

How to improve production yields in the dairy industry

An applications guide



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EXECUTIVE SUMMARY

The dairy sector is at turning point. Slow growth, shifting consumer tastes, growing demand for sustainability and price pressure is pushing dairies to consider changing mature and proven processes. But this trend is not about huge investments in complete processing line reconfigurations. Instead, increasing numbers are finding a quick return on investment and a boost to bottom-line profitability, by switching technologies for targeted tasks such as cheese curd processing and yogurt transfer.

This report looks at the growth of the dairy processing sector and sets out the achievements delivered by a number of real-life application examples. Intended as a 'best practice' guide, the report will be of value to anyone charged with delivering efficiencies within their dairy.



Manufacturing efficiencies remain the main source of competitive advantage



GROWTH OF THE DAIRY PROCESSING SECTOR

The dairy sector has always had its challenges. Most growth forecasts for the dairy industry as a whole are modest at best, which presents company directors with a commercial test. This is particularly the case when blended with consistently high levels of competition, shifting consumer tastes, and tariffs.

Maintaining planned programmes of investment is important to the dairy sector's ability to remain competitive and retain customers. However, a recent report from McKinsey¹ reveals that return on capital investments in the dairy industry is declining. Of particular note is that revenue and margin growth are also failing to keep pace with the cost of capital to generate economic value. As a result, the carefully considered selection of capital investments is paramount, with particular focus on manufacturing technologies that are capable of delivering proven returns, ideally in short timeframes. Manufacturing efficiencies remain the main source of competitive advantage at dairy companies.

SHIFTING TASTES DEMAND AGILE RESPONSE

The industry is currently experiencing a drop in the sales of traditional dairy, as increasing numbers - shift in line with the vegan trend of nut and plant-based alternatives. Younger adults are gaining influence for numerous reasons, including:

- Alternative tastes and demands
- Less affinity for traditional dairy products
- More interest in plant-based products (and the impact a low-dairy diet has on sustainability)

Adopting a flexible approach at dairies will be vital as management teams seek expansion to other segments and kick-start growth. Despite this, just 16% of the dairy executives surveyed by McKinsey described their companies as "very agile" in responding to consumer trends and market opportunities .



WORLDWIDE VIEWPOINT

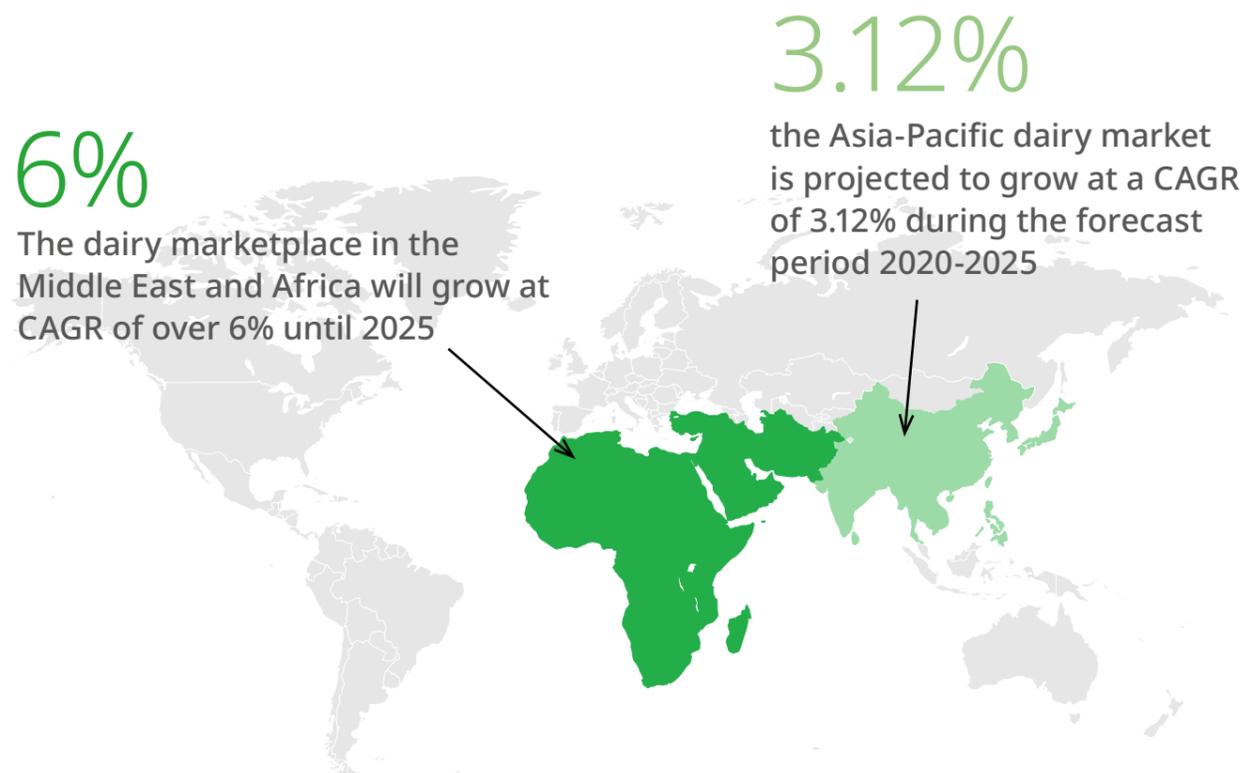
The global picture shows that developed markets in Europe and North America face a growing dairy surplus, whereas emerging markets in Africa and Asia show the opposite, with large supply shortages. Current thinking suggests that Western Europe has the most stagnant dairy market due to slow population growth and growing consumer interest in dairy alternatives.

