

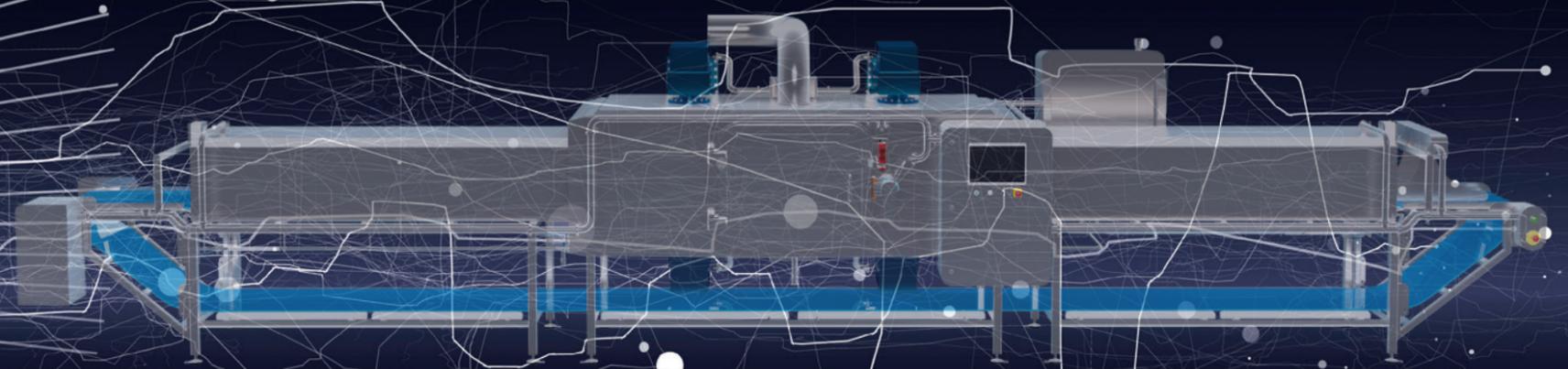
MICROWAVE TECHNOLOGIES

INDUSTRIAL MICROWAVE HEATING TECHNOLOGIES

BY **WEINDICH** 

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WEINDICH TECHNOLOGIES
EQUIPMENT
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1. WHAT ARE MICROWAVE HEATING TECHNOLOGIES?

Microwave heating technology are used in the industry more and more often. Microwave systems are used not only for thawing, but also for cooking, drying, and pasteurization. The unlimited application possibilities translate into optimized production, efficiency, and effectiveness of processes – starting from the chemical industry, through the food and pharmaceutical industries, to mining and metallurgy. The list of applications keeps growing. Microwave heating is more beneficial economically than conventional heat treatment. One of the most important advantages of microwave heating is its speed; it reduces the duration of processes that normally (using conventional methods) take days or hours to just minutes and seconds! An example is production of aspirin by the pharmaceutical industry: use of microwave driers makes it possible to shorten the heating process from over 2 hours to just 1 minute! Microwave systems also enable great energy savings, higher efficiency, and higher quality of the end product.

WHAT ARE MICROWAVES?

Microwaves are electromagnetic waves in the frequency band of 300 MHz to 300 GHz and wavelength in the range of 1 mm to 1 m. Microwave heating consists in transformation of the energy of a variable electromagnetic field into heat as a result of the so-called microwave dielectric heating effect. Radiation in the microwave band causes uniform alignment of dipole molecules (such as water particles) and ions in the created electric field. Because the field is variable, both dipole particles and ions try to become aligned in accordance with the field and oscillate and rub against one another and against other particles, thus transforming the energy supplied as a result of the rubbing into heat.

Most conventional heating and drying methods supply heat from a surface. As a result, moisture is removed from the surface very quickly but removal of liquids from the interior of a product is very ineffective. If the outside temperature is maintained on a sufficiently high level (as it is in an oven), moisture inside the material diffuses to its surface and evaporates. However, this is a passive and long process. In the process of microwave heating, the electromagnetic field acts on the entire material. Heating takes place nearly at the same time in all parts of a heated object (so-called volumetric heating).

