

Dry Hopping

A new dimension of efficiency

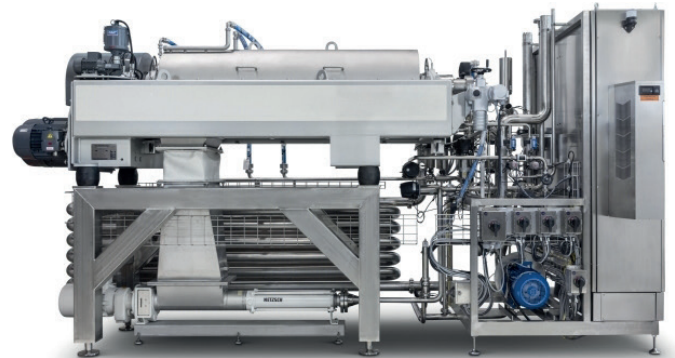


Fig 1: LoopulEX®: Hop pellet dissolving tank incl. agitator (left), decanter and aroma booster (right).

all pictures banke

In 2020, the first LoopulEX® dry hopping systems from banke GmbH were commissioned. The highest extraction efficiencies of hop oils are achieved with extremely low beer losses in short process periods. The experience and practical results of the first three installations are summarized below.

The LoopulEX® process employs "external dry hopping", which takes place in a bypass process outside the fermentation or storage tank and effectively retains the hop particles (Fig.1) [1].

The innovative patented process (DE102019130400.8) takes place in three process steps:

1. dissolving the hop pellets in beer and producing a homogeneous, highly concentrated hop suspension.
2. dilution of the hop suspension in a bypass with base beer from the fermentation or storage tank to a low suspension concentration.
3. separation of the hop suspension into particle-free dry-hopped beer and "dry" hop particles.

Hop pellets are added to the hop solution tank. Once the air has been displaced with inert gas and oxygen-free conditions prevail, the dissolving tank is filled with beer. A special agitator produces a homogeneous hop suspension with 6-8 mass% within 30-60 minutes. The "fast dissolving agitator" developed by banke disperses the pellets in a short time, while maintaining gen-

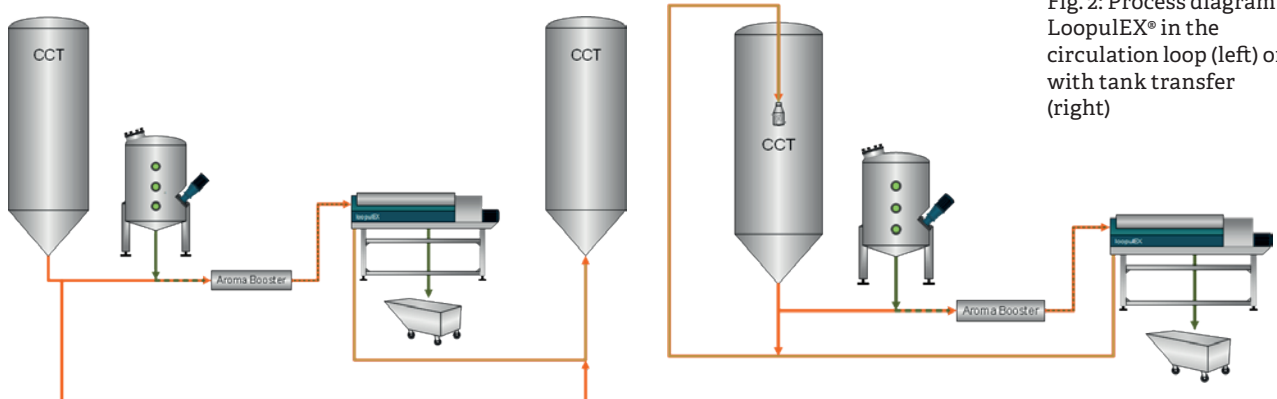


Fig. 2: Process diagram LoopulEX® in the circulation loop (left) or with tank transfer (right)

tle mixing, so that the vitality and viability of the yeast cells are preserved. In this highly concentrated hop suspension, many supersaturated hop oil components are present and would only be extractable with poor efficiency [2, 3].

To achieve ideal and optimal extraction efficiency, the hop suspension is diluted to 1.0-1.5 mass% with base beer on the way to separation. In the holding section to the particle separator, a new extraction equilibrium is established in a short time and the aroma substances are dissolved highly effectively in the beer.

In the final sub-process, the hop particles are continuously separated in a decanter. Separation rates of 98-99 % and dry matter content of 35-40 % for the spent hops are possible. Up to 96 % of the beer that would be lost in the hop sludge can be recovered. Depending on the hop dosage, up to an additional 15 % of sales beer is obtained.

The specifics, differences in integration, and the experiences of the installed plants in the USA, Norway, and the U.K., which were commissioned between 2020 and 2022, are described below (Tab. 1). Process times of 5-26 hours were achieved in the installations, allowing very flexible integration in the cellar and processing of large quantities. The pellet quantities range from 200 to 3,500 kg per batch with beer volumes between 200 and 6,000 hl.