Companies operating in large but mature dairy markets in Europe and the US face limited market growth opportunities in volume terms, as per capita consumption levels are among the highest in the world. As a result, growth can only occur by increasing market share or switching to higher value-added products. Due to these limited market opportunities in developed countries, multi-national dairy companies are often attracted to strong growth markets in developing countries.

According to Mordor Intelligence^{2,3}, the Asia-Pacific dairy market is projected to grow at a CAGR of 3.12% during the forecast period 2020-2025.

- China is the most significant Asian market for dairy, driven primarily by increased consumption trends
- India and Indonesia are the fastest growing markets in Asia, driven largely by expanding populations

The same research company predicts that the dairy marketplace in the Middle East and Africa will grow at a CAGR of 6.03% during the same timeframe.



Strong performing cheese sector

Among the dairy product markets, cheese stands out as a major focus area. The global cheese market achieved a value of US\$72.26 billion in 2020, and expects it to reach US\$105.93 billion by 2026, exhibiting a CAGR of 6.81% in that period.

Within the global sector for cheese, the Asia-Pacific market is again likely to be a strong performer, growing at a CAGR of 6.91% in the period from 2018 to 2026, at least according to Inkwood Research⁴.

World cheese market value



Within the global sector for cheese, the Asia-Pacific market is likely to be a strong performer

THE CHEESE PRODUCTION SECTOR

The challenges of cheese curd production

When producing cheese it becomes essential to keep product integrity high and avoid waste.

Delivering this goal is achievable, but it requires careful handling of the curds and whey, an operation where genuine savings can accrue assuming the optimum pump is deployed. Here, it is vital to:

- Reduce the amount of fines
- Retain the fat content of the cheese curd, so avoiding any transfer into the whey

By the very nature of their operation, many alternative pump technologies will break curd into fines that pass through whey screens on drain tables.

