

BANKING ON THE BREWHOUSE

Maximizing value in the brewery Part 3: New aromas

Better wort quality, greater foam stability, higher yield, faster rinsing, more flexibility in terms of brew volume, lower energy consumption and fine-tuning hop aromas. These improvements can often be achieved even in older breweries with relatively modest investment and without having to face expensive new construction. The company BrauKon, based in Chiemgau, has established itself as a well-known manufacturer of brewhouse facilities and complete, mid-volume breweries. In cooperation with the company Banke process solutions, numerous modernization projects in breweries with greater than 1 500 hl output have been realized for more than ten years. The following report from our three-part series about ongoing projects illustrates process improvement possibilities – up to brew sizes of 1 500 hl and beyond – and are offered here as inspiration for master brewers who keep a close eye on their own processes in order to identify and exploit untapped potential.

The Craft Beer wave has focused attention on the use of aroma hops in the brewhouse. Whirlpool hopping is used not only for extremely hoppy beer styles like pale ales and IPAs, but also for

brewing traditional styles in order to achieve a more pronounced and balanced hop aroma with high “drinkability.” The desire to use extra hops to round off the flavor of their Pils was the impetus

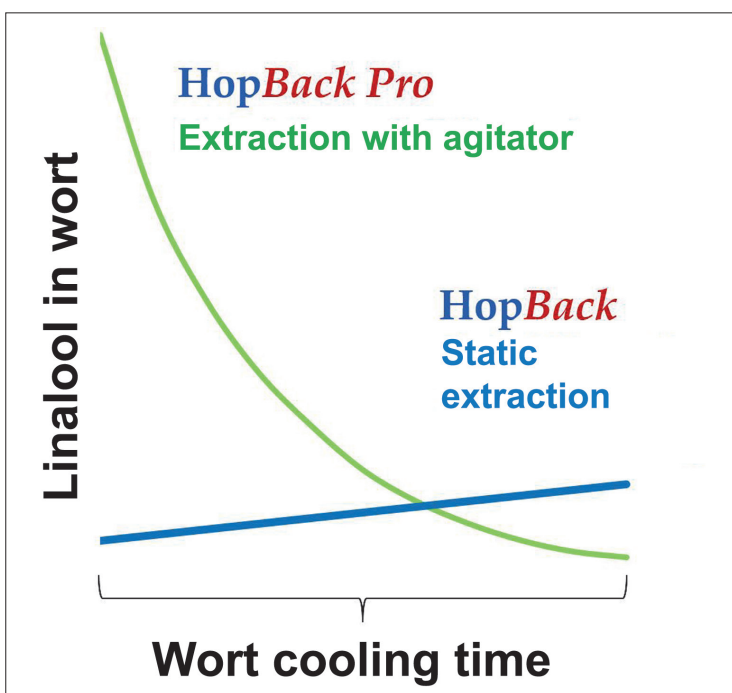
behind the first HopBack Pellet installation in a Bavarian brewery. Late hopping is also beneficial for hop aroma stability [11,12].

A wide variety of technological solutions

“Late Hopping” has been a central theme for BrauKon and Banke process solutions brewers and engineers since entering the US craft beer market over a decade ago. Over the years, successive progress has been made in the optimization of additive management in the brewhouse alongside gradual development of the consumer market.

Renaissance of the hop cone

Mostly initiated by marketing departments, practical use of hop cones has technical limitations because brewhouse installations are generally designed to accommodate pellets and extracts. Hops tend to block pipes, so separation and discharge often require manual labor. Some brewers, therefore,



Extraction curve of linalool for static and dynamic extraction.

pack the dried hops in sacks, bags or baskets. Although residue is indeed reduced, on closer inspection, you'll find several "dry" spots, especially at higher volumes, where insufficient leaching of valuable hop oils has taken place.

Hop oils in the lupulin glands are protected by the leaves in the interior of the umbel and therefore leach much more slowly than from pelleted hops. Extraction efficiency leaves much to be desired in this scenario.

Controlled hop-oil extraction

Introducing and controlling doses of hop aroma is made possible using HopBack technology, which can easily be retrofitted in existing brewhouse installations. In the "basic" HopBack system, umbels are exposed to a static flow of wort. Controlling wort flow ensures thorough extraction. A sieve keeps the solids back and a slider allows easy discharge of the leached draff.

For large quantities and frequent use there is HopBack Pro: A special agitator opens the umbels within a few minutes and allows quick release of the lupulin glands. Thus, hop oils can be extracted more efficiently and even faster than with the aforementioned static flow application (see extraction curve) [13]. Since the extraction process is not tied to whirlpool occupancy or wort cooling time, process times can be shortened, thus reducing washout of slow-dissolving leaf ingredients, which often cause a scratchy, trailing bitterness.

Whirlpool processing issues

Rapid turbulence and post-isomerization in the whirlpool environment represent a major problem for over-hopped brews. Research shows that a certain amount of time is required for the efficient extraction of hop oils, even in turbulence – clearly longer than the few minutes it takes for the trub cone to form.

Retrofitting additional hop-dissolving stations and targeted metering of the hop suspension can achieve more desirable efficiency as well as reproducible quality of the hop aroma. BrauKon hops extractions are characterized by very short dissolution times of well under

one minute, which perfectly matches the technological processes already in place, enhancing aroma quality in general.

Balancing aroma with bitterness – advantage for traditional beer styles

Balancing hop bitterness and aroma is often challenging and difficult to achieve in over-hopped beers. Adding hops to the whirlpool often leads to exaggerated bitterness due to post-isomerization.

