



Application Bulletin

SUPRApak™ Technology in Canadian Whisky Production is Demonstrably Superior to Flat Sheet Filtration

Overview

The global whisk(e)y¹ market is the third largest segment in the global distilled spirits market, representing 11.4% of market revenue. The market is enjoying steady growth, projected at a CAGR growth rate of 4.45% in revenue from 2013 to 2018². This growth, along with an increased consumer demand for premium and varied products, is fueling the need for producers to increase productivity or expand while maintaining or improving quality standards.

Whisky is distilled from a mash of fermented grains, including barley, corn, rye and/or wheat. Whisky producers apply expert and proprietary techniques for the creation of their unique brands. Particle removal and haze filtration are an indispensable step in production, common but essential to achieving quality specifications.

Sheet filter presses have historically been employed in these applications. With excellent capability to achieve depth filtration and adsorption, filter sheets are an ideal solution for turbidity reduction and haze removal in distilled spirits.

However, sheet filters in a press configuration pose challenges such as labor-intensive handling and change-out, high hold-up volumes which negatively affect yield on product changes, and drip losses, resulting in lower yields or the need for reprocessing. Additional drawbacks are the potential for microbial growth on exposed edges of filter sheets, large footprint, and relatively high capital investment.

Finally, sheet filters are open systems. Therefore volatile organic compounds escape to the surrounding environment and must often be exhausted via area ventilation systems, to avoid air quality and safety concerns.

Pall's SUPRApak technology has a proven track record in brown spirits production. Its primary application with demonstrated benefits is in the

replacement of traditional flat filter sheets for particle and/or haze removal, resulting in quality improvement, capacity expansion, and cost of ownership reduction.

The Challenge

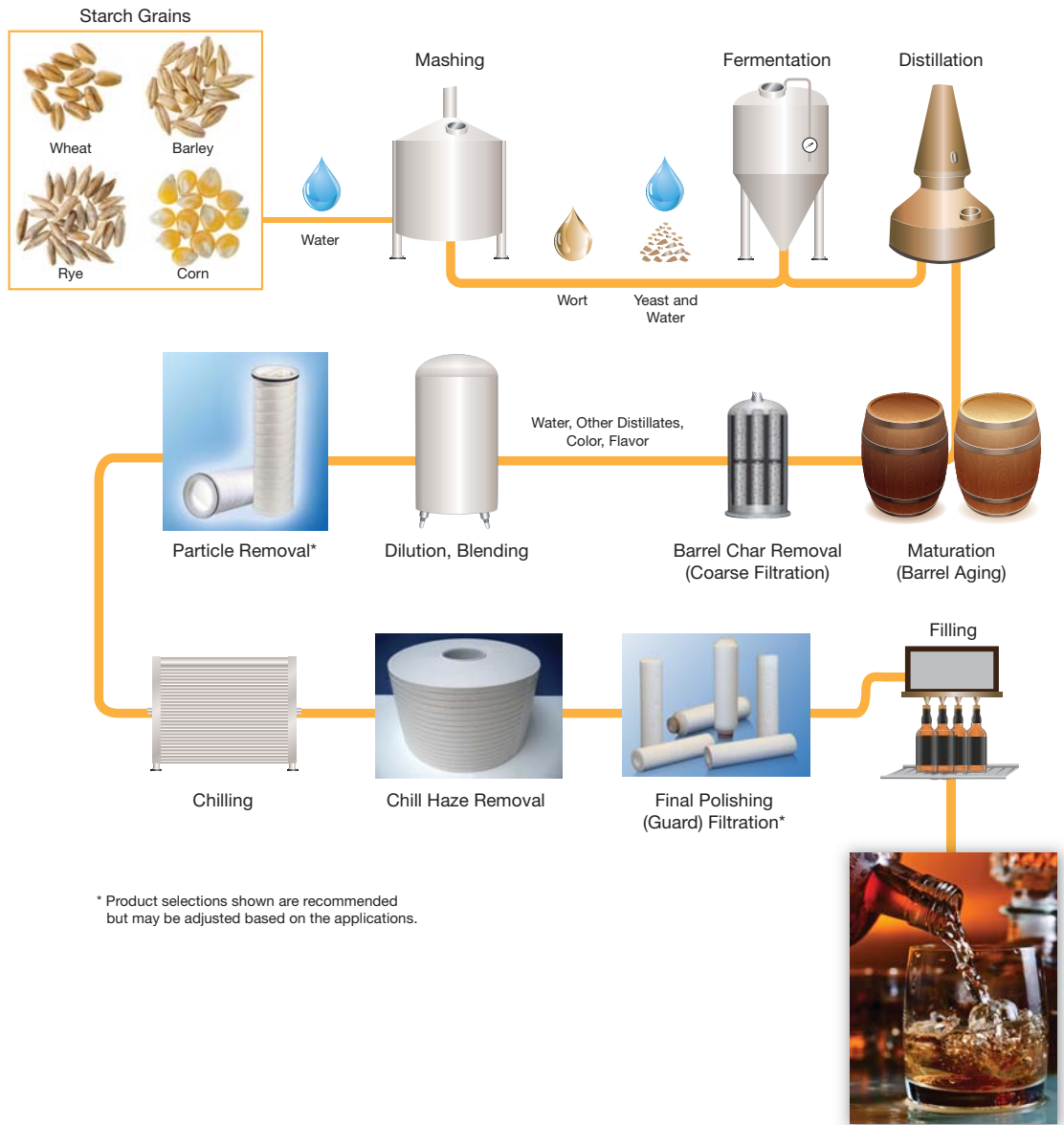
A large distillery produces several million liters of different brands of Canadian whisky. Due to increased demand for contract bottling projects, they faced the need to increase productivity so that additional capacity could be opened up within their plant. This target needed to be accomplished while achieving consistent and excellent filtrate quality and reducing production complexity.