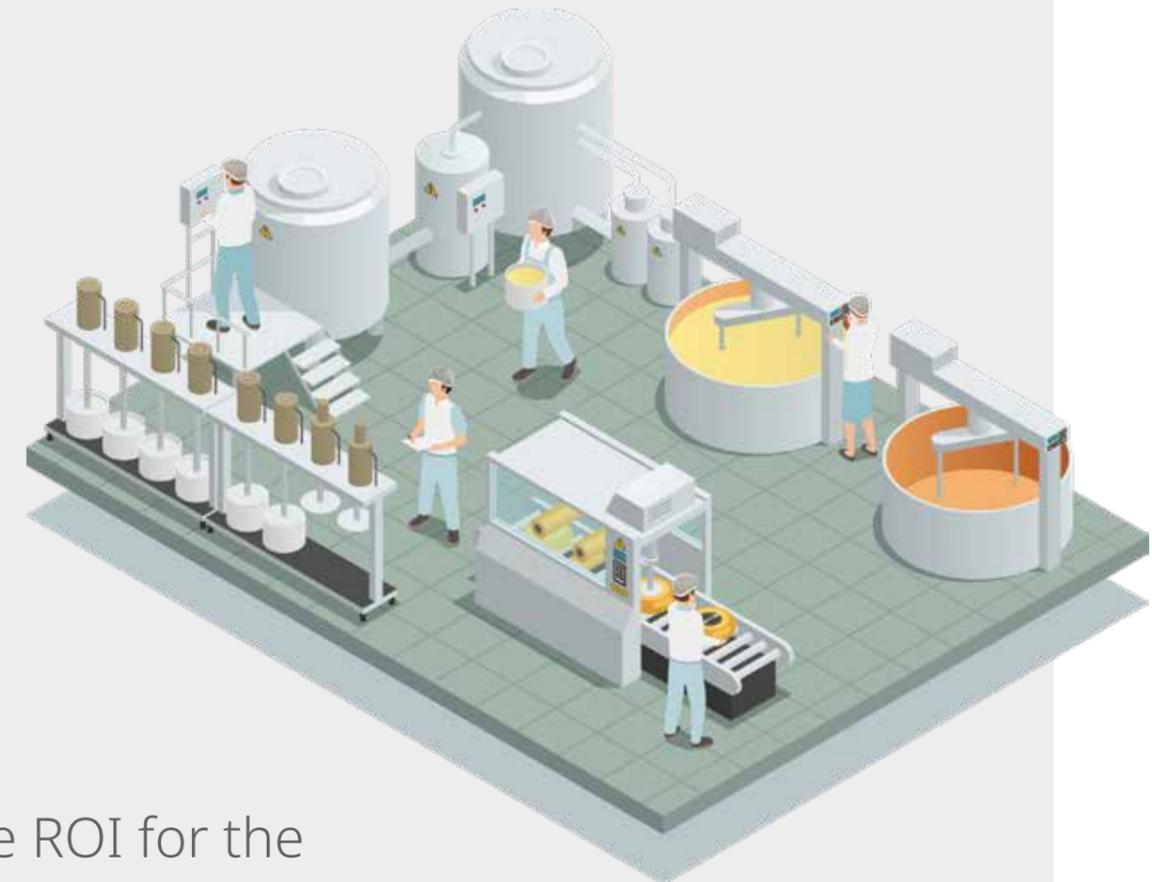
The generation of cheese fines is in direct relation to production loss, which means plants produce less cheese from a certain quantity of milk. The result is that, after each cycle, these fines require reprocessing for use as a second-grade product.

Customers transferring cheese curd need a pump that gently produces a constantly displaced volume. Such a pump will generate a higher cheese yield by lowering the fines content.

€76,000 more profit per annum

Among the cheese plants exemplifying the path to better returns and less waste is a major Scandinavian dairy producer. This large facility has a throughput of around 70,000 litre/hour of cheese curd and whey, and an annual cheese output of approximately 70,000 tonnes.

By replacing its existing positive displacement pump technology with a Certa Sine pump, the plant achieved an average fines reduction of 900g per tonne of manufactured cheese. When multiplying the annual output of 70,000 tonnes by 900 g per tonne, the additional yield is 63 tonnes of cheese every year. With a price difference as much as approximately €1.20 per kg, the plant is enjoying increased profit of €76,000 per annum thanks to its new investment.



