



Keep on running

Increase uptime with
Alfa Laval Extend™

Introduction



30% water saving



30% energy saving



Significant cost saving

Water scarcity is an increasingly critical, global issue and the demand for fresh water rapidly increases. According to literature, dairy processing globally uses between 0.2 to 11 litres of water per litre of milk produced (Daufin & al, 2001). 28% of the water consumed is used for CIP (Prasad, 2005) and 25% consumed in the pasteurization step – believed mainly to be in the CIP of this process. Effluent waste from milk and dairy processing is in the same range, 0.2 to 11 litre effluent per litre of milk processed. Many dairy companies are situated in areas where water conservation is becoming a critical priority. Plus, the need for efficient energy use and the drive to increase productivity means the industry is looking for innovations.

This white paper will focus on the Alfa Laval Extend™ technology to support the dairy industry to increase uptime on the pasteurizer and subsequently reduce the number of CIPs. By reducing the number of CIPs on the pasteuriser, water and CIP chemical consumption is reduced. In addition, it corresponds to large energy and cost savings for heating and pumping CIP liquid as well as wastewater treatment.

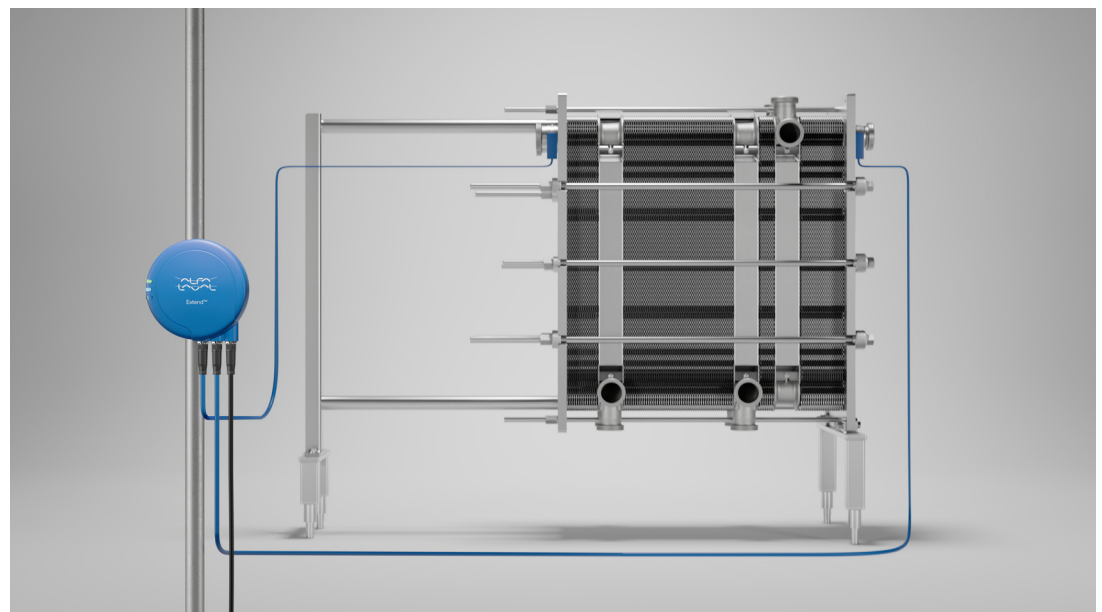
Do more while consuming less.

Alfa Laval Extend™ technology

Alfa Laval Extend™ technology is a non-invasive, low footprint, plug and play solution to increase uptime on dairy pasteurizers. Alfa Laval Extend™ technology is based on electrical current, and it can be applied to any size of pasteurizer.



Despite its small size of 15 cm ø, Extend will have a significant impact in the dairy



Background

Thermophilic

Grow in higher temperature range, usually 45-80°C

Thermoduric

Survive temperatures above max temp for growth

Industry practice show and academia confirms that thermoduric, thermophilic bacteria in the pasteurized milk is the STOP parameter for many milk pasteurizers. Thermoduric, thermophilic bacteria in the raw milk survive pasteurization. As the temperature is favourable, there is plenty of nutrients and water available, if given enough time these bacteria will form a layer on the heat exchanger surface, primarily in the regenerative section. This layer is stage 1 in the formation of a bacterial biofilm (Sophie Marchand, 2012). Years of industry practice has shown that the bacterial count in the product coming off the pasteurizer start to increase around 6 to 8 hours due to bacteria release from the forming biofilm. Before the acceptable microbiological limit is passed, CIP is performed. For cheese and powder manufacturing where downstream process steps are at elevated temperatures the control of the thermophiles is of particular importance to secure high quality final product. Resulting in a recommendation of 8-hour maximum run time before CIP.

