

MICROWAVE AND RADIO FREQUENCY TECHNOLOGIES A GUIDE TO FOOD APPLICATIONS

Together, we reinvent your processes with our
Microwave and Radio Frequency solutions since 1978





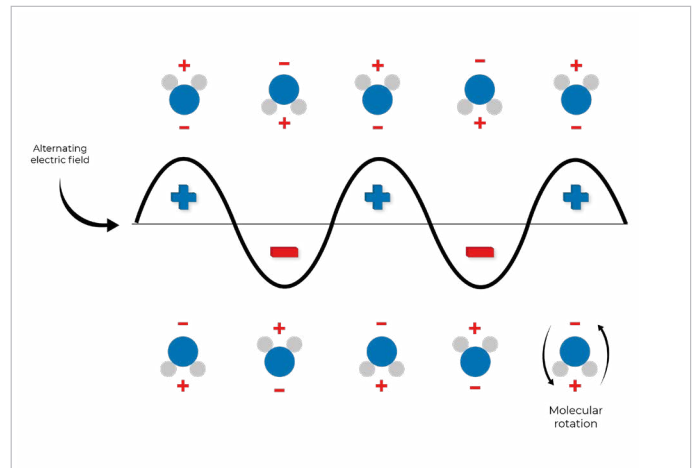
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HOW DOES MICROWAVE & RF HEATING WORK ?

Microwave and Radio Frequency technologies are perfectly suited to improving thermal processes as defrosting, sanitizing, cooking, heating, and drying all kinds of foodstuffs thanks to their ability to heat quickly and homogeneously. These two technologies are complementary and they both have their advantages depending on the products to be treated. SAIREM can advise you which technology is most suitable for your product or process.

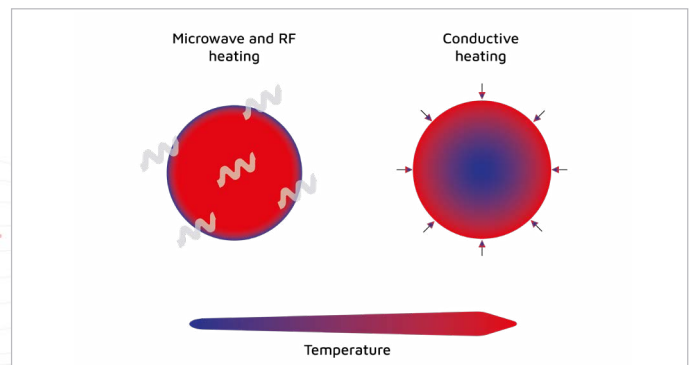
MW and RF are heating technologies based on the dissipation of electromagnetic energy within the targeted product. The heating process is generated by the quick polarity reversal of the electromagnetic field which creates vibration and rotation of the polarized molecules inside the material. This is made possible thanks to the dielectric loss properties of materials. As water molecules are highly polarized, RF and MW technologies are very effective at heating up wet materials.



Homogeneous heating

With a traditional heating solution, heat is transferred by conduction from the outside to the center of the product. Microwave and radio frequency technologies heat the product uniformly: this is called volumetric heating.

Thanks to these properties, SAIREM's technology offers fast and reproducible results when used within industrial drying or food-processing systems.



Almost instantaneous

MW and RF have the ability to heat thanks to the dielectric loss properties of materials. This phenomenon is caused by the vibration and rotation of polarised molecules inside the material, induced by the quick polarity reversal of the electromagnetic field (a million times per second).

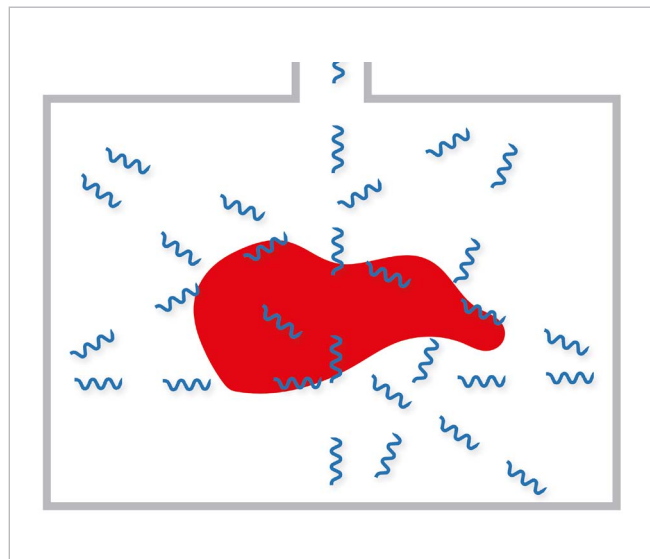
Heat generation is almost instantaneous and allows for a perfectly controlled process thanks to rapid, uniform heating. Moreover, almost all the energy is transferred to the treated product, drastically reducing energy losses.

