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Reducing the Environmental Impact of Wine Filtration

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Abstract

Filtration is used to clarify and stabilize wine before bottling. The filtration process must be controlled, repeatable and must not affect the body, aroma or taste of the wine. It can be a water, consumables and energy intensive process.

Sartorius filtration systems allow you to recycle and reuse water used for cleaning and sterilization, recover energy from heat generated during cleaning, and optimize the use of filtration consumables to maximize their shelf-life. The systems reduce consumption and waste, while maintaining cleaning efficiency and eliminating microbiological contamination.

This white paper presents a series of studies carried out to compare the consumption of energy, water and consumables when using Sartorius' wine filtration systems compared with other, widely used systems.

Introduction

The business case for sustainable manufacturing has never been stronger, with reducing water and energy usage at the heart of the challenge. Winemakers must consider all parts of their production processes when looking to control costs and reduce their environmental footprint.

Filtration is used to clarify and stabilize wine before bottling. The filtration process must be controlled, repeatable and must not affect the body, aroma or taste of the wine. It can be a water and energy intensive process, with systems requiring cleaning between production batches.

Filtration with Kieselguhr filters based on diatomaceous earth (DE) is a widespread technique in the world of wine, particularly in the roughing and polishing phases of musts and wines. Not being an automated system, Kieselguhr filtration requires a qualified operator, and the exhausted DE must be disposed of in a responsible way, e.g. by composting.

Crossflow filtration was introduced to winemaking in the 1980s and is now the most frequently used technique for the preparation of wines in the cellar, before bottling. It uses a selective porous membrane to filter wine.

In recent years, more environmentally aware consumers and an increase in international competitiveness within winemaking have driven new technological advances in wine filtration, enabling further reductions in cost and waste.

Introduction to products

Sartorius designs custom filtration skids based on the specific Wine master requirements and proposes the most suitable system according to local regulations and production constraints.

Drawing on our extensive experience and use of new technology developments over the years, we introduce two solutions below:

1. Custom engineered filtration systems

Sartorius' custom engineered filtration solutions are based on cartridge filters technology. The careful selection of filters from pre- to final filtration guarantees optimal filtration flow and performance for production lines. The systems have long cartridge lifetimes and individual cleaning is required for each filtration stage. Water loss is limited during sterilization steps through the option of a water recovery loop when connected to a CIP system.

The portfolio includes manual, semi-automated, or fully automated systems. Semi- or fully automated systems associated with a CIP reduce energy consumption by the timed filling and heating of atmospheric tanks during off-peak hours, recovering heat in kcal from cleaning cycles at 50°C with heat exchanger technology, and limiting water usage by recovering it from the sterilization process.

2. Jumbo Star Technologies

Drawing on the experience acquired in designing and manufacturing microfiltration systems for the past 50 years, the Jumbo Star systems have been developed with optimally automated filtration and regeneration stages, and available options include semi-automated and fully automated systems.

Comparison of filtration methods

This white paper presents a series of studies carried out to compare the consumption of energy, water and consumables when using the following wine filtration systems:

- fully automated custom engineered filtration skids + CIP systems
- Manual filtration skid
- Jumbo Star technology
- Crossflow filtration systems
- Kieselguhr filtration systems

Performance of Fully Automated Custom Engineered Filtration Skids and CIP System



Two studies, carried out in France on 15 installations, analysed the consumption of energy, water and filtration consumables when using fully automated customized filtration skids with a CIP system. Usage data is compared to those of a standard model of manual custom engineered skids, without a CIP system.

Study 1

Savings were analysed when using 2 × – 8 Round × 30" Filter Housings. This corresponds to 80% of the filtration skids installed in France.

- Options; heat Kcal recovery and filtration skid + filling machine sterilization water recovery kit
- Use: 250 days per year, 8 production hours (daily)
- Values compared to a manual custom engineered filtration skid without CIP

	Annual consumption savings	Savings in %	Annual savings in Euro*
Water	1,400 m ³	58%	€ 5,600
Energy	136,107 KW	70%	€ 21,097
Consumables Cartridges		15%	€ 2,025
Total			€ 28,722

* 1 m³ = 4 € and 1 KW = 0,155 €

Conclusion

In this specific study, using a 2 × – 8 round × 30" filter housings save 58% of water, 70% of energy and 15% of consumables. The total annual saving is € 28,722.

Study 2

Savings were analysed when using 3× - 5 Round × 30" Filter Housings. This corresponds to 15% of the filtration skids installed in France.

