrifuge

- Operation on haze control (turbidity at separator outlet) is optimal for automatic control
- If this control is not available, timed discharges should work
- Trial and error may be necessary to find the optimal discharge interval to provide appropriate solids concentration and consistency
- Optimum discharge interval will depend on the solids load (e.g., hop dosing rate)

Requirements for Alfa Laval IMXD implementation

- Removable/swing cone on tank
- Minimum 1-meter clearance below tank
- Tank volume typically > 150 hl
- Any method of hop addition suitable
- Control of hop dosing rate necessary
- Hop removal by centrifugation optimal
- Hop removal by sludge-out okay as well

Site installation of Alfa Laval IMXD on the fermenter

Customer results with Alfa Laval IMXD

	Brand 1		Brand 2	
Criterion	**Old method**	**IMXD**	**Old method**	**IMXD**
Tank residence time (from end of ferment to filtration)	5–7 days	24-36 hours	7–10 days	24-36 hours
Number of tanks used	4	2	4–5	2
Cropping loss	Up to 10% cold break + hops	Solids removed through centrifuge <2% loss in maturation from cold break	Up to 15% cold break + hops	Solids removed through centrifuge <2–3% loss in maturation from cold break

Summary:
Dry hopping with Alfa Laval IMXD

- Significant reduction in process time and energy consumption
- Significant reduction in beer losses and waste streams
- Complete hop removal by centrifugation
- Faster and more efficient aroma/flavour extraction
- No significant differences in beer flavour
- Potential for larger product batches
- Potential for higher dry hop dosing
- Additional benefits with mixed fermentation and accelerated cooling (reduced energy consumption)
- Product ROI less than one year

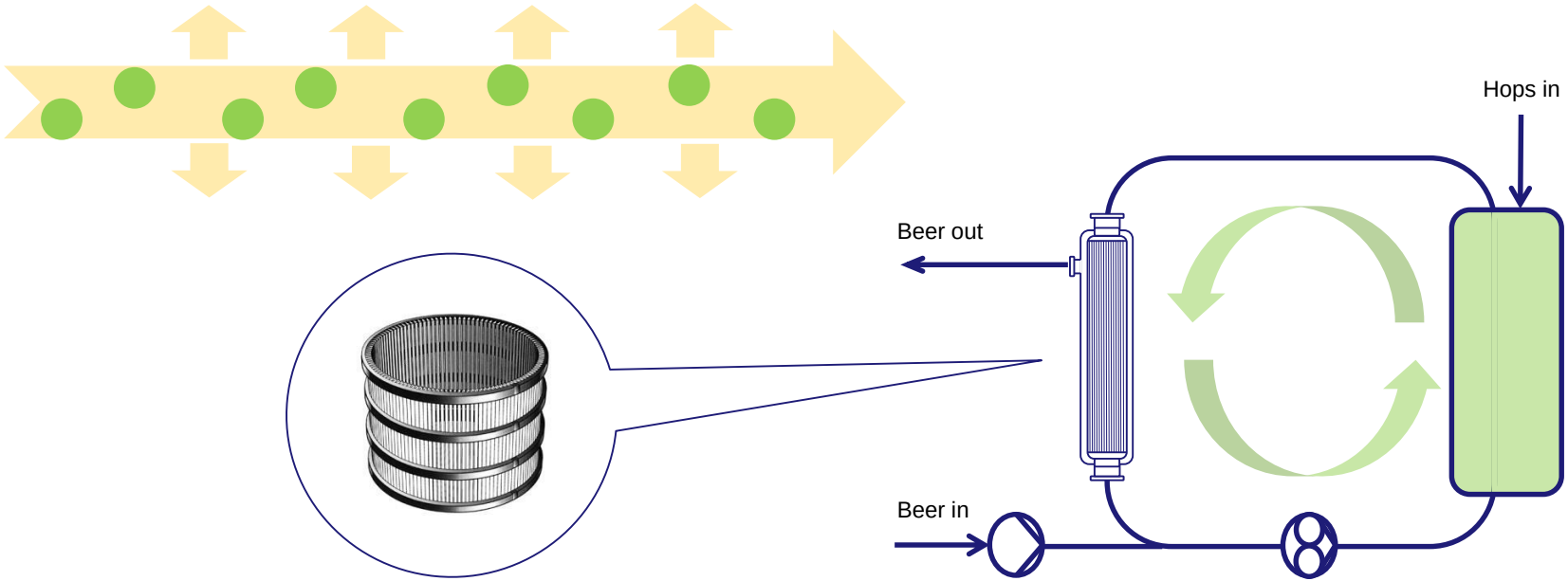
Solution 2: Alfa Laval Alhop Dry Hopping System