Microwave vs Radio-Frequency

Microwave insight (MW)

Microwave energy is generated by a MW generator and must be guided by waveguides to the cavity. Their wavelength varies between 10 cm and 30 cm depending on the frequency used. They are highly effective for treating different types of products at high speed, and in particular those which have an irregular shape, like pieces of meat for example.

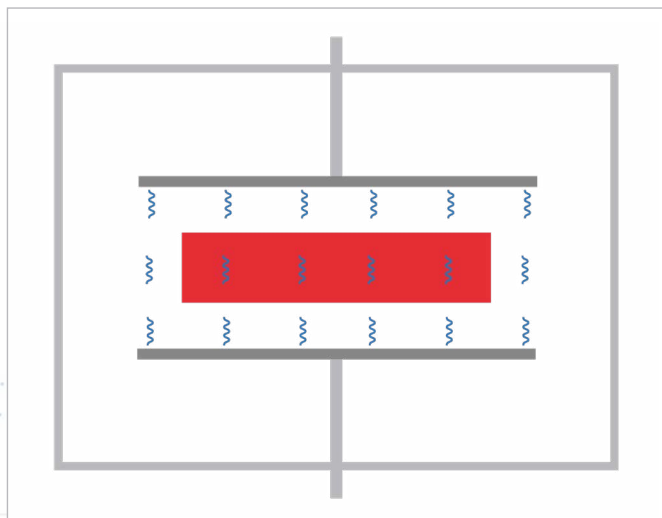
Thanks to their ability to heat uniformly, microwaves are often used to quickly heat or dry industrial material or foodstuffs. They are highly efficient for the pasteurization of liquid products and sanitizing operations.



Radio-Frequency insight (RF)

Generated by a RF generator, radio frequency energy moves from one electrode to the other inside the applicator and passes through the treated material. This makes it more effective on products of regular size and shape, which are thus heated uniformly.

Thanks to its longer wavelength, around 10 m, radio frequency energy can penetrate deep into the material and thus heat thick products. It heats more slowly than microwaves and can be used to treat more delicate products which require gentle heating.



Some applications



Pasteurizing dates



Fruit drying



Beef tempering



Black peppercorn
debacterizing



Insect drying



Fish block tempering



Spring roll cooking



Chicken tempering



Butter defrosting



Pasteurizing jam



Fruit tempering



Seed sanitizing



Dessert cooking



Vegetable tempering



Coffee bean roasting



Minced meat tempering



Fish thawing



Herb debacterization



Pork tempering



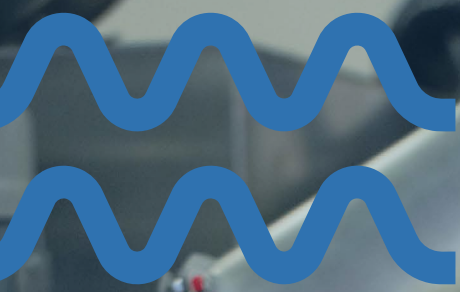
Edible flower sanitizing

FROM R&D TO INDUSTRIAL SCALE

When it comes to food industry, one of the main challenge is to scale up your process. Indeed, a solution can work perfectly on a small scale, but prove to be problematic when scaling up. When choosing your partner, take care to select a company able to support you throughout your development process, from your first tests, to the supply and commissioning of your production equipment.