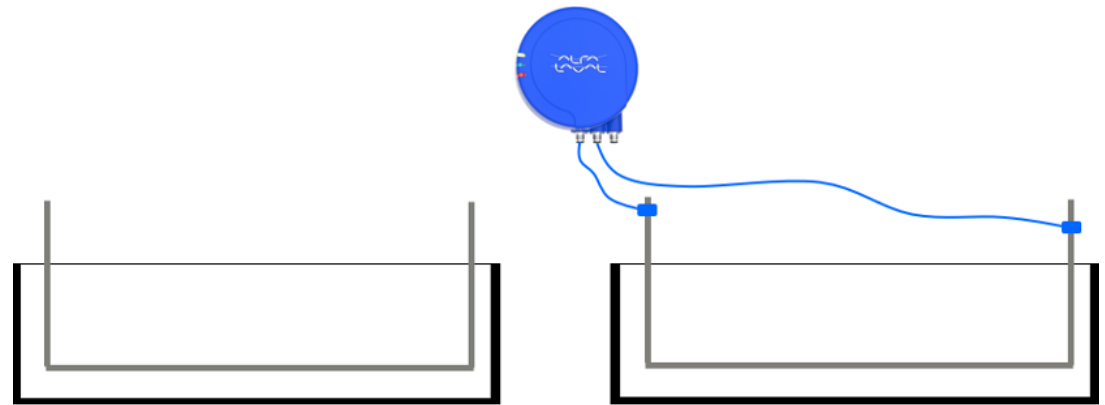
The Alfa Laval Extend™ technology has shown to significantly reduce the biofilm build-up on stainless steel surfaces and reduce the amount of thermophilic bacteria in the milk sampled after the pasteurizer.



Reducing biofilm build-up

Laboratory scale trials with stainless steel coupons submerged in skim milk stored at room temperature for 12 hours show a significant reduction in bacterial build-up on the stainless steel surface with the Alfa Laval Extend™ technology.

The experimental setup consisted of two identical containers, stainless steel coupons and skim milk. One reference and one with Alfa Laval Extend™. Both were stored at room temperature for 12 hours before a sample was taken from the milk and the stainless steel coupons were swabbed. Samples were analysed using TPC incubated at 30°C for 72h.



Repeat tests show a reduction in viable vegetative bacteria of 80% on the stainless steel surface and about 40 to 50% reduction in the milk with Alfa Laval Extend™.

Validation

With the introduction of the Alfa Laval Extend™ the running time of milk pasteurizer can be extended significantly. The Alfa Laval Extend™ technology has been validated on an industrial scale in a dairy in Scandinavia running pasteurized milk on two Pasteurizers processing 70 000 litres/hour each. The two pasteurizers were run in parallel drawing milk from the same raw milk silo. Microbiology samples were collected from the raw milk and pasteurized milk samples were collected from a sample tap just before the divert valve at 8, 10, 11 and 12 hours.

Samples were analysed using standard methods in the dairy industry:

- TPC incubate at 55°C for 48 hours.
- TPC incubate at 30°C for 48 hours.
- Samples were plated on both PCMA agar and Petri film AC.

Alfa Laval Extend™ reduced the bacterial count in the milk by 90–99%.

