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There's more than one way to extract wort...

Lauter grant (Photo: BRAUWELT)

In the new edition of her book 'Process Engineering and Technology in the Brewery', PD Dr Annette Schwill-Miedaner gives an overview of state-of-the-art technology and processes in breweries. In an interview, she explained which lautering process is most suitable for which type of brewery, and where further technological advances can be expected in the already well-developed brewing process.

Lautering with lauter tuns is historically the oldest method of wort extraction. Can this system be enhanced further from a technological point of view, or is it already fully developed? And what about mash filters?

Dr Schwill-Miedaner: Lauter tuns with a daily capacity of up to 14 brews, and mash filters with up to 16 brews, are both highly developed separation systems, and their potential for further development is almost exhausted. Compared to mash filtering operations, a lauter tun requires a large amount of space – some have a diameter of up to 15 metres. The advantage lies in its flexibility, as it can be over-loaded by 15% or under-loaded by 50%. However, the maximum percentage of raw grain that can be processed is approx. 40%.

Further improvements in both separation systems are only expected to be small. Current investigations into the acceleration of wort run-off, as this is the current bottleneck in breweries, are concerned with the behaviour of fine particles during lautering using a lauter tun. In a mash filter, uniform extraction in chamber filters still poses a challenge.

The advantage of a mash filter compared to a lauter tun is in processing up to 100% of raw grain and producing a high gravity wort (first wort ≤ 25° Plato). In the meantime, membrane filters with a lower sparging water quantity of ≤ 2.8 l/kg are used as an alternative to chamber filters with a sparging water quantity of ≥ 3.2 l/kg. A further development can be seen in separator sets that can be switched on and off for varying fillings (± 15%). In comparison to lauter tun operations though, the higher cleaning time/cost and wearing parts such as filter cloths and press membranes must all be taken into account.

Which breweries should be using a mash filter? And which breweries should use a lauter tun?
Dr Schwill-Miedaner: On the one hand, this is a philosophical question for the respective brewery. On the other hand, a brewery producing an assortment of beers with highly varying fillings or batch sizes will decide in favour of a lauter tun, while a brewery with a high brewing sequence and uniform variety (main variety with a high extract strength) will rather decide in favour of a mash filter – also if a lot of raw grain is being processed, of course.

Are there decisive differences between the systems with regard to beer quality? Do parameters have to be adjusted accordingly during mashing, boiling or in the fermenting cellar?
Dr Schwill-Miedaner: Only grist composition needs to be adapted for the lautering process: The lauter tun requires a relatively coarse grist (roller mill), whereas the thin layer filter requires a fine powder grist (hammer mill). The raw ingredients are therefore adapted to the technology. There are no processing differences in the later production steps. With both separation systems, high-quality wort can be obtained, and it has been shown in recent years that too much clarity in the lautered wort can also have negative effects on the fermentation process.

The most recent system for wort extraction, the highly regarded Nessie, uses rotary disc filters in a cascade arrangement to save an enormous amount of time during lautering. You were involved in its development – how does the system work?

Dr Schwill-Miedaner: The Nessie separation system combines four-stage separation with intermediate counterflow extraction. Each filter module has a pair of wheels (diameter 1 m), which are covered with a sintered stainless steel 70 µm mesh. The mash flows through the filters, which rotate in the direction of flow. At a setting of 4 rpm, one particle has a dwell time of only three minutes before it passes through.

Separation of solids from liquid is performed in the lower segment of the wheel pairs without any accumulation. The entire system is encapsulated and is under a steam atmosphere. While the filtered wort is continuously discharged, the spent grains are transported to the next module. The rotating movement of the wheel pairs prevents build-up at a filter layer and creates a self-cleaning effect for the filters. To wash out the spent grains, sparging water (2.5–3.5 l/kg) is applied between the last two modules.

The resulting wort flowing from the 4th wheel is then returned to the connecting shaft of the 2nd and 3rd module, or from the 3rd wheel to the transition from the 1st and 2nd wheels for counterflow extraction. In the transitions, the spent grains and fluid are homogenised by means of a damming element, which creates a turbulent flow.

This all brings the lautering time in line with the mashing time. The overall time in the brewhouse is about 30% lower compared to lauter tun operations.

Do special adjustments have to be made in the brewing process?

Dr Schwill-Miedaner: The new Nessie separation process led to the development of the completely new Omnium brewhouse concept: as already described, the mash filtration system separates four parallel wort streams, which together contain more particles (grit) and turbidity components. Therefore, after boiling, a 1% first wort extract (taken from the separated wort of module 1 at approx. 72°C and temporarily stored in the buffer tank) is added at approx. 83–90°C to break down the dextrins produced during the breakdown of starch. The enzymes present are then denatured after a short time.

Since the protein precipitation associated with boiling normally leads to high losses of bittering substances, the wort streams from the 3rd and 4th wheels are fed into a conical, heatable stainless steel vessel with stirring mechanism to encourage increased hop isomerisation. Having the wort isomerise in this way means that it can be added at different stages in the brewhouse or as a sterile hop addition in the cold area.

As in a conventional brewhouse, a whirlpool, a centrifuge or a settling tank – or a combination of settling tank and centrifuge – are used for settling and separation of the hot trub. With a controlled trub setting, it's possible to retain a part of the increased content of zinc and long-chain unsaturated fatty acids in the Nessie wort. Due to this optimised nutrient supply for yeast metabolism, fermentation time can be shortened to around 5 days.

Due to the lower tannin content of the beers, the stabilisation measures can be adjusted and reduced. In addition, the technological scope is increased through uncoupling the grist composition (type of mill), malt quality (annual variations) and type of raw ingredient (raw grain) from the separation system. It's even possible to process special types of grain, such as buckwheat, rye and oats, which may have a role in the future when environmental conditions change. Filling and first wort concentration (up to approx. 32° Plato) can be adjusted as required.

Which breweries might find it particularly advantageous to use the Nessie separation system?
Dr Schwill-Miedaner: Basically, any brewery can work with the Nessie separation system. The advantages are obvious, especially when there are structural bottlenecks (lack of space, structure of the building) and when the brewing sequence is short (saving time). In addition, it's possible to process problematic raw ingredients such as oats and old grain varieties.

At what point in the brewing process do you think further technological advances can be expected?
Dr Schwill-Miedaner: The example of the Omnium brewhouse concept has shown that new technological paths can be taken. Inevitably, the wide range of results obtained will lead to unexpected questions regarding existing schools of thought, for example regarding the scope of action for enzymes, and also the significance of long-chain unsaturated fatty acids and tannins for the entire brewing process. Due to the influence on the material

composition of the wort, new regulating screws are available, which will have an effect on the whole cold area, starting with fermentation, then stabilisation, and through to the finished product. So, in a nutshell, there are numerous questions and perhaps new answers, too!

Many thanks for the interview!

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