NO LONGER FLAT

Filter modules for fine filtration of beer

Pall Corporation have developed a new generation of depth filter modules for fine filtration. The SUPRApak filter module is a closed depth filter system which eliminates the main disadvantages of the flat sheets such as dripping, sticking and the build of mold. For the first time worldwide this new technology was tested on a production scale for fine filtration of beer in cooperation with the Alsatian brewery Météor for a period of seven months and after a successful completion of the tests the existing sheet filter was replaced completely.

For many decades breweries have almost exclusively used what is known as flat filter sheets. Now, Pall is breaking completely new ground with the patented SUPRApak depth filter module in connection with the new "Edge Flow" technology and the accompanying SUPRApak housing. Besides a closed depth filter system advantages include increased process security and a much lower surface area, attained by a higher power density.

Directly compared to flat sheets, considerable cost savings may be achieved, especially in the rinsing and sanitization media, and also in lower labour costs, reduced beer losses and last but not least, in disposal fees.

The brewery Météor is situated in Hochfelden, northeasterly of Strassbourg, amidst of the wonderful Alsace region. Several speciality bottom fermented beers are produced there with an annual output of approx. 600,000 hl. Météor is the only brewery in East France, still managed by its proprietor family.

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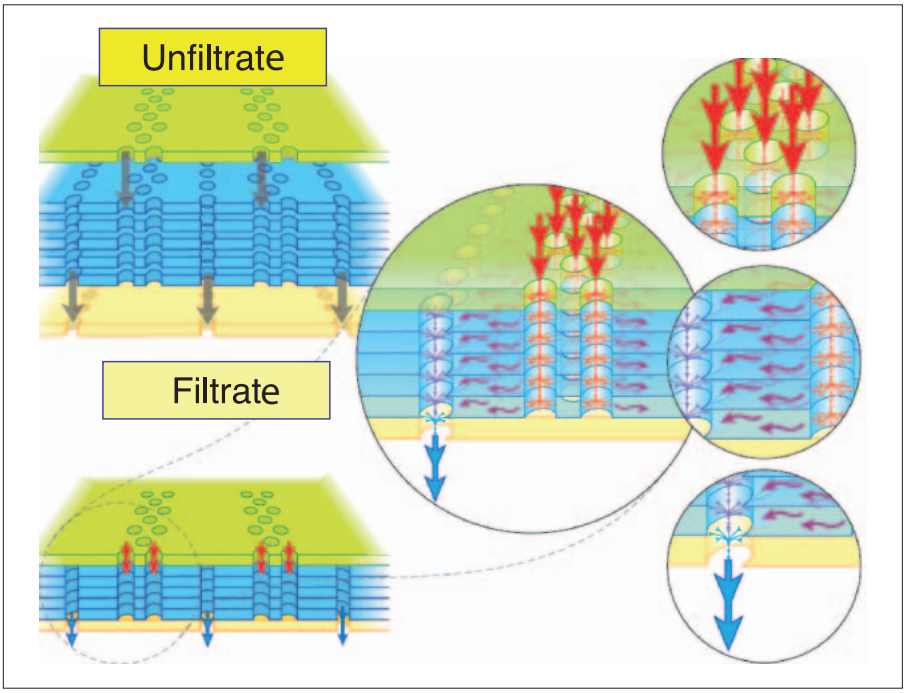

Fig. 1: Schematic illustration of a SUPRApak Module with Edge Flow technology

SUPRApak filter modules and housing

Filter modules

In response to the requirements of the industry, Pall developed the SUPRApak filter module as a direct alternative to the classical sheet filter. The filter module is an extremely compact, cylindrically shaped filter in which the sheet is passed across to the surface (i. e. "Edge flow"). As can be seen in fig. 1, the unfiltrate passes through the holes, (marked in red), then is filtered across the flow direction and discharges in the filtrate channel (marked in blue).

Filter housing

To accommodate the SUPRApak filter module, a special modular housing series was developed (see fig. 2). A compression device with a torque supported fuse is used to fit the individual modules together within the housing. The sealing and center rings between the modules are compressed by the compression device to an exact defined force into the modules whereby the complete module unit is self-sealed.