By pre-cooling the wort, this effect can be controlled in a targeted manner, clearly emphasizing fruity hop aromas. Beers thus become more palatable.

For traditional lager beer, the reduced replication of free DMS from the precursor due to wort pre-cooling also has significant sensory implications. In addition, thermal load is significantly reduced, which in turn is positive for the beer stability while aging [14].

Special heat exchangers are installed with the piping, gently and efficiently cooling the flow to ensure optimum operational reliability, even with large hop loads. The overall design allows complete emptying as a prerequisite for lossless style changeover.

Hop aroma in the whirlpool

As simple as late hopping via pellets in the whirlpool might be, there are still some disadvantages associated with the process. For large dry-hopping volumes, residue management becomes a problem and wort loss is not negligible – often more than ten percent for larger volumes. Our own investigations show that, even under optimal conditions, the proper extraction of hop oils requires approx. 20 to 30 minutes. The turbidity cycle in the whirlpool is concluded after a few minutes, thus limiting residue transport from the turbidity cone.

This can be problematic, especially in larger brewhouses, because here the specific surface area for material transfer is smaller. Varying periods required for turbidity cone manifestation often lead to noticeable variations in hop aroma. Wort cooling time also influences the retention time of the last dose,



HopBack Pellet retrofit installation for 60 kg (USA)

so that post-isomerization in the whirlpool emphasizes bitterness over aroma, creating a flavor imbalance.

Hop aroma enjoys wider degrees of freedom

The HopBack Pellet system, in which pellets are extracted in transit to the wort cooler, i.e. after the whirlpool phase, offers additional degrees of freedom for flavor blending. Pellets are introduced in the bypass to the main flow of the wort, so that extraction times can be more precisely adjusted. Thus, a better balance

between bitterness and aroma can be achieved. α -acids, which are rinsed out, are not exposed to lengthy periods of heat retention since they are immediately cooled in the wort cooler. This reduces isomerization and, therefore, bitterness.

Efficient retention of residue

To capture the residue, the Hop-Back Pellet system comes with a large filter basket, similar to the stainless steel filter cartridges designed for beer filtration. A filter “cake” comprised of hop residue ensures the safe retention of fine particles as it builds up very quickly on the filter surface. So even without filtration or separation, no unsightly hop residue lands in the bottle.

Extraction of aromatic substances in turbulence

Turbulent flow in the HopBack Pellet system ensures efficient extraction of aromatic substances and prevents sediment formation. In addition, the turbulence ensures that most of the hop particles remain suspended and only a thin, permeable hop “cake” forms on the filter surface, similar to the mechanisms in crossflow filtration. Thanks to this technology, even large quantities of up to 200 kg per brew can be efficiently extracted.

Wort loss reduction

Wort losses can be reduced because the hop filter “cake,” caught in the filter basket, is much drier than the residue in the whirl-

pool. Residue is discharged mechanically by spraying the tank with hot water. For easy disposal, the hop trub is ideally washed out with the spent grain or discharged into the trub tank.

Controlled discharge of hop residue

An increase in operational safety when residue is properly managed is another significant reason to retrofit a HopBack Pellet system. This can be confirmed by every brewer who ever had to clean a cooler plate covered in residue. If you want to reduce wort losses in the whirlpool, you usually run the risk of unwanted discharge of hop residue into the wort and thus into the fermentation tanks.

A dry-hopping alternative

The HopBack Pellet system is a complementary alternative to dry hopping in the cooling phase. Late hopping can be used to create a flavor base that survives fermentation. The light components, such as myrcene, are almost completely stripped by carbonic acid during fermentation – and are lost. Linalool and other medium and heavy volatile hops oils are preserved as a solid aroma base. If you introduce this fraction into your beer during dry-hopping, the resulting taste is often overwhelming and the beer appears to have been perfumed.

By combining late hopping and dry hopping into one phase, a better balance between smell and taste can be achieved. Consistent development of the desired hop aroma throughout the various brewing phases leads to much higher stability of the hop aroma [11].

Fruit, spice and herbal flavorings

Special aromas from other flavor carriers such as orange peel, coriander or spices and herbs can be efficiently introduced with spice extraction systems developed several years ago. A special feature is residue retention and also a high, constant extraction efficiency, which leads to savings of more than 30 percent. These extraction systems can be flexibly integrated into brewing processes at the wort kettle and whirlpool and also at the hop feeding station due to their dimensional compatibility.



Hop dispenser including spice extraction integrated into the whirlpool (USA)

Custom solutions

Individual, customized solutions are offered for all modernization projects to integrate and retrofit these technologies into existing installations. On request, existing plant technology will be thoroughly analyzed, taking into account the overall situation of the brewery. Existing technical interfaces, planned logistical changes, energy flow as well as new products and beer styles are all considered.

Post-analysis solutions are developed and implemented in close cooperation with our clients.

Further optimization potential

Potential for further optimization can also be found in fermentation and storage tanks as well as in yeast management systems. In particular, several new technologies have recently been developed for dry-hopping which not only reduce the volume of hops needed and improve the quality of hop flavor, but also significantly reduce overall beer loss.

The large portfolio of innovative technologies from BrauKon and Banke process solutions opens up a variety of possibilities for brewing optimization. Engineers and master brewers in both firms work continuously on innovative processes that lead to new opportunities for brewing beers with character.

Appreciation

I wish to express my special appreciation regarding this Brewhouse Optimization series of articles to both late Managing Directors of the Sudhaus Technik company, Essen: Franz Schröer and Rolf Lambeck. They were highly valued colleagues of Banke process solutions since 2015, generously sharing their expertise and experience from half a century of brewing technology successes. □

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