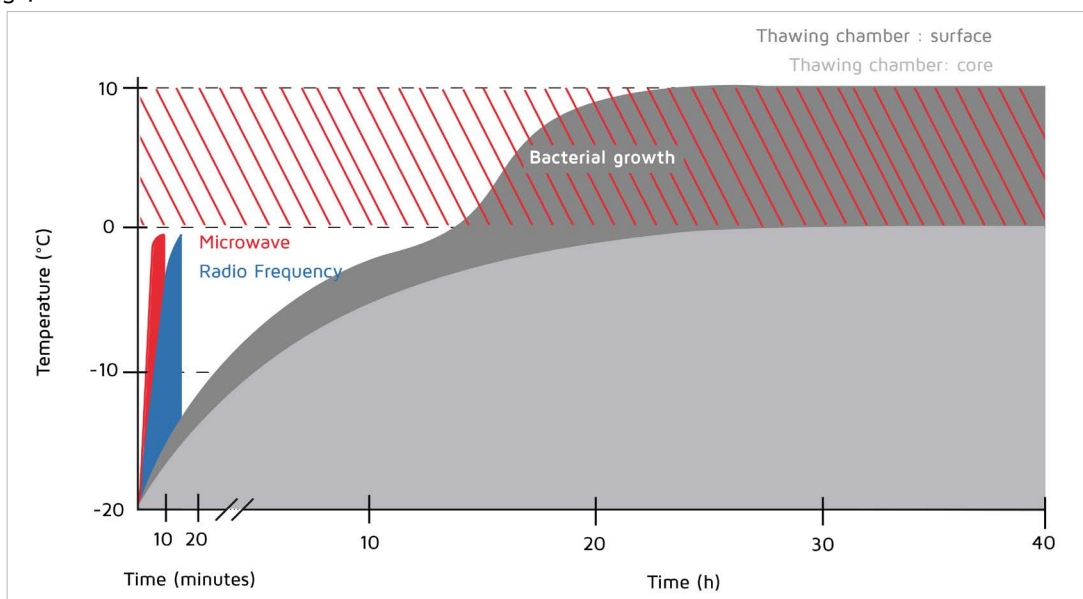
SAIREM is offering solutions from R&D and laboratories scale up to high power industrial systems. The perfect mastering of microwave and radio frequency technologies allows us to scale up our equipments easily and with predictable results.





TEMPERING & DEFROSTING

Defrosting and tempering by microwave or radio-frequency has many advantages compared to traditional processes :



Speed : while classical defrosting and tempering methods take hours or days to temper or defrost your food products, MW and RF technologies take from 3 to 20 minutes. In addition, there is no need to waste time unpacking your products. They can easily be tempered or defrosted in their original packaging (plastic film, cardboard, plastic box, etc).

Savings : the speed and uniformity of MW and RF processes minimize product drip losses and degradation. By completely eliminating weight losses caused by conventional defrosting methods (which can represent up to 8% of the ingredients to be transformed) you immediately improve your raw material yield. The payback can be as short as 6 to 12 months. In addition to saving money, you also save space thanks to the small footprint of our tempering equipment. Our machines replace large tempering or defrosting rooms and eliminate the need for space to house the pallets waiting to temper slowly in the traditional way.

Safety : thanks to the rapidity of MW and RF tempering and defrosting processes, bacterial growth is limited. Defrosting food products with a traditional method can take hours or even days, increasing the health risk. On demand, and for optimal food safety, our tunnels allow you to separate incoming and outgoing product flows to avoid cross contamination. In addition, microwave and RF technologies are safe and SAIREM's systems are fitted with sensors to prevent microwave/RF leakage.

Quality : unlike some traditional methods, MW and RF tempering and defrosting preserves all the organoleptic properties of your food products: color, weight, taste, vitamins, nutrients... Moreover, the temperature homogeneity of $\pm 1^{\circ}\text{C}$ throughout the food block allows for better post processing of your products.

Meat and fish tempering

- Microwave and RF are perfectly adapted to thaw meat and fish products. These technologies work with all kinds of meat: beef, pork, poultry... They are effective on raw or processed products (like sausages for example) without oxidation or alteration of the product's organoleptic properties.
- The temperature homogeneity of $\pm 2\text{ }^{\circ}\text{C}$ throughout the food block allows for better post processing of your products.
- MW and RF tempering processes allow you to heat significant quantities of products, in the form of pieces or blocks of meat and fish, with or without packaging.
- This tempering process is extremely fast: you will be able to process several tens of tons of meat products in one day versus several days with traditional processes.
- Thanks to the speed and performance of the MW and RF tempering process, bacterial development is significantly reduced. Your meat products are tempered in a totally safe way.
- Unlike classical tempering processes such as tempering chambers, microwave and RF processes **significantly reduce drip loss**. It's a very profitable way to defrost your meat products.



Fruit and vegetable thawing

- The gentle heating process of RF and microwave technologies totally respect the organoleptic properties of fruits and vegetables: there is no oxidation or color change, no alteration in taste or texture and no nutriment loss. Your products remain attractive and healthy.
- Thanks to the speed of the process, bacteriological risks are greatly reduced. There is no risk of bacteriological development as there can be in a defrosting room.
- You save precious time by using the MW or RF thawing process. Thanks to the quickness of this solution, you will be able to temper your products in a few minutes rather than hours.