- Options; heat Kcal recovery and filtration skid + filling machine sterilization water recovery kit
- Use: 250 days per year, 8 production hours (daily)
- Values compared to a manual custom engineered filtration skid without CIP

	Annual consumption savings	Savings in %	Annual savings in Euro*
Water	917 m ³	51%	€ 3,667
Energy	90,867 KW	64%	€ 14,084
Consumables	Cartridges	15%	€ 2,025
Total			€ 19,776

* 1 m³ = 4 € and 1 KW = 0,155 €

Conclusion

In this specific study, using a 3 × - 5 round × 30" filter housings save 51% of water, 64% of energy and 15% of consumables. The total annual saving is € 19,776.

Both the above studies showed reductions in water, energy and consumables, as compared to manual custom engineered skids, without a CIP system.

With these fully automated systems you can save up to 60% in water and 40% in energy, while maintaining cleaning efficiency, meeting required regulations and International Food Standardization/British Retail Consortium requirements, controlling microbiological risks, and reducing water waste.

Filling and heating the atmospheric tank with water during off-peak hours saves energy costs, and heat-exchanger technology recovers heat from cleaning cycles. The recovery and reuse of water from sterilization decreases consumption and waste. The systems maximize efficiency and control of the cleaning steps, enabling robust and repeatable processes, while lowering your environmental footprint.

Other positive impacts of using automated custom engineered skids with a CIP system.

Steps	Parameters	Impacts
Production	Wine-Impregnation	Limitation of waste and wine losses
	Underfilling of housing	Optimization of both production times between two cleanings and cartridge life time
	Fluid pressure	Control of the clogging level and its impact on cleaning conditions
Cleaning	Temperature	Optimal cleaning efficiency
	Water flow rate	Optimal cleaning efficiency and control of water consumption
	Chemicals	Efficiency and control of chemical product concentrations Validation of rinsing
	Time	Control of water and energy consumption
	Energy consumption	Recovery of heat kcal from hot water (from the generation step at 50°C 122°C and sterilization step at 90°C 194°C F)
	Water consumption	Limit water usage by recovering it from the sterilization process
Production & cleaning	Automatization	Repeatability of process and limitation of the risk of human error

Comparison of Filter Modules and Cartridges



Study 3

This study was carried out in France to compare the performances of different filtration consumables used in the industry.

Size for a flow of 3,000 bottles/h or 22.5 HI/h with 250 production days per year

Consumable type	Qty	Water consumption daily production					Total per year
		Rinsing before filtration	Sterilization	Cooling	Rinsing after filtration	Hot water regeneration	
12" Sartocell filter modules	3	0.3 m ³	0.75 m ³	0.125 m ³	0.375 m ³	0.75 m ³	575 m ³
30" cartridges	3	0	0.45 m ³	0.125 m ³	0.125 m ³	0.5 m ³	300 m ³

	Annual consumption savings	Annual savings in €*
Water	275 m ³	€ 1,100
Energy	9,135 KW	€ 1,415
Total		€ 2,515

* 1 m³ = 4 € and 1 KW = 0,155 € (energy requirement for water heating)

Conclusion

In this specific study, using 3 × 30" cartridges save 275 m³ in water and 9,135KW in energy per year, compared to using 3 × 12" Sartocell filter modules.

The total annual saving is € 2,515.

Study 4

Size for a flow of 17,000 bottles/h or 130 HI/h with 250 production days per year

Consumable type	Water consumption daily production						Total per year
	Qty	Rinsing before filtration	Sterilization	Cooling	Rinsing after filtration	Hot water regeneration	
16" Sartocell filter modules	6	1.2 m ³	3 m ³	0.5 m ³	1 m ³	2 m ³	1,925 m ³
30" cartridges	8	0	1.2 m ³	0.33 m ³	0.33 m ³	1.33 m ³	797 m ³

	Annual consumption savings	Annual savings in €*
Water	1,127 m ³	€ 4,508
Energy	46,875 KW	€ 7,265
Total		€ 11,773

* 1 m³ = 4 € and 1 KW = 0,155 € (energy requirement for water heating)

Conclusion

In this second case, using 8 × 30" cartridges save 1,127 m³ in water and 46,875 KW in energy per year, compared to using 6 × 16" Sartocell filter modules.

The total annual saving is € 11,773.

