



# Steam Infusion

Process food faster without burn-on

*First for Steam Solutions*

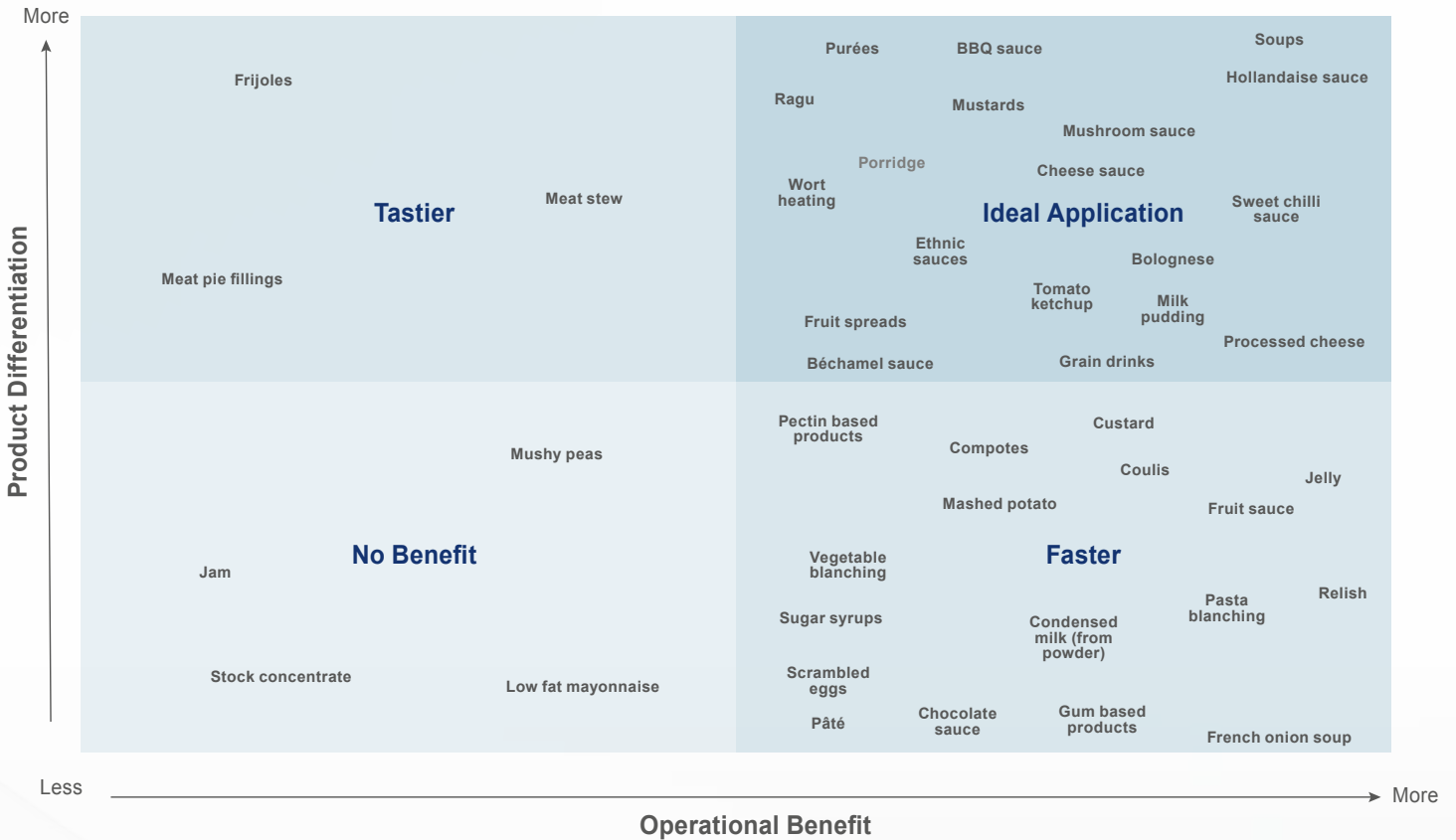
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# Could Steam Infusion work for your process?

Steam Infusion has the ability to create a product that is both differentiated (improved flavour, nutrition and colour) and at a greater operational efficiency (faster production times, lower CIP frequency and energy reduction).

This matrix highlights the benefits that can be realised when processing a variety of food and beverage products using Steam Infusion.



Source: Innovate UK funded "Nutrition for Life" project, developed in partnership between OAL and the University of Lincoln.