Skid-mounted system

Hop addition → Dis-aggregation → Extraction → Hop removal

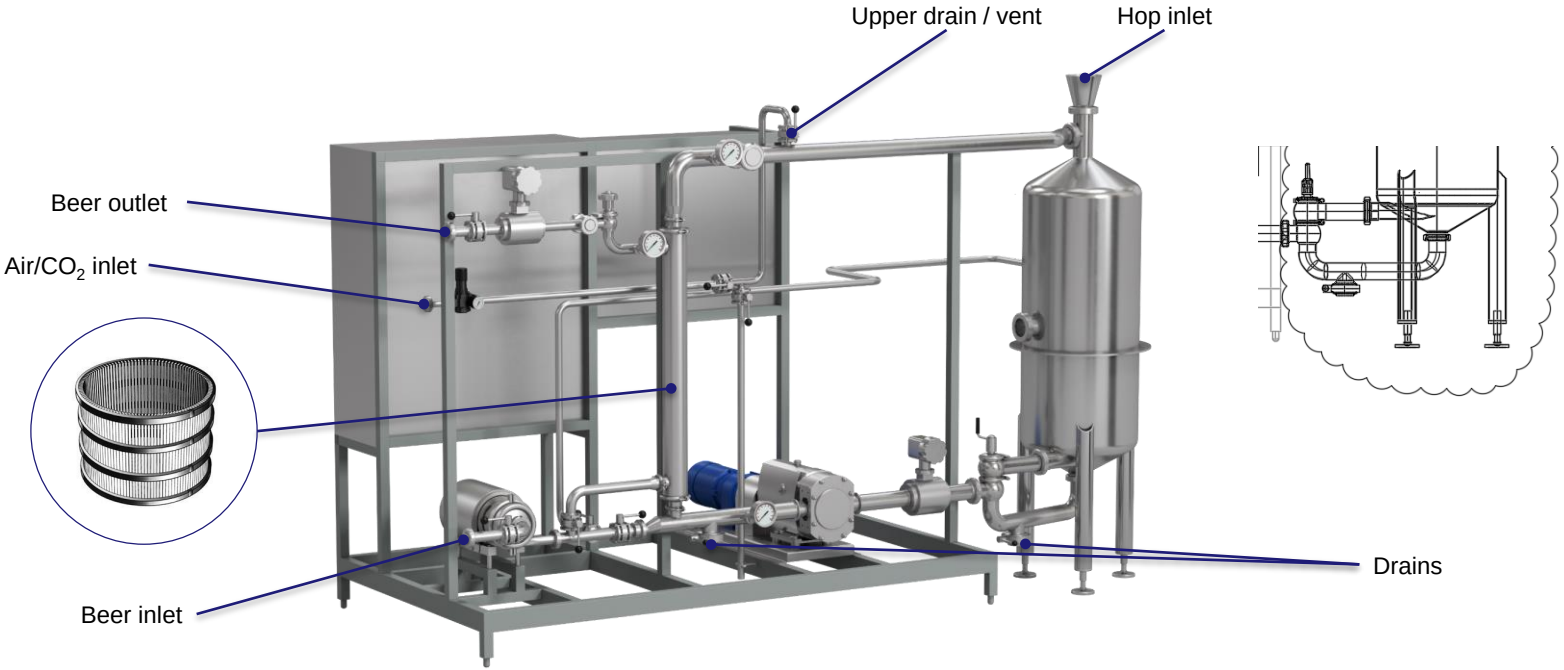
Alfa Laval Alhop Dry Hopping System

How it works



Alfa Laval Alhop Dry Hopping System

Overview



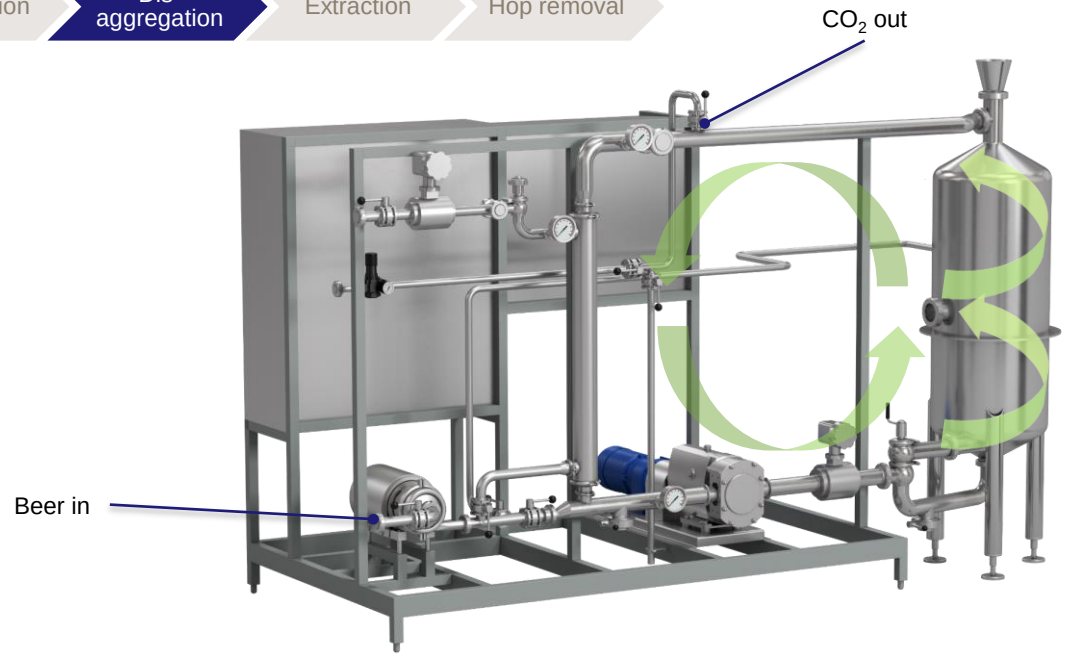
Alfa Laval Alhop Dry Hopping System

Hop addition | Dis-aggregation | Extraction | Hop removal

Status: clean and empty system