Defrosting butter

- Microwave technology is an excellent solution to defrost fatty food products such as butter. Indeed, the high fat content of this product makes it possible to defrost butter completely, up to $+10^{\circ}\text{C}$.
- You obtain a product that is homogeneously thawed and ready to be worked.



Our solutions

Batch tempering ovens



AMW100



AMW200



AMW400

Power (kW)	5 kW	10 kW	60 kW
Capacity* (kg/h)	Up to 200 kg/h	Up to 400 kg/h	Up to 1000 kg/h
Dim. (LxWxH)	1.9 x 2.3 x 1.8 m	2.1 x 2.3 x 2.3 m	3.6 x 3 x 2.6 m

Continuous flow microwave tempering tunnels



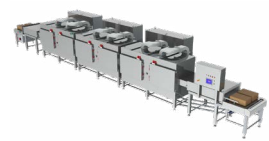
TMW35



TMW75



TMW150



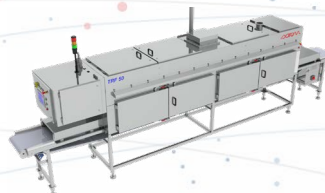
TMW225

Power (kW)	35 kW	75 kW	150 kW	225 kW
Capacity* (t/h)	Up to 1.5 t/h	Up to 3 t/h	Up to 6 t/h	Up to 9 t/h
Dim. (LxWxH)	7.9 x 1.8 x 1.9 m	9 x 1 x 2.4 m	12 x 1 x 2.4 m	15 x 1 x 2.4 m

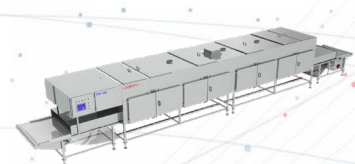
Continuous flow radio frequency tempering tunnels



TRF30



TRF50



TRF100

Power (kW)	30 kW	50 kW	100 kW
Capacity* (t/h)	Up to 1 t/h	Up to 1,9 t/h	Up to 3,8 t/h
Dim. (LxWxH)	5.4 x 1.12 x 2 m	7 x 1.12 x 2 m	16.1 x 2.1 x 3.9 m

* Actual capacity may depend on initial and final temperatures.

FOOD SAFETY

Sanitization

The process of sanitization using our technologies consists in exposing the product to a microwave or radio frequency field during a short time within a temperature-controlled processing cavity. The intensity of the field and the process duration depend on the product to be treated and the parasite to be eliminated.

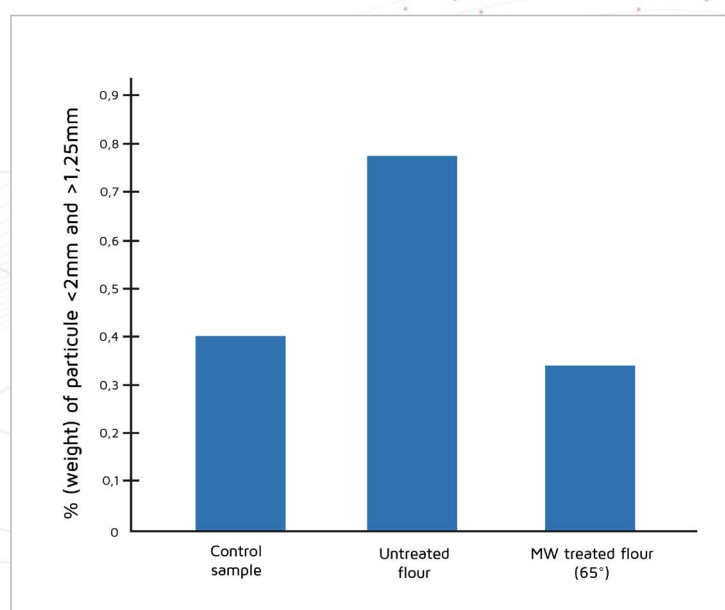
Eco-friendly process : the use of a MW and RF sanitization process avoids the use of chemicals and thus meets the demand of suppliers and customers. This eco-friendly process is therefore **compatible with organic certification**. This sanitization or disinfestation solution is extremely quick, economical and particularly effective on larvae, eggs and other insects.

Selectivity : thanks to the polar properties of water, MW and RF have the ability to heat water faster than many materials. Consequently, parasites full of water are quickly eliminated and the properties of the treated product preserved.