**Every day 10,260,300kg kilograms of product is processed using Steam Infusion.**

Correct at time of printing

# Advantages when processing with Steam Infusion technology

Steam Infusion can heat, pump and mix ingredients simultaneously to create the perfect finished product.

## Eliminate burn-on contamination

No hot spots, a low pressure vapour phase and low residence times mean that ingredients are not exposed to excess temperatures. This prevents the occurrence of the Maillard reaction and the resulting burn-on.

No burn-on enables CIP times to be reduced by on average 40%. Steam Infusion allows customers to run up to 10 batches one after another without the requirement of a full CIP.

Both In-Tank and In-Line units are cleaned by running them during the CIP process to remove product from the inside of the nozzle. A simple spray ball ensures a full clean of the exterior when mounted in a vessel.

## Double production capacity

Unlock high speed cooking and make more product within a smaller footprint. With Steam Infusion you can cook 1000kg of product in less than 10 minutes.

Heat three times faster when using Steam Infusion when compared to traditional cooking technologies.

Reduce the need for CIP and minimise downtime, thanks to a lack of burn-on.

Ideal for processing more viscous or difficult to heat products where higher steam pressures can be used for shorter cooking times without compromising quality.

Boost your productivity by using Steam Infusion to scale up production from the footprint of your existing plant, without the need for the significant investment.

## Extend vessel life

Upgrade instead of replace. Steam Infusion is a cost-effective way to extend the life of a steam-jacketed vessel that is at the end of its operating life.

Use of Steam Infusion allows you to regain the efficiency of your plant without needing to invest in new equipment.

## Reformulate to meet health targets

The high-speed controllable mixing environment created with Steam Infusion achieves a homogenising effect.

Processing with starch allows a fat mimetic to be created, resulting in a creamier mouth feel.

Trials on high dairy fat sauces have achieved a 20% fat reduction when compared to conventional cooking methods, while maintaining luxurious mouthfeel and taste.

Salt and sugar additions can be reduced as more flavour from the ingredients is captured in the product.

Processing using Steam Infusion can achieve up to a 50% reduction in spices when compared to cooking with a steam jacketed vessel.

## Maintain particulate integrity

Particulate damage can be a challenge for food manufacturers cooking chunky soups and ready meals. Slow cooking times and agitator damage can break down particulates, creating unappealing textures.

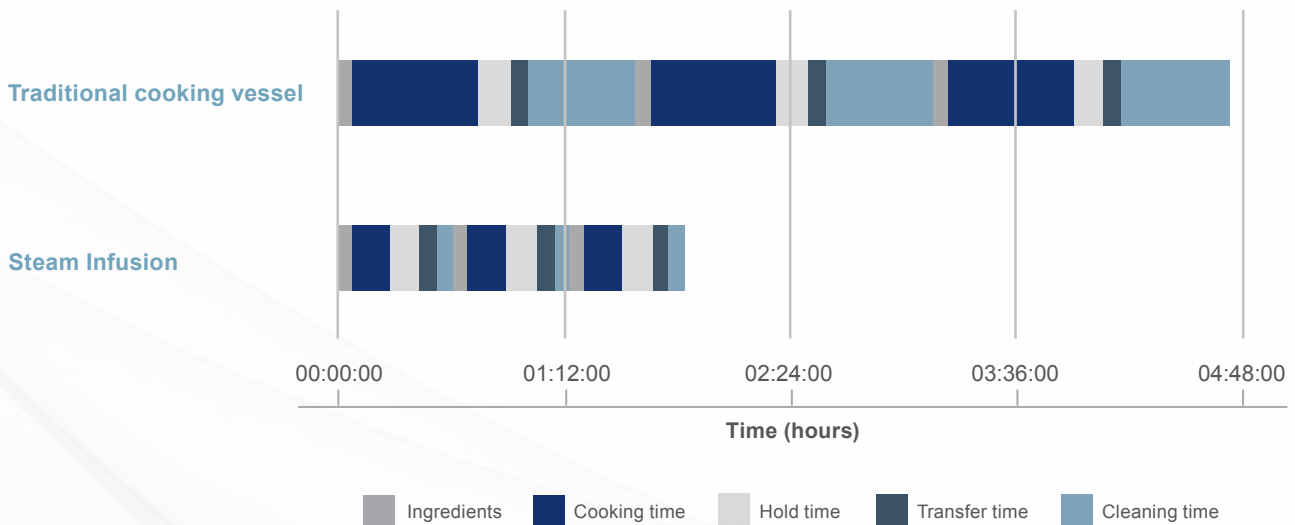
Steam Infusion features an unrestricted bore which allows for processing of particulates up to 20mm.

