



Towards zero waste in beer production – New trends for brewery solutions

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Introduction

Leading brewers are seeking more sustainable ways for higher utilization of raw materials and to optimize production by increasing yields and reducing losses, all while maintaining beer quality and expanding production capability. Alfa Laval Brewery provides a series of solutions.

Discussion

Significant losses in beer production – between 2.1 and 6.4 percent

In a year about 200 billion litres of beer are produced globally, corresponding to around 4 billion bottles and cans plus numerous kegs and beer drives worth some EUR 130 billion. Meanwhile, the various losses at different stages of production can be between 2.1 and 6.4 percent of total production, representing a considerable amount in terms of beer and money.

In the face of increased environmental legislation and its associated costs, the global brewing industry is challenged by reducing these losses and waste streams to a minimum. The need for greater efficiencies in the brewing process is driven by the desire for higher productivity using the same resources. In growing beer markets, brewers are also looking to expand production with smaller footprint sites with lower investments and at reasonable operations costs.

The global growth in beer production is in the range of 2 to 5 percent per year, led by Asia, Brazil and Africa. In recent years Brazil has been the market leader in terms of the highest investments levels in breweries.

Globally some EUR 10 billion is invested in the industry each year, much of it driven by capacity and efficiency improvements.

China is the world's largest beer market and leads the United States, producing some 4.6 billion litres per year. Chinese beer consumption has risen six-fold over the past two decades, so greater efficiency is needed to meet the consequent increased production requirements.

In all markets, brewery companies want to become more environmentally friendly by aiming for a zero waste operational philosophy with highest extract recovery.

Each stage of the brewing process produces waste. For every 1,000 tonnes of beer produced, 137 to 173 tonnes of solid waste may be created in the form of spent grain, trub (an unwanted material generated during wort production), waste yeast and kieselguhr, main material used to filter the beer. In China, with its yearly 4.6 billion litres of beer production, around 500,000 tonnes of high gravity wort are left in the trub after fermentation. During filtering some 120,000 tonnes of kieselguhr slurry is generated and 5 to 6 million tonnes of spent grains are produced.



Many ways to reduce waste and recover by-products

Breweries can reduce the waste problem in many ways. Some by-products of the brewing process – spent yeast and spent grains – can be transformed into potentially valuable products. A substantial amount of beer can be recovered in the main wort and beer lines, and volumes of waste for disposal can be reduced dramatically.

Beer recovery - Alfa Laval's range of BREW centrifugal separators and BRUX beer recovery separators used with M39 membrane beer recovery filtration modules can recover beer that would otherwise be lost.

Here, the surplus yeast is collected in a tank and is further processed in the membrane system where the beer is separated from the yeast by filtration. The filtered beer of good quality is recovered and waste yeast is concentrated. Between 30 and 50 percent of the volume of the surplus yeast is reduced and a similar amount of beer can be recovered. This beer recovery percentage means an additional 6 million 33-centilitre bottles for each million hectoliters of beer capacity per year. Surplus yeast represents 2 to 4 percent of the beer produced, and 2 to 3 percent of the total produced volume can be recovered. At this stage, beer has a high gravity and represents a value of EUR 20 per hectolitre. The total potential value of recovered beer from surplus yeast is then about EUR 500-700 million per year.

Dewatering of spent yeast, spent grains and kieselguhr and beer recovery - Alfa Laval Foodec decanters are used to improve waste and by-product handling to produce drier by-products with high market value and effluence with a reduced biological load. Typical applications are dewatering of spent yeast, spent grains and kieselguhr plus recovery of wort and beer.

Wort recovery – With an Alfa Laval decanter, installed to circulate wort over the whirlpool during wort transfer from the wort kettle, it is possible to recover 99% of the wort otherwise left in trub.

Additional advantages include less whirlpool cleaning time, lower water consumption plus recovered wort going into “same brew” (as opposed to back to lauter tun).

With Alfa Laval decanters the trub is separated into a dry consistency waste product with about 35 % dry matter (DM), so it can be added to spent grains. This also eliminates the risk of having trub in wort coolers, reducing the cooling transfer or blocking as well as avoiding undesirable trub in fermenters.

All in all, use of a decanter together with a whirlpool system results in minimum waste, maximum extract recovery and improved wort quality.

Kieselguhr dewatering - Alfa Laval decanters can reduce kieselguhr slurry volume five times (80%), so the kieselguhr waste volume is only one fifth compared to non-dewatered kieselguhr. And the dry kieselguhr with 35% dry matter can be buried without any trouble in authorized disposal areas.

Due to very rough working environment for kieselguhr dewatering, Alfa Laval decanters are equipped with a special wear protection in tungsten carbide in several areas in the decanter bowl. This proven application is already recommended by major brewery groups.

