Innovative technology to reduce beer losses at dry hopping

GENTLE ON THE PRODUCT | The BrauKon HopSteiner (already presented as BeerCleaner) is an economical alternative for the separation of hop trub particles. Without the need for additional drives, the system is gentle on the product and allows for a wide range of applications.

THE CRAFT BEER BOOM of the last few years has, amongst other things, brought about the rediscovery of dry hopping technology. This gave hops as a raw material a new value in beer production. Well-known and also new hop varieties, which bring special aromas into beers, can be intensified when hops are added into the cold stage of the process. As the intensity of the hop aroma in most applications is related to the quantity used, a technological solution is also necessary at the end of the process to remove the large volumes of partly insoluble trub components from the beer. The resulting beer losses have a significant influence on the economic efficiency of the entire beer production process. To keep these losses as low as possible, the BrauKon HopSteiner was developed for separation of the hop trub. In addition to the reduction of beer losses, this application also demonstrates that problems in further processing, centrifugation and filling can be avoided. Experiences from practical applications are presented in this article.

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Problem consideration

With the commonly used dry hopping processes, sometimes enormous quantities of hops, mainly hop pellets, are added to the beer. The swelling of the pellets increases their volume by about 6 times. At the end of this extraction process for transferring the hop aroma substances into the beer, an incomplete/inhomogeneous separation of the hop particles in the container is usually observed. Subsequently, the beer charged with hop trub is often disposed of directly unused from the tank, or a technical solution for clarification in the form of beer centrifuges and beer filters is applied. As these were usually not designed for the separation of insoluble hop particles, massive problems can occur, especially with larger amounts of trub or by blasts of trub from the tank. This will finally stop the process, for example due to blockages, or, as with centrifuges, because of major damage.

As a solution to this, the BrauKon HopSteiner has turned out to be an easy to control device for the above-mentioned application purpose. The technical and constructive approach of Hopsteiner was carried out together with Banke Process Solutions, the hop technology partner of BrauKon.

Functionality of the BrauKon HopSteiner

The construction and the schematic sequence of the process are shown in figures 1 and 2.

The hop trub remover consists of a steeply inclined arch screen which is inserted into a pressure vessel with a similar angle of inclination. At the upper end of the screen there is an inlet distributor which creates a

Fig. 1 Hop trub remover ready for operation

constant thin liquid flow evenly across the whole width of the screen's surface (see fig. 3). The major amount of hop particles is separated from the beer by sieve slits which are arranged crosswise to the direction of flow. The cleaned beer enters a small collecting tank located at the bottom of the sieve. From there, the beer is pumped out of the system by means of a level controller into an outlet buffer tank (BBT). The remaining hop trub continuously slides down the front of the screen due to gravity and finally falls into the sludge chamber provided for this purpose (see fig. 4). Any kind of blocking of the slits is impossible since a self-cleaning effect is achieved by the subsequent beer flow and its trub substances.

The entire internal area of the vessel is CIP compatible. The configuration of the unit to 4 bar excess pressure also allows the use of already carbonated beers without foaming. Due to its design, it is possible to flood the tank with water and then empty it with CO_2 to ensure oxygen-free operation.

The BrauKon HopSteiner is currently available in one size and can be operated with a throughput rate of up to 100 hl/hr or even higher under ideal conditions.

Figures 3 and 4 from inside the apparatus show a test run carried out with a very high hop dosage of 7.5 kg pellets/hl beer. Even under such extreme conditions the system ran without any problems with an outstanding flow capacity.

Trub separation with larger gap wid

An analysis of the particle distribution in the filtrate surprisingly showed that a large number of particles that had a significantly smaller diameter than the defined gap width of the screen were not found on the filtrate side. Most of the particles have a size of 50 µm, which is considerably smaller than the sieve gap width. The distribution density of particles >50 µm decreased very quickly with increasing size. This phenomenon can be explained as follows:

The so-called Coandă effect describes the deflection of a flow on solid bodies so that the flowing particles will follow the shape of the solid body. With increasing mass and/or speed of a particle, the change of direction into another flow path (sieve gap) according to the Coandă effect is no longer possible, so these particles will maintain their original flow direction.