The shear effect of the pump can be controlled to accommodate delicate particulates and retain them in the finished product. Alternatively, a high shear effect can be achieved when creating pulps and purées.



## CASE STUDY

The graph below illustrates how the Steam Infusion technology significantly reduced the total production time for three 1000 kg batches of Béchamel sauce compared to a traditional steam jacketed kettle.



Source: Results obtained from a joint study between OAL and the University of Lincoln.

## Steam Infusion vs steam injection

Steam injectors are commonly used in food and beverage processing to reduce cooking times and improve output. This often comes at a cost, with high temperatures and pressures causing burn-on and affecting the colour, flavour and texture of the product you are creating. The design of a typical steam injector features multiple voids and surfaces which can mean regular down-time to clean after each batch.

Steam Infusion is different to a typical steam injector, with a simple, compact design which heats the product faster by mixing it with the steam under vacuum conditions.

This reduces the interface temperature and retains the desired appearance, taste and particle integrity. Through gentle heating of the product and a simple design, Steam Infusion reduces down time due to cleaning.

The table below gives a comparison of the performance of Steam Infusion in relation to a traditional steam injector.

	Steam Infusion	Steam Injection
<b>Method of processing</b>	High steam velocity disrupts the liquid phase, creating droplets under vacuum conditions. This ensures full mixing of the steam and a lower interface temperature for gentle heating. The steam pressure is controllable across a wide range to achieve optimal processing conditions for a variety of temperatures, viscosities and textures in the end product.	Reliant on a longer contact time between the steam and product to allow for mixing. Final mixing of steam and product will occur downstream of the injector where complete mixing may not take place.
<b>Cooking speed</b>	There is no compromise between speed and efficiency. Complete mixing of steam and product creates a fast and energy efficient cooking process without affecting product quality. 1,000L of water can be heated in 8 minutes (based on trials conducted at The National Centre for Food Manufacturing).	Fast heating times can be achieved with higher steam pressures but this can negatively impact the appearance and taste of the product. Higher steam pressures and faster processing may cause the steam to not be fully condensed within the product, creating energy losses or noise and vibration being experienced in the downstream pipework.
<b>Product appearance</b>	Processing under vacuum conditions at a lower temperature interface prevents Maillard reactions, avoiding discolouration and creating an attractive product.	Can expose product to high temperatures, causing burnt flecks to occur and creating discolouration. For example, tomato-based recipes turning orange due to over-processing.
<b>Product texture</b>	By varying the steam pressure, the shear effect can be adjusted to change the characteristics from gentle heating to high shear processing. This allows particle integrity to be retained or a fat mimetic to be created.	Good at processing for a smooth texture. A complex nozzle design does not allow for particulates to be processed.
<b>Cleaning</b>	No moving parts and no burn-on means fewer and shorter cleaning in place (CIP) cycles.	Typically manufactured from multiple parts and contains a number of voids and surfaces. This can increase the CIP time and frequency required.