During both filtration and cleaning the filter is easy to operate and only needs to be opened for

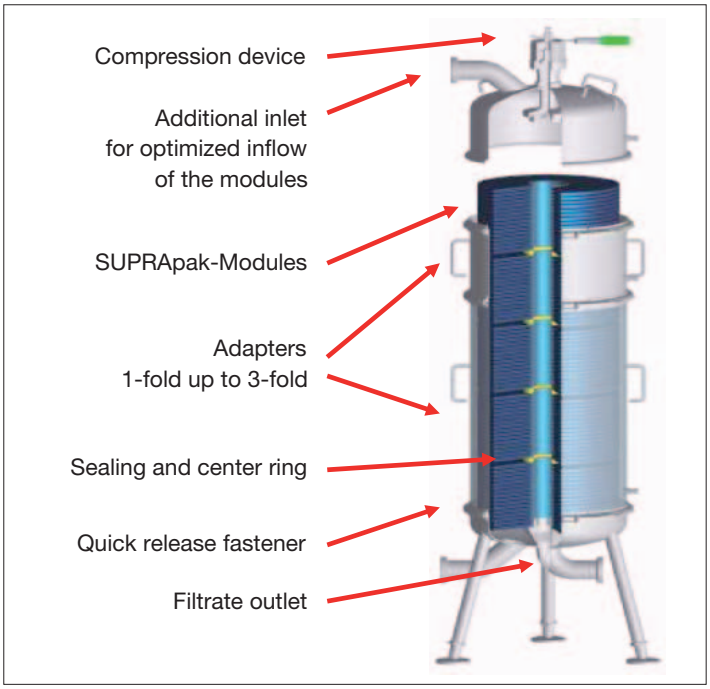

Fig. 2: Modular assembling of a SUPRApak housing

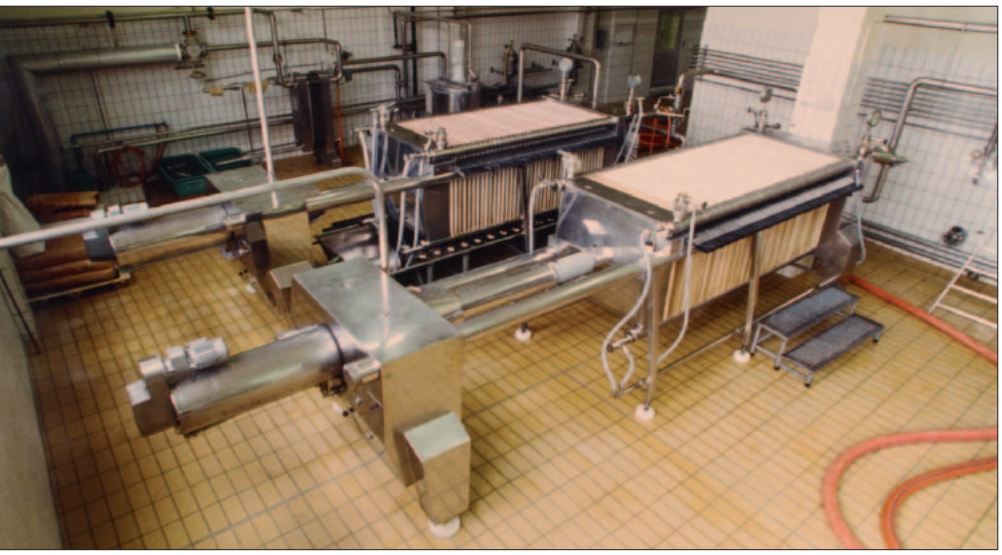

Fig. 3: Filter cellar prior to the SUPRApak tests, kieselguhr filter (background), sheet filter (foreground).

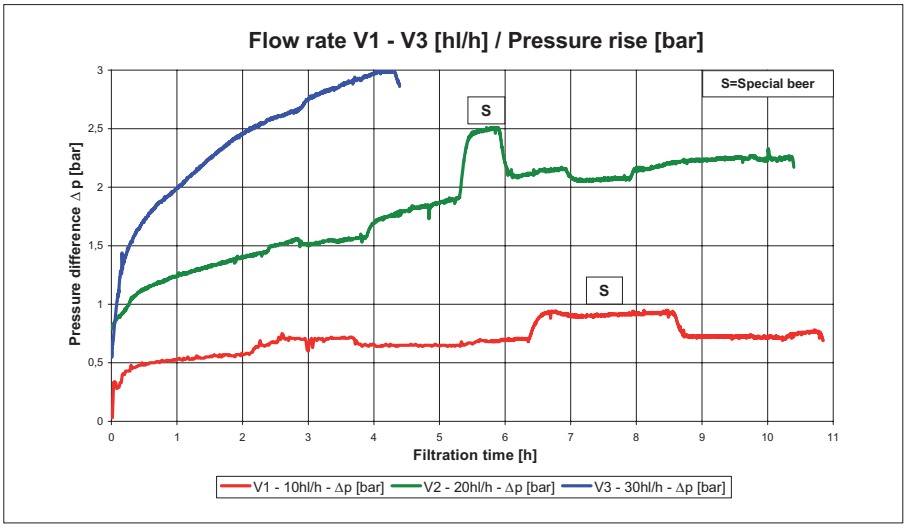

Fig. 4: Different flow rates depending on service life. The additional short-time pressure increases in the diagram were caused by alcohol-free beer with higher amounts of yeast.

module change. A quick release fastener allows removal of the tank dome whilst a module removal device provides short set-up times when changing the SUPRApak filter modules.

