Reducing the cost of microbial stabilisation of beer

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Tackling the cost of microbial stabilisation head on.

Cold stabilisation of beer, also referred to as sterile filtration, can return significant cost savings over pasteurisation. In addition to providing an increased level of microbial security, and better protection of beer quality, cold stabilisation is by far the most efficient process to operate in comparison to pasteurisation from a cost perspective. This article will discuss the four main areas where cold stabilisation returns significant cost savings over flash pasteurisation.

The changing shape of brewing

The ever-evolving brewing industry is currently going through an exciting period of change. With established markets buoyed by the craft revolution and new beer drinkers in regions typically associated with wine consumption, the future of brewing is looking increasingly optimistic. However, as these positive trends are driving opportunities, there are also negative trends which need to be navigated and which are driving the industry to change.

The spectre of increasing utility costs have to be managed for brewers to remain profitable and competitive. With energy and water costs set to increase in most nations, brewers are being driven to implement process efficiency improvements to remain sustainable. What was once viewed as a conservative industry and reluctant to change, is now open to process innovations which can yield better beer quality and increased operational improvements.

Historically, most breweries have relied upon pasteurisation techniques to kill spoilage organisms and produce market stable beer, however this process can be costly to operate and can lead to a deterioration in beer quality. Through recent developments in filtration technology, cold stabilisation is now the optimum process to achieve microbiologically stable beer, to protect beer quality at the lowest operational cost.

As cold stabilisation of beer may still be viewed as a new technique for some brewers and therefore poorly understood, this article will outline some of the operational aspects to demonstrate where process efficiency improvements can be achieved over pasteurisation.

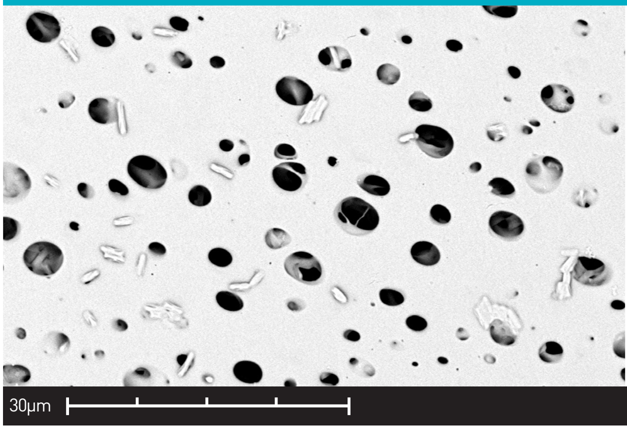
One area of brewing which is a perfect candidate for process efficiency improvements is the "utility hungry" process of final microbial stabilisation.

Key cost savings

If beer is to last for more than a few days once packaged, then spoilage micro-organisms need to be removed completely. Typical spoilage organisms include brewer's yeast, wild yeast, and specific anaerobic bacterial strains capable of surviving in beer – typically lactic acid and acetic acid species.

Traditionally, pasteurisation techniques have been relied upon to produce commercially sterile beer which is capable of achieving the required shelf-life demanded by various customers. Typically this would be 12 months for bottled beer and several weeks for kegged beer. Pasteurisation involves heating the beer in order to achieve a microbial kill. Initially, tunnel pasteurisation was largely employed, where the beer is pasteurised once packaged into the container – with typical conditions being 60°C for tens of minutes depending upon the beer specification and the required "pasteurisation units" (PU).

Typical beer spoilage organism *Lactobacillus lindneri* captured on 0.45µm PES membrane



Tunnel pasteurisation can be viewed as the traditional technique to stabilise beer, however the systems themselves are large, require a high degree of maintenance and can therefore be costly to purchase and operate. In addition, it is widely accepted that pasteurisation can impact upon beer quality. So in recent years tunnel pasteurisation has become superseded by flash pasteurisation – where the beer is pasteurised at a higher temperature, typically 70°C for a much shorter time – typically measured in seconds. This process development represented an evolution in an attempt to protect the beer from over-pasteurisation and to preserve the complex molecular compounds which make up the unique characteristics of the beer.

Even with the evolution of flash pasteurisation, the risk of damaging the beer's unique characteristics is still present no matter how precise the process control. In a recent technical study performed by a large UK brewery, the effects of flash pasteurisation were compared to cold stabilisation. In this study, the same batch of beer was split, where some was sent for bottling via flash pasteurisation and some was sent for bottling via cold stabilisation. The bottled beer was then compared in triangular taste tests where the sterile filtered beer was identified to have the most appealing taste and longer shelf-life.