Alfa Laval Alhop Dry Hopping System

Hop addition | Dis-aggregation | Extraction | Hop removal



Alfa Laval Alhop Dry Hopping System

Hop addition | Dis-aggregation | **Extraction** | Hop removal

Alfa Laval Alhop Dry Hopping System

Hop addition | Dis-aggregation | Extraction | **Hop removal**

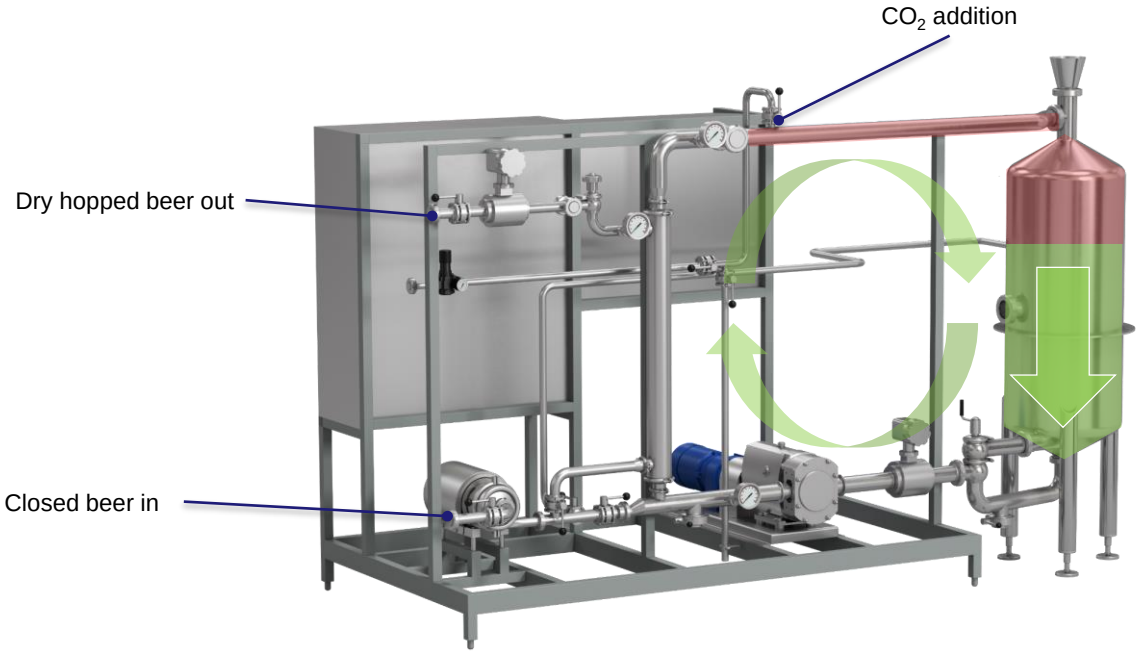
Alfa Laval Alhop Dry Hopping System

Beer recovery