Figure 1 indicates a typical process flow diagram in whisky production.

The distillery was using a 60 cm x 60 cm sheet filter with a filtration area of 19.7 m² (212 ft²), resulting in flux rates of 749-1153 liters/m²-hour. The filter sheet grade in use was relatively tight, in order to meet the filtrate quality specification of less than 1 NTU.

With batch sizes of 30,283 liters (8,000 US gallons), filter sheet change-out occurred sometimes mid-batch or at varying points during the filtration, due to sheet blocking and differential pressure build up. Some batches were filtered once, while others required two or more passes through the sheet filter to achieve the required result. The process discrepancies and the tightness of the filter grade caused the color of the filtered whisky to be inconsistent. This was compounded by sets of sheets being at varying stages of saturation, depending on how long they had been in production. As a result, the product blending sometimes had to be adjusted to mask variation. Process consistency was a struggle with the existing set up, and labor and time expenditure for managing the sheet filter further limited productivity.

Figure 1: General Schematic of Whisky Production



The Solution

SUPRApak technology is Pall's latest generation closed system alternative to sheet filtration for distilled spirits production. Constructed of the same depth filter media as classical filter sheets, SUPRApak SH modules achieve a better filtration effect due to unique edge flow technology. They remove components responsible for particulate and colloidal haze formation with minimal color adsorption³. The result is a visually clear product, which meets producers' organoleptic profile requirements. In addition, SUPRApak modules offer further key benefits, which drive down operating costs. Different from both flat sheets and lenticular modules, they demonstrate substantially higher throughputs due to the unique and proprietary flow path of their design. Finally, they feature a modular format, fitting easily into enclosed housings for safe, simple and hygienic operation. Figure 2 shows a typical SUPRApak installation.