# Depending on your requirements, Steam Infusion can enhance your production in two ways:

## Batch processing: In-Tank

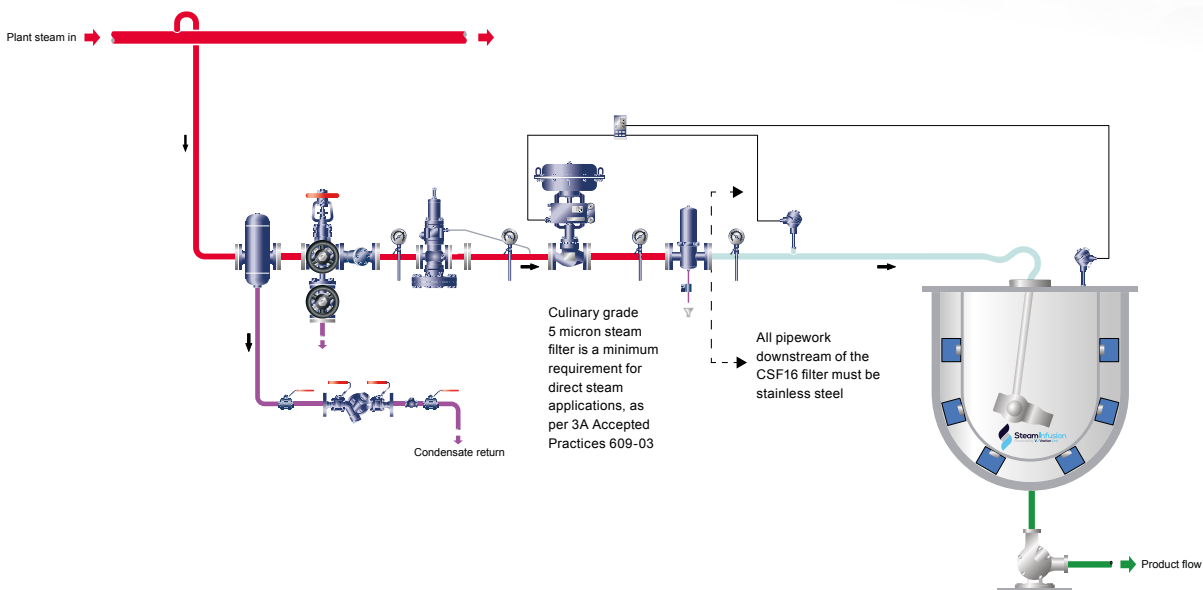
Batch processing is preferred by many food and beverage manufacturers with a lot of product changeovers. By using Steam Infusion in batch processing, it's possible to shorten cycle times and reduce the cleaning requirements thanks to the elimination of burn-on. The unique processing conditions within the Vaction Pump also allow manufacturers to reduce processing stages on some products while cutting the heat-up time.

Batch processing with Steam Infusion is ideal for product development during the R&D phase as it's possible to cook up smaller quantities to test out different variables, enabling you to achieve the perfect product without wasting your resources.

This batch cooking process is possible with both the In-Tank and In-Line Steam Infusion Vaction Pumps. The lance provided with the Steam Infusion Vaction Pump is double-skinned, providing insulation to prevent any burn-on while in the vessel.



Retrofit to existing vessels from 400L and double your cooking capacity. Particulates up to 20mm will pass easily through the unrestricted bore.