Comparison of Jumbo Star Technologies and Crossflow Filters

Two studies in France and a study in Spain compared Jumbo Star Technologies with crossflow filters:

Study 5



Equipment	Fully automated Jumbo Star filtration skid with twin filtration lines and 3 stages	120 m ² Crossflow filter (Competitor)	Annual saving
Daily production	500 hl/12 h filtration	500 hl/12 h filtration	
Use	250 days/year	250 days/year	
Annual filtered volumes	125,000 hl	125,000 hl	
Wine	Soft wine and red wine, Languedoc, France	Soft wine and red wine, Languedoc, France	
Water in l/hl wine	7.2 l	18 l	60%
Energy in KW/hl wine	0.036 kW	0.432 kW	92%
Chemicals in l/hl wine	0.0028 l	0.016 l	84%
Environmental footprint	€ 0.04	€ 0.19	78%

1 m³ = 4 € and 1 kW = 0.155 €

Chemicals: soda (3 €/l) booster and citric acid (4.5 €/l)

Size of pumps: 18 kW for crossflow and 1.5 kW for Jumbo Star System

Conclusion

Filtering with a fully automated Jumbo Star system is more environmental friendly thanks to a limited water (-60%), energy (-92%) and chemicals (-84%) consumption compared

to those consumed by a 120 m² crossflow filter for a daily production of 500 hl over 12 hours. The environmental footprint is about 78 % lower.

Study 6

Equipment	Semi-automated Jumbo Star filtration skid with 3 stages	60 m ² Crossflow filter (Competitor)	Annual Saving
Daily production	300 hl/8 h filtration	300 hl/8 h filtration	
Use	150 days/year	150 days/year	
Annual filtered volumes	45,000 hl	45,000 hl	
Wine	White sparkling wine, Provence, France	White sparkling wine, Provence, France	
Water in l/hl wine	1.2 l	1.5 l	20%
Energy in KW/hl wine	0.006 kW	0.024 kW	75%
Chemicals in l/hl wine	0.0004 l	0.015 l	75%
Environmental footprint	€ 0.07	€ 0.15	53%

1 m³ = 4 € and 1 kW = 0.155 €

Chemicals: soda (3 €/l) booster and citric acid (4.5 €/l)

Size of pumps: 18 kW for crossflow and 1.5 kW for Jumbo Star System

Conclusion

Filtering with the semi-automated Jumbo Star system uses less water (-20%), energy (-75%) and chemicals (-75%). Compared with the crossflow filter.

The environmental footprint is 53% lower. Crossflow filters have longer washing cycles than the Jumbo Star system, and so require more water. The Jumbo Star system does not require a recycling pump unlike the Crossflow filtration technology.

Study 7

A comparison study in Spain produced the following data:

Equipment	Crossflow (Sartoflow)	Fully automated Jumbo Star
Daily Production	1,700 hl	2,500 hl
Days per year	260	208
Annual filtered volumes	442,000 hl	520,000 hl
Annual water consumption	2,808 m ³	1,716 m ³
Water consumption for 1 hl of wine	6.35 l	3.30 l

Conclusion

In this study, filtration with a fully automated Jumbo Star system used significantly less water than the crossflow filter, leading to a 48% lower environmental footprint

Comparison of Jumbo Star Technologies and Kieselguhr Filters

The following study was carried out on white sparkling wines using closed tank technique in Provence, France.

Study 8

Equipment	fully automated Jumbo Star system with 3 stages, 3 cartridges	15 m ² manual Kieselguhr filter (double filtration on white and pink DE)	Annual Saving using Jumbo Star
Use	110 days/year	220 days/year	
Annual filtered volumes	30,000 hl	30,000 hl	
Water in l/hl wine	8.4 l	3.3 l	-155%
Energy in KW/hl wine	0.22 kW	1 kW	78%
Chemicals in l/hl wine	0.009 l	0.01 l	20%
Waste in kg/hl wine	0.002kg	2.2kg	100%
Environmental footprint	€ 0.10	€ 0.33	70%

1 m³ = 4 € and 1 kW = 0.155 €.

Chemicals: soda (3 €/l) booster and citric acid (4.5 €/l).

Size of pumps: 15 kW/h – 7 h/d

Conclusion

Despite lower water consumption, Kieselguhr filters generate more waste and require more energy than the fully automated Jumbo Star filtration skid. The filtration using the Jumbo Star system has a 70% lower environmental footprint.

Conclusion

The studies in this paper consistently demonstrate a lower environmental footprint for all Sartorius' filtration systems, with savings of up to 60% in water and 40% in energy consumption when using fully automated custom engineered filtration skids and CIP systems when compared to manual custom engineered filtration skids without CIP.

