Filtration in the brewery (Part 3): Fine filtration

OPTIMIZING BEER QUALITY | Whether at home, at a restaurant or at a local festival, there are many opportunities in life to enjoy a refreshing beer. To ensure that it has a polished, clear appearance and tastes good, it must be the right color and not turn turbid when poured—traits that are achieved thanks to fine filtration during the brewing process. Part three of a five-part series on the filtration process in breweries deals with this topic.

AFTER CLARIFICATION, precoat filtration, trap filtration, microbial removal and stabilization processes have been completed, beer has already gone through many steps that improve taste and appearance and reduce microbial load. However, there is one more stage to finalize before filling bottles, kegs, barrels or tanks: fine filtration. This process allows breweries to optimize both the quality and the overall taste of their product. This step is, in a sense, an optional extra at the end of the process to help meet the expectations of both the manufacturer and the customer in terms of quality and a polished, clear finish.

Reducing the amount of yeast and bacteria

Fine filtration takes place at different stages of the brewing process depending on its intended purpose in the application at hand. The process varies – as evidenced by the fact that it is used in the production of wine and fruit juice in addition to the brewing of beer. The terms used are also not very clear-cut: Depending on the application and the retention rate, trap or depth filtration can also be considered as types of fine filtration. However, in practice, many breweries use the term fine filtration to refer to the step that reduces turbidity before filling.

Ultimately, the essential function of fine filtration is vital for master brewers: It reduces the amount of yeast above a retention rate of 1.2 µm; if the rate is between 0.4 and 0.3 µm, it reduces the number of microbes. It removes unwanted agglomerates from protein-tanning processes and also gives the beer its final clarity and color as part of current common brewing practices. The color and turbidity of beer and wort, which is indicated by the EBC (European Brewery Convention) value, can be deliberately influenced by the degree of fine filtration.

Brewing philosophy determines process steps

In many breweries, fine filtration is carried out at the end of the brewing process as it helps to protect the membranes used to remove microbes in the subsequent membrane filtration step. The membrane filtration process must take place in sterile conditions, so any yeast or bacteria must be removed from the beer before it reaches this step. However, in some breweries, it is com-

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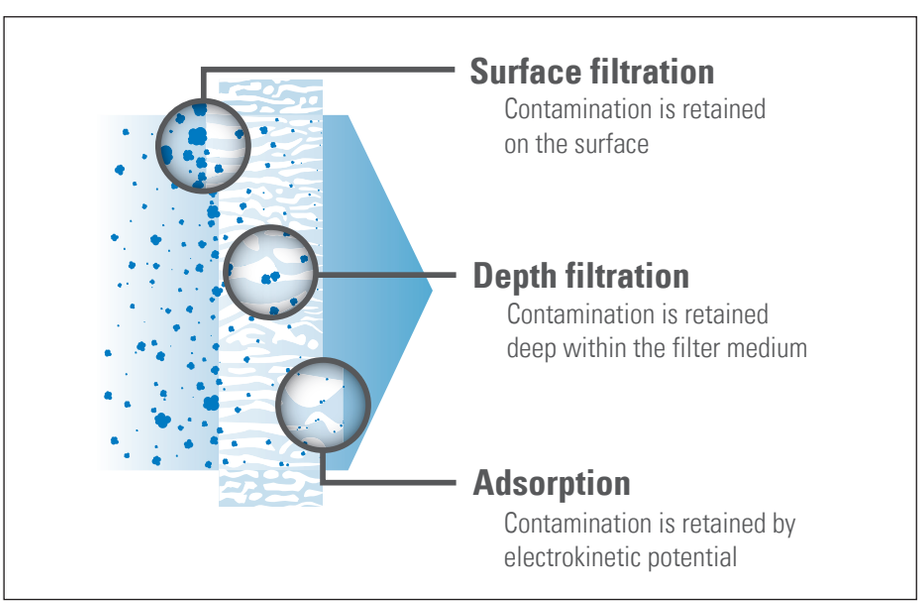

Fig. 1 Various fine-filtration mechanisms can be used for brewing beer. A common variant is mechanically separating the materials via depth filtration