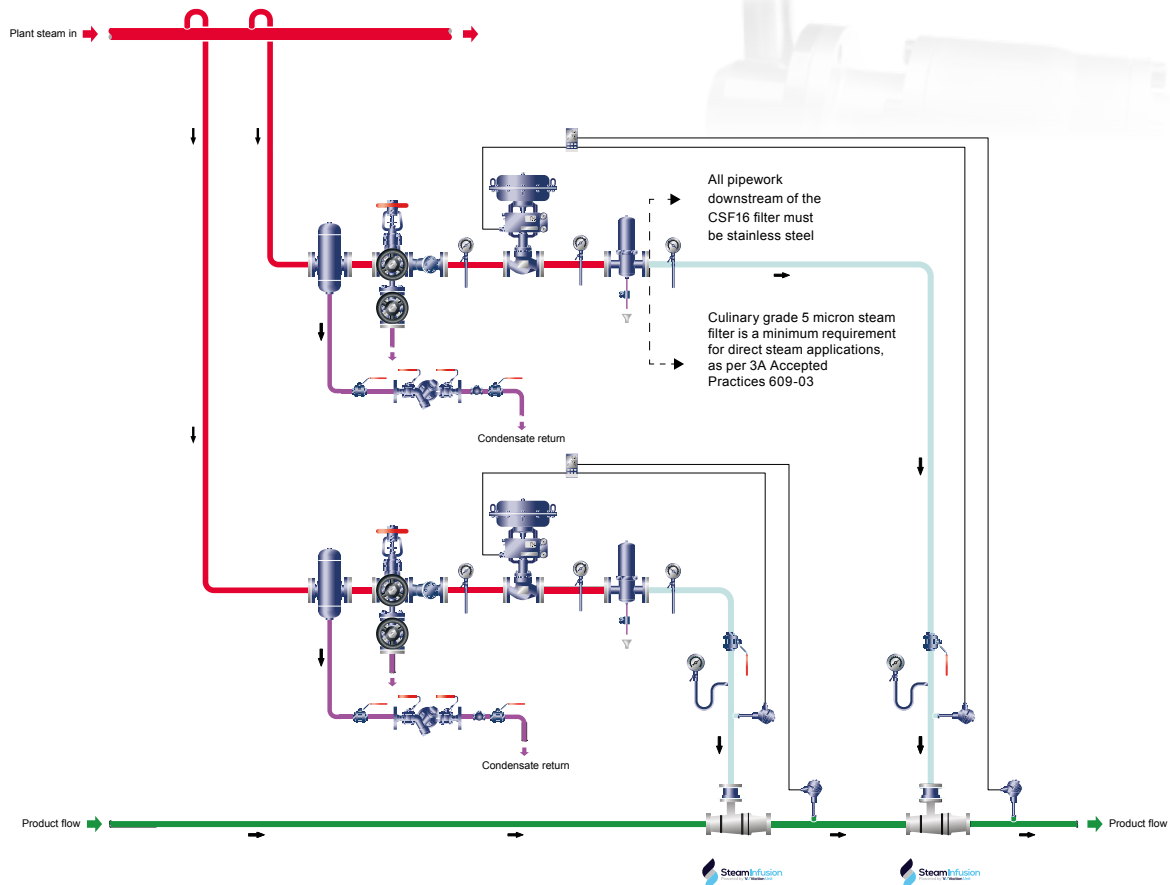


## Continuous processing: In-Line

Direct steam injection or heat exchangers are usually used in continuous processing, but it's also possible with the Steam Infusion In-Line Vaction Pump.

To achieve the right processing conditions, a multi-In-Line Steam Infusion system can be installed where multiple Steam Infusion In-Line Vaction Pumps are placed in series or parallel depending on the needs or the configuration of the facility. The system can achieve flow rates ranging from 1000kg/hr to volumes in excess of 200 000kg/hr to meet your throughput requirements. At the same time, the temperature and shear rate across each Vaction Pump can be adapted to ensure product characteristics and temperature profiles are achieved without the issues of fouling or burn-on seen with traditional methods.

With multiple In-Line Vaction Pumps in a single pass Steam Infusion system, it's possible to increase the temperature, while at the same time controlling the temperature and shear across each Pump so that 100% of the product is processed once through each unit.



# How the Steam Infusion Vaction Pump™ works

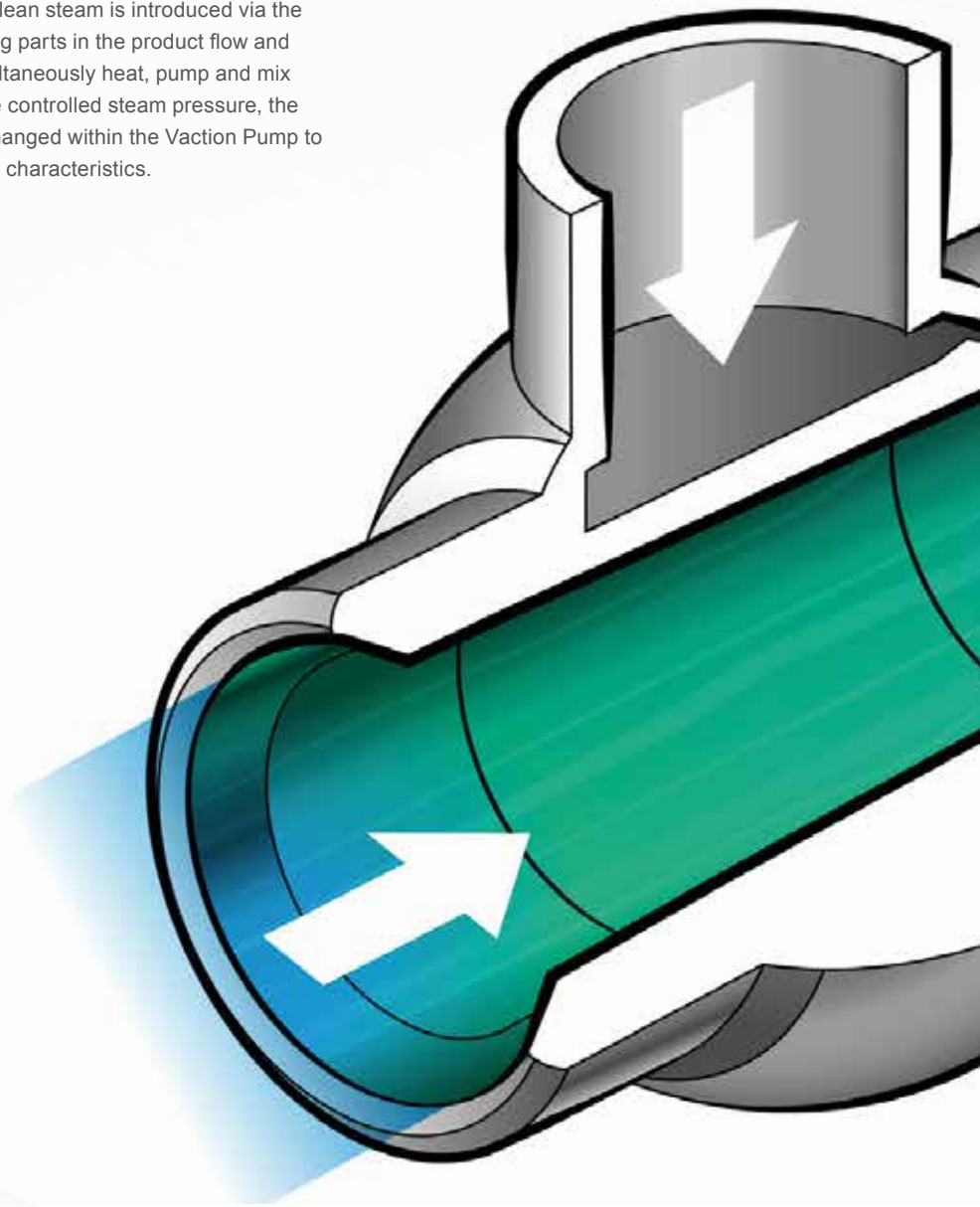
Based on operating at 6 bar steam pressure

