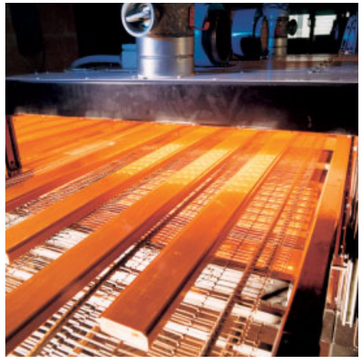
Tested, Checked and Proven

Know-how with tradition
Heraeus Noblelight has many years' experience in infrared heating technology and provides individual advice and service. Heraeus Noblelight offers its customers the capability for proving trials in its in-house Applications Center or on-site with experienced technical assistance. In Application Centers in Kleinostheim (D), Liedekerke (B), Neston (GB), Atlanta (USA) and Cavenago Brianza (I), you can examine the effects of infrared and the different infrared spectral radiation on your product as well as measure the temperature distribution during the heating process. From these results Heraeus engineers can calculate the required power output and other parameters needed for your new thermal process. In addition we offer a range of portable test equipment which can be used for an online appraisal of the benefits of infrared.

Areas of Application
- Heating
- Drying
- Coating
- Laminating
- Annealing

Tests in the Application Center



Tests with customer materials

Heraeus Noblelight is your partner for industrial heating processes in
- Glass
- Plastics
- Textiles
- Automotive
- Semi-conductor Manufacture
- Food Processing
- Print and Paper
- Electronics
- Metals

Heraeus sales engineers use 30 years of company experience from all major industries to give you expert guidance during the initial stages of your thermal process design.

Drying trials on-site with portable test equipment

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Heating Techniques for Plastics Processing

Heraeus Noblelight

Heating for Plastics

Commodities or objets d'art, high-tech equipment or toys, packaging materials or construction materials – we come across plastics today in all shapes and forms used in seemingly countless applications. In space exploration and in the house, in clothing and for food packaging, in medicine and for protecting the environment – plastics are not only used as a substitute for other materials but often provide the solutions to previously unsolvable problems. In all sectors of modern industry, plastics are processed to form part of a product or to protect a product.

Heat plays a central role in forming and processing plastics, especially thermoplastics. Heat is used for softening and forming operations such as bending, stretching, blowing, deep drawing and stamping or for packaging materials with sterilised wrapping, shrink wrapping, heat sealing, laminating. Heating can also be used to temper, harden, glue and dry plastics. Heating processes are even used to separate plastic waste. Infrared radiation is a key technology in plastic processing and offers many possibilities for heat transfer.

Infrared heat meets all requirements

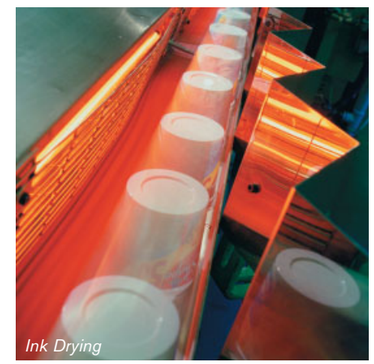
- Heat transfer is simple – it requires no contact with the material and no intermediate medium such as air or water.
- Infrared transmits high power – foils, plates and even irregular shapes are heated in seconds.
- The heating process fits in easily with the manufacturing process – by appropriate choice of emitter or emitter cassette, the heating can be matched to the speed of the process.
- The process is economical – the correct emitter selection allows high efficient heating. Moreover, the heat loss is small, since the radiation is directed at the process material.
- Infrared processes are compact and generally have a smaller footprint in the factory.
- Infrared heat can be targeted exactly where it is required. Large surfaces can be heated in exactly the same way as small parts, curved surfaces or solid plastic materials.
- Infrared radiation is safe and can be easily switched on and off.
- Targeted infrared is innovative use of a traditional, reliable technology.
- Targeted heating allows new finishing processes to be developed.

Heraeus offers complete infrared technology

- Infrared emitters, including processing raw quartz, are produced by Heraeus.
- Infrared modules and complete infrared systems are built to customer specifications.
- Control systems for modules and systems are designed in-house.
- A technical centre for investigating infrared applications is available.
- Heraeus has many years of experience providing solutions for hundreds of installations.
- Comprehensive advice and customer care are always available.