The ROI for the pump was just six months

By switching to a MasoSine Certa pump, it is possible to generate a number of savings in relation to fines, moisture content versus dry matter and fat

SETTING OUT THE POTENTIAL

As an example of the potential savings available from switching to MasoSine pumps, consider a plant with a total annual cheese production of 50,000 tonnes. The amount of milk required to produce 1 kg of cheese varies according to cheese type, but assume an average of 8 litres.

By switching to a MasoSine Certa pump from WMFTS, it is possible to generate a number of savings in relation to fines, moisture content versus dry matter, and fat.

FINES REDUCTION

Customer trials reveal that a plant of this capacity using a Certa pump will enjoy a 0.9 kg average reduction in fines per tonne of cheese production in comparison with alternative pump technologies. Moreover, the increase in cheese yield per year will be in the region of 45,000 kg.

With the price advantage of cheese compared with lower-grade fines-related products at around €1.20 per kg, calculations suggest that such a plant can save €54,000 a year.



MOISTURE CONTENT VERSUS DRY MATTER

The story is similar when scrutinising moisture content versus dry matter. Here, according to the same customer trials, using Certa pump technology rather than a centrifugal pump will see a better retention of moisture (whey) within the curd after pumping.

The high centrifugal forces of centrifugal pumps squeezes moisture out of curd.

In addition, the increased weight (yield) of cheese curd will amount to circa 5 tonnes per year. With an average price per kilogram of cheese at €3.00, the annual savings from avoiding this loss of whey will be €15,000.

THE FAT FACTOR

With regard to fat-related savings, around 400 million litres of milk will be required based on the same example of a plant producing 50,000 tonnes of cheese a year. Trials indicate that the average reduction of fat (cream) content in the whey when using a Certa pump is around 0.03% on average. This reduction is a positive effect because the higher the fat content of the whey, the worse the result after it is pumped.

As the proportion of whey to curd is about 80%, the cheese plant can save around 96,000 litres of fat (cream) per year – which equates to savings of €96,000 based on a price per litre of €1.00.

The high centrifugal forces of centrifugal pumps squeeze moisture out of curd

TOTAL SAVINGS

A cheese plant producing 50,000 tonnes of cheese a year can potentially expect the following from its investment in a Certa pumps:

- Total annual savings of €165,000 from fines, moisture content versus dry matter, and fat
- A return on investment for its Certa pumps of just 8 months



€165,000

Total annual savings of €165,000 from fines, moisture content versus dry matter, and fat

HOW TO REDUCE CHEESE PROCESSING COSTS AND INCREASE YIELDS

Showing exactly how to boost yields and cut the costs of cheese processing through astute investment in optimised pump technology is a market-leading cheese maker based in Denmark. The facility was suffering shear damage from its positive displacement pumps, resulting in increased fines that were entering the whey stream, in turn reducing yield.

Another issue at the plant was the limited suction capability of these positive displacement pumps. Reduced suction causes system cavitation that can lead to broken pipe joints and welds. The result is increased maintenance and more unplanned downtime.

Significantly fewer fines meant that the MasoSine pumps treated the fragile cheese curd more gently and caused less damage. In each tonne of cheese produced, the installed MasoSine pumps gave 2.552 kg of fines per tonne of cheese. The existing positive displacement pumps had 3.481 kg of fines per tonne, providing savings of 0.929 kg of fines per tonne, equating to a 27% reduction in lost cheese fines.

The dairy produces 70,000 tonnes of cheese every year. Using the MasoSine pump, an extra 65 tonnes of cheese is produced annually (0.929 kg/t x 70,000 tonnes = 65,030 kg) with a value of DKK 780,000 (approximately €105,000). As a result, the dairy's CAPEX investment for the two new MasoSine pumps achieved ROI in just 9 months.

SOFT CHEESE PRODUCERS ALSO BENEFIT AT PILOT PLANT

When pumping sensitive curds, the most important factor is to convey them as gently as possible. Otherwise, if there is strong shear, cheese dust will form that subsequently promotes the risk of reduced yield and quality. With these thoughts in mind, a major mozzarella dairy in Switzerland wanted to replace its previous time-consuming and laborious transfer of curd/whey mixture into filling tubs with a high-performance feed pump that would transfer the mix directly into a new drainage system via pipes.

