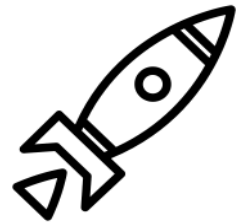
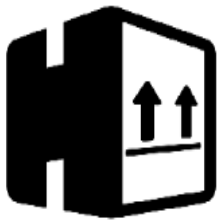





Complete Engineering Solutions...

About KERONE

KERONE is one of the most admired and valuable company for customer satisfaction.

KERONE has reported annual revenue of $18 to $20 Million , increasing year-on-year.

KERONE is possessing employee strength of more than 280 experts continuously putting efforts for happy industrial engineering solutions

KERONE is possessing experience of 48+ years in engineering excellence.

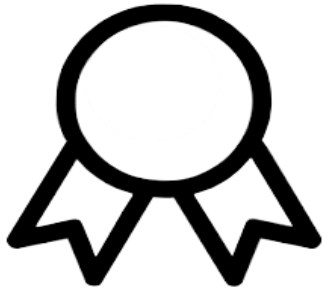
KERONE is having immense expertise in manufacturing and implementing various types of engineering solutions.

KERONE is possessing employee strength of more than 280 experts continuously putting efforts for happy industrial engineering solutions.

KERONE

48+

Years Experience



150+

Experts

5000+

Satisfied Clients

280+

Employees

Our Vision and Mission

Vision

- Turn into world leader in providing specialized, top-notch quality and ecologically sustainable industrial heating, cooling , drying and engineering solution across the globe.
- To attain global recognition as best of quality and environment friendly engineering solution company.

Mission

- To enhance the value of customer operation through our customer need centric engineering solution.
- We are committed to provide our customers, unique and best in class products in Industrial heating, drying and cooling segment, with strategic tie-up for the technical know-how with renowned leader in the industry specific segment.
- We are company that believes in strong ethics and timely commitment helps to build long term relationship.

Value Propositions

Highly
Customized Product

Sound
Infrastructure

Adherence
to
Standards

Timely
Delivery

Team of experts
Delivering Quality

Cost Effective
Solutions

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Recognized and Rated by CRISIL	CRISIL Verified	Member of A.M.P.E.R.E. (Europe)	ASCB(E) Certification for Best practice

We are Certified by...

ROHS

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ISO 9001:2008 | ISO 9001:2015 | OHSAS 18001 | EMS 14001

Microwave Vacuum Technology

Introduction

- Heat-drying has become important in almost all areas of industrial processing. Apart from the popular conventional procedures based on conduction, convection, or infrared radiation, heat- drying utilising microwave energy is an attractive solution to many problems in process technology. In microwave drying, heat is generated by directly transforming the electromagnetic energy into kinetic molecular energy, thus the heat is generated deep within the material to be dried. Especially in vacuum drying the fact of volume heating gives an enormous importance in order to dry bulk and viscous products with low thermal conductivity.
- MVT has gained prominence in materials science for sintering, annealing, and synthesis of advanced materials. The rapid and uniform heating provided by microwaves enables precise control over the material's microstructure and properties. In the electronics industry, MVT is used for vacuum drying of sensitive electronic components, leading to improved reliability and performance.

What is Microwave Vacuum Technology?

- Microwave Vacuum Technology (MVT) is a specialized technology that combines the principles of microwave heating and vacuum processing. It involves the use of microwaves to heat and treat materials in a vacuum environment. This unique combination offers several advantages and applications in different industries.
- In MVT, microwaves are electromagnetic waves with frequencies ranging from 300 MHz to 300 GHz. These microwaves penetrate the material being processed and interact directly with its molecules. Unlike traditional heating methods like conduction, convection, or radiant heating, microwaves cause the molecules to rotate rapidly and generate heat from within. This volumetric heating effect enables fast and uniform heating throughout the material.

Working Principles

- MVT utilizes microwaves, which are electromagnetic waves with frequencies ranging from 300 MHz to 300 GHz. These waves consist of electric and magnetic fields that oscillate rapidly. When microwaves encounter a material, they interact with its molecules.
- MVT employs a phenomenon known as dielectric heating. When microwaves pass through a material, the electric field causes the charged molecules within the material to rapidly reorient themselves to align with the changing field direction. This continuous reorientation of the molecules results in friction and collisions, leading to the generation of heat within the material.
- Unlike conventional heating methods that primarily heat the surface of a material and rely on heat conduction to transfer energy to the interior, MVT offers volumetric heating. Microwaves penetrate the material and directly interact with its molecules, causing them to rotate and generate heat from within. This results in rapid and uniform heating throughout the material.