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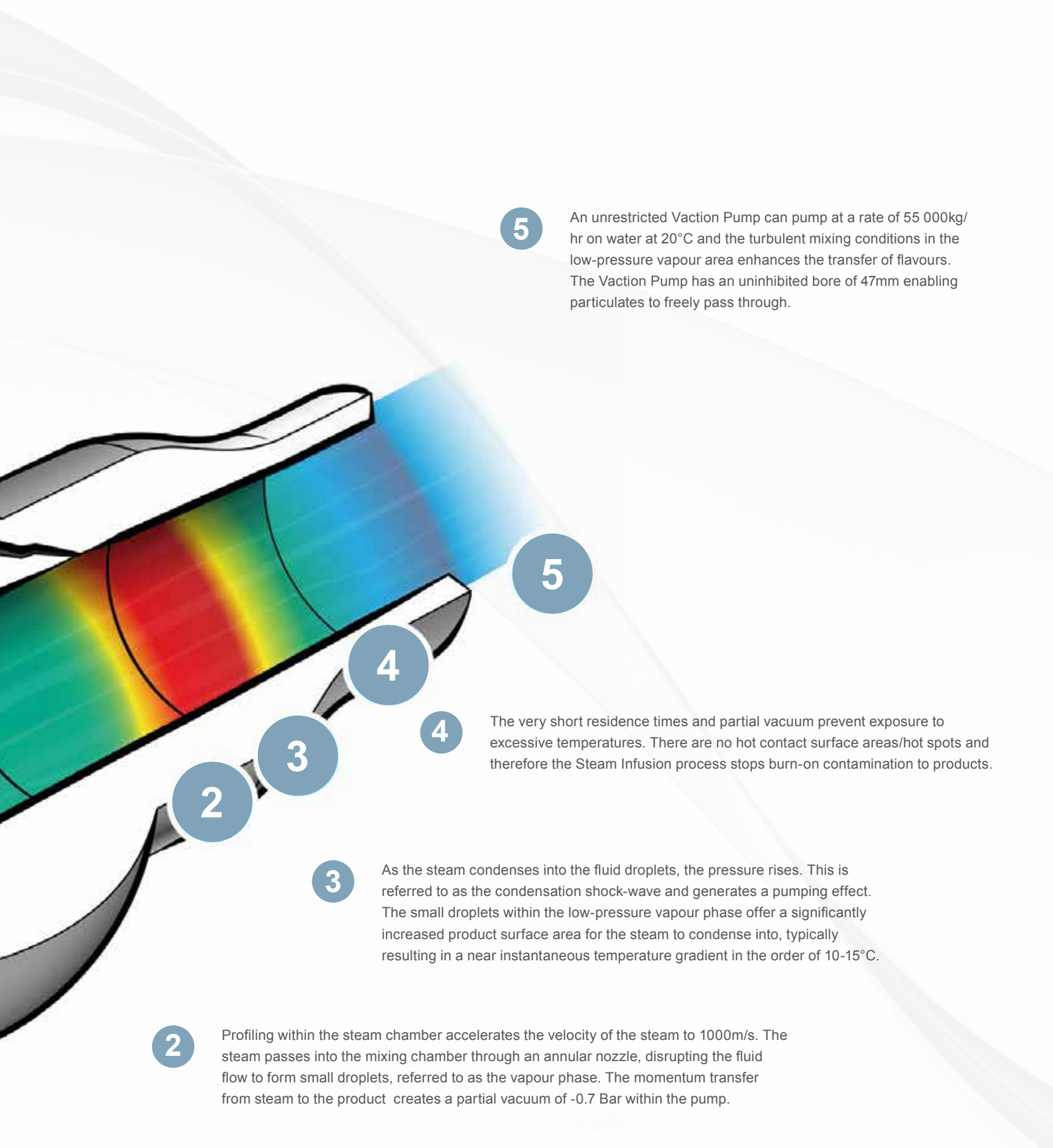
The Vaction Pump sits within the cooking vessel flooded with product as culinary grade / clean steam is introduced via the steam lance. It has no moving parts in the product flow and uniquely uses steam to simultaneously heat, pump and mix the product. By changing the controlled steam pressure, the processing conditions are changed within the Vaction Pump to achieve the required product characteristics.