For full details of the taste test visit, www.Parker.com/ColdStabilisation.

In flash pasteurisation, the beer is pasteurised as it travels to the filling machine, so hygienic filling conditions are required to prevent recontamination. The same hygienic filling conditions are required when running cold stabilisation, so we will focus on the operational differences between cold stabilisation and flash as opposed to tunnel pasteurisation.

Whilst quality improvements both in terms of flavour protection and shelf-life extension can be achieved, what about the comparative cost, or the "operational expense" (OPEX)? As cold stabilisation is a much simpler process to operate, this translates into significant cost savings.

It is difficult to talk in exact terms as every brewery around the world is unique and there will be variances in operational costs per hl, and utility costs (gas, electricity, water etc) may vary too. However, by making some sensible assumptions, and applying identical operational parameters such as; flow rate, hours in operation and operational days per week, it can be seen that for a typical brewery running cold stabilisation as opposed to flash pasteurisation, the OPEX savings can run into six figures per year!

There are four main categories where this significant difference in OPEX is realised, they are:

- Beer losses.
- Water consumption.
- Electrical energy consumption.
- Consumable spend.

Beer losses

Flash pasteurisers work by passing the beer through a plate heat exchanger (PHE) at a required flow rate. The PU level is a function of temperature and time, thus flowrate through the system is critical. The correct pressures also have to be maintained to achieve the correct carbonation level and prevent degassing as the beer heats up. If these parameters fluctuate and cause the PU level to change, the process is typically stopped and held in standby mode until the issue is resolved. Typically, this involves dumping the beer to drain and water is circulated through the PHE instead.

With cold stabilisation there is no reliance upon flow rate, temperature or pressure, and as such, any deviation in these parameters will not affect the filtration efficiency or the performance of the sterilisation process.

In addition, the hold-up volume inside the PHE is much larger and this contributes to much higher mixing phases in comparison to cold stabilisation, further accounting for increased beer losses. Even if the flash pasteurisation process is relatively stable, and the PU levels do not fluctuate during production, every time there is a batch or product change, the increased phase separations cause a higher degree of beer losses and therefore significantly increased OPEX when compared to cold stabilisation.

Water consumption

As outlined above the mixing phases are much larger in flash pasteurisation as opposed to cold stabilisaiton. As such, every time there is a batch change, or change in PU level the water consumption far outweighs that associated with cold stabilisation.

In today's environment where brewers are having to be flexible and adapt to market conditions, there is a requirement to change the products being packaged more frequently. In this environment, the water consumption and hence the associated increase in OPEX for flash pasteurisation over cold stabilisation will become more pronounced.

Electrical energy consumption

Flash pasteurisers work by heating the beer up to approximately 70°C. Due to Henry's law, the process of heating the beer will cause the CO_2 to come out of solution unless the line pressure is increased and tightly controlled. As such, booster pumps which regulate the line pressure at approximately 10 – 14barg are necessary to effectively control degassing. The requirement to run pumps against a 10 – 14barg differential pressure ultimately consumes a significant amount of electrical energy.