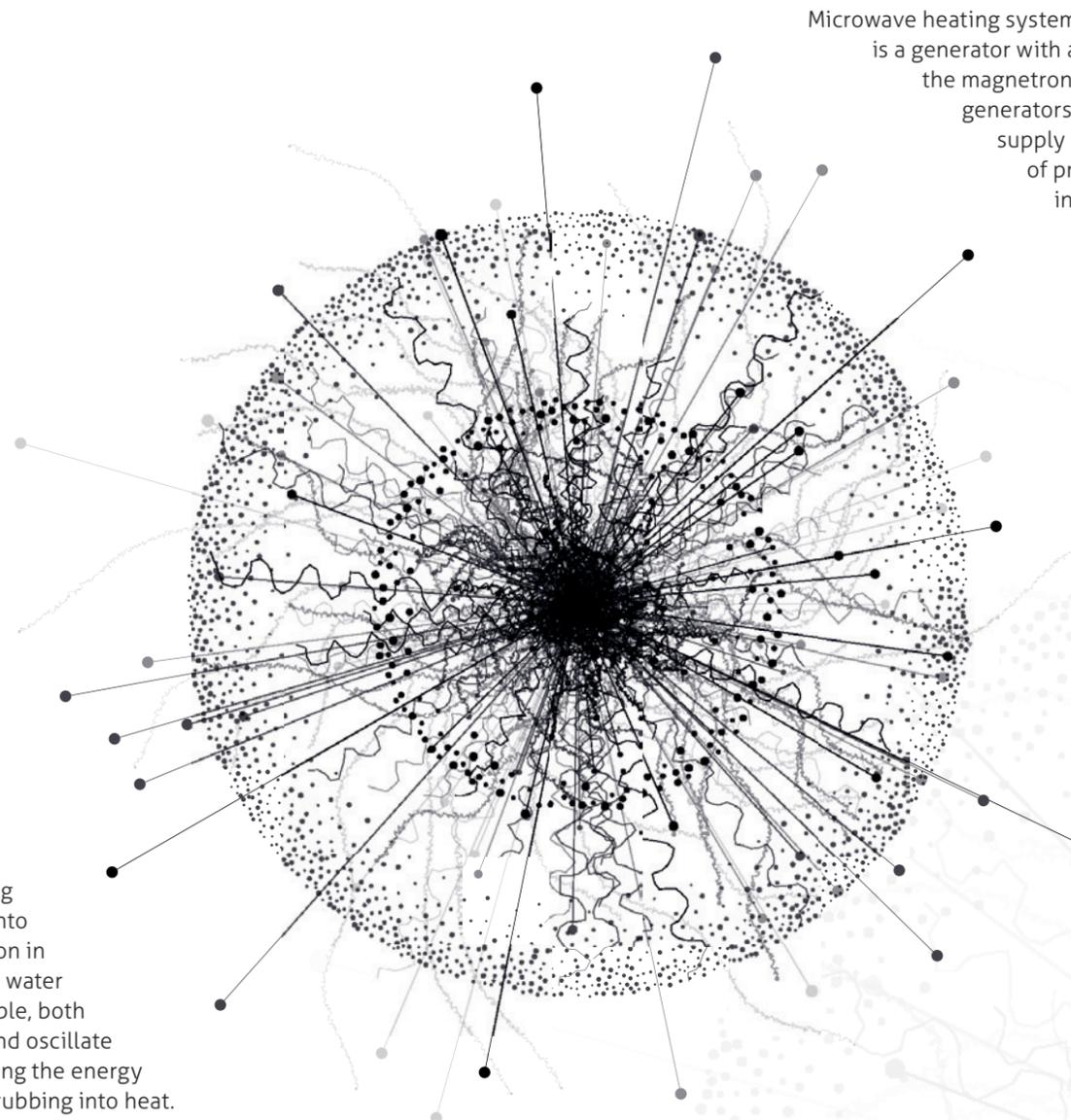
HOW IS A MICROWAVE HEATING SYSTEM BUILT?

Microwave heating systems consist of several elements. The „engine“ of the machine is a generator with a microwave oscillator, called magnetron, located inside; the magnetron is responsible for the power of the machine. Microwave generators can be used as single microwave supply sources that usually supply 5–100 kW of energy during continuous operation. In the case of processes that require higher power, they can be used in combination with other generators. Microwave heating systems also have a heating chamber, a waveguide that transports microwaves from the generator to the heating chamber, and a control panel.

In industrial practice, microwave systems working with the frequency of 915 MHz (most industrial systems) and 2,450 MHz (home microwave systems) are used most often. Lower frequency allows for more efficient penetration of microwaves through the material, which translates into lower operating costs of such systems.