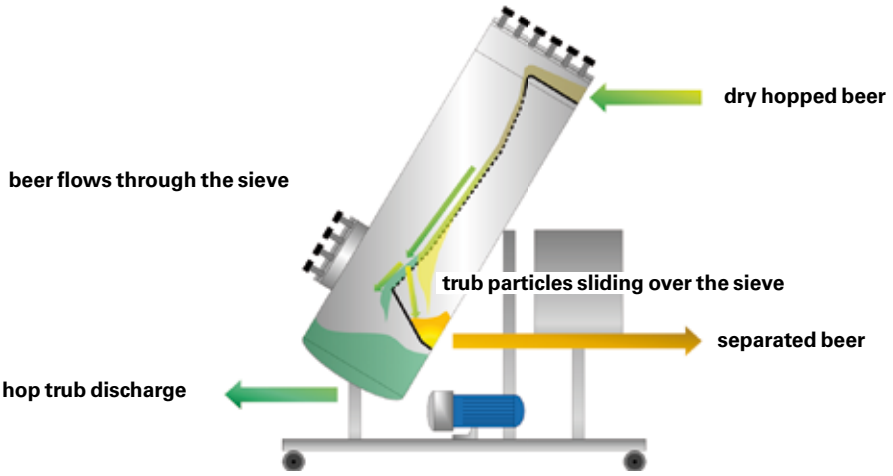

Fig. 2 Design and process flow

According to this fact, the selectivity of the device is above the clearance of the sieve. Smallest particles, whose size is mainly within a range of 50 µm, remain in the beer. For this reason, a final clarification process is always recommended before the dry hopped beer is transferred to the filling line.

The hop trub remover in operation

Important findings have been obtained from numerous practical applications in breweries. Due to the differences in the technical installations of the breweries and the batch sizes of the dry hopped beers, various application scenarios have resulted for the BrauKon HopSteiner.

First example of use: two-tank procedure

Dry hopped beer is transferred from a CCT through the BrauKon HopSteiner and collected in another tank. In order to feed the sieve with a constant load of hop trub, the tank content was previously homogenised with CO_2 gas shocks from the bottom. The collected filtrate is then allowed to remain in the tank for a certain period of time to allow sedimentation, or it is more or less directly adjusted to its final turbidity by a centrifuge.

With this experimental approach, by using the effect of the natural sedimentation, beers were produced in which no hop particles could be detected. Besides small hop particles, the sediment mainly contained trub components like protein-tannin precipitates and processing yeast, as long as those were not already separated prior to the dry hopping process. It is therefore advisable to discard the sedimented material. Even if a centrifuge is used, the separation of the sediments would tend to make a negative contribution regarding beer losses – the machine would have to discharge more frequently.

Second example of use: single-tank procedure

A similar observation is also applicable to a single-tank procedure, provided that this tank has the possibility for recirculation. After dry hopping in a CCT, the tank volume can be circulated to be homogenized. Irrespective of this, at the end of the intended process time of dry hopping, the beer is transferred over the BrauKon HopSteiner for pre-clarification. Depending on how well the circulation of the tank contents performs, the hop trub particles can be removed more intensively. However, trub accumulations that stick to the inner wall of the tank and then peel off later when the tank is being discharged can cause difficulties for the subsequent separation. If this is the case, the smaller trub particles can be allowed to sediment and the fine trub removed analogous to the first example of application mentioned.

Third example of use: tank zones

The large number of tests carried out with the technology of dry hopping clearly showed an inhomogeneous distribution of the hop trub over the tank volume. If the hop particles can move freely, then at the end of the process the main proportion of them can be found in the bottom zone of the tank. In the middle area, however, there are only a few to no trub particles, while in the upper part of the liquid there is again con-

Fig. 3 Beer inlet top

Fig. 4 Bottom discharge of hop trub

siderably more material. This demarcation becomes even more pronounced with larger and taller tank and beer volume.

Consequently, it can definitely be recommended that only the beer from the lower part and from the upper part of the tank is passed over to the BrauKon HopSteiner and the middle part of the batch is directly transferred to a buffer tank. With this approach, as already mentioned in the previous example of use, the problem of trub shocks by delamination from the tank wall and the quantity or separation of fine trub must be considered. The extent to which this affects further proceedings must be examined on a case-by-case basis.