The solutions developed by SAIREM offer an economic and efficient process for the sanitization or disinfestation of dried food and ingredients such as: flour, cereals, lentils, beans, mushrooms, cocoa beans, nuts, seeds, cannabis...

Case study : flour disinsectization



Test carried on flour for disinsectization process showed microwave efficacy against insects. Indeed, the untreated and microwave treated flour were passed through a 1,25mm mesh sieve to analyse the contamination of the product by eggs, larvae and insects.

The graphic shows that the microwave treated flour at 65°C is less contaminated than the untreated one, for an incubation period of 21 days at 32,5°C and 70% relative humidity.

Debacterization

In a microwave or radio frequency debacterization process, the product is heated up in a very short time within a temperature-controlled cavity. The duration and the intensity of the treatment depends on the product and the bacterias that must to be eliminated.

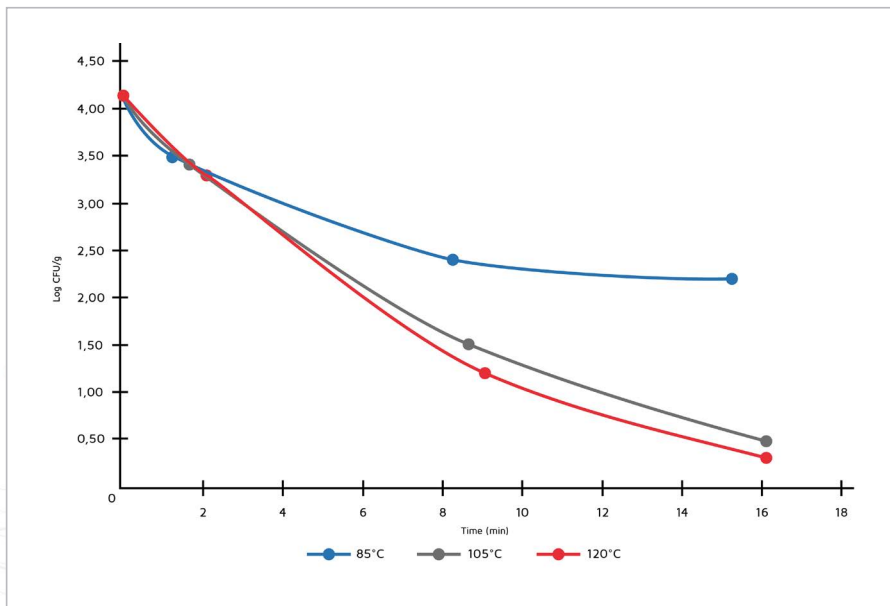
Homogeneity : MW and RF technologies offer very homogeneous heating due to their volumic heating properties.

Rapidity : as a quick way to reduce bacteria load, MW and RF heating is perfectly suited for this application, allowing a very short treatment time.



SAIREM's solutions offer very efficient and quick processing to achieve a debacterization treatment on food ingredients such as : flour, cereals, lentils, beans, nuts, seeds, spices, milk powder...

Case study : black peppercorn debacterization



Our tests on black peppercorns show good results. The product was treated at three different processing temperatures, 85°C, 105°C and 120°C, and three different holding times: 0, 7 and 14 minutes. For a total of 9 treatments modalities. Thanks to microwaves, the temperature rises very quickly.

With the initial level of contamination of 4.30 log, the microbial level was reduced by 3.38 log after a 14 minutes holding time at 120°C.

Read the full case study [here](#).