CHAMBER VS. TUNNEL EQUIPMENT

The simplest example of a chamber microwave oven is a regular microwave used at home: a product is placed in a chamber where it is heated up. Tunnel systems, on the other hand, work in accordance with the continuous flow principle. The product is placed on a transport belt which moves it through a tunnel with microwave radiation inside. Tunnel equipment is more efficient. Currently, the so-called hybrid systems are becoming more and more popular; they combine treatment by microwave heating systems with conventional heating, which improves the efficiency of both processes.



2. MICROWAVE TECHNOLOGIES IN THE INDUSTRY

Microwave technologies are used in such processes as drying, sterilization, pasteurization, thawing, blanching, and cooking. During the process of dehydration, the main objective is to remove water from a product. In sterilization and pasteurization processes, microwave systems are specially designed to raise the temperature of the product to a specific level so as to kill all pathogens while maintaining integrity of the product. During blanching, the product is heated up and cooled down instantaneously and during cooking the temperature of the product is maintained on an elevated level for a long time. Microwave drying can be used successfully to dry wood, industrial coatings, ceramics, and various types of powdered materials.



FOOD INDUSTRY

THAWING – e.g. blocks of meat (boneless) and fish, fruit, and vegetables.
 BAKING – e.g. baking of bread, preliminary baking of bacon.
 DRYING – e.g. potato chips, pasta, fruit, and vegetables.

The food industry is one of the main sectors where microwave heating is used. Drying of potato chips was one of the first application for microwave systems in the food industry. Currently, microwave drying is also used for such products as pasta, potatoes, and fruit juice concentrates.

Microwave ovens are also used for baking bread. By quickly raising the temperature, microwave baking enables quick deactivation of enzymes inside the dough, which prevents decomposition of starch. Preliminary baking, especially of bacon, has also been increasingly popular. During grilling, bacon loses large quantities of fat, which results in loss of weight and shrinkage of the end product. By using microwave systems, which reduce the processing time, those shortcomings are minimized.



Microwave systems are used in the process of thawing of food products, especially meat.

Conventional thawing of meat blocks

Can sometimes take not just hours but even days and result in a large temperature difference inside and outside of the product. This, of course, results in reduced quality, both microbiological, and sensory, of the thawed meat and in large leaks of juices. This, in turn, increases both losses (shorter best before date and deteriorated colors) and production costs due to larger quantities of wastewater.

Equipment for microwave thawing

Is able to raise the temperature of a thawed product block from -20°C to -1°C in 60 seconds. Microwave thawing is most of all characterized by high efficiency, equal to as much as 15 tons per hour, and by better microbiological quality of the product. Moreover, microwave thawing systems reduce energy consumption, eliminate production of wastewater, ensure flexibility of production, and reduce production space requirements. Blocks can be thawed directly in the cardboard box or in plastic film, which significantly improves the sanitary conditions of the end product, and the shorter processing time eliminates bacterial growth. This, in turn, results in a product with a longer best before date.