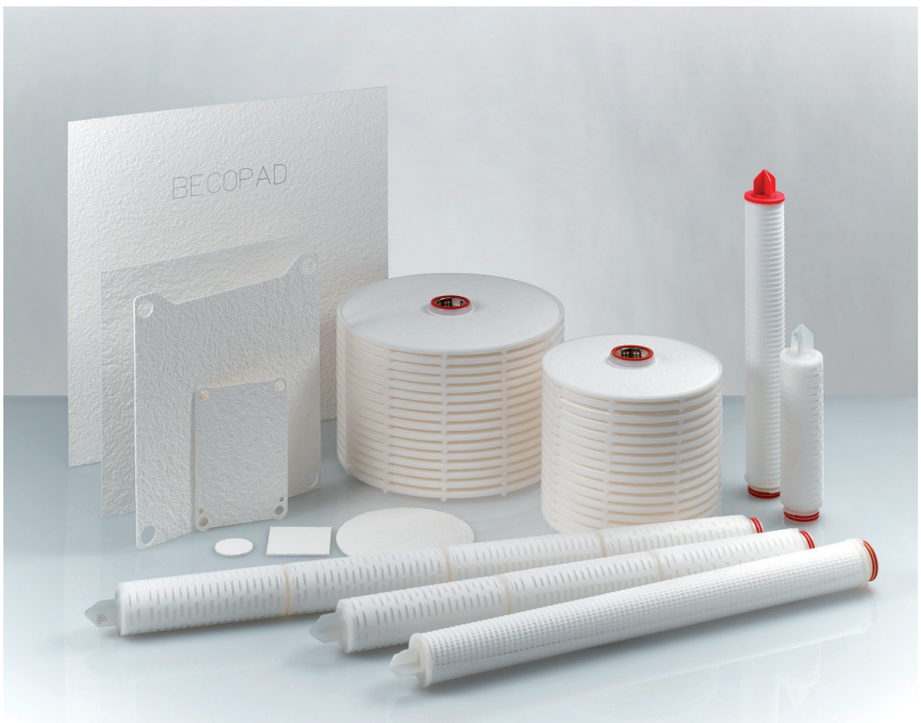

Fig. 2 Cellulose or polypropylene: Filter media for fine filtration can be selected to suit any application

mon practice to also perform fine filtration earlier in the brewing process, for example after flash pasteurization (HTST). In this case, fine filtration is used to fulfill the same purpose as trap filtration, i.e., it removes small, fine particles in the beer.

Another special case is craft beer breweries, which rarely include fine filtration in their brewing process, as this type of beer has a shorter shelf life.

Wide range of methods and principles

If fine filtration is carried out without a subsequent membrane filtration step, there are now several options available to brewers that mean they can still offer a product with a long shelf life. The most common method is depth filtration using filter sheets or stacked disc cartridges, but wrapped or pleated depth filter cartridges can be used as an alternative.

It is difficult to objectively evaluate the quality of the filtration methods – established processes, personal preference and the philosophy of the brewery are ultimately decisive when choosing which to use. Willingness to invest also plays a certain role: In existing brewing systems, the design of the established system can influence the decision.

In principle, there are three distinct mechanisms that can be used in the fine filtration process to separate particles, turbidity and microorganisms from the beer (fig. 1):

- Mechanical separation on the surface (surface filtration);
- mechanical separation in the inner hollow space structure of the filter media (depth filtration);
- adsorptive separation using positive zeta potential (electrokinetic potential).

Surface filtration is the most commonly used mechanism and can be found in most commercially available filter media. Depth filtration is a second type of mechanical separation mechanism. Adsorption is the third filtration mechanism; however, it is only achievable if depth filter sheets or stacked disc cartridges are used.