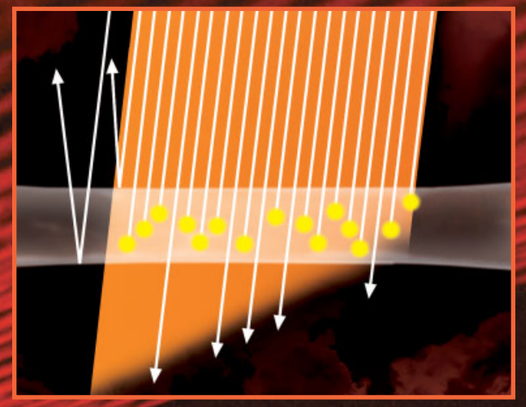
Infrared emitters for targeted applications

New emitters and emitter shapes are developed in close and confidential collaboration with customers. These new developments extend the application of infrared technology in your process and help create new processing technologies.

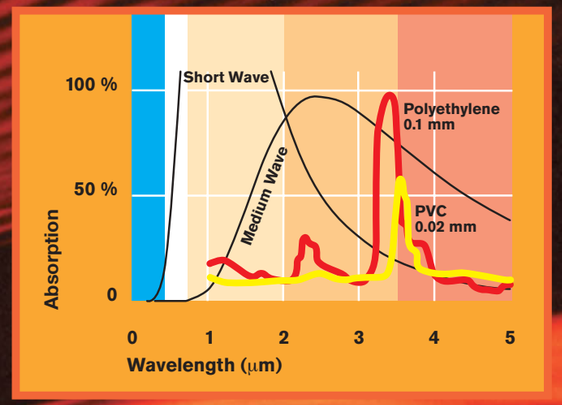


Ink Drying

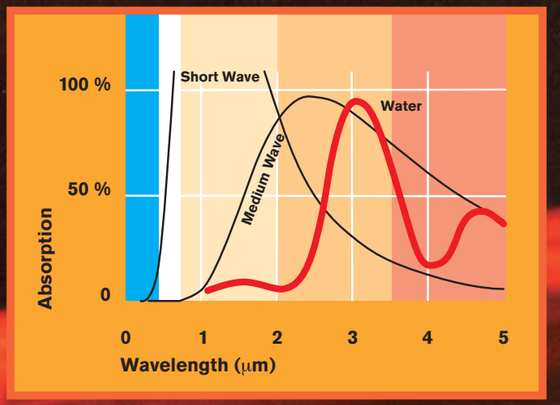
The heating power of the sun is the perfect natural example. Infrared radiation is the heat which we feel in sunlight. Like light, infrared radiation is electromagnetic radiation and is transmitted just as quickly and at virtually unlimited power.
With infrared technology we use the infrared radiation energy in a controlled manner. Heraeus emitters supply the infrared radiation which is converted into heat when absorbed by a material. Twin tube emitters achieve a particularly high radiation strength because they double the radiation density directed towards a material.



According to their material properties, plastics absorb some of the infrared radiation, reflect some at the surface and allow some of the radiation to pass through.
By carefully selecting emitters to match their spectra to the material being processed, the majority of the radiation is absorbed and converted to heat creating an efficient operation.



The absorption spectra for polyethylene and polyvinylchloride (PVC) show strong absorption for infrared radiation between 2.5 and 4 µm. For these materials medium wave emitters have a greater efficiency then short wave and halogen emitters.



This overlay of the absorption spectrum of water demonstrates that medium wave emitters also have a significantly higher efficiency than short wave emitters for drying applications.