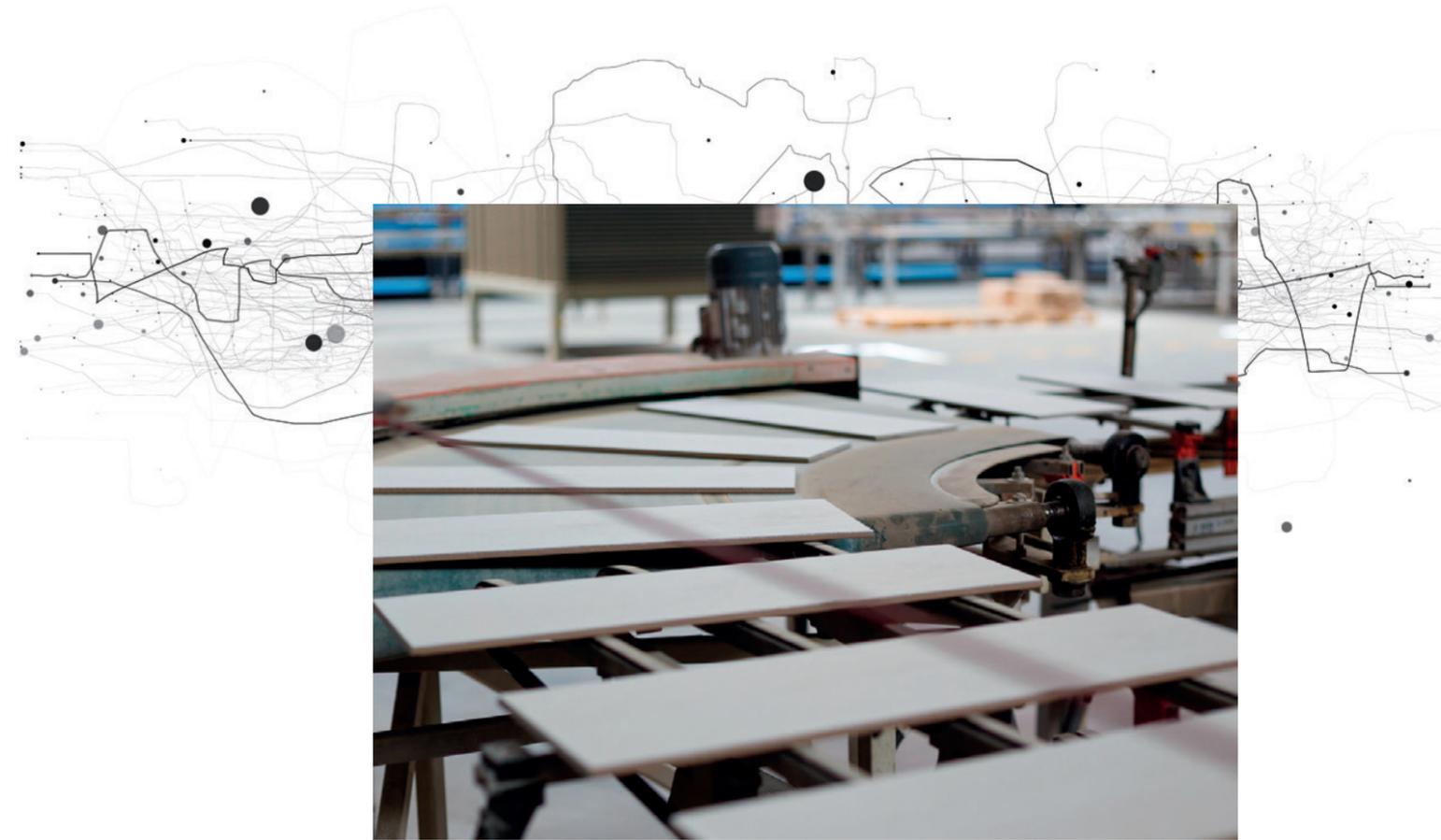
CHEMICAL AND PHARMACOLOGICAL INDUSTRIES

The chemical and pharmacological industries are among the most important customers, which use microwave heating for catalyzing various chemical reactions and synthesis of organic compounds, including many medicines. Currently this is one of the main methods for heating of chemical reactions in laboratories. It not only reduces the reaction time, but also reduces the number of side reactions and increases the effectiveness and repeatability of processes. In the analytical chemistry sector, microwave heating systems are used to incinerate and mineralize samples, testing dry method measurements, and extraction. Of note is the fact that extraction performed with microwave equipment not only takes place faster, but also enables a significant reduction of reagent consumption.



CERAMIC INDUSTRY

Microwave drying systems are also successfully used in the ceramic industry where removal of solvents and moisture are very important processes. In the plastics industry, microwave heating is used for conducting polymerization processes, e.g. ring-opening polymerization used in production of aliphatic polymers, polycondensation used in production of polyamides and polyesters, and free radical polymerization used in production of polystyrene.



MINING AND METALLURGY

In the mining industry, microwave heating systems are used to separate certain minerals from ores, e.g. gold. This technology enables a significant reduction of the ore milling time, as well as wear of machines and equipment during the milling process, and an increase of efficiency and cleanliness of the mineral obtained. Microwave heating systems are also used to purify coal ores from the pyrite they contain. They are also used successfully in the metallurgical industry.



3. WEINDICH – MICROWAVE TECHNOLOGY EXPERTS

Our company was established in 1990. Industrial automation, process lines, and assembling of machines for production are areas in which we have extensive knowledge and skills. We design dedicated solutions that increase effectiveness and functionality of process lines, machines, and equipment for the meat industry and the food processing industry. We hold patents for, among others, a fast cooling chamber, Diamant Line smoking sticks, and a secondary pasteurization technology. We keep evolving, observe market trends, and listen to the needs of our customers. The continuous growth of our company, our investments in modern technologies and the competences of our workers, our specialization and versatility, our passion and commitment, and our knowledge and experience allow us to be among the leading suppliers of specialized equipment for food processing companies and to be an expert in innovative approaches to production and business.