In order to find the most suitable type of pump for the task, the plant's milk technologist and production manager for cream cheese pooled their knowledge to design a series of comprehensive tests with different pump types, including:

- A centrifugal pump
- Air operated diaphragm pump (AOD)
- A twin screw pump
- A MasoSine Certa pump from WMFTS

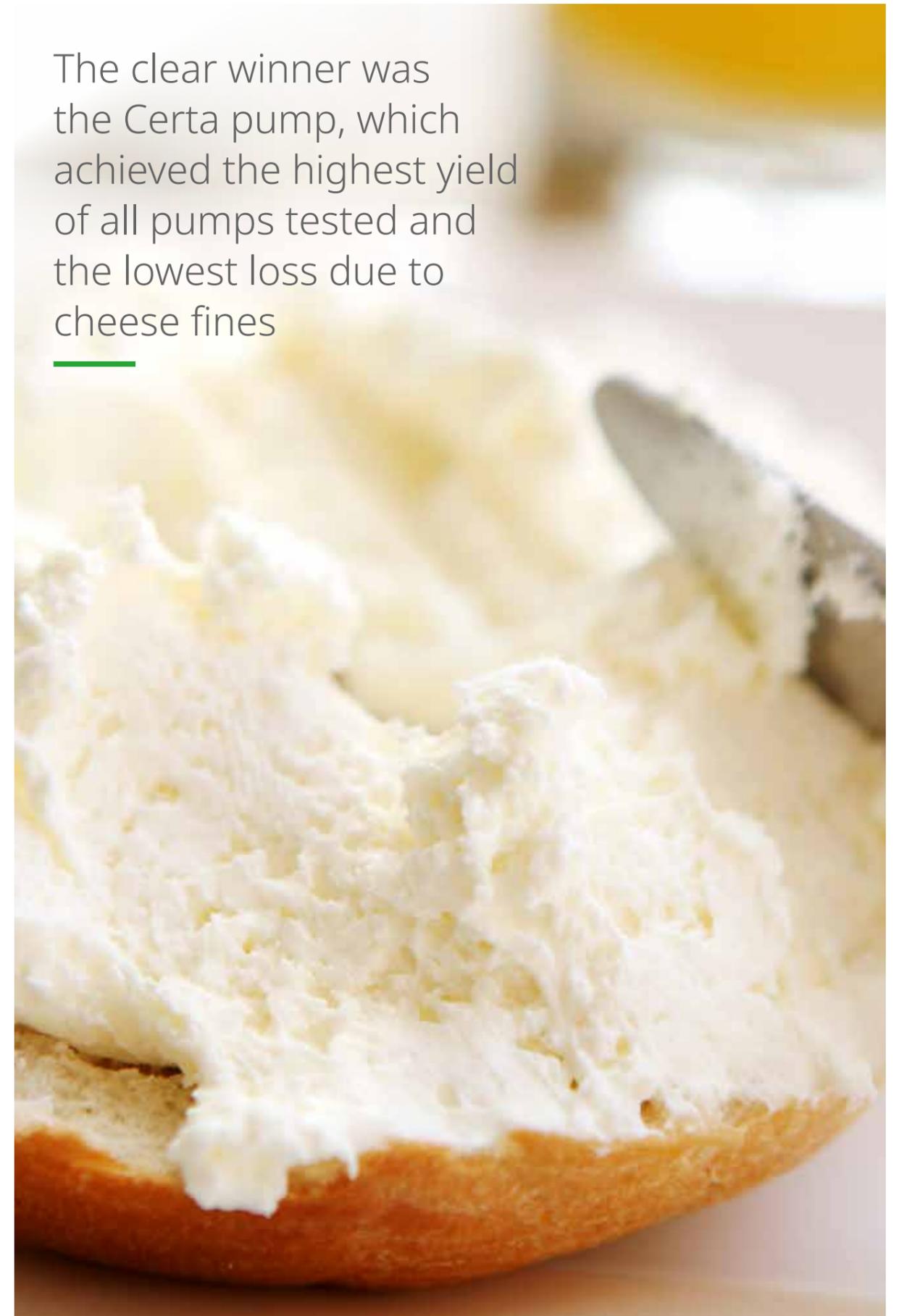
In order to meet the specified production time of around two hours for a batch, the pump had to transfer 5,000 litres in less than 25 minutes. By carefully dimensioning the pumps, all candidates met this requirement. However, when analysing the results, considerable qualitative differences quickly became apparent.