Infrared Radiation – natural heat

Infrared has many spectra

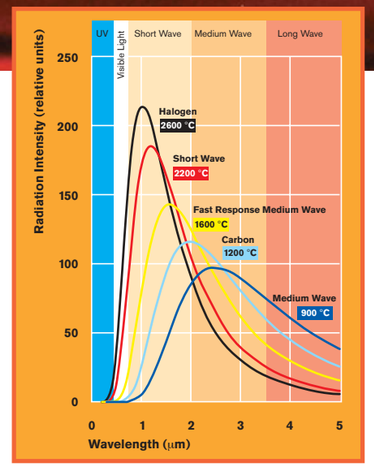
Infrared rays are electromagnetic waves just like visible light. In incandescent lamps and halogen emitters, infrared radiation is produced together with visible light. Oscillating atoms or molecules in (hot) matter emit electromagnetic waves.
The many different oscillations produce a wide spectrum of wavelengths – from visible light to long wave infrared.
With infrared emitters the temperature of the emitter determines the spectral distribution of the wavelengths produced. With decreasing temperature, the spectrum shifts to the longer wavelengths. The position of the peak intensity in the spectrum gives the emitters their name – short wave, medium wave and long wave emitters. Emitters manufactured with very specific heating elements produce optimum properties for these wavelengths.

Only the infrared radiation which matches the processed material is absorbed

Just like visible light, a part of the broad infrared radiation spectrum is reflected from the surface of the material while the rest is either absorbed within the material or passes through the material. Every material consists of molecules and molecular structures that absorb specific radiation wave-lengths. The radiation wavelength that is absorbed by a material coincides with the wavelength of the molecular oscillation in that material. For instance, plastics generally absorb infrared radiation in the wavelength range above 2 µm.

Wavelength fitting to the material

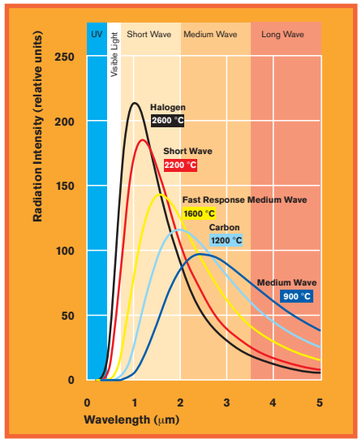
Thin materials such as foils are difficult to heat with short wave infrared because only a small component of the short wave radiation matches the absorption spectrum of the material. Thin materials are transparent to the infrared radiation and short wave IR is not efficient. Medium wave radiation, on the other hand, is absorbed more readily and the result is that the foil heats significantly faster at the same electrical power input.



To avoid the loss of radiation Heraeus offers a **wavelength converter**, consisting of a plate with mineral fibers. This absorbs the radiation which has passed through the material and radiates it back into the material at a different wavelength.
The wavelength converter absorbs transmitted infrared radiation, heats up to 500 - 600 °C and then radiates back medium- and long wave radiation. For solid materials, because of low absorption rates, short wave infrared penetrates deep into the material and provides uniform volumetric heating. Medium wave radiation is absorbed in the material's outer layer and generally heats only the surface.
With the correct infrared emitters, heating plastics can be controlled according to very specific requirements. Pigments in coloured plastics increase the infrared absorption.

The power density determines the amount of heat transferred

In turn, the amount of heat transferred to the material depends on the emitter's power, its temperature and distance from the material. Once the product material has determined the spectrum, the spectrum fixes the temperature and thus the electrical power of the emitter. Therefore, to increase the amount of heat transferred, the power density (radiation output per unit surface area) has to be increased. This is achieved by physically arranging the emitters, by using twin tube emitters and by additional reflectors.

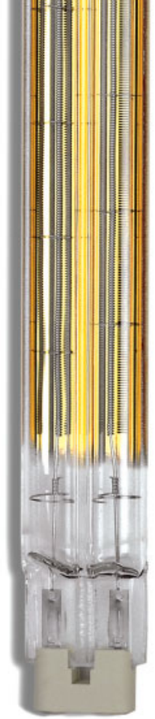


The infrared spectrum of different Heraeus emitters. The curves show the radiation intensity in the different wavelength ranges at the same electrical power ratings. While the halogen emitter in the short wavelength region provides the highest power output, carbon emitters and medium wave emitters have significantly higher outputs at wavelengths above 2 µm.