We are a 100% Polish owned family company. At our headquarters in Chorzów, there is a specialized shopping center, a production building, warehouses, a 24h/7 technical service center, and a Culinary Center where, during technological training sessions, workshops, demonstrations, as well as vocational examinations, expert knowledge is shared by specialists in the culinary and catering sector from all over the world.

We work based on a quality management system compliant with the ISO 9001:2015 standard concerning maintenance and professional service on each stage of delivery and sale of machine and equipment for the food industry



and catering sector. We cooperate with our customers on each stage of design of process lines, from preparation of the concept, through production and startup, to the entire service life of the machinery. This allows us to act in a comprehensive manner and to offer our customers professional advice, project supervision, maintenance, and technical training.

4. INNOVATIVE SOLUTIONS OFFERED BY GLOBAL MANUFACTURERS

For many years we have developed, created, and implemented technologies for the meat industry and the food processing industry. Upon a custom order, our team of designers make non-standard elements to connect various parts of production lines, including transport systems and other structural-assembly elements. The high quality of our services has been confirmed by hundreds of implementations and installations, and by our long cooperation with well-known global manufacturers and suppliers. The unique characteristics and versatility of our activities make us one of the largest companies in the sector, not only from the quality standpoint, but most of all in the economic sense. We are a distributor and representative of many global brands whose products are included in our commercial portfolio.

Our process lines are made with tried and tested assemblies of well-known manufacturers. Thanks to cooperation with them, we are free to choose and fit equipment to make complete and optimized process lines. In the field of microwave technologies, we are a representative and distributor of equipment of such manufacturers as AMTek and SinnovaTek, which we offer to our customers – innovative food producing companies.



AMTEC INDUSTRIAL MICROWAVE SYSTEMS – FAST, EFFICIENT, AND EVEN HEATING

The flexible layout and design of the systems make it possible to use the equipment in virtually any application that requires the use of microwaves. In the case of batch systems, the typical thawing time of a 20 kg block from -18°C to -2°C is equal to 50–60 seconds. The result of thawing can be very different for each raw material; however, we can thaw products to the maximum temperature of -2°C.



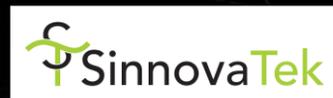
APPLICATIONS

1. Liquid substance heating systems:
 - quick, efficient, and uniform heating of products;
 - perfect for heating up all liquid substances, from vegetable oil to sauces, soups, and purées;
 - PLC controllers enable defining the heating profile requires to achieve excellent results for each type of product;
 - eliminates burning of surfaces;
 - reduces the process times by as much as 66% compared to conventional boilers;
 - as a result of even heating of the entire product batch, the quantity of waste and the possibility of overheating are reduced.
2. Product drying and cooking systems:
 - a double belt conveyor system is available;
 - durable structure made of stainless steel 304;
 - a system of stainless steel conduits.
3. Thawing systems:
 - simple and efficient thawing of deep-frozen meat blocks;
 - precise process control;
 - better food quality and safety;
 - reduction or elimination of contaminants;
 - multi-language software.



SINNOVATEK - STERILIZATION OF LIQUID PRODUCTS

SinnovaTek is an authorized supplier of breakthrough Aseptia technologies. AseptiWave is a perfect solution that utilizes the microwave technology for the most demanding processes. It enables sterilization of all products with high content of proteins and vitamins, e.g. food for children. As a result, the use of additives that enrich products to achieve the recommended consumption level can be reduced. Reduce use of expensive ingredients in the production process translates into higher profits from each unit of the product produced. AseptiWave is also an effective solution for sterilization of liquid products containing solid particles that makes it possible to preserve their integrity, natural color, and nutritive value. This makes it possible to reduce the heating time by as much as 70% compared to conventional steam-based solutions.



PRESERVATION OF NUTRIENTS, COLOR, AND FLAVOR HAS BEEN CONFORMED IN STUDIES

Microwave energy gently warms up food products, such as soups, hummus, beverages, and sauces to raise their temperature to a level that ensures food safety. By reducing the time needed to achieve this temperature, the microwave technology makes it possible to achieve such quality-related benefits as preserved color, flavor, aroma, consistence, and nutrients. The system is scalable and can be used in small- and large-scale industrial production.

NUTRIENT RETENTION



| Attribute | AseptiWave |
|-----------------------|------------|
| Vitamin C Retention | 93% |
| Antioxidant Retention | 93% |
| Anthocyanin Retention | 86% |

Results of AseptiWave nutrient retention is based on third party testing of commercial products.

