Thinking Ahead

How to avoid alteration of heat-sensitive sauces during thermal treatment

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Sauces coming off ultra-high temperature (UHT) process lines are driving innovation and growth in the shelf-stable sauce segment. These UHT sauces, packaged in cartons, plastic pouches or bag-in-boxes, are increasingly taking market share from hot-filled or retorted sauces packed in traditional glass or metal containers. Why? UHT treatment combined with aseptic cold filling enables sauce manufacturers to improve product quality, reduce production costs, enhance their sustainability profiles, and offer consumers added convenience.

However, due to their high viscosity, heat sensitivity and/or particle content, sauces are among the most challenging food categories to process at ultra-high temperatures. To meet these challenges, sauce makers need processing equipment that offers versatility, gentle product handling, and compliance to the highest hygienic standards. Unmatched by comparable UHT technologies, the Alfa Laval Contherm® scraped surface heat exchanger offers an optimal solution for UHT processing of all types of sauces.

Trends drive demand for ready-made sauces

Shelf-stable ready sauces are fast becoming popular packaged food items in homes and food service establishments around the globe. According to Euromonitor, worldwide sales of table sauces reached US$46 billion in 2015, and are forecast to reach US$62 billion in 2021. Asia Pacific is the largest regional, sauces, dressings, and condiments market, accounting for one-third of global value sales, with China set to be the main contributor to growth during 2015-2020 at a CAGR of 6%, thanks to rapidly changing eating patterns. Latin American markets also offer strong growth potential, with regional sales projected to grow at a CAGR of 4% during 2015-2020; this translates to 20% of the absolute value sales growth worldwide. Brazil and Mexico will be the main growth generators in this region. Table sauces include categories such as barbecue, curry, brown and yoghurt sauces as well as salad dressings and condiments, such as ketchup and mayonnaise.

Innovative recipes

Ready shelf-stable sauces offer consumers and foodservice establishments a convenient, time-saving way to vary and customize meals. With a shelf life of six months or more, these easy-to-store sauces do not require refrigeration. Meal preparation time is drastically reduced. Prep time for homemade lasagne, for instance, only takes a few minutes. Similarly, it is easy to complement meat or fish dishes with sauces heated for a few seconds in a microwave oven. The growing popularity of ethnic food has fuelled consumer interest in sauces, which are key components of a variety of traditional dishes around the world.

Over the past two decades new products, such as béchamel sauce, chunky salsa and true butter-based béarnaise or hollandaise sauce, have appeared on store shelves. This results, in part, from the food ingredients industry and the key role it has played in developing solutions for stabilizing heat-sensitive sauces. These processing

solutions have led, for instance, to sauces with consistent quality and shelf lives that are compatible with commercial distribution at ambient temperature. Ingredients have also become more sophisticated, enabling the development of "light" or low calorie variants of traditionally fat-rich products, such as mayonnaise, which maintain the same high quality as well as great taste and texture that consumers demand.

Innovative technology

Also playing a big role in driving change is technology. UHT treatment combined with aseptic cold filling in cartons, plastic pouches or bag-in-boxes holds appeal as an attractive alternative to hot filling and in-container retort.

Improved flavour

A major success factor behind UHT sauce processing is improved flavour. Total heating time is reduced from 15 to 30 minutes to just a few minutes, ensuring tastier sauces. In addition, unlike retort, heat treatment of aseptically packaged UHT products is independent of container size. This enables large containers to be filled for use by restaurants and the foodservice industry without compromising the products' organoleptic properties.

3 Challenges of UHT sauce processing

While moving from batch pasteurization and retort to continuous UHT heating and cold filling is attractive to food manufacturers, it also raises a variety of technical challenges. There are three major challenges associated with UHT sauce processing:

1. Viscosity: After cooling, sauces generally have medium to high viscosities and may also contain solid particles such as herbs, seasonings and chunks of meat or vegetable. During UHT treatment, sauce viscosity has a direct impact on the efficiency of heat transfer. Viscosity that is too high results in a laminar product flow inside the heat exchanger, along with poor thermal efficiency. Laminar flow may also cause fouling and burning, especially when formulations include heat-sensitive components such as whey proteins or lactose. Burning ultimately affects sauce taste and consistency, and must therefore be avoided.

Sauce viscosity also affects cooling efficiency prior to filling. Like most food products, sauces increase in viscosity while cooling, thereby reducing heat transfer.

2. Cavitation: Emulsified sauces like mayonnaise are also sensitive to mechanical stress such as that generated by cavitation. Cavitation may occur during pumping or flash cooling and may result in phase separation and oil release.