In the case of assemblies using 3 to 6 filter modules, a second inlet at the unfiltrate side leads to the tank dome to allow optimal flow to the modules.

The modular housing concept, consisting of a tank bottom, tank dome with compression device and adapters (1- 2- or 3-fold high), allowing an additional capacity increase of up to max. 6 filter modules (table 1). Both the modules and the housings comply with current food stuff contact regulations.

Initial tests

Initial tests were carried out with the SUPRApak filter pilot plant equipped with 1 module. The plant was run in bypass, i.e. installed after the kieselguhr filter and the filtered beer again was compressed in front of the sheet filter. The aim of the initial tests was to determine the optimum flow rate for fine filtration of the beer with the SUPRApak filter modules which would then allow the dimensioning of a commercial plant. Additionally, the data of the 25° and 90° turbidity measurement, particle measurement and O_2-measurement were recorded throughout the piloting period. Microbiological samples were taken and analysed by the laboratory of the brewery Météor.

Equivalent to the presently used flat sheet in the sheet filter, modules of type SUPRApak SW5500LW were used for the tests. To determine an optimum flow rate the modules were run in different tests at 10, 20 and 30hl/h per module. The test with 10hl/h (see fig. 4, red curve) ran for 10.5 h. A very low pressure rise was observed and the pressure difference at filtration end was only at 760 h Pa.

Doubling the flow rate to 20 hl/h (green curve), the test also run for 10.5 h and the pressure difference increase at filtration end was just under 1,500 h Pa. At 30 hl/h the test had to be aborted after just

4.5 h as the pressure difference at the end of filtration was at almost 3,000 h Pa.

The tests at different flow rates showed that 20 hl/h per module to be an optimum flow rate which simultaneously served as the basis for further tests. The second test series was carried out to determine the maximum service life of the SUPRApak filter modules. The test was completed over 13 filtration cycles and 17 hot water sanitization cycles (85 °C). Here the pressure difference did not exceed 1,500 h Pa. The module resisted this long-term load and this is confirmed also by the microbiological examination results of the brewery Météor. Although very good values were measured after 17 hot water sanitization cycles, Pall recommends not to exceed 10 filtration/sanitization cyles.

Qualification

Based on the good filtration results of the initial tests and the technological advantages that the SUPRApak filter modules offer compared to the flat sheets, the brewery Météor could be won to test also the industrial scale implementation. For a period of 7 months all beer which would normally have been filtered via a sheet filter was filtered only through SUPRApak filter modules. Without any hesitation the sheet filter was partially demounted and the SUPRApak filter unit was installed between the sheet filter beams (see fig. 5).

The filtration capacity of the existing sheet filter with a filtration area of 170 m^2 was 240 hl/h. 230,000 hl are sheet filtered out of an annual output of approx. 600,000 hl. On average 85 sheets were exchanged after approx. 10,500 hl, thus over a year 22 changes were required. Based on the results of the initial tests 12 SUPRApak filter modules were necessary for the same filtration capacity of 240 hl/h.

Thus, the sheet filter was displaced by two SUPRApak filter housings, each holding 6 SUPRApak filter modules. The plants were run parallelly, i. e. the incomming volume flow is distributed to both filters. In order to record as many parameters for the quali-

Table 1: Technical Data SUPRApak Filter Unit L-0100 up to L-0632

SUPRApak modules per housing	1 to 6
Design temperature tank	–10 to 150 °C
Design pressure tank	–1 to 8 bar
Max. pressure difference*	1.5 bar
Tank diameter	450 mm
Tank volume without modules	53 – 267 dm^3
Product contacted material	1.4404 (316L)
Sealing material	EPDM
Surfaces product contacted	Ra ≤ 0.8 µm, e-polished
Connections in-/outlet DIN 11851 with Tri-clamp adapter	DN65 2.5“
Filter measurements without fittings	L 0.7m x W 0.7m x H 2.6m (max.)
Filter capacity for beer	20 – 120 hl/h

* Operating Conditions SUPRApak™ Modules:

Max. pressure difference up to 40 °C	1,500 h Pa
Max. operating temperature	75 °C, 8 h
Max. sterilization temperature	85 °C, 20 min.
Max. number of filtration/sterilization cycles	10

Fig. 5: SUPRApak installation between the beams of the dismounted sheet filter as an interim solution during qualification time, clearly to be seen the essentially smaller place requirement.

fication as possible, the following data was measured and recorded separately for every plant by means of a 12 channel data logger:

- Inlet / Outlet pressure
- Flow rate
- 25°/90° Turbidity
- Temperature.