Working Principles

- The vacuum environment plays a crucial role in MVT. By removing air and other gases from the processing chamber, the vacuum reduces the thermal resistance between the material and the microwaves. This facilitates efficient transfer of microwave energy to the material, leading to faster heat transfer and more precise control over the heating process.
- MVT enables a wide range of thermal processing operations such as drying, pasteurization, sterilization, sintering, and annealing. By adjusting the power and duration of the microwave energy and controlling the vacuum level, the temperature and processing conditions can be precisely controlled. This allows for optimized processing parameters tailored to the specific material and desired outcome.

Applications

- ## Food Processing

  MVT is utilized in the food industry for several processes, including drying, pasteurization, and sterilization. The rapid and uniform heating provided by microwaves allows for efficient removal of moisture from food products, resulting in reduced processing times and improved product quality. MVT can also be used for pasteurizing and sterilizing food, ensuring safety and extending shelf life while preserving the nutritional content and sensory properties of the food.

- ## Pharmaceuticals

  In the pharmaceutical industry, MVT finds applications in drying and formulation processes. The precise control over temperature and vacuum conditions allows for gentle and efficient drying of pharmaceutical products, including powders, granules, and capsules. MVT is also utilized in the formulation of drugs, where it can be used for blending, granulation, and coating processes. Additionally, MVT can be employed for sterilizing medical equipment and devices, ensuring proper hygiene and safety.

Applications

- ## Materials Science

  MVT plays a significant role in materials science research and development. It is used for sintering, a process that involves heating and compacting powdered materials to form a solid object. The rapid and uniform heating provided by microwaves allows for controlled sintering and improved material properties. MVT is also used for annealing, a process of heating and cooling materials to alter their microstructure and improve their mechanical or electrical properties. Additionally, MVT can be employed for the synthesis of advanced materials, such as nanoparticles or thin films, where precise control over heating conditions is crucial.

- ## Environmental Applications

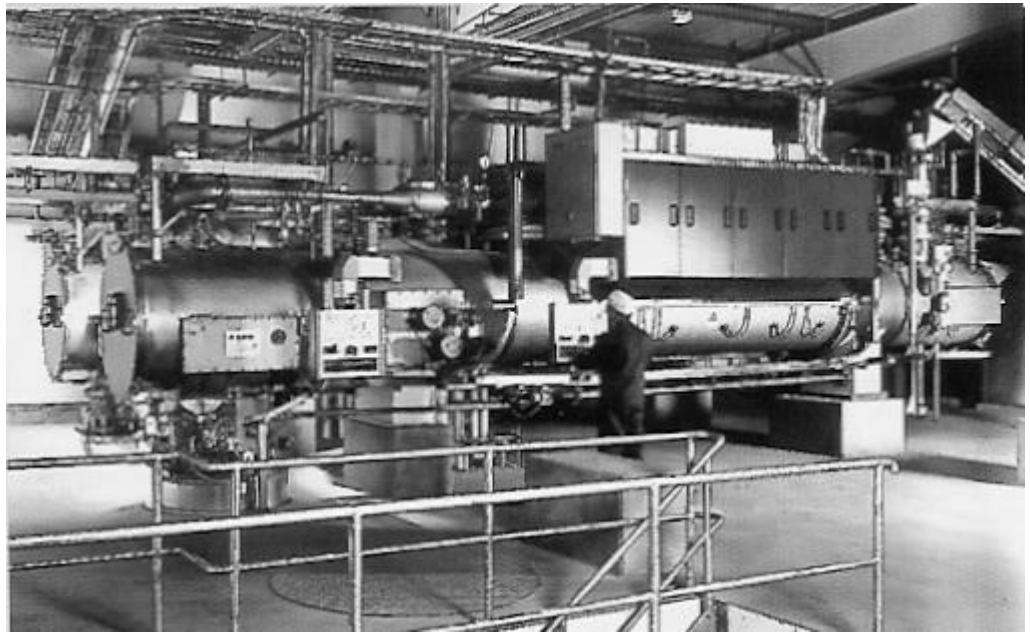
  MVT can be applied to various environmental processes, such as wastewater treatment and waste management. Microwaves can be used for drying sludge, reducing its volume and facilitating its disposal. MVT can also be employed for the decomposition of hazardous waste materials or the decontamination of contaminated soil.