Modern depth filter media used for fine filtration are usually made of pure cellulose. Thanks to its properties, these media are highly effective at retaining yeast and solids, while losing less of the valuable ingredients, such as hop oils, than traditional, mineral-based filter media. Because filter cartridges and stacked disc cartridges are usually very compact, this saves space in the brewery, which is beneficial in terms of asset investment. The enclosed filtration system does not just simplify the product filtration process for the operator; the systems

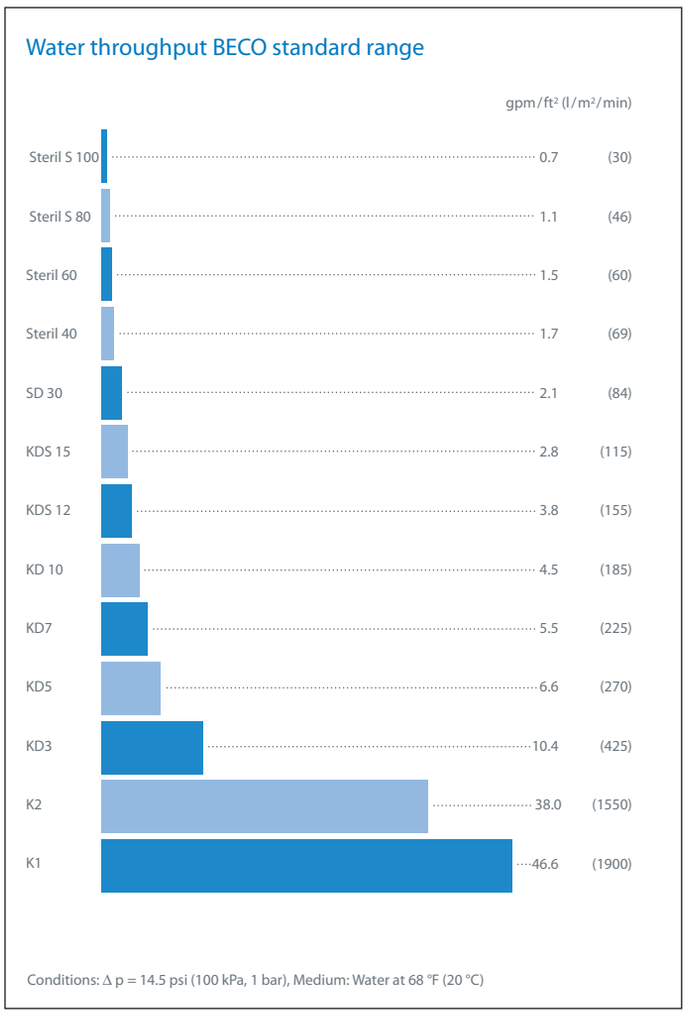

Fig. 3
The water throughput provides information about the fineness of the filter. It also enables the optimal filter surface to be determined for the respective application

are also easy to clean (Cleaning in Place, CIP) and sterilize (Sterilization in Place, SIP).

Water throughput provides information about fineness

While it is difficult to rate the different filtration methods in terms of quality, it is possible to compare the range of filter media available on the market. When evaluating depth filter sheets and stacked disc cartridges, an optimal water throughput for providing information to operators about the effectiveness of the media is used. The water throughput is a laboratory value; it serves as an indicator for comparing the filter media and demonstrates just how diverse they can be. The water throughput must not be confused with the flow rate of the product.

Under defined conditions (Δp = gpm/ft² at 14.5 psi and 68 °F or Δp = l/m²/min at 100 kPa = 1 bar and 20 °C ambient temperature), the water throughput is also an indication of the fineness of the filter. If the value is within a range of between approx. 0.5 and 3.7 gpm/ft² (20 and 150 l/m²/min), fine filtration and a microbial removal effect can be assumed (fig. 3). Of course, this can only actually be confirmed by performing a special microbiological analysis and evaluation, during which the LRV (Log Reduction Value) is evaluated using a test microbe. In drinks, cultured yeasts or malolactic bacteria are usually used for this purpose. The retention rate is the best measurement parameter for evaluating different depth filter cartridges. Currently, values between 0.3 and 5 µm are considered standard for fine filtration in the industry.

Influencing the character of the beer

In terms of formulating clear guidelines and rules, there are few steps in the brewing process as undefined as fine filtration: It performs different tasks, is achieved using different filtration methods and mechanisms, and can be performed at different process steps. Conversely, it is also an area in which breweries can develop their own brewing philosophy and give their product character and a unique feel.

Whatever the route the beer takes during the brewing process – at the end of the brewing process before filling, final sterilization is performed using HTST or sterile membrane filtration. This final filtration step will be discussed in the next article in this series. ■