For instance, the centrifugal pump caused reduced fat content of the cheese curd, while the compressed air operated diaphragm pump incurred considerable losses due to the formation of cheese fines (ultimately leading to less cheese yield). Due to its geometry, the screw pump reduced broken grain size. Processing finer curd is undesirable due to the poor quality of the resulting cheese.

The clear winner was the Certa pump, which achieved the highest yield of all pumps tested and the lowest loss due to cheese fines and the fat remained in the curds. Product quality also gained from the gentle pumping of sinusoidal technology.

Based on the annual usage of 46 million litres of milk in a mozzarella plant and a reduction in whey fat content of 0.1% (from 0.65% to 0.55%), the mozzarella dairy is benefitting from impressive annual savings of CHF 294,400. This calculation is based on a yearly reduction in whey fat content of 36,800 kg (at a cream fat price per kg of CHF 8). As a result, it took just 1.4 months to achieve ROI for the Certa pump.

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THE YOGURT PRODUCTION SECTOR

The challenges of yogurt transfer

Among the major challenges when it comes to using a pump for yogurt transfer is viscosity loss. Pumps that offer low-shear transfer, reduce viscosity loss and necessitate fewer expensive additives to thicken the yogurt.

Consider a dairy plant with an annual yogurt production of 15,000 tonnes per year, where the average cost of proteins/additives is €3.00 per kg. Based on customer trials, a Certa pump from WMFTS reduces viscosity loss by 20% (on average) in comparison with competitor pump technologies.

Typically, 7 kg of protein is required per tonne of yogurt. A reduced viscosity loss of 20% means 10% (0.7 kg) fewer additives. The result is annual reduction in the use of additives amounting to 10,500 kg, just by changing to a Certa pump. Based on the figures from these trials, ROI is achievable in 11 months.

How to reduce yogurt processing costs and increase yields

A major Brazilian yogurt manufacturer has successfully shown that Sine pumps reduce yogurt viscosity losses on average by more than 20% compared with progressive cavity (PC) pumps in the same duty.