JUICE SMOOTHIES: A CONSUMER SENSORY STUDY

| Question | AseptiWave Shelf Stable / 12 Month Shelf-Life | 3 Market Leaders Flash Pasteurized & Refrigerated |
|--------------------|---|---|
| Freshness | ★★★★ | ★★★★ |
| Overall Preference | ★★★★ | ★★★★ |
| Purchase Intent | ★★★★ | ★★★★ |

AseptiWave matched the refrigerated products in every way. Results are based on a third party preference test of 106 people.



THE ASEPTI WAVE™ SOLUTION: INNOVATIVE PRODUCTS

| Consistency | Product acidity | |
|-------------|---|--|
| | High | Low |
| Chunky | <ul style="list-style-type: none"> ✓ Beverages with inclusions ✓ Chunky fruit puree ✓ Chunky smoothies ✓ Fruit prep | <ul style="list-style-type: none"> ✓ Chili ✓ Chunky soups ✓ Vegetables - whole or diced |
| Viscous | <ul style="list-style-type: none"> ✓ Fruit purees ✓ Fruit juices and smoothies ✓ Fruit/vegetable juices and smoothies | <ul style="list-style-type: none"> ✓ Dairy smoothies ✓ Hummus ✓ Mashed potatoes ✓ Refried beans ✓ Smooth soups |
| Thin | <ul style="list-style-type: none"> ✓ Fruit juices ✓ Bar mixers ✓ Teas | <ul style="list-style-type: none"> ✓ Coffee / Frappuccino ✓ Infant nutrition ✓ Milk ✓ Non-dairy milk (almond/rice) ✓ Vegetable juices |

5. PROPRIETARY MICROWAVE EQUIPMENT

We know very well that use of microwave heating technologies in the industry translates into higher process speeds, high energy savings, improved efficiency, and better quality of the final product. This is we have specialized in microwave technologies for food processing that can be used in such processes as thawing, drying, pasteurization, and cooking.

THERMWAVE. ONE PIECE OF EQUIPMENT. MANY POSSIBLE APPLICATIONS



thawing
blocks of meat (boneless) and fish, fruit, and vegetables



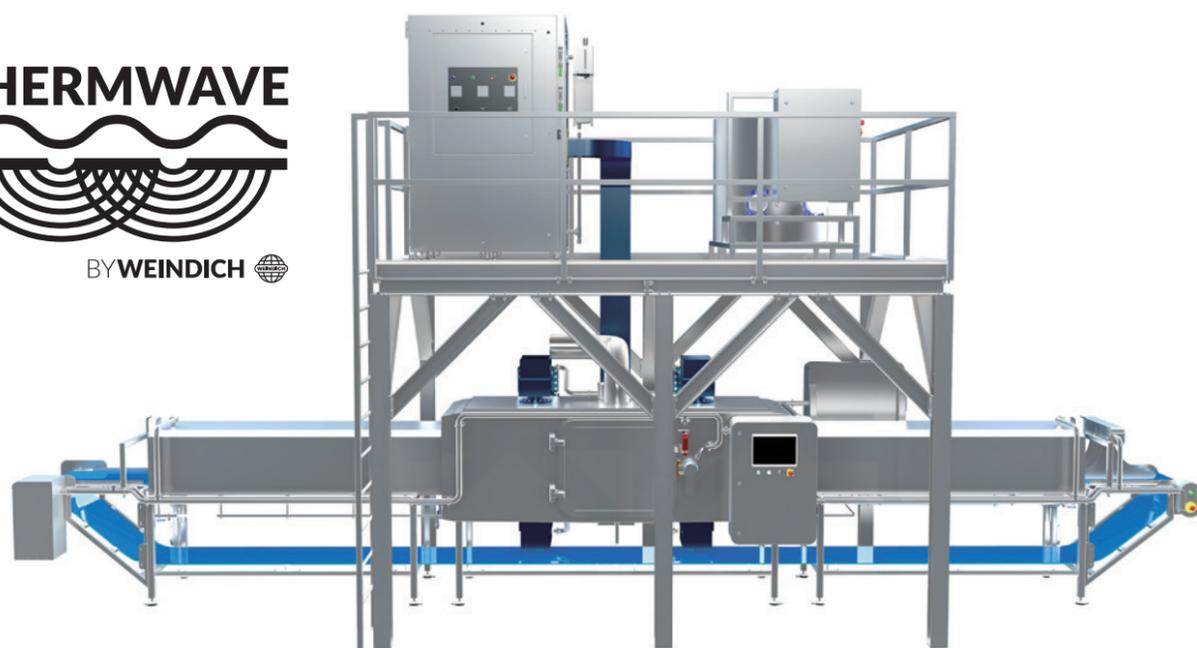
drying
blocks of meat (boneless), fruit, vegetables, wood, and ceramics



pasteurization
ready-made meals, e.g. frankfurters



cooking
ready-made meals in sauce



TECHNICAL SPECIFICATION

1. Connected load of the generator 110 kVA.
2. Connected load of the line 15 kVA.
3. Pneumatic connection 0.2 bar, 0.31 m³/min.
4. Maximum microwave power 75 kW.
5. Efficiency, depending on the application/product/end requirements.