Liquids and pasty product pasteurization

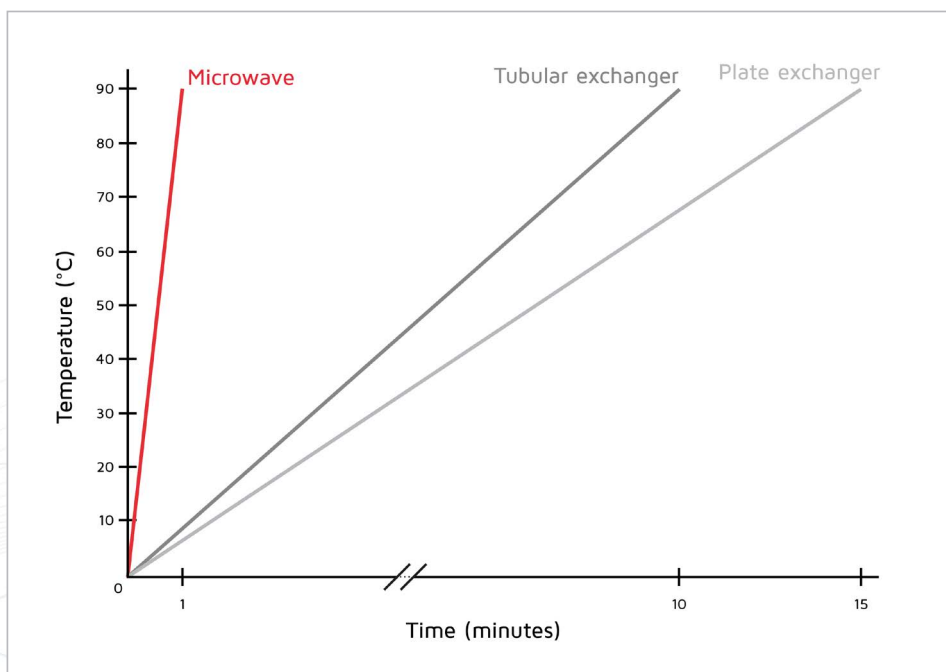
The pasteurization process is one of the main food preservation methods for pasty and liquid products. It aims to limit spoilage of the product by reducing the presence of micro-organisms in it. Microwave technology is well suited to heat up the product to the temperature you need within a few seconds. It is a great way to do your pasteurization process.

Quality : this process greatly reduces the risk of product degradation. Indeed, it preserves the organoleptic characteristics of your food product. Thanks to the high temperature increase in a short time, you can treat reduced sugar product and preserve the integrity of whole fruit pieces.

Rapidity : MW and RF pasteurization quickly and homogeneously reduces microbial load at the core and the surface of the food simultaneously. This homogeneity is allowed by the microwave heating process and is more difficult to achieve with conventional heat convection (steam, hot air, hot water). Unlike traditional processes, the required pasteurization level is achieved in a matter of seconds, instead of minutes.



SAIREM's solution offers a quick and efficient heating process adapted to different liquid and pasty products such as jam, juice, dairy products...



Packaged products pasteurization

Pasteurization of packaged product with microwave and radio frequency technologies is emerging as a quick, efficient and safe process.

Rapidity : MW and RF technologies are perfectly suited to achieve uniform heating are quick way to reduce microbial load at the core and the surface of the packed food product simultaneously. Unlike traditional processes, the required pasteurization level is achieved much faster, in matter of minutes.

Quality : this process greatly reduces the risk of product degradation. Indeed, the organoleptic properties are preserved but also its freshness, even for heat-sensitive packaged food products. MW and RF are capable to guarantee a fresh taste and a safe food with a shelf-life extension.

Savings : unlike conventional pasteurization and sterilization systems, microwave and RF solutions allow significant savings in time, space and energy. They are a quick and economical heating process that transmit the energy directly to product and avoid losses into the surrounding atmosphere.

All kind of packaged food products can be pasteurized and sanitized by MW and RF ready-meals, tortillas, bread ...



Case study : freshly sliced bread pasteurization



Control (+10 days)



Microwave treated (+10 days)

Our test consists of treating 10 breads at the same time in a microwave cavity.

Knowing the initial shelf life of the breads is 4 days, our microwave treatment (140 seconds) produced very good results by doubling the shelf life.

Case study : ready-meal pasteurization

Our results show that microwave treatment for ready-meals pasteurization is a great alternative. Indeed, it is a quick, efficient and energy saving process.

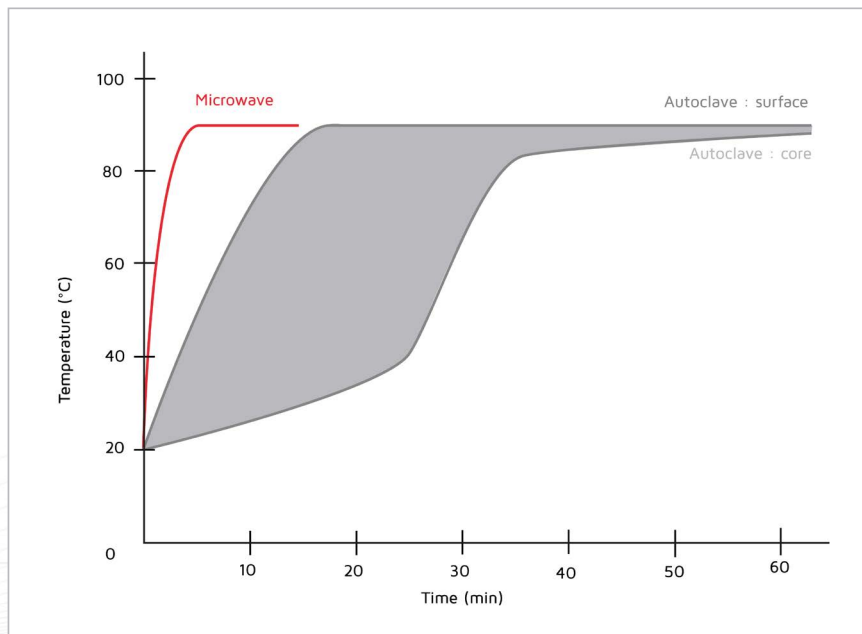
On the graphic, it is blatant that microwave is a real time saving process, heating up the core and the surface at the same time.