Fourth example of use: pre-dissolving in stirring tanks

Figure 5 shows a setup in which the hop pellets are pre-dissolved, homogenized and pre-extracted in a stirring tank (HopGun Pro), preferably using beer. This results in a better dissolving behaviour with no dilution effects being generated. Since the BrauKon Hopsteiner can also handle very high hop quantities and respectively hop trub concentrations, a liquid aroma concentrate can be produced with this method. This suspension, released from the bulk of the hop particles, is now used for the actual dry hopping, and is pumped into a beer tank. The removal of the main trub quantity has therefore already been carried out before the process of the actual dry hopping. Large quantities of hop trub and especially the coarse hop particles have no influence on the further processing. This technique is particularly suitable to produce larger quantities of dry hopped beer and for breweries with a high degree of fixed piping and a corresponding degree of automation.

Whilst the first attempts with this procedure were successful, it was also recognised that with very high hop dosages into the HopGun Pro a kind of saturation effect occurs regarding the hop aroma substances in the solution. The yield would therefore not be optimal with this mode of application.

First tests with a different operation method demonstrate that these disadvantages of the extraction efficiency can be avoided and thereby highest yields of hop aromas in combination with the HopSteiner can be achieved. Banke process solutions, BrauKon's hop technology partner, will publish further results shortly.

The question of the best appropriate process depends on the brewery's equipment and the batch size to be handled. Investment costs are manageable, especially because the use of movable and driven parts was minimised as far as possible.

Summary

The BrauKon HopSteiner has been tested in many practical trials under various conditions and demonstrated its high flexibility. It was shown that it is possible to produce

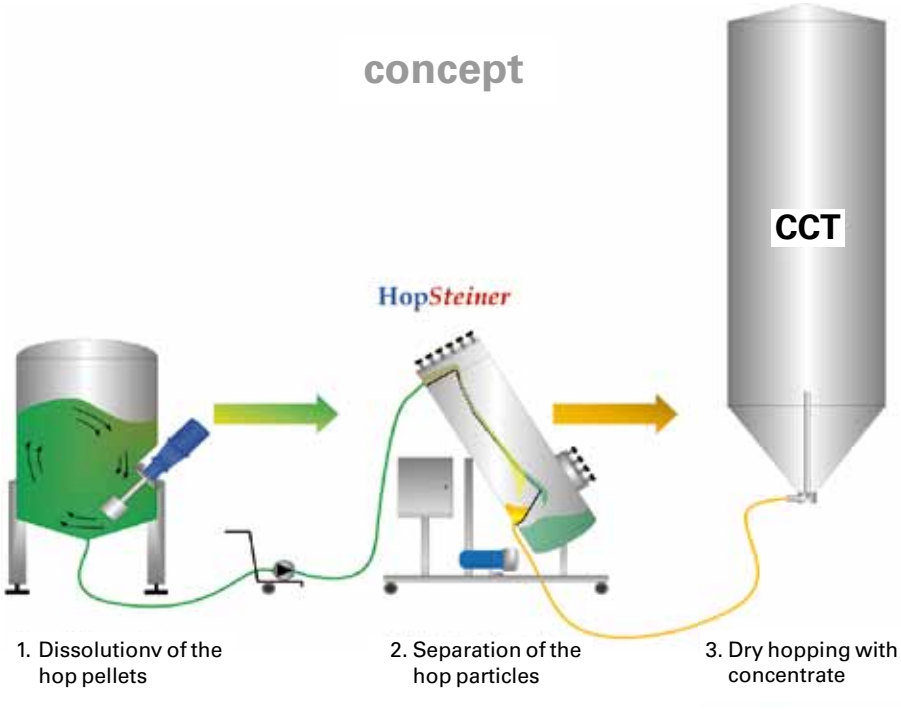

Fig. 5 Concept for dry hopping with aroma concentrate while minimizing the hop trub load

dry hopped beers that are largely free of hop particles without the need for additional centrifugation or filtration.

The integration of the unit into the production process will always depend on the existing setup in the brewery. In small breweries a very good result can be achieved with the hop trub remover alone. In larger breweries or with larger batches, the device should be part of an overall concept for dry hopping. It can especially be used where a high degree of automation is existing and large quantities of hop trub often lead to blockages and malfunctions.

Another important advantage is that problems in the subsequent processing of the beers, for instance during centrifugation, filtration and bottling, can be avoided by using the BrauKon HopSteiner.

The reduction of beer losses resulting from dry hopping can be determined in each individual case and compared to other processes. With the apparatus presented, a dry substance content of 10% by weight can be achieved. If these values are significantly lower in the brewery, it is recommended to consider the BrauKon HopSteiner. ■