DIMENSIONS OF THE MACHINE:

1. Length 9.2 m.
2. Width 1.6 m.
3. Height 2.0 m.

SAFETY OF THE SYSTEM

1. With regard to microwaves – the key safety element of the machine is two microwave leak sensors that are calibrated so that the machine is stopped when even the smallest microwave leak is detected.
2. With regard to electric shock – the system is equipped with dual disconnecter and switch systems and with numerous interlock systems that prevent operation of the machine in dangerous conditions, e.g. when the generator cabinet door is opened.
3. With regard to protection of the magnetron and to economic aspects – the system is designed to prevent switching the generator on when there is no product in the chamber.

SERVICE AND MAINTENANCE

In addition to downtime associated with cleaning and inspections, conventional heating and drying systems require periodic maintenance using expensive spare parts and performed by highly specialized personnel. In the case of microwave systems, the only element that requires maintenance and is the magnetron. Like all electron tubes, the magnetron has a limited service life and should be considered as a consumable. However, there is a number of factors that affect its service life. Most of all, a magnetron must be provided with an appropriate cooling system. Most magnetrons with power below 3 kW require only air cooling. On the other hand, most magnetrons with power above 3 kW require water cooling systems to properly dissipate the heat they generate.

Generator

a power electronics system enclosed in an electrical cabinet, equipped with a magnetron (an element responsible for generating microwave energy), control system elements, waveguide elements, and microwave accessories. It is the „engine“ of the entire machine.

The set of antennas

with a correct operation monitoring system, ensures the best distribution of microwaves inside the chamber.

Product entry and exit tunnels.

A modular belt conveyor

600 mm wide, ensuring continuous transport of the product across the entire machine. It is equipped with a system for monitoring the movement of the belt and to trace the product in the chamber, which ensures adjustment of the microwave power according to the extent to which the working chamber of the machine is filled. Also, the system monitors the integrity of the tape.

Control system

enables recording recipes with descriptions and process parameters.

Waveguide

a passive element of the machine responsible for transport of microwave energy from the generator to the work chamber of the machine. Thanks to the waveguide, the generator can be located in a separate location from the machine so as to enable better use of the available space.

Work chamber

This is where the microwave heating takes place. Depending on the process, the product may be thawed, dried, cooked, or pasteurized. The product enters and exists through properly designed tunnels that ensure safe operation. Microwaves are brought to the chambers through antennas that ensure even distribution of the microwave field so as to achieve the highest uniformity of the heating. Also, the chamber is equipped with a door that enables easy access after the work is completed and easy cleaning of the machine. It is provided with coded active safety elements and a system for monitoring and control of bolting elements from the control system level.

A stainless steel structure

designed so as to ensure the highest level of hygiene.