- Concentration
- Diafiltration

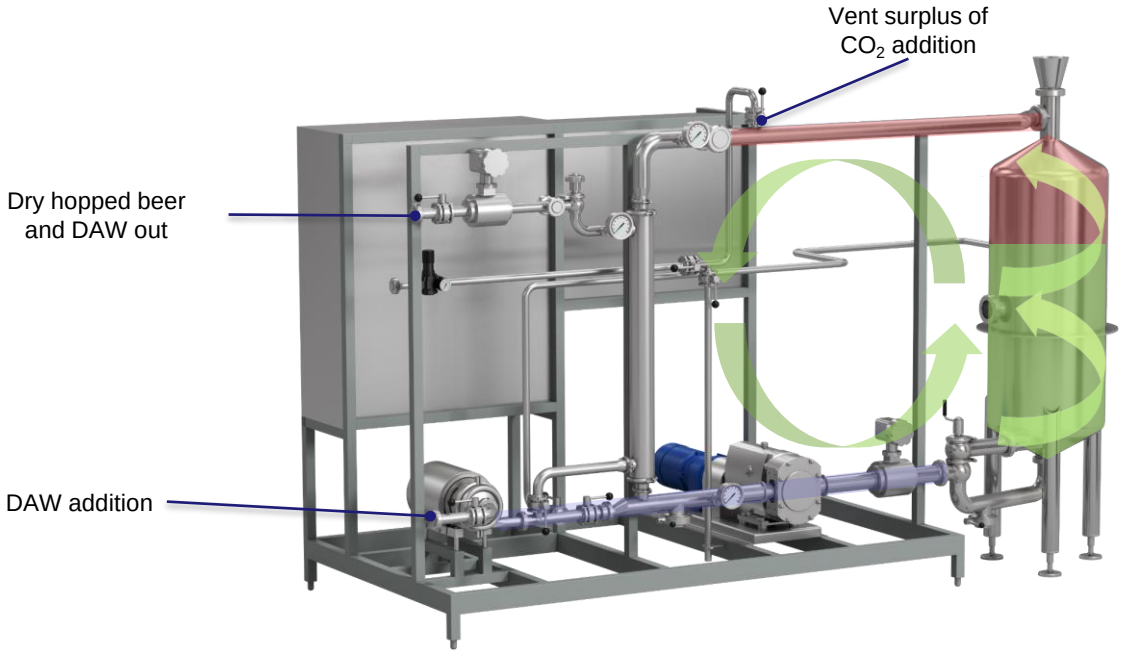
Alfa Laval Alhop Dry Hopping System

Beer recovery – concentration



Alfa Laval Alhop Dry Hopping System

Beer recovery – diafiltration

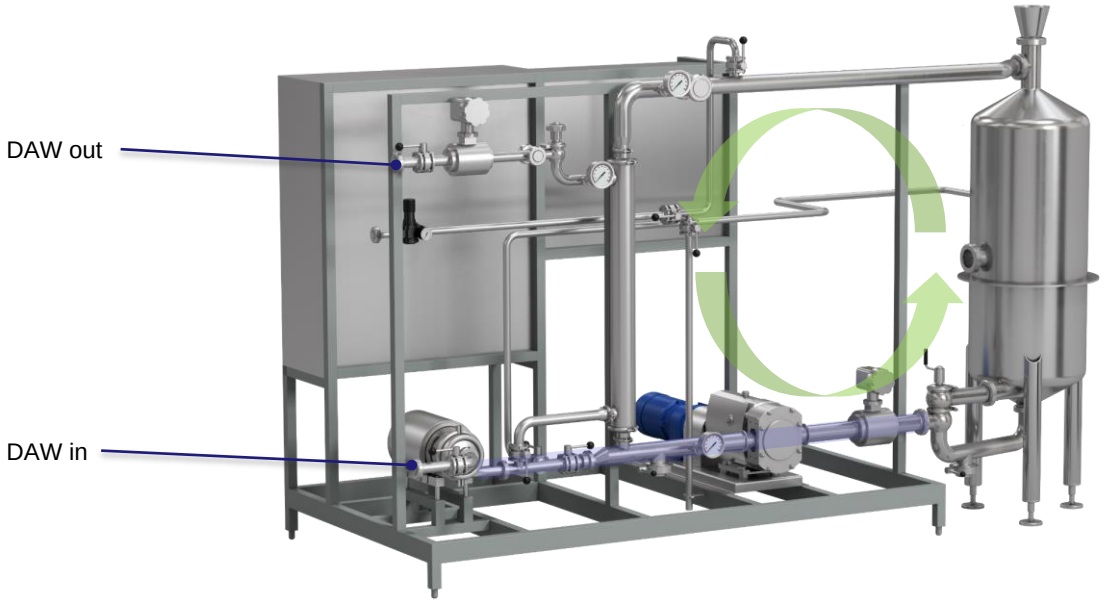


Alfa Laval Alhop Dry Hopping System

Is hop recovery possible?

Alfa Laval Alhop Dry Hopping System

Hop recovery



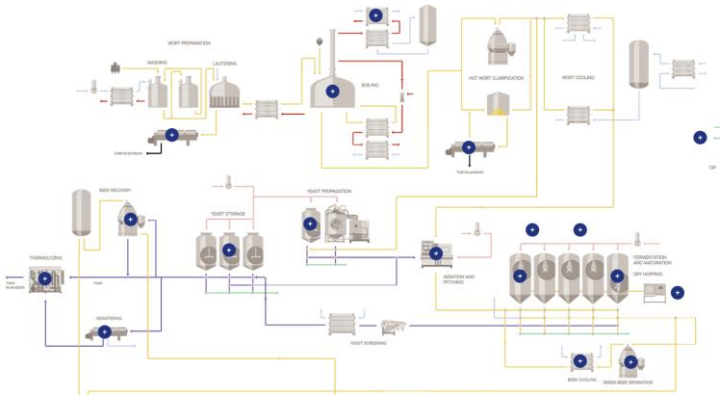