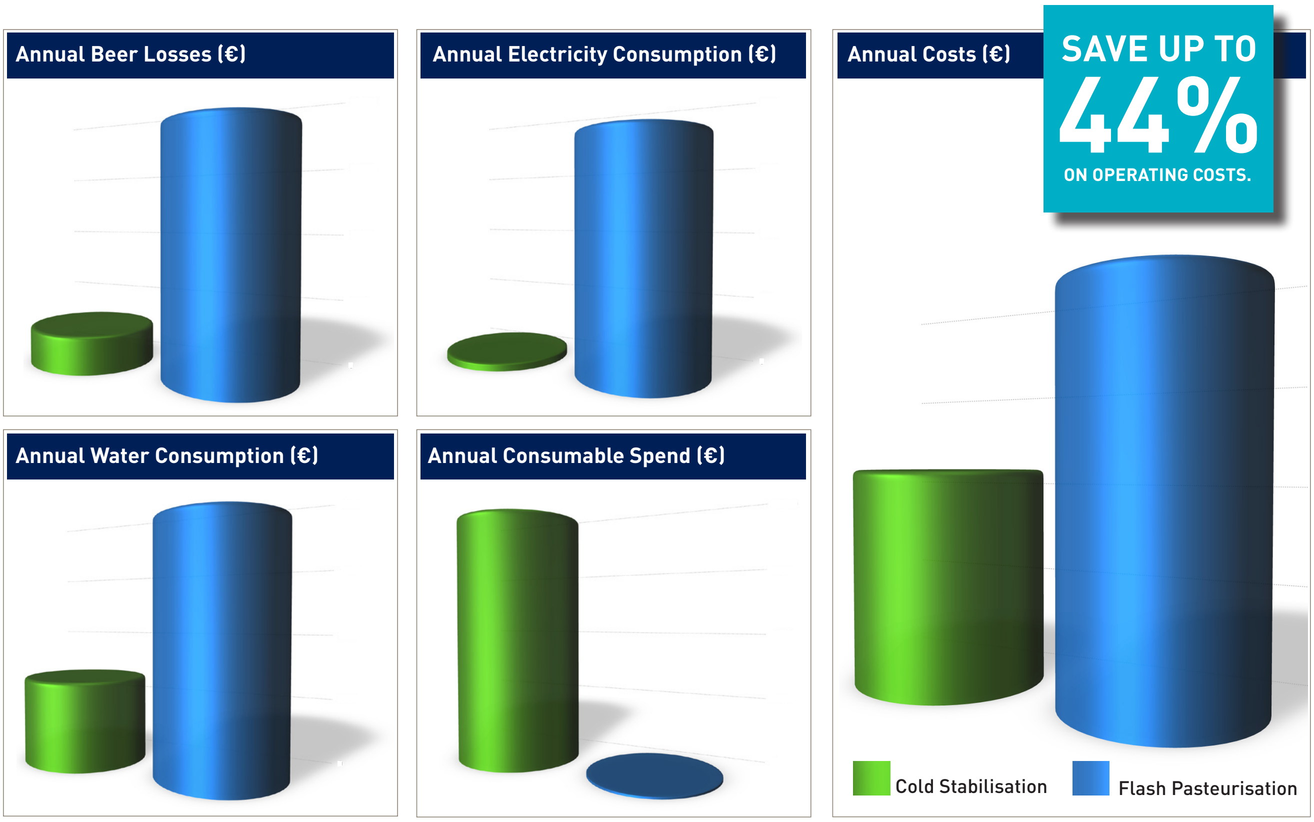
With cold stabilisation, as long as the line pressure is maintained at approximately 1barg - there is no requirement to run booster pumps. The electrical energy demand and hence OPEX is therefore significantly reduced.

Consumable spend

This is the aspect where flash pasteurisation can compete with cold stabilisation as the consumable spend for running cold stabilisation will be higher than flash pasteurisation. The increase in spend comes from the requirement to replace blocked filters when they are at the end of their usable life. However, through recent advances in membrane filtration technology, the blockage rate of the membranes used and their cleanability now makes the cold stabilisation process far more economical.

The primary cause of filter blockage is through a build-up of colloidal material such as protein and carbohydrate agglomerations as opposed to micro-organisms. By optimising the base chemistry of the filter membrane, the likelihood of protein or carbohydrate binding can be far reduced – which in turn will reduce the rate of blockage. In addition, by tweaking with the filter construction (to provide high filtration area and immediate pre-filtration), the possibility for further lifetime extensions can be achieved.

To find out more about recent advances in membrane development visit, www.Parker.com/BevporBR.



In like for like process conditions (same flow rate, same capacity), you could reduce your operating costs by up to 44% by choosing filtration as an alternative to flash pasteurisation.

As can be seen from discussing the points above, the cold stabilisation of beer represents a far more economical solution than flash pasteurisation when we consider these operational factors. There are other factors to also consider, such as energy required to heat the PHE and CO_2 consumption – however these are marginal when compared to those discussed above. Even discounting the increased microbial control and better protection of beer flavour, cold stabilisation represents the optimum choice for brewers wishing to achieve efficiency improvements and protect bottom line profits.

For a detailed cost analysis taking exact parameters into account visit, www.Parker.com/CSMCostAnalysis

Conclusion

Cold stabilisation is recognized as a tried and tested method of achieving microbiological stability both in the food and beverage and pharmaceutical industries. As can be seen from the points above, the cold stabilisation of beer represents a more advantageous process than pasteurisation techniques on a number of levels. As brewers become more aware of the benefits of this process, interest and demand for this technology is increasing.

Parker supply final filtration systems to the brewing industry, both at the micro brewery level and for the large breweries. These systems can be easily automated and integrated into the packaging line and provide the optimum technique for producing fresh, quality beers at the lowest operational cost.

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