Advantages

- A temperature gradient directed towards the surface, i.e. temperatures inside are higher than on the outside giving rise to a higher partial pressure that drives the evaporating liquid to the surface
- Consequently, the superficial layer does not dry out completely and the surfaces remain permeable
- The liquid evaporating inside the product is emitted through the pore structure of the solid material's macro-capillary system, resulting in a high drying velocity
- The heating of water and most organic solvents occurs selectively - due to the greater dielectric losses of water as compared to the product to be dried
- Swift and thorough drying of moist products with low thermal conductivity
- Stationary drying of thick layers without frictional losses
- High total efficiency of energy application
- High-speed control of the energy transport
- Short processing times, i.e. suitable for automated manufacturing

Benefits

- Local controlled energy zones with high controller speed
- Defined and short residence times of the product to be dried
- Cooling zone at the outlet for viscous products
- Closed system
- Simple setting of different plant operation modes for every product
- Continuous operation mode possible
- Short process times, high efficiency and full automated guarantees an economic operation
- Service friendly because of modular system and full-automated cleaning



Special Conditions for Vacuum Drying

For integration of microwave components into a vacuum system, some important high frequency specific items have to be taken into consideration. These are in particular:

- Dielectric properties
- Installed transport systems
- Product throughput rate
- Drying parameter
- Used vacuum, in particular the depth of the vacuum

A homogenous microwave energy distribution over the cross section of the product bed is a significant requirement. Especially in applications of end-drying or in applications using products with poor dielectric losses, special microwave antenna systems are required in order to achieve even temperature and drying results.

Special Conditions for Vacuum Drying

Also peaks in the electric fields strength have to be avoided using high quality DC microwave power supplies, because the breakdown field strength is reduced by the vacuum. If the breakdown field strength is exceeded, the results are sparks and plasma.

The process parameters as well as the microwave applicator or microwave antenna system have to be evaluated using microwave vacuum trial plants. Figure 2 shows a microwave trial plant, which can be equipped with different applicators or antenna systems. Using an infrared and fibre-optical temperature measurement system, core and surface temperatures can be measured. Additional the weight loss, pressure and the absorbed microwave energy can be measured also.

Recent Developments

- ## Advanced Control Systems

  Recent developments in MVT may involve the integration of advanced control systems for more precise and automated processing. These systems could include real-time monitoring and feedback mechanisms, allowing for enhanced control over temperature, vacuum levels, and processing parameters.

- ## Improved Efficiency and Energy Management

  Researchers and engineers may have focused on optimizing the efficiency of MVT systems by developing new microwave sources, waveguide designs, and vacuum pump technologies. These advancements could lead to improved energy management, reduced energy consumption, and enhanced overall system performance.

- ## Enhanced Processing Techniques

  Ongoing research may have explored novel processing techniques using MVT. For example, researchers may have investigated the use of MVT for selective heating or localized treatments, enabling more targeted processing and control over specific regions within a material.

Recent Developments

- **Multifunctional MVT Systems**

  Recent developments may have focused on expanding the capabilities of MVT systems. For instance, efforts may have been made to integrate additional functionalities, such as the ability to perform multiple processing steps sequentially or simultaneously within a single MVT system.

- **Application-Specific Innovations**

  Researchers and industry experts might have explored new applications and process improvements in specific industries. This could involve advancements in MVT for specialized processes, such as controlled crystallization, controlled-release drug formulations, or advanced material synthesis techniques.

Summary

- Microwave Drying has a big advantages compared with conventional drying, because in microwave drying, heat is generated by directly transforming the electromagnetic energy into kinetic molecular energy, thus the heat is generated deep within the material to be dried.
- Especially in microwave vacuum drying this advantages has a big significance for viscous and bulk products with poor thermal conductivity.
- The described microwave vacuum technology is used for high-end drying applications of thermo sensitive products in order to achieve higher product qualities and shorter drying times.
- Using appropriate process control even applications with explosive protection can be managed.
- As microwave vacuum technology always has to cover specific application requirements due to the transport system, microwave applicators, dielectric losses of the product, the effort on development work is quite high. Therefore this technology is mainly used for high value products.

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