

# REVIVAL OF A PROCESS

## Dry hopping – basics and techniques

*Dry hopping had more or less become a thing of the past in Germany, but US craft brewers have given this process a new lease of life. About 20 to 25 years ago, American craft brewers started brewing beers which differed considerably from mainstream commercial beers both in terms of bitterness and hop aroma. The existence of more than 1800 craft breweries is clear evidence of the huge success of an industry which continues to grow steadily, as demonstrated by plans for the construction of a further 750 brewing plants [1]. This notable trend is reflected by renewed interest in dry hopping in Germany.*

A stagnating beer market provides opportunities to arouse consumer interest in beer by promoting “specialities” which focus on completely new variations in flavour and, in particular, new aromas.

### Definition of dry hopping

Hops and hop products are usually added in the brewhouse. In order to maximise bitter substance utilisation, early hop addition to the kettle is essential. However, this, in turn, evaporates aroma substances after only a few minutes of exposure to the boiling wort. Late hopping in the hot section results in a decent hoppy note, but hardly reproduces the character of the hop variety/ varieties used.

This is due to the fact that the volatile aroma substances which characterise a specific hop variety are lost, even if only briefly exposed to high temperatures. Hopping in the cold section is an ideal way to impart an aroma note typical of the variety used. In this case the hops need to be added either during fermentation or to the storage tank.

A statement released by the Bayerischer Brauerbund [2] confirms that hopping in the cold section does not contravene current beer legislation and clearly states that according to §9 para. 5, reference is made only to hop extracts which may be added during wort boiling. Consequently there is nothing to stop dry hopping with leaf hops, hop powder, or hop pellets.

### Techniques

#### Addition to the storage tank

No great technical know-how is required for the addition of leaf hops or pellets to the storage tank. Of course the presence of insoluble hop components in the green beer is a drawback which can hamper clarification and ensuing filtration. This problem can be minimised by putting the hops into small sacks. The sacks need to be very fine mesh, especially if using pellets. However, this method does not provide optimum extraction of the aroma substances.

Neither of these methods guarantee homogenous distribution in the tank. Hopsteiner’s analyses of commercially available beers show that aroma substance

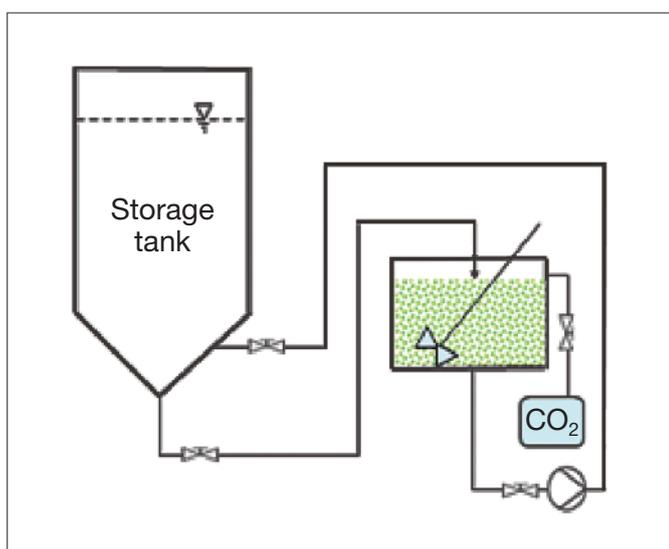


Fig. 1: Pre-dissolving and Recirculation

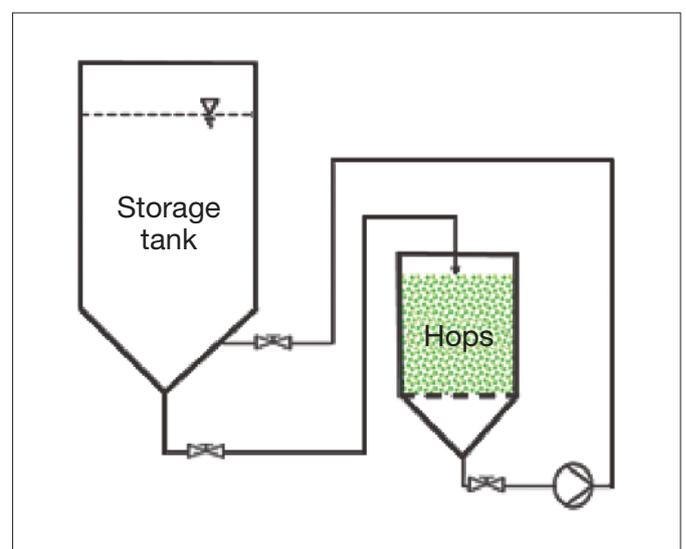


Fig. 2: Continuous Extraction

concentrations often differ from one beer batch to another. In a few cases hops are added during fermentation. This usually takes place towards the end of fermentation with a view to using the yeast to reduce some of the oxygen introduced by the hops.

On the other hand the carbon dioxide resulting from fermentation acts as a kind of carrier gas, eliminating some of the highly volatile hop oils which would be of particular significance for dry hop aroma.

#### *Pre-dissolving pellets*

The best extraction of hop aroma can be achieved by pre-dissolving the hop pellets. This can be done either with beer or water which must be oxygen-free and fully demineralised. We recommend a weight-based ratio of pellets to beer (or water) of 1:20 in order to make mixing easier. The suspension can be added to the storage tank manually, but it can also be pumped in.