Microwave pasteurization



Autoclave pasteurization

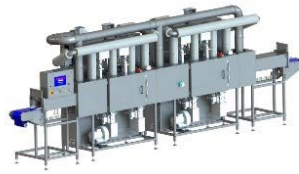


Our solutions

Microwave



AMW



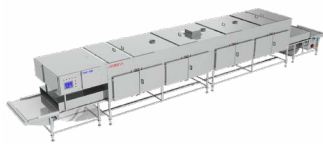
TME16



ILH200

Process	Batch	Continuous	Continuous
Power (kW)	10 kW	16 kW	50 kW to 200 kW
Capacity* (kg/h)	Up to 150 kg/h	Up to 250 kg/h	Up to 12 t/h
Dim. (LxWxH)	2.1 x 2.3 x 1.9 m	6.7 x 1 x 2.3 m	1.8 x 1.7 x 2.2 m

Radio frequency



TRF100

Process	Continuous
Power (kW)	100 kW
Capacity* (kg/h)	Up to 1500 kg/h
Dim. (LxWxH)	

* Actual capacity may depend on initial and final temperatures.

DRYING

Our equipment associates microwave or radio frequency with hot air, steam or vacuum, for excellent results in various applications such as drying herbs and plants, fruits, vegetables, cereals, insects or other food products ...

Homogeneous drying : with MW or RF drying, the process will occur at the same rate inside the product and on the surface, avoiding burnings.

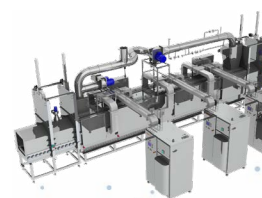
Selective heating : with this process, you can dry a specific part of your product, without damaging the final product properties or quality. Our machines are designed so that drying temperatures can be perfectly controlled. The selective drying to the core of the product is quick and homogeneous while preserving the food's properties, as the MW and RF heat faster the water to be evaporated than the product itself.



Our solutions



Batch Dryer



Continuous Dryer

Power (kW)

10 kW

300 kW

Capacity (kg/h)

Up to 10 kg of evaporated water /h

Up to 300 kg of evaporated water /h

Dim (LxWxH)

2.1 x 2.3 x 1.9 m

11 x 2 x 4 m

Case Study : insect drying



Our latest installation for insect drying consisted in drying 150 kg/h of different types of insects.

The initial product contain 60% water. After a 13 minutes microwave drying process, we ended up with 6% of water in the product, which means 75 kg/h of water are evaporated.

Case study : biscuit checking (cracking) reduction

The checking effect is broadly present in the biscuit industry. A post-baking microwave treatment allows the water to be homogeneously distributed, reducing this effect from 60% breakage to only 2%.



Case study : crispy carrots



This test was done with the aim of drying carrots but also to give them a crispy texture.

Thanks to a gentle microwave drying at 500 W for almost 20 minutes which made crispy carrot chips without any hot spots.

COOKING

Microwave and RF technologies have many advantages when it comes to rapid cooking. This process allows you to cook your products evenly and may deliver results impossible to achieve with traditional cooking.

Precision and homogeneity : thanks to the power control offered by MW technology, the cooking process is much more precise and adapts better to treatment of different products. Using microwaves which pass through the product is ideal to cook evenly the surface and the core of the product.

Process combination : for optimal results depending on your needs, MW technology can be combined with complementary processes such as infrared, hot air or steam. SAIREM has years of experience in combining technologies and will be able to advise you to achieve the best results.

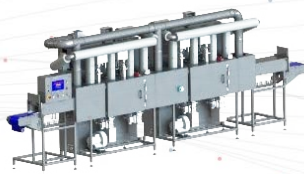
Time-savings : traditional cooking processes are made longer by the formation of a crust. By cooking the product evenly, microwave technology is more efficient and above all much faster. The product cooks in a few minutes and is ready to use. It can also be simply preheated before being fried, for example.

