BIER TO THE LAST DROP

Due to the increasing intensity of competition, improving the cost-effectiveness of the company itself is currently in focus. And a brewmaster can't avoid the topics of efficiency, cost savings, or optimization any more than any other process manager. To squeeze the last drop from the process, several separation processes are compared using the example of beer recovery in the brewery.

Thanks to increasing price pressure, manufacturers of foods, beverages, and especially breweries are looking for solutions to improve the cost-effectiveness of their processes. Many companies find there is economically interesting potential for improvement not only in the production process itself, but also in the processing of byproducts. Making use of them should be kept as simple as possible – no-one wants to integrate additional equipment into their production process that eliminates the potential savings by operating effort, high operating costs, or the risk of faults.

Based on the sample of the brewing industry, this article presents three examples of process optimization using separator technology. The focus will be on beer recovery from surplus yeast. (Surplus yeast is the yeast that settles onto the bottom of the tank during fermentation). Surplus yeast contains a significant proportion of beer. A brewery's average quantity of surplus yeast and tank bottoms can be 2 to 3 percent of the total yearly yield, depending on the brewing process. So a brewery with a yield of about

- million hectoliters per year can expect a loss of 3 million liters of beer – that's no small amount. There are different processes available to separate the beer/yeast suspension:
  - Separation using crossflow membrane filtration
  - Centrifugal separation with a separator
  - Centrifugal separation using a decanter or a Sedicanter

The decisive factor in the efficiency of barm beer recovery is a high proportion of yeast dry matter (YDM) in the separated yeast. The higher that content, the better the yield of recovered beer. It's important to avoid any oxygen uptake. And the effort required for both operation and CIP cleaning should be as low as possible. Ideally, these separation systems should be easy to integrate into existing systems.

Crossflow: Efficient Technology, but Costly

In practice, crossflow membrane filtration has significant advantages over traditional methods like yeast pressing. This filtration method can be operated as a continuous process or as a batch process. The yeast is concentrated to about 20 to 22 percent YDM. This system also largely prevents oxygen uptake in the beer recovered. The finest particles are filtered out at pore widths of 0.02 to 0.45 µm.

The suspension flows over the membrane surface. The beer flows through the membrane, with the solids remaining behind. To achieve the crossflow effect, high flow rates are needed within the filter system. This leads to high pressure losses in the tubular channels of the membrane, which has to be counteracted with corresponding power input from the conveying pumps. Due to the power added and the heating effect of the pumps, cooling is needed for the circulating yeast suspension.

The system undergoes automatic cleaning using a CIP process. The cleaning process and cleaning agents must be specifically adapted to the membranes in use. The success of cleaning depends not only on the process technology, but also on the temperature and concentration of the cleaning agent. So the advantages of crossflow membrane filtration are offset somewhat by high technology costs.
Separators: Efficient, but Low Solid Quantity

An efficient method for the separation of beer and yeast is to process the suspension in a disc pack separator. Here, the yeast suspension is pumped centrally into the separator bowl and accelerated to full speed. There, the yeast and individual protein fractions are separated from the beer using centrifugal force. The separated yeast slides into the solid chamber of the bowl and is carried out of the bowl periodically using an opening mechanism. The high centrifugal forces also permit the separation of particles smaller than 3 µm.

The solid content in the yeast cake are about up to 20 percent YDM. The hermetic seal of the separator, for example with degassed water, largely prevents oxygen uptake.

To ensure the perfect operation of the separator, the solid concentration in the machine’s intake should be kept as low as possible. To be able to process high solid concentrations in the feed, the throughput of the separator must be sharply reduced.

Decanters: Efficient, but Poor Clarification

Decanter centrifuges, however, are not sensitive to solid concentrations or fluctuations in the feed. Automatic adjustment of the scroll speed and regulation of the fluid level in the bowl (the pond depth) permit flexible reactions to feed concentrations. The solid is carried out continuously through the conveyor scroll. Higher solid concentrations are no problem for these centrifuges, offering the operator greater flexibility. The discharged yeast cake can reach solid content levels of about 20 to 22 percent YDM. An additional advantage of this system is its fully automatic operation and CIP capability.

The lower g forces within the machine due to its construction, however, mean that the clarification of the barm beer, especially in protein-rich suspensions, are not as good as in a separator.

Sedicanter: Efficient Combination of the Advantages

The Sedicanter is a special form of the decanter centrifuge with a special construction combining the advantages of both separators and decanters.
Within the bowl, accelerations between 6,500 and 20,000 g are achieved. That separates out even the finest of material. The bowl wall consists of a long, flat cone that forms the clarification zone, and a very short, steep cone through which the separated yeast is discharged as a paste. A feed pipe that extends to the end of the long cone introduces the suspension and accelerates it gently. So the entire length of this cone is available as a clarification zone. Both liquids and solids flow through the clarification zone in the same direction (uniform flow principle). This avoids turbulence and remixing. The yeast experiences the greatest compression at the largest diameter of the bowl, just before the discharge. This concentrates the solid even more. The liquid is discharged under pressure. Oxygen uptake in the beer is less than 0.05 ppm.

Due to the speed of processing the suspension, a temperature rise in the product is as good as eliminated. So no additional cooling is needed in the process room. The SimpDrive concept regulations the differential speed of the scroll, that is: when larger solid content fluctuations occur in the feed, the amount of solid in the bowl rises to match. The system detects that added quantity based on the higher torque of the scroll, and automatically adjusts to the optimum differential speed.

Using an adjustable impeller, the liquid ring (pond depth) within the bowl can be adjusted.

Together, that ensures a high solid content in the discharged yeast of 24 to 28 percent YDM, a good Clarification of the recovered beer and consistent product quality.

Automated CIP cleaning of the Sedicanter is easy. The machine can be integrated into the brewery’s existing cleaning cycle without problems.

If we consider a brewery with a yearly production of 1 million hectoliters, about 20,000 hl/year can be recovered from surplus yeast using the Sedicanter. Depending on the sale price of the beer, the system can ideally amortize within one or two years.

**Beer Recovery Pays**

The recovery of beer from surplus yeast can significantly improve the profitability of the brewing process. The Sedicanter offers a promising alternative to other separation technologies. This technology is impressive for its high bee yield, high solid content in the yeast cake, and minimal oxygen uptake. The system is also characterized by ease of installation, low maintenance and operating costs, and user friendliness.

**Literature**