Halogen Short Wave/NIR

Halogen Short Wave/NIR

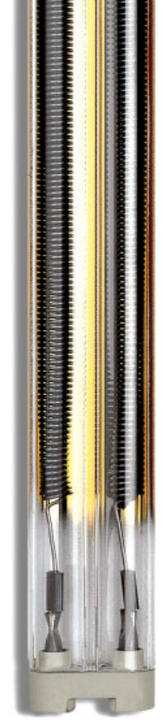
Short Wave



Fast Response Medium Wave

Carbon Round Tube

Carbon Twin



Medium Wave

Infrared Emitters – for every application

As a supplier of complete infrared technology, Heraeus offers a wide range of infrared emitters which have been developed for many different materials and process technologies. The right match for your process means will save energy, heat faster and increase productivity.

Infrared Spectra define the heat distribution in plastics. By matching the infrared spectrum to a specific application, the process flow rate, heating time and energy used are optimised.
The emitter's rates of heating and cooling are important for control, cycling process stages and process safety. Short wave emitters, fast response medium wave emitters and carbon emitters have the quickest response times and therefore the most favourable control characteristics.
Radiation Output for infrared emitters reaches a maximum between 1 MW/m^2 for halogen emitters and 20 – 80 kW/m^2 for medium wave emitters.

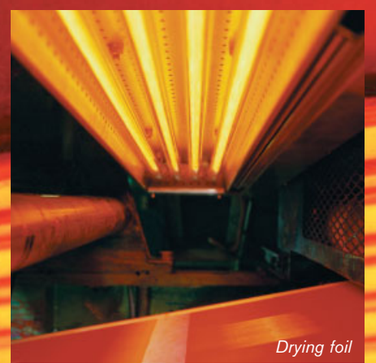
Length and Physical Strength
Halogen emitters are manufactured with a heated length of up to 1 m and carbon emitters with a heated length of up to 3 m. Because of their high physical strength, twin tube infrared emitters can be supplied in any length required up to 6 m.
Gold Reflectors (Au) which Heraeus places on its emitters can virtually double the efficiency. The gold coating reflects approx. 95 % of the IR radiation that would otherwise be wasted.
Non-Dazzle IR Emitters – for safety reasons with some applications it makes sense to filter out intense light radiation. This is achieved by applying an antiglare coating on short wave emitters.
Emitter Shapes can be designed to meet your individual needs. Since Heraeus processes quartz we can produce twin tube and round tube emitters in curved shapes. Consequently, the heating process can be matched exactly to your manufacturing line resulting in custom-made targeted heating.

InfraLight Halogen Emitters are cost-effective emitters produced to standard commercial dimensions used in many infrared systems. Heraeus Gold reflectors increase the efficiency of the halogen infrared emitters. This short wave, high light component emitter is used to heat thick sheets and solid plastic materials.
Short Wave, Twin Tube Emitters are comparable in spectrum to halogen emitters. Because of their stable construction, twin tube emitters can be supplied in lengths up to 2.4 m. They offer virtually double the life compared to halogen emitters because of their stronger heating elements.

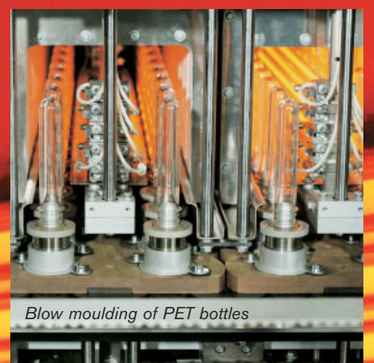
Fast Response, Medium Wave Emitters are twin tube emitters with a spectrum between short wave and standard medium wave emitters. These emitters can be supplied in lengths up to 6 m so they are ideally suited to be used in large modules. They achieve a significantly higher area heating power than standard medium wave emitters.
Carbon Infrared Emitters CIR are a recent development. These emitters use a carbon ribbon as the heating element. They have very fast heating times (1.5 sec) which means they are especially suitable for processes where the heat must be switched on and off quickly. The spectrum is the same as medium wave emitters so carbon emitters are efficient for heating plastics and for drying processes. They are produced in lengths up to 3 m.