1

Steam at up to 750kg/Per Hour







**2** Profiling within the steam chamber accelerates the velocity of the steam to 1000m/s. The steam passes into the mixing chamber through an annular nozzle, disrupting the fluid flow to form small droplets, referred to as the vapour phase. The momentum transfer from steam to the product creates a partial vacuum of -0.7 Bar within the pump.

**3** As the steam condenses into the fluid droplets, the pressure rises. This is referred to as the condensation shock-wave and generates a pumping effect. The small droplets within the low-pressure vapour phase offer a significantly increased product surface area for the steam to condense into, typically resulting in a near instantaneous temperature gradient in the order of 10-15°C.

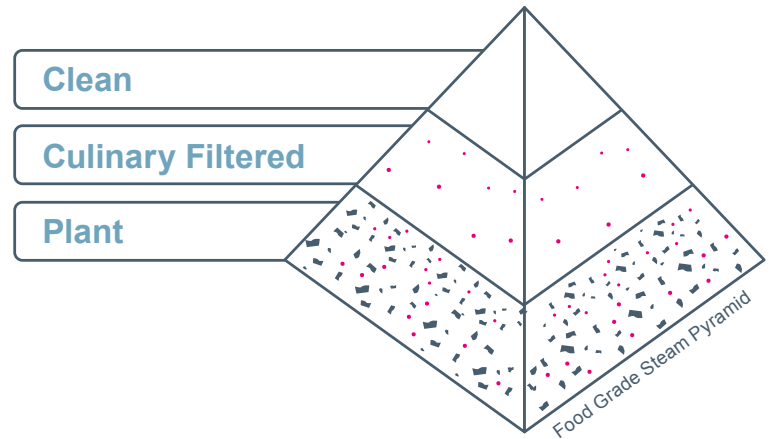
**4** The very short residence times and partial vacuum prevent exposure to excessive temperatures. There are no hot contact surface areas/hot spots and therefore the Steam Infusion process stops burn-on contamination to products.

**5** An unrestricted Vaction Pump can pump at a rate of 55 000kg/hr on water at 20°C and the turbulent mixing conditions in the low-pressure vapour area enhances the transfer of flavours. The Vaction Pump has an uninhibited bore of 47mm enabling particulates to freely pass through.

# Which grade of steam is correct for your process?

For every process where steam is in direct contact with your product, we recommend the use of clean steam. Clean steam is generated in a way that eliminates the risk of contamination to your product, reducing the risk to your business and giving you consistent results that your customers and consumers will enjoy.

If you are already processing using steam, the switch to clean steam is simple. Please ask us about the use of clean steam for your facility.



The Spirax Sarco clean steam generator is designed specifically to meet the needs of food and beverage manufacturers with full compliance to all food contact material regulations.