The solid/liquid ratio as described above should make this fairly easy. Any oxygen intake must be avoided. In addition to improved hop aroma extraction – which may vary from batch to batch – a further advantage of this method is the somewhat more uniform distribution of the pellets.

#### *Pre-dissolving and recirculation of pellets*

This is a further development of the previously described process. Figure 1 shows how leaf hops or, preferably pellets, are pre-dissolved in beer, then pumped into the storage tank and, finally, recirculated gently for a certain amount of time. There are different time frames for this process, ranging between only one hour and up to several hours.

The mixing tank must be flushed with CO<sub>2</sub> in order to expel any oxygen. The shear forces created by the process of recirculating and the consequent, intense contact with the beer result in improved extraction.

#### *Continuous extraction of hops with beer*

Figure 2 shows a free-standing stainless steel vessel with a sieve plate, into which leaf hops are added. As described in the pre-

vious process this vessel is also flushed with CO<sub>2</sub>. Beer is then pumped from the storage tank into the “hop extractor,” the main objective being to dissolve hop oils and transfer them into the beer. Again, the duration of each individual process can vary greatly and may last up to several hours. The time spread influences extraction efficiency and its uniformity from one brew to another.

*Dosing hop oils*

The best reproducibility is probably achieved by direct dosing of hop oil to beer. The required hop aroma can be achieved by dosing specific amounts of oil. There are numerous types of hop oil which are suitable for this purpose and impart a multitude of aroma notes to the beer. This method of aroma addition, however, does not comply with the German Purity Law (“Reinheitsgebot”).

These products are usually added before filtration. Due to the low concentrations required, the hop oil is generally added to the beer flow as a solution prior to filtration. This ultimately results in small quantities of undissolved hop oil being retained in the filter. The same dosing system can be used as for isomerised extracts, using a frequency controller to set the rate of oil addition according to the beer flow. The more uniform aroma in the beer is complemented by the major benefit of solid-free dosage, which explains why some craft brewers are moving towards this product group.

*Addition to the keg*

In English Brew Pubs hops are often added to the empty keg prior to filling. So-called “hop plugs” are usually used for this purpose. This method does not guarantee

a fixed contact time as the rate of keg consumption can vary considerably.

*Use of a “Hop Back”*

There is another method which deserves a mention, as it provides an interesting alternative to dry hopping, and takes place in the hot section. It is similar to the previously described method of hop extraction using beer, but, in this case, the wort becomes the active “solvent” (see figure 3).

The extent to which the extraction effect remains uniform in individual brews still needs to be examined. However, it has been confirmed that fermentation leads to greater losses of volatile oils than is the case for hopping in the cold section. Although this method results in most of the “dry hopping” character being lost, it may nevertheless provide an option for the brewer who prefers an intense, but somewhat more rounded hop aroma.

**Possible problems associated with dry hopping**

The high content of solids generated by hops during most processes makes the use of a centrifuge prior to filtration necessary. Without a centrifuge, the filter life cycle would be considerably shortened. This might even be true, albeit to a lesser degree, if a separator were located upstream. In addition to this, beer losses are incurred by adsorption to the solids. The possible intake of oxygen and the prevention of associated problems have already been addressed.

Depending on the process which is implemented, aroma substance contents can vary from one beer

batch to another. It is therefore essential to focus on the type of addition, the contact time, the crop year etc. A further important issue is the danger of infection when hopping in the cold section, although as far as gram-positive bacteria are concerned, beer is protected by the bacteriostatic effect of hops. Research carried out at the University in California shows that hopping in the cold section generally does not cause any microbiological problems [3].

**Conclusion**

Dry hopping is nothing new. In England it has a deep-seated, long tradition. This is also the case in Germany, although it did almost become extinct there during the last few decades. In the USA the craft brewing scene has not only brought it back to life, but has refined existing techniques, while further development will generate processes which are more sophisticated than those currently in use. Hop oil products which allow more uniform aroma adjustment may increase in popularity.

Detailed research still needs to be carried out into the yields of the various processes and how best to achieve uniform distribution of the aroma substances. We will report further in Part two. □

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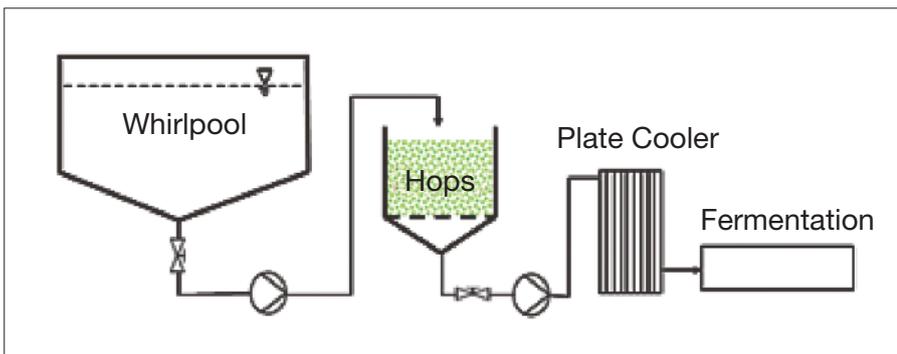


Fig. 3: Use of the “Hop Back”