3. Particle size: Another challenge is the introduction of solid components, such as vegetable chunks that are several millimetres in size, into a sauce formulation. This requires a sufficiently wide channel inside the heat exchanger as well as low-shear transfer in order to preserve particle integrity. Fibres and herbs can also get trapped inside the heat exchanger, which presents additional challenges during cleaning and sanitization.

What to consider when selecting a UHT heating system for sauces

When selecting continuous UHT pasteurization systems to process sauces, manufacturers should only consider equipment capable of handling medium to high viscosities. There are two main categories for these systems: direct heating systems and indirect heating systems.

Direct heating systems. Here, the product is heated via direct contact with culinary steam by one of two methods: (1) an injection system whereby pressurized steam is introduced into the product flow, or (2) an infusion system whereby the product is introduced into a steam chamber. In both systems, the sauce passes through a holding tube and then is instantly cooled via vacuum flash cooling, which simultaneously removes the excess water from steam condensation. Both injection and infusion systems can handle medium viscosity fluids.

Direct steam systems have advantages and disadvantages. The main advantage is that the product does not come into contact with heating surfaces, which may cause burning. Disadvantages include emulsion destabilization and loss of flavour, both of which require additional equipment downstream. With injection systems, for instance, the steam condensation inside the fluid mass causes cavitation, which destabilizes emulsions and requires an aseptic homogenizer to be installed downstream at an extra cost. For

starch-stabilized sauces, downstream homogenization requires the use of special shear-resistant modified starch types. Moreover, the vacuum flash cooling required by both injection and infusion systems strips the most volatile flavour components from the sauce, which must then be added back into the sauce.

Indirect heating systems. Here heat is transferred from the heating media (steam, water or preheated product) to the product via contact with the metallic surfaces of a heat exchanger – whether plate heat exchanger, tubular heat exchanger, or scraped surface heat exchanger.

Plate heat exchangers. For low viscosity and shear-thinning sauce types, such as soy sauce or salad dressing, a plate heat exchanger optimized for heat-sensitive products like the Alfa Laval FrontLine can ensure cost-effective UHT treatment of products containing fibres or particles several millimetres in size and with viscosities of up to 800 cP.

When formulations contain large particles or have viscosities that exceed 800 cP, tubular heat exchangers or scraped surface heat exchangers are recommended. Both tubular and scraped surface heat exchangers offer minimal shear, which safeguards fragile emulsions, thus allowing the use of a non-aseptic homogenizer upstream.

Standard tubular heat exchangers. For viscosities up to 4000cP, which covers most commercial sauces a standard tubular heat exchanger such as the Alfa Laval ViscoLine can be used. Special high-pressure tubular heat exchangers can handle viscosities up to 10,000 cP. Different tube geometries, such as mono-tube, multi-tube or annular tube, are available and allow the passage of particles up to several centimetres in size without causing damage.

In addition, due to the absence of mechanical parts, tubular heat exchangers are easy to clean and sanitize for aseptic purposes. There are drawbacks, however. The main drawback is that it is difficult to maintain turbulent regime for viscous products, especially when processing sauces at UHT temperatures. This results in fouling build-up inside the tubes for heat-sensitive formulations and, as a consequence, shorter production cycles due to the need for increased cleaning frequency.

Scraped surface heat exchangers. These are single-tube tubular heat exchangers equipped with internal scraping systems to clean the heating surfaces. The scraping system prevents fouling build-up and forces convection inside the flow mass by continuously moving the heated product away from the hot surface. This ensures efficient and uniform treatment regardless of viscosity. Even highly viscous products like cheese sauce, tomato paste and formulations with particles of

Image 1. Alfa Laval Contherm®

one centimetre or larger in size can be processed by a scraped surface heat exchanger. Cooling after UHT is performed in-line with an additional scraping element cooled by chilled water or glycol. Properly dimensioned, scraped surface heat exchangers can handle all types of viscosity, large particles and heat-sensitive products while at the same time preserving fragile sauce textures and flavours. This makes scraped surface heat exchangers the most versatile UHT system for sauce producers. However, due to the presence of mechanical parts, its compatibility with aseptic filling calls for flawless hygienic design and high-quality aseptic components that are able to withstand the pressure and temperature constraints of UHT.