Contact us

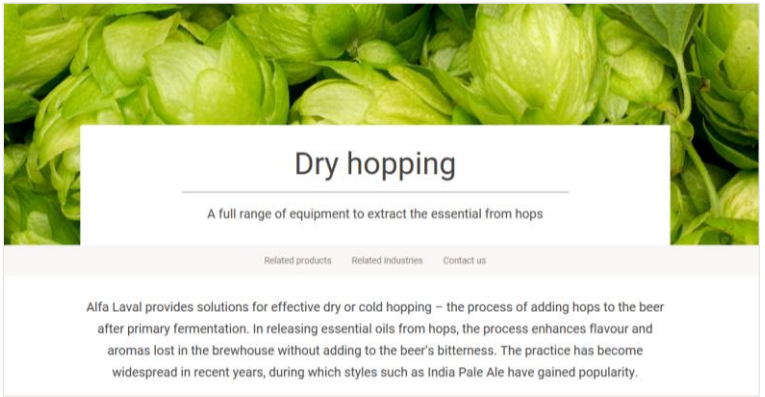
Click below and fill in the contact form.

https://www.alfalaval.com/products/process-solutions/brewery-solutions/dry-hopping/contact-us/

More information

- Dry hopping
- Alfa Laval IMXD
- Alfa Laval Alhop
- Beer production
- Commercial brewing
- Craft brewing



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