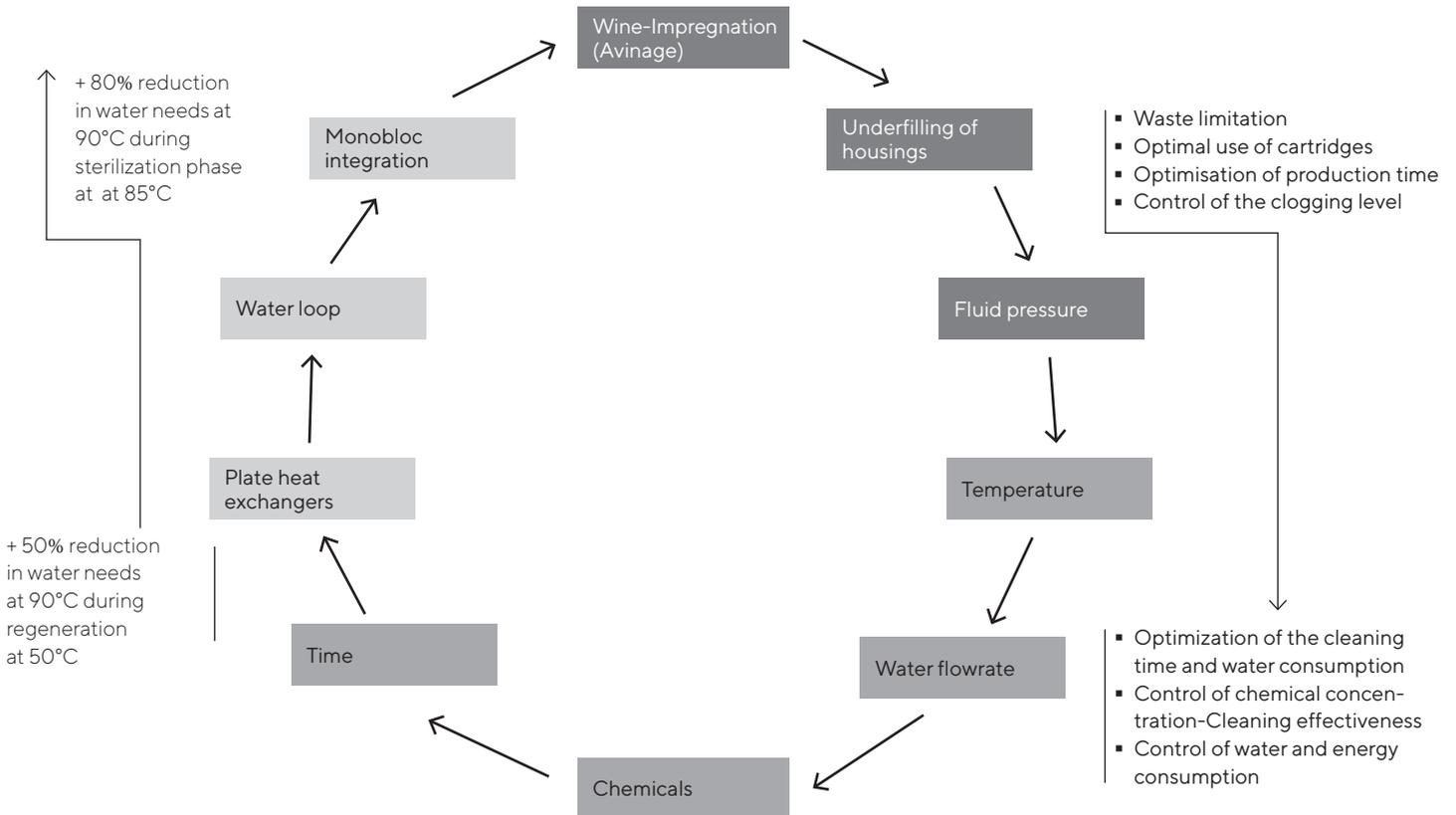
When the Jumbo Star technology is compared to other frequently used filtration techniques such as Kieselguhr filters or crossflow filters, it is clearly shown that savings are significant in each case, 70% compared to Kieselguhr filters and between 53% and 78% compared to crossflow filtration depending on the size of the crossflow filters.

Sartorius filtration systems allow you to recycle and reuse water used for cleaning and sterilization, recover energy from heat generated during cleaning, and optimize the use of filtration consumables to maximize their shelf-life. The systems reduce consumption and waste, while maintaining cleaning efficiency and eliminating microbiological contamination.

Water recovered from filtration can be used in other parts of the wine production process, e.g., cleaning production lines, floors and cellars, or watering agricultural land. Sartorius' systems guarantee high quality standards as well as controlling production costs, while reducing water and energy consumption.

The diagram below summarises the technical solutions Sartorius have developed to reduce water consumption and reduce waste during the production and cleaning phases of the filtration process.

Technical solutions to control water consumption and waste



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