The SUPRApak solution proved itself as expected in a full scale trial at the distillery. At a comparable flux rate as that used on the sheet filter an entire 30,283 liter (8000 gallon) batch was processed through one SUPRApak SH7200LW module, which has less than half the surface area of the 19.7 m² sheet filter. Aside of substantially higher throughput, the SUPRApak solution consistently surpassed the filtrate quality specification after just a single pass through the module, achieving 0.4 NTU without negative impact on color. Trial results demonstrated the optimum sizing for purposes of specifying a production-sized installation.

The production scale now encompasses three manufacturing cells, each dedicated to filtering different types of Canadian whisky concurrently. In each cell, two 5-high module housings with SUPRApak SH7200LW modules are installed in parallel, preceded by 5 micron particle filtration.



Figure 2: SUPRApak modules are enclosed in housings of modular design, which enables use of one up to six modules stacked on top of each other for different capacities. In the haze removal application described in this bulletin, a 5-high installation handles a flow rate of 17,034 liters/hour (75 US gal/min) and achieves a throughput exceeding 151,400 liters (40,000 US gal)⁴.

Conservative sizing ensures successful single pass filtration and infrequent change-outs. The modules are run continuously to exhaustion, so that the cost per filtered volume is kept low and product losses are minimized. Batches are run successively, without the need to replace modules in between. Recirculation of fluid occurs for 5 minutes only after installation of new, unused modules, to bring them to a uniform level of saturation. Inconsistencies in color no longer pose a problem and the need for blending has been eliminated.

Each manufacturing cell is sized to handle 50% higher flow than the previous sheet filter installation. Together the 3 manufacturing cells process 3 different batches concurrently in 4 hours, whereas previously it took an average of 8 hours to complete one batch. In effect, capacity has increased by 6 times. The footprint in each cell requires about 66% of the space required by the sheet filter.

Due to the substantial operating cost reduction realized, payback for the capital investment in filter housings was achieved in less than 10 months.

The Benefits

With SUPRApak modules, the whisky producer achieved cost-effective and quality-enhancing filtration. When using these modules to replace the traditional sheet filter, they realized the following benefits:

- Closed system with zero drip losses, minimal escape of volatiles to the environment, and overall, a more hygienic installation
- Improved filtrate quality, with better color control and elimination of blending step
- Productivity increase of 6 times, due to extremely high throughput, reduced downtime, and less frequent and shorter change-out times
- 93% labor expenditure reduction due to less frequent filter change-outs and a 75% reduction in time required to do a change-out
- 33% footprint reduction when comparing SUPRApak installation in each manufacturing cell with original sheet filter
- Concurrent production of 3 different whisky types made possible by extremely compact arrangement and reduced capital investment costs
- 78% reduced capital investment compared to new sheet filter assemblies
- Reduced operating costs with a short return on investment
- Minimal spare parts and maintenance

Pall's SUPRApak technology has similarly been used in multiple other brown and white distilled spirits applications, such as in Scottish, Irish, and American whiskies, cognac, sherry, other brandies, rum, vermouth, vodka, tequila, and more.



References and Footnotes:

- ¹ The terms whisky and whiskey are spelled based on the preferred approach taken by the countries of origin. US and Irish whiskey is typically spelled with an 'e' while Scottish, Canadian and Japanese whisky is spelled without an 'e'.
- ² Technavio Market Report: Global Whiskey Market 2014-2018, Oct. 15, 2014
- ³ As with any sheet-based media, some color adsorption occurs with new, unused modules until the point of saturation. Saturation is achieved by a short recirculation of the fluid, until inlet and outlet color measurement is the same.
- ⁴ Capacity and throughputs in brown spirits filtration are application-dependent, influenced in part by incoming fluid turbidity and end product specifications. Please contact Pall to discuss the details of your application.

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Pall Corporation

Pall Food and Beverage

25 Harbor Park Drive
Port Washington, NY 11050
+1 516 484 3600 telephone
+1 866 905 7255 toll free US

foodandbeverage@pall.com

Visit us on the Web at www.pall.com/foodandbev

Pall Corporation has offices and plants throughout the world. For Pall representatives in your area, please go to www.pall.com/contact

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