## Would you like to know more?

**Spirax Sarco, experts in steam system solutions have partnered with the world's leading provider of Steam Infusion technology to deliver a unique processing solution.**

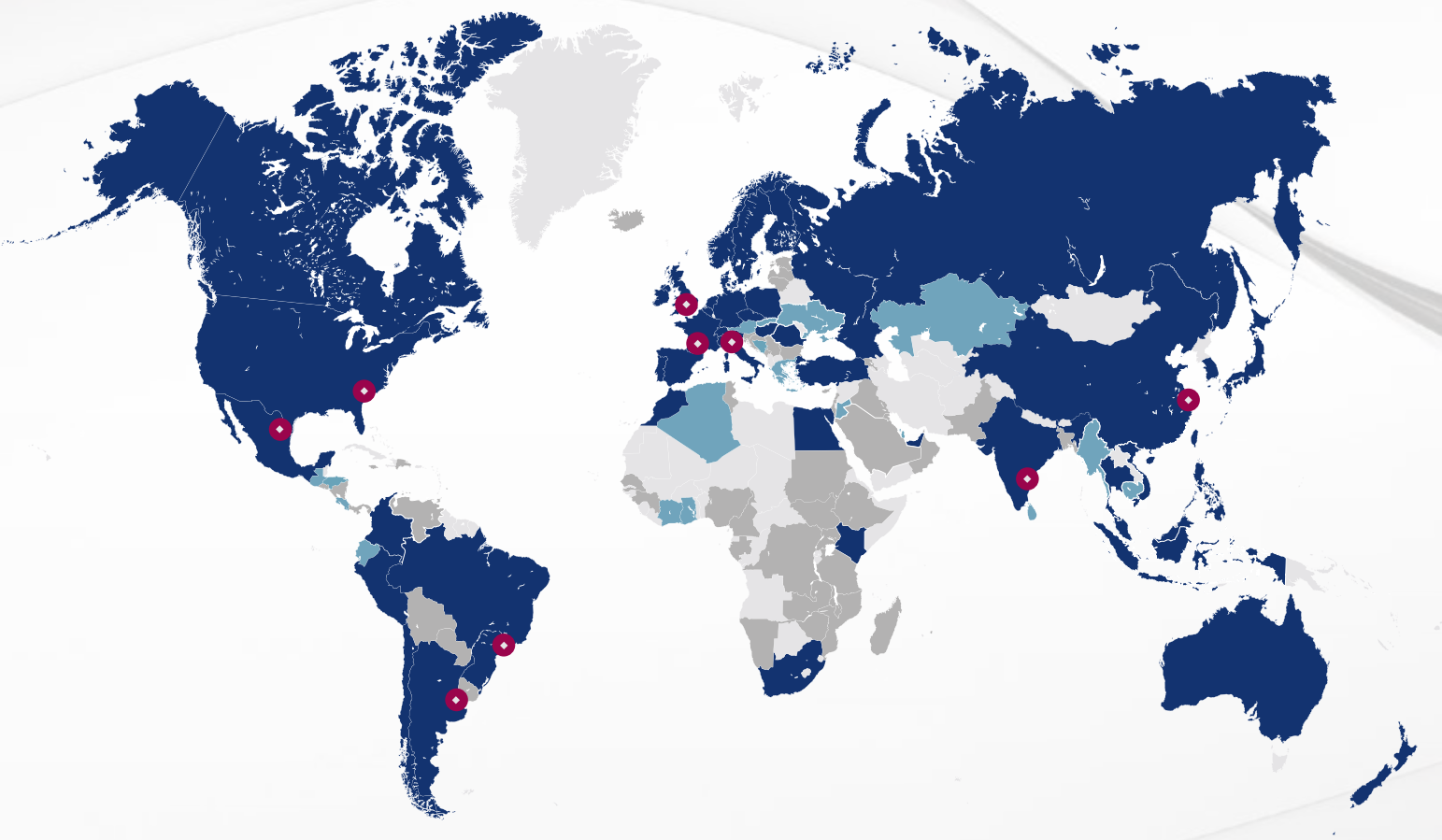
Our global network of steam experts, together with development chefs and food technology experts, can help deliver benefits to your process with Steam Infusion technology.

If you're already using direct steam injection, with either culinary grade steam or clean steam, the switch to Steam Infusion couldn't be easier. Why not contact our team to discuss how you could integrate the technology in your process?

We recommend live testing as the best way to understand and quantify the benefits of Steam Infusion or your process. Talk to us about onsite testing support at your facility, or offsite testing at our partner's dedicated test centre in the UK.



Steam Infusion Vaction Pumps In-Line.



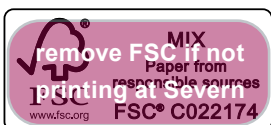
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