Alfa laval Contherm® scraped surface heat exchanger

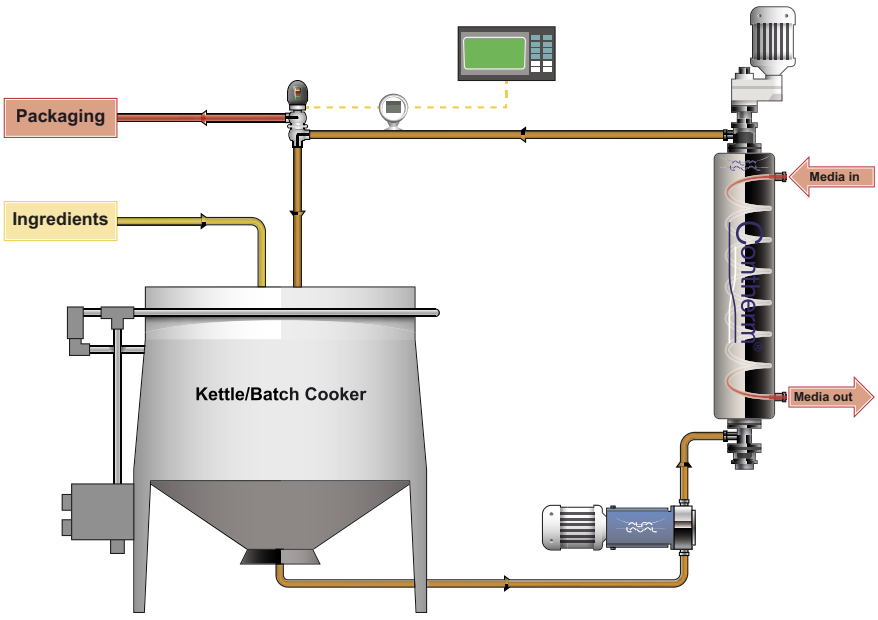
Alfa Laval Contherm® (Image 1.) is specially designed for heating and cooling of sticky, viscous and particulate-laden food products. It prevents damage of fragile components as well as loss of volatile aroma compounds, making it an excellent choice for manufacturing premium sauces. No burnt product build-up occurs during the production cycle, which contributes to both uniform product quality and more uptime compared to other heating systems.

Connected in series for in-line heating and cooling, Alfa Laval Contherm® is a compact, hygienic and efficient thermal treatment system. It easily handles changes in viscosity during processing, such as the swelling of native starch, which is less expensive to use than precooked starch in sauce formulations. Its specially designed low-shear rotor can successfully heat and cool chunks of food up to 36 millimetres in size while preserving product integrity.

As an alternative to in-line systems, Alfa Laval Contherm® can also be mounted on a recirculation loop (Image 2.) for batch heating of a kettle. This solution is especially attractive for upgrading an existing plant equipped with double-jacketed kettle at minimal costs. Heating time can be reduced by more than 50%. Moreover, burnt deposits on the kettle wall are kept to a minimum, resulting in both higher product quality and less downtime for tank cleaning.

A fully enclosed and intrinsically hygienic machine, Alfa Laval Contherm® can be used as part of an aseptic plant for UHT treatment of shelf-stable sauces packed in sachets or cartons.

Image 2. Batch process system with external recirculation loop



Because Alfa Laval Contherm® is easy to open, a single person can safely undertake inspection and preventive maintenance. In fact, it includes a device that can automatically open and close the heat exchanger without using any additional lifting equipment.

Wide range of solutions to meet your needs

Alfa Laval Contherm® scraped surface heat exchanger exists in different versions, adapted to various grades of viscosity and fouling. In addition, it is available in the modified Convap variant, which works simultaneously as scraped surface heat exchanger and evaporator, for removing moisture from viscous and heat-sensitive products.

As long as a product can be pumped, the Alfa Laval Contherm® scraped surface heat exchanger can handle it. To help verify this prior to installation, and select the right model, test units are available, either for shipping to customer sites, or at Alfa Laval Customer Testing facilities in either the U.S. or Europe.

About Alfa Laval

Alfa Laval is a leading global provider of specialized products and engineered solutions that help customers heat, cool, separate and transport products such as oil, water, chemicals, beverages, food-stuffs, starch and pharmaceuticals.

Alfa Laval's worldwide organization works closely with customers in nearly 100 countries to help them stay ahead in the global arena. Alfa Laval is listed on Nasdaq OMX, and, in 2015, posted annual sales of about SEK 39.7 billion (approx. 4.25 billion Euros). The company has about 17,500 employees.

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With more than 25 years of experience in food industry, Frédéric brings vast experience in the product development, upscaling and start up of new productions, process optimization, innovation and new business development. During his career, he has focused on food ingredients, food science and technology. He holds a Masters of Science degree in Food & Agronomy from ENSA Rennes, France.

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With a background in the Food and Beverage industry, Martin brings more than 30 years of experience in food processing. Martin supports sales companies in the application of the Alfa Laval Contherm technology for difficult food products. With a combination of both process knowledge and equipment knowledge, Martin is able to add value by using industry, process and application know-how. Martin holds a Bachelor's Degree in Mechanical Engineering.

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