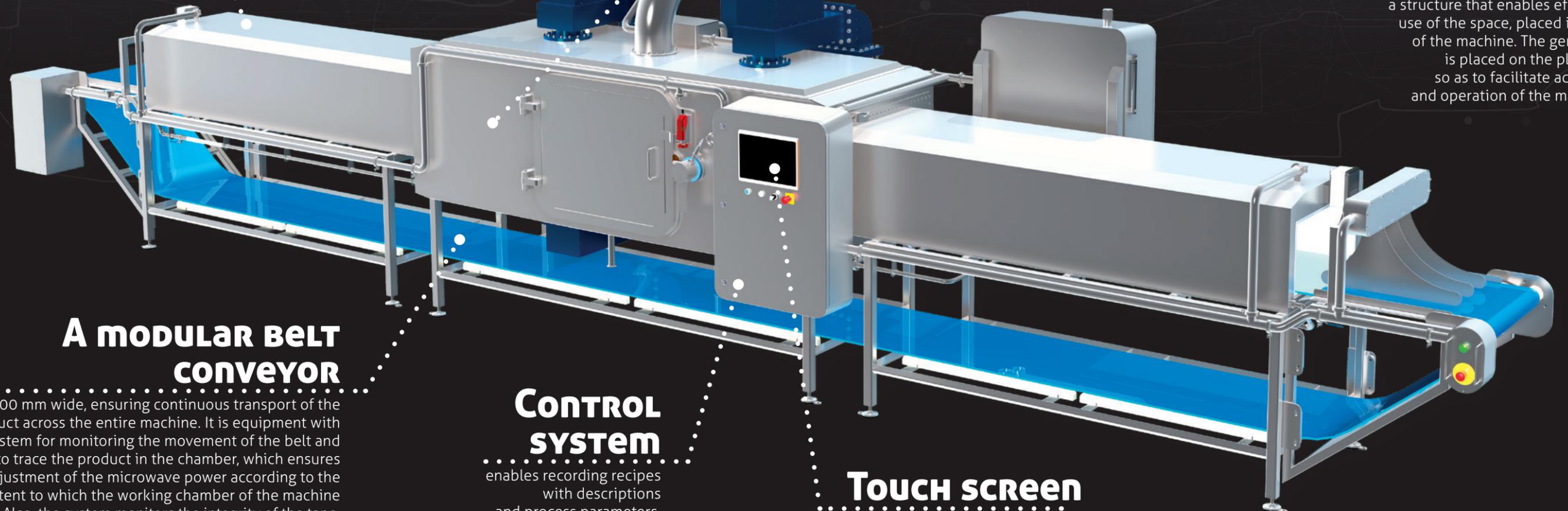
Platform

a structure that enables effective use of the space, placed in front of the machine. The generator is placed on the platform so as to facilitate access to and operation of the machine.

Touch screen

PanelView Plus 7–12" to control the entire system.

6. ELEMENTS OF THE SYSTEM. TUNNEL ARRANGEMENT





7. BENEFITS RESULTING FROM USE OF MICROWAVE SYSTEMS

Every food producer who makes thousands of kilograms of food every day knows very well how important it is to have highly efficient and reliable machines and equipment in his facilities. Due to high competition and high supply of goods in the market, customers force food companies to quickly adapt to their frequently changing needs. Quick reaction and ability to satisfy the demand existing at a given time largely determine the profitability level of the production.

WHY MICROWAVE SYSTEMS?

1. Microwaves generate energy of higher power density, thus increasing the efficiency and reducing the production costs.
2. Microwave systems are more compact and require less working space.
3. Microwave energy is highly controllable and can be switched on and off immediately, which eliminates the need for warming up and cooling down. The lack of high temperature on the surface of the product reduces the risk of burns and overheating to a minimum.
4. Microwaves reduce the time of production, washing, and disinfection, and the quantity and cost of products used for this purpose.
5. Microwaves enable contact-free drying method.
6. Microwave energy ensures uniform distribution of energy. This results in a more uniform temperature and humidity profiles, higher yield, and higher efficiency. This, in turn, eliminates such shortcomings of conventional drying as loss of weight by drying, hardening, and cracking of the surface, as well as local overheating.
7. Use of the microwave technology eliminates production of inflammable waste gases, which eliminates the need for any special environmental permits.
8. Appropriate for the most demanding processing.
9. Enable sterilization of all products with high content of proteins and vitamins, e.g. food for children.
10. Compared to conventional heating, more nutrients and flavoring and aromatic ingredients are preserved in microwave-heated food products.

8. CUSTOM-MADE BUSINESS SOLUTIONS

We create custom-made microwave solutions. Tell us what the needs and plans of your company is and we will design, manufacture, and implement microwave solutions that are custom-made for you and will enable you to optimize your production processes and improve the quality of your end product. **Do not wait: use microwave technologies and grow your business!**

BUSINESS COOPERATION MODEL

01. ANALYSIS OF THE CUSTOMER'S PROCESSES:

his needs, expectations, and problems;

02. TESTS AT THE CUSTOMER'S FACILITIES,

preparation of the details of the purchase order;

03. PREPARATION OF THE TECHNOLOGICAL PROCESS,

selection of proper parameters of the equipment;

04. DESIGN AND PRODUCTION OF THE EQUIPMENT

with the entire system (tunnel, generator, platform, and cooling system);

05. ASSEMBLY INCLUDING CONSTRUCTION OF SYSTEMS,

startup of the equipment;

06. COMPLETE TRAINING OF THE STAFF,

preliminary selection of products;

07. INVESTOR SUPERVISION,

advice, service.



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