Althogether 232,250 hl of beer were filtered via the SUPRApak filters during the qualification period from 1st of December 2008 until 30th of June 2009. Both filter units were equipped 11 times with new SUPRApak filter modules, resulting to an average filtration capacity of 21,114 hl/change. (10,557 hl/ filter plant) and an average service life of between 13 and 15 filtrations/sanitizations was achieved per module change (table 2).

Table 2: Summary of the filtration data

Qualification period	7 months
Filter: 2 SUPRApak L-0632 housings	2 x 6 Modules
Total filtered volume:	232,250 hl
Number of new-charges	11
Total filtrations	144
Ø Filtrations/charge	13
Ø Volume/charge	21,114 hl
Ø Volume/filtration	1,613 hl
Ø Volume/charge/module	1,759 hl

Table 3: Comparison of the filter systems compared to the filtration area

	Flat Sheet	SUPRApak Module
Area – Number of modules	170 m^2	12
Filtration volume/charge	10,250 hl*)	16,240 hl**)
Filtration capacity	60.3 hl/m^2	1,353 hl/Module
➡ ca. 22.4 m^2 flat sheet replaced by 1 SUPRApak Module		

*) Ø Filtered volume of the sheet filter according to Météor
**) Ø Filtered volume of SUPRApak filter referred to 10 filtrations/sanitazitions.

Microbiological results

Beer samples were taken at the filter inlet (outlet kieselguhr filter) and at the outlet of the two SUPRApak filters for microbiological analysis. During filtration, a collective sample (via sterile membrane) and individual samples (200 ml) were taken in intervals of 1.5 to 2 hours.

Afterwards the samples were examined by means of membrane filtration for the presence of yeasts and mold fungus (Lysin-Agar) as well as beer spoilage bacteria (MRS-concentrate).

Microbiological testing was performed in the laboratory of the brewery Météor.
The direct comparison of the microbiological results showed equivalence between the sheet filter and the SUPRApak filter modules.

Savings & profitability

Filtration capacity: Flat sheet vs SUPRApak filter module

Firstly the filtration area necessary for a given filtration volume of the presently used flat sheet is compared with the filtration capacity of a SUPRApak filter module (table 3).

The housing design and high density packing of the modules means there are minimal dead spaces resulting in minimal cut-off quantities offering the brewery the following savings:

- Reduction of the water consumption by 16 per cent
- Reduction of energy costs by 66 per cent
- Shorter set-up times due to quicker changeout of the filter modules
- Reduction of the personnel costs due to easier handling and operating
- Low investment costs
- Low costs for maintenance and servicing.

Fig. 6: Filter cellar with kieselguhr filter in the background; new installed SUPRApak housings in the foreground. Small photo: Technical Manager Jean-Marie Kessler (right) and Brewmaster Ernewein Roger

Table 4: View of total costs

Parameter	Savings with SUPRApak [%/hl]
Filter material	55.1
Labour time – Handling costs	87.5
Rinsing & Sanitization	86.0
Product losses	99.2
Disposal fees	66.7
Specific running costs	68.0

View of total costs

The view of total costs of both systems as identified at Météor Brewery is shown in table 4.

The specific running costs of the SUPRApak filter modules are 68 per cent lower than when using flat sheets. Referred to the annual filtered beer quantity of 240,000 hl, savings amounting to € 23,197 per year can be achieved by using the SUPRApak filter module technology.

Summary

The qualification of the new closed sheet filter system with Pall Corporation's SUPRApak modules at the brewery Météor resulted in the following essential advantages for the customer:

- Increased process safety due to closed system
- Lower filter material costs
- Lower handling costs
- Lower rinsing and sanitization costs
- No drip losses
- Lower disposal fees
- Simplified operation
- Improved product quality
- Essentialy lower surface requirement achieved by high power density
- Modular, flexible housing concept
- Longer filtration cycles
- Lower water consumption

Based on the convincing filtration results and the above mentioned advantages the SUPRApak filter plant was purchased by the brewery Météor at the end of the qualification period (see fig 6).

Thanks to the excellent cooperation of all persons involved, both from the brewery Météor and from the Pall project team, this new technology for the fine filtration of beer was qualified in a realtively short time. We express our special thanks to the brewery Météor – at all times they gave us their complete support. □