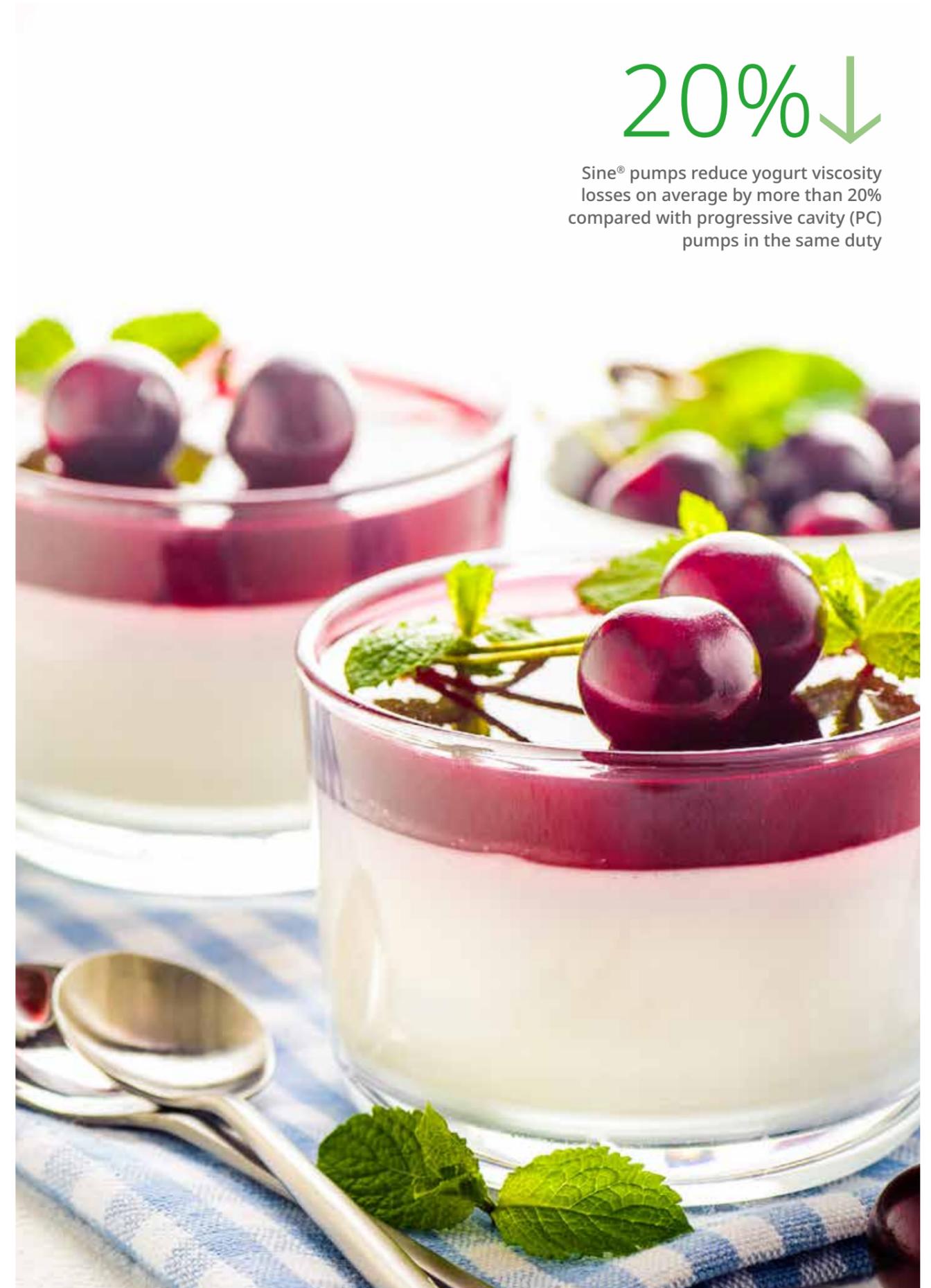
During transfer with its previous progressive cavity pumps, Frimesa noted that the viscosity of the yogurt was breaking down during transfer, necessitating the use of additives to retain the thick and creamy consistency. This task was adding a further process and extra cost.

During trials of a MasoSine pump there was a clear and dramatic reduction in viscosity loss. Instead of the 41.2% loss experienced with the PC pump (850 cP down to 500 cP), the Sine pump only lost 2.4% (850 cP down to 830 cP) - an improvement of 330 cP. The MasoSine pump also proved highly successful on a much thicker yoghurt. In summary, the PC pump resulted in a 1300cP viscosity loss while, in contrast, using the MasoSine model reduced losses to just 650cP.

Ultimately, switching its yogurt transfer to MasoSine pumps has led to a reduction in the amount of additives used at Frimesa, lowering manufacturing costs and resulting in product quality improvements.

20%↓

Sine® pumps reduce yogurt viscosity losses on average by more than 20% compared with progressive cavity (PC) pumps in the same duty





CONCLUSION

There is solid evidence that dairy processes can benefit from carefully considered investment in the latest sinusoidal pump technology. The advantages relating to improvements in yield, as well as savings in energy, water and fines, deliver a boost to both bottom-line profitability and sustainability. In such a competitive arena, made even more challenging by the growing pressure of regulatory conformance, few can afford to ignore the clear gains offered by MasoSine sinusoidal pumps.



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