LoopulEX® USA

In the largest unit, the pellet quantities of up to 3,500 kg are fed into a storage silo and pneumatically conveyed to a dosing hopper on top of the dissolving tank (frame elements, see Fig. 1). There they are weighed and the air from the pellet load is displaced with inert gas, which enables multiple oxygen-free refilling of the dissolving tank and therefore almost continuous operation is possible.

Additionally, in order to fully automate hop discharge, the hop particles are rehydrated with water in the decanter outlet so that they can be pumped again and thus continuously conveyed into a disposal tank.



Fig. 3: Mixing section after bypass at the top of the picture; LoopulEX® Norway



Fig. 4: Hop feed; LoopulEX® U.K.



Fig. 5: Spent Hops separation via decanter; LoopulEX® U.K.

LoopulEX®	USA	Norway	U.K.
Pellet mass	max. 900 kg hops per batch	max. 1000 kg hops per batch	max. 350 kg hops per batch
Beer-Vol. and process timing	Dry hopping of 6450 hl CCT in 24–26 h	Dry hopping of 1400 hl CCT in 7–10 h	Dry hopping of 800 hl CCT in 5–7 h
Reduction of beer losses	beer losses significantly reduced (not quantified yet)	96% (Beer loss down to 14 hl from 400 hl per batch) [4]	beer losses reduced (not quantified yet)
Hop savings and oxygen uptake	Up to 25–30 % for T45 and T90 pellets; no detectable oxygen uptake	Up to 30 % T90 pellets; no detectable oxygen uptake	Up to 30 % T90 pellets Up to 18 % T45; no detectable oxygen uptake
Integration	Mixing cycle	Tank transfer	Tank transfer
Pellet insertion	Pneumatically from storage silo in separate room	Manually via feed table situated above	Pneumatically via feed table
Hop discharge	Wet	Dry	Dry
Flavor-match	Yes, confirmation by tasting panel	Yes, confirmation by tasting panel	Yes, confirmation by tasting panel

Table 1 Overview LoopulEX® installations

For integration into the cellar, two CCTs were each equipped with a circulation loop connected to the LoopulEX® dry hopping system (Fig. 2). The two process tanks are ideally mixed via this loop, so that the dry hop aroma is homogeneously present in the entire beer volume of up to 6,000 hl.

LoopulEX® Norway

Here, the pellet feed is carried out from an operator level above, where the hop cooling chamber is also located. A feed table with funnel for manual filling sits on top of the hop dissolving tank. The hop particles are discharged dry and collected in mobile containers. The external dry hopping process takes place in the tank transfer (Fig. 2). The unit is integrated via a pipe fence. This concept allows the process to take place in a classic fermentation and storage cellar, where the CCTs are only equipped with an inlet and outlet. In the transfer, a volumetric dosage of the beer, enriched with hop aroma takes place, so that after the transfer the entire beer volume has the same aroma intensity without the need for further mixing or homogenization in the tank (Fig. 3).

LoopulEX® U.K.

The system was installed between the fermentation and storage cellar and integrated via a valve manifold so that two different transfer lines can be fed - one line for the pressure tanks for keg filling and one line for the supply of

the bottle filling line. The dry-hopped beer also passes directly through a centrifuge after the LoopulEX® system, for the separation of yeast and fine particles.

In this system, due to the low ceiling height, the dissolving tank is filled in a user-friendly manner at floor level via a feed funnel, from where the pellets are pneumatically conveyed into a separator on top of the dissolving tank (Fig. 4).

Here the spent hops are also collected dry in containers, which can be conveniently held and exchanged by means of a roller conveyor (Fig. 5).

Summary

Guaranteed savings of hops and beer were achieved in all three installations. The beers are characterized by consistency and improved aging stability of the hop flavor.

Particularly important for the breweries was the flavor match to the beers already launched on the market. This was achieved in all three plants after a short optimization phase.

The ROI of the three plants at the respective production volumes is between 6 months and 3 years when considering hop and beer savings without side effects.

Operational practice has also shown that the LoopulEX® plants operate smoothly in all phases of fermentation and storage, even with high yeast loads, without any loss of throughput or process times.

Important decision criteria for the LoopulEX® technology were also the savings in wastewater costs and labor, as well as occupational safety for the operators. The selective separation of hop particles - yeast is only separated to a small extent - results in major advantages for yeast management and vitality.

Also noteworthy are the low maintenance costs of the plants, which are evident after more than 1.5 years of operation for the first two plants.

A test unit is available for any interested brewery. Based on the test results of current inquiries, pay back times of 3.5-5.0 months could be determined. Thus, the LoopulEX® system is likely to be the most efficient technology for dry hopping large volumes of beer. ←

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