Spent yeast dewatering - More and more breweries all over the world are interested in spent yeast dewatering for either vital yeast or thermolized yeast. The reasons for this vary from brewer to brewer, but the most common reasons are:



- a) Finding new customers and/or higher payment customers for the drier spent yeast for sale
- b) Reducing the BOD impact at the wastewater plants
- c) Recovering/separating a large part of the extract-alcohol contained in the yeast slurry (> 95% alcohol is recovered-separated)
- d) Minimizing transportation costs for these by-products
- e) Combining spent yeast dewatering with kieselguhr slurry dewatering, most breweries solve 2 problems with only one system.

Alfa Laval decanters can provide up to 25% DM consistency in vital yeast, and even more than 30 % in thermolized yeast. By concentrating yeast the transportation costs are also reduced.

Spent grains dewatering – Today, wet spent grains are unwanted in many areas in the world. Also renewable energy systems based on biomass power plants demand higher dry matter content in order to achieve a higher calorific power with these brewery by-products.

Alfa Laval decanters help breweries achieve 45% DM content in spent grains through mechanical centrifugal separation instead of using expensive driers based on steam consumption. This enables them to deliver this by-product to biomass power plants, thereby getting interesting revenue for drier spent grains.

Other Alfa Laval solutions to reduce waste in breweries

Alfa Laval Toftejorg jet cleaning heads, used for tank cleaning, can reduce of up to 50 of the water and detergent usage. Generation G2 and G3 decanters and MFG filtration membrane modules are also used in brewery sewage plants. Decanters provide efficient sludge dewatering to reduce the number of trucks transporting solid waste from the breweries by 50%, whereas filtration modules reduces COD content in final effluent by up to 10 times.

The technical solutions that Alfa Laval provides the brewing industry help brewers meet increasingly challenging environmental as well as financial targets. The solutions enable brewers to efficiently produce beer of a high and consistent quality, with minimal losses and improved management of value-added by-product.



Example 1 - Recovery of beer from surplus yeast

Oettinger Brewery, Moenchengladbach, Germany

Oettinger Brewery in Germany has a production capacity of about 200,000 tonnes annually. This generates a surplus yeast volume of 7,500 tonnes per year with a dry matter content between 11 and 14 percent. The brewery has installed a system from Alfa Laval that uses membranes made of polymer to recover the beer from the surplus yeast. After filtration, the high-class beer product is re-dosed back into the normal process stream before it is filtered again.



An important issue for the recovery of beer from surplus yeast is the quality level of the recovered beer as provided by the membrane system.

It is not necessary to blend the recovered beer back to an earlier stage of the process. The recovered beer from the membrane system is generally blended with standard beer just before kieselguhr filtration.

Thanks to the membrane system, the brewery recovers 3,400 tonnes of good-quality beer – some 14,000 bottles a day – and has reduced the volume of waste yeast by 45% to 4,100 tonnes per year. The payback time for membrane technology is between 18 months and two years.

Example 2 – Kieselguhr and yeast dewatering

Baltika Carlsberg Group in Russia, St. Petersburg



Five brewery plants in the Baltika Group in Russia have been equipped with Alfa Laval decanters for kieselguhr and yeast dewatering applications.

By dewatering these waste slurries, breweries has achieved a reduction of the average moisture content in their kieselguhr slurries from 95% to 50%. At the same time they have improved the performance in the waste water plant as yeast is separated and dewatered before been drained.

Baltika's main brewery in St. Petersburg is equipped with a Foodec 300 decanter from Alfa Laval. And another four breweries in the group have had kieselguhr decanters in production in the last 3 years.



Example 3 - Recovery of wort

Brains Brewery, Cardiff, Wales

The 125-year-old brewery owned by Brains in Cardiff, wanted to improve both the quality of its beer and the processes that make it. Having identified an opportunity to make savings through wort recovery from trub in the whirlpool, the brewery invested in a decanter centrifuge from Alfa Laval.

The premium driver for the whole project with the decanter centrifuge was to save wort. The brewery estimates that between 5 and 7 percent of wort is saved through the project, delivering payback in less than the initial two-year target, probably around 18 months' payback.

Previously, the trub recovered from the whirlpool was high in wort content, and disposal of this material was a costly exercise. The trub material of the centrifuge is now of such a dry consistency that they can add it to the spent grains and actually receive revenue as it's sold for cattle feed.



Second to the recovery of wort, energy usage was also a driver for the project. Brains brewery is constantly looking at improving recycling of all waste and waste reduction, and at all angles of reducing their carbon footprints across the business.

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