Total count 55°C

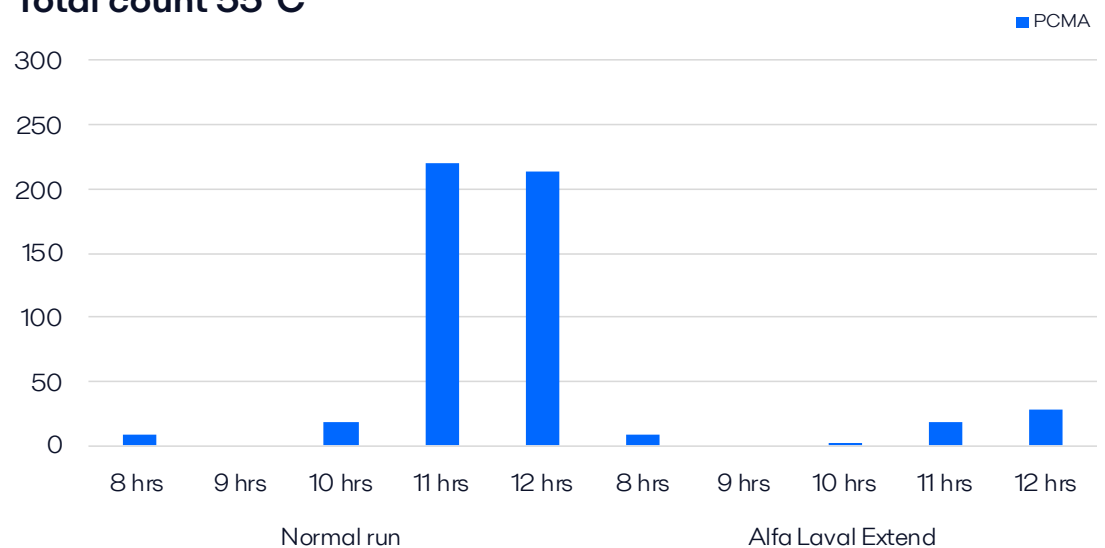


Figure 1 Alfa Laval Extend™ reduced the bacterial count in the milk by 90–99%.



A Scandinavian dairy equipped two 70,000l/h Pasteurizers with Extend™

50%	increase in uptime
7000m³	water saved yearly
100,000kWh	saved in pumping and heating
35 000kg	CIP chemicals saved
Subscription model	pay as you save

Samples were also sent for organoleptic and compositional analysis and all standard test on final product were performed. Results show no difference on a sensory and chemical level compared to milk and final product processed without the Alfa Laval Extend™.

Interviews with customers in different regions of the world confirm that the 12-hour results sit well below the acceptable limit for thermophiles. The results plus customer confirmation shows that we with the Alfa Laval Extend™ comfortably can run the pasteuriser for 12 hours or longer.

Mechanism

The Alfa Laval Extend™ technology is based on electricity, sending a weak electrical current through the heat exchanger.

Physical and chemical properties of a surface regulate cell attachment and affect early stages of biofilm formation. The exact mechanism is not known but, surface properties such as surface charge density and wettability are considered important factors in bacterial adhesion to surfaces (Zheng et al, 2021). According to Renner and Weibel (2011), van der Waals forces and electrostatic interactions are one of the major factors affecting bacterial adhesion. The mechanism of surface charge affects bacterial adhesion and considering that bacteria typically have a negative surface charge due to amino, phosphate and carboxyl groups (Rijnaarts et al, 1999) we apply a controlled and varied electrical current to the heat exchanger. Bacteria are less prone to adhesion and possibly detach more easily from surface. In combination with the shear rate caused by the high milk flow rate the bacteria are kept in motion.

Recommended pre-requisite

Success of the technology depends on a number of factors:

- Raw milk quality within specification of (Directive 92/46/EEC)
- CIP validation
- Cleaning regime including sanitation with the ability to remove biofilm to maintain a surface free from microorganisms
- Cold milk storage temperatures
- Hygienic design

Conclusion

Alfa Laval Extend™ a subscription-based offer with high impact:

Reduced no. of CIP

- Reduce water consumption
- Reduce energy need
- Reduce CIP chemical
- Reduce effluent generation

Longer up-time with

- More uptime with retained quality
- Higher degree of utilization
- Optimize plant efficiency

Maintained product quality – due to less thermophiles

- No product contact
- Plug and play installation
- Subscription model

Altogether minimizing operational cost and securing a more sustainable plant operation.



White paper
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This is Alfa Laval

Alfa Laval is active in the areas of Energy, Marine, and Food & Water, offering its expertise, products, and service to a wide range of industries in some 100 countries. The company is committed to optimizing processes, creating responsible growth, and driving progress – always going the extra mile to support customers in achieving their business goals and sustainability targets.

Alfa Laval's innovative technologies are dedicated to purifying, refining, and reusing materials, promoting more responsible use of natural resources. They contribute to improved energy efficiency and heat recovery, better water treatment, and reduced emissions. Thereby, Alfa Laval is not only accelerating success for its customers, but also for people and the planet. Making the world better, every day. It's all about Advancing better™.

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How to contact Alfa Laval

Contact details for all countries are continually updated on our website.

Please visit www.alfalaval.com to access the information.