Microbrewery Achieves Consistent Quality and Higher Productivity with SUPRAdisc™ II Solution

Overview

Since their rebirth in the 1980's, microbreweries have seen rapid growth in North America, as well as in the rest of the world. Fueling the demand in North America was the growing exposure of the American public at that time to different, more flavorful types of European beers, which were distinct from familiar American beers produced for the mass beer market. This demand has grown and in 2013, microbrewery production[1] represented 3% of all beer sales in the United States[2].

In order to carve out a sustainable niche in the brewing market, microbreweries today focus on producing unique and innovative beers different from mainstream brands. They are characterized by experimentation, different brewing techniques, rapid expansion, and the need for more modern production methods. They form part of the larger craft brewing industry, which grew by 17.2% in volume output in the USA in 2013[2].

Filtration is a key operation in a modern brewing process, which focuses on delivering a visually appealing, high quality and shelf-stable product. Cost-effective filtration solutions, which maintain product authenticity, provide high quality, and position microbreweries for increased productivity and expansion are a good fit for this rapidly evolving industry.

The Challenge

A 3500 hL per year microbrewery produces tart, barrel-aged sour beers, an emerging beer style in many regions of the United States. A wide variety of wheat, blonde, quad, red, brown and porter beers are aged in a selection of French oak, Kentucky Bourbon and Northwest wine barrels for a period of 6 to 18 months. They are then blended with ingredients such as fruits and spices to create uniquely flavored final products that have found broad acceptance.

Traditionally, after aging, the beer was racked from the barrels into sedimentation tanks. There it was kept for several days, to enable settling of suspended solids, prior to further blending and processing steps. This sedimentation step required not only capital investment for tankage, but took up space and could be costly in terms of discontinuous production and down time. In addition, depending on beer type, the visual clarity of the product was variable.

The microbrewery's requirement was for a replacement of the sedimentation step with a cost-effective filtration solution that would save time, help increase production capacity within limited space, and produce a product of consistent visual quality for sending to the bright beer tank.

The Solution

After initially considering a filter press option, the microbrewery selected a Pall SUPRAdisc II (SD II) filtration solution to satisfy their requirements.

Both filter press and SD II module technologies are based on the use of filter sheets, already proven over many years in the brewing industry. Filter sheets consist of a unique matrix of cellulose, diatomaceous earth, and perlites that provide an excellent combination of adsorption, surface and depth filtration to effectively remove a wide range of contaminants. They are characterized by extremely high dirt holding capacity due to their high area and porosity: a 1 m^2 (10.8 ft^2) filter sheet has 21,000 m^2 (226,000 ft^2) of inner surface area and 3,100 cm^3 (189 in^3) of pore volume.

Filter sheets are available in many different grades to cover applications from coarse particle filtration to fine filtration, colloidal removal and microbial reduction, all typical tasks in the brewing process.

SD II modules capitalize on the excellent removal performance of filter sheet media while overcoming the marked disadvantages of filter presses. They are installed in enclosed housings and thus provide a hygienic solution with no drip losses, the ability to

Figure 1: SD II modules are robust, cleanable, backflushable, and in-place steamable, satisfying rigorous production requirements in breweries. The housings provide flexibility in production.

pressurize the beer out of the housings with carbon dioxide for higher yields, no exposure to air or other environmental contaminants, and no mold growth on sheet filter edges as is the case with traditional filter presses.

The microbrewery selected 410 mm (16 inch) diameter SD II modules, incorporating K700 grade sheet media, for clarification. These were installed in a single 4-high Pall lenticular housing suitable for beer filtration at 37 hL/hour. For flexibility, additional housing internals were purchased to enable use of this housing in both 3- and 4-high configuration. Featuring the highest filtration area among lenticulars in the industry, namely 5 m^2 (53.8 ft^2) per module, the 4-high installation provides throughputs of approximately 1400 hL filtered beer before the modules are exhausted. This throughput results both from the extremely high filtration area, and from the ability to regenerate and reuse the modules.

The extremely robust design of the SD II modules makes it possible to regenerate them by multiple forward and reverse flushing steps. With the use of special hardware devices, backflushing at maximum 0.5 bar (7.3 psid) differential pressure releases the surface load of hop particulates and residues, yeast and other particles (Figure 2). Forward flushing with warm water, typically at 60 °C (140 °F), solubilizes any contaminants but avoids denaturation of trace proteins, which could cause premature module plugging[3].

Another feature which is economical for microbreweries is the ability to store and reuse the modules, even up to a production break of 4-6 weeks. After cleaning, backflushing, sanitizing and cooling, they are stored under carbon dioxide positive pressure in their housings, until they are needed again. Prior to next use, they are sanitized once more.

Figure 2: Backflush hardware enables regeneration of the modules for increased service life.