Healthy way to cook : by cooking the product inside out and with no contact with hot elements, the level of fat can be considerably reduced. You can easily keep your recipes healthy by using MW and RF cooking process.

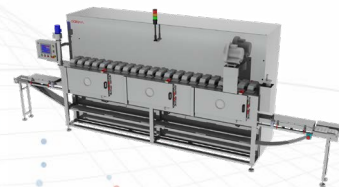
Products like flans and spring rolls, can benefit from our technologies.



Our solutions



TME16



TME300

Power (kW)

16 kW

300 kW

Capacity (kg/h)

Up to 150 kg/h

Up to 3 t/h

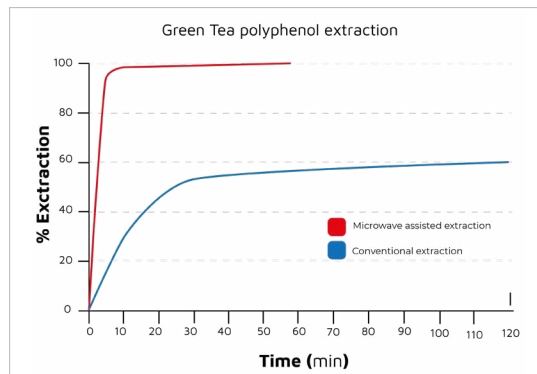
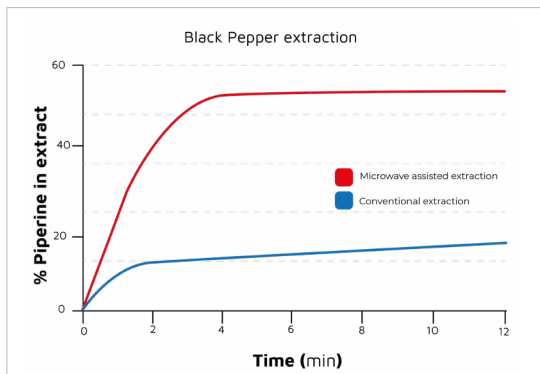
Dim. (LxWxH)

6.7 x 1 x 2.3 m

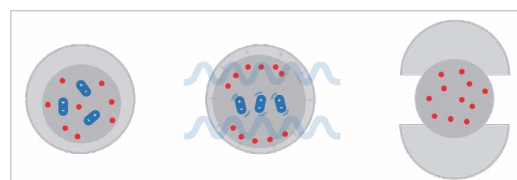
Custom

COMPOUND EXTRACTION

Microwave-assisted extraction offers several advantages over more traditional techniques, such as shorter extraction time, lower solvent use, higher compound extraction rates, and overall lower processing cost.



Selective process : MW have a low thermal effect on edible oils. They act selectively on the plant cells, vaporizing the water matrix, causing the breakage of the cells and directly releasing aroma in the oil or solvent. This leads to a high extraction rate while fully preserving the organoleptic and physical-chemical properties of the extracted product.



Improved yield : combined with a traditional solvent, MW assisted extraction is very effective because it increases the extraction kinetics and thus the yield of the process. Our microwave solutions can process anything from a few kgs to several hundreds of kgs of product per hour, depending on your production rate.



All kinds of plants, flowers and herbs are suitable for microwave-assisted extraction of essential oils.

Our solutions



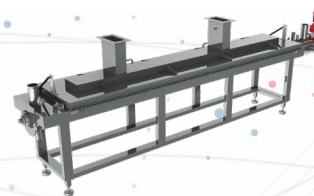
Lab-Scale Extraction

Power (kW)

3 kW to 6 kW

Dim. (LxWxH)

1.1 x 0.7 x 1.5 m (3kW)
1.1 x 0.9 x 1.6 m (6kW)



Industrial-Scale Extraction

72 kW

5.5 x 1 x 1.3 m

ABOUT SAIREM



SAIREM is a world leader in industrial microwave and radio-frequency applications, with more than 5000 references in operation in 70 countries, from the standalone 200 W solid-state generator to the fully automated processing line delivering 700 kW.

Today, SAIREM offers the most advanced range of industrial microwave and radio frequency equipment for thermal processing and plasma generation.

Key figures



Created in 1978



70+ employees



**5 000 machines
across 70 countries**



**10 nationalities
in our team**



18 M€ yearly turnover



90% export share



10% invested in R&D



CONTACT US !

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microwave & radio frequency