The Design Makes the Difference

SD II modules differ significantly from typical lenticular modules. Commonly available lenticular modules are designed according to a traditional stacked disc concept, in which the filter sheets are exposed and unprotected from reverse flow or back pressure shocks. Typically two filter layers are joined with a plastic drainage disc in between to form a filter cell (Figure 3). The filter cell border is sealed by injection molding around the edge and filter cells are

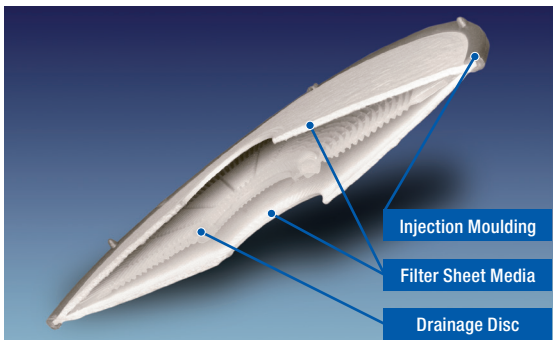


Figure 3: Typical cell in a classic lenticular module

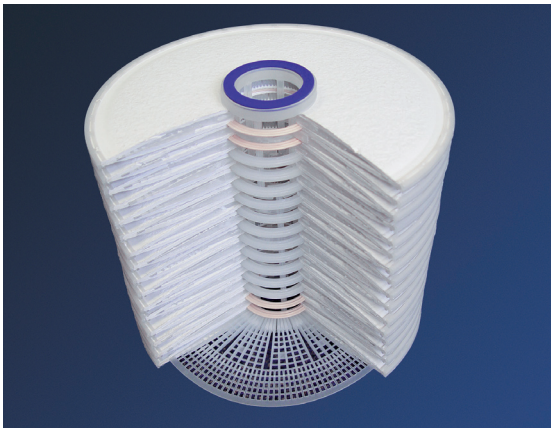


Figure 4: Cutaway view of classic lenticular module

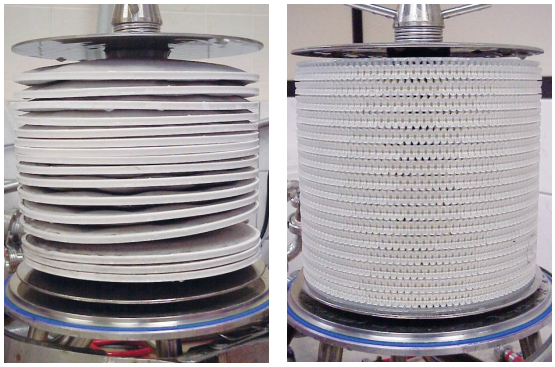
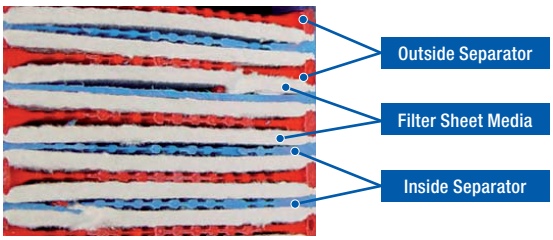


Figure 5: After 21 steam cycles, deformation is evident on classic lenticular modules (left). SD II modules (right) maintain their shape, keeping the individual filter cells separate from each other, unobstructed and fully available for filtration.

then assembled in a stack to form the module (Figure 4). In this design, since support is only in the forward flow direction, backflushing is not possible. Additionally these modules are prone to cell deformation during filtration, hot water sanitization or steaming (Figure 5). This deformation causes the filter sheet cells to contact each other, which limits the filtration availability of those surfaces.

On the other hand, the unique performance and robustness of SD II modules is due to its patented double separator design, which provides upstream and downstream support for the filter media (Figure 6). The media is individually sealed and separated between polypropylene flow distribution plates, which results in optimal flow and higher throughput through the available surface area, as well as a mechanically robust module suitable for flow in both forward and reverse operation. The design also minimizes the risk of media tearing if the modules are subjected to reverse pressure shocks.



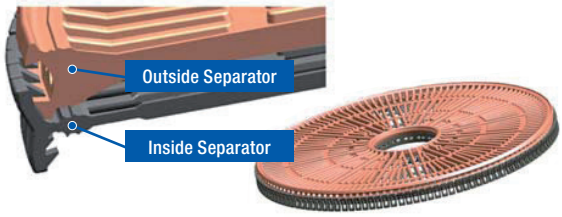


Figure 6: SD II module cutaway and separator plates

The Benefits

The benefits realized by SUPRAdisc II technology in this application include:

- Improved and consistent visual filtrate quality
- Long service life resulting in economical filter spend, due to regeneration and storage capability of the modules
- High yields, with beer losses estimated at less than 1% (depending on suspended solids load in the beer)
- Excellent product protection from oxidation, due to enclosed system
- Simple and flexible installation, quick filter change-out, and ease of handling both pre- and post-filtration
- Productivity increase with smaller footprint, due to elimination of sedimentation tanks

For this microbrewery, the SUPRAdisc II solution resulted in an improved, more consistent product and it enabled higher productivity within the same, limited space.

References and Footnotes

[1] USA Brewers Association defines microbreweries in terms of output as producing up to 17,550 hL per year.

[2] USA Brewers Association 2013 data, www.brewersassociation.org

[3] Please contact Pall regarding protocols for cleaning, backflushing, and sanitization suitable for your application.

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