Medium Wave Emitters distinguish themselves by being highly efficient and stabile while having a long operating life. The Medium Wave Emitter spectrum is well suited for heating processes with most materials and the emitters are available in lengths up to 6 m.
Emitters for Targeted Heat
They heat small components, part surfaces or curved surfaces. These emitters represent a genuine integration of heating technology into the manufacturing process. They allow manufacturing processes to be simplified and sometimes processes can be completely reengineered.

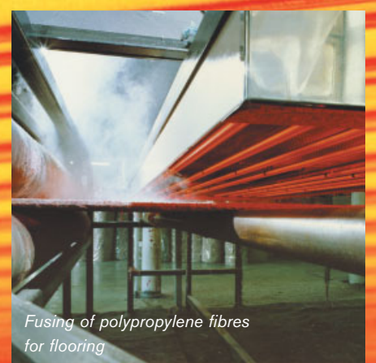
Cutting PTFE foil



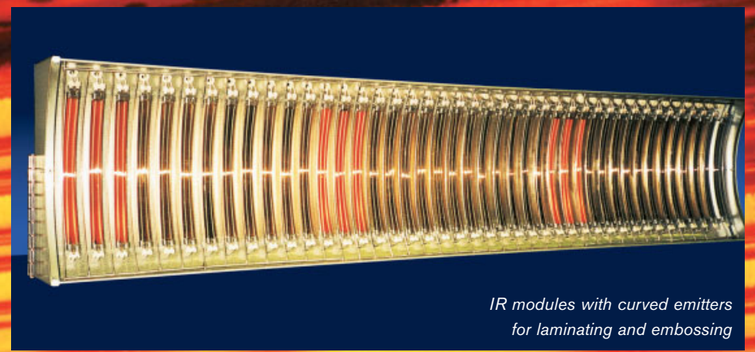
Drying foil



Blow moulding of PET bottles



Fusing of polypropylene fibres for flooring



IR modules with curved emitters for laminating and embossing

Drying of granulates

Infrared Modules – process heating to order

Infrared modules comprise small and large emitter cassettes, mobile drying systems or IR dryers combined with an intensive air flow.

Modules – manufactrued for the process

The Heraeus KR-module is the infrared building block for every application. The modules are tuned and equipped to suit your particular process and come in a variety of sizes to accommodate a range of customer systems. The module systems have custom built infrared emitters and are designed to supply exactly the required power for your process. The module design also takes into account issues specific to infrared technology such as emitter design, mounting, thermal and mechanical stability, visual and contact protection and ventilation. These modules are ready for immediate connection, either for retro-fitting or for installing in new projects.

Infrared systems – complete thermal processes

If needed, Heraeus can supply complete infrared systems with automatic emitter output and product temperature control. Our systems are a combination of infrared modules and come complete with a switch-board cabinet. Every module and system combines comprehensive infrared technology and Heraeus application know-how.

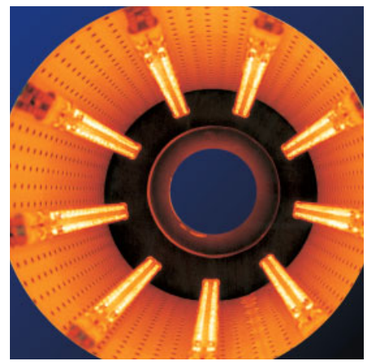
All possibilities

In designing a heating module, the most important consideration is developing a productive solution for the specific heating requirement. Because of our modular concept, Heraeus can provide heating for practically any size application using emitter lengths up to 6 meters. Our flexibility with emitter length, design, and control means that virtually every industry process requiring thermal technology can be accommodated. Situations having production lines with varying widths, specific temperature profiles, high power density requirements are easily handled including control specifications.

Applications

Different process cycles and the large range of different materials make every application and every module seem different. However, using our modular concept, Heraeus is able to use standard emitter sets in such diverse processes as continuous material webs with carpets and thin foils, gluing shoe soles, laminating, drying granules, blow molding bottles and heating tubes before forming. From the design data that is normally obtained by collaboration with customers at the Heraeus technical centre, the heating modules are matched to your needs. When designing the heating modules take into account the material, energy requirement, production rate (output) needed, desired temperature profile and safety requirements. The modules are then built by Heraeus to match your individual specifications.

We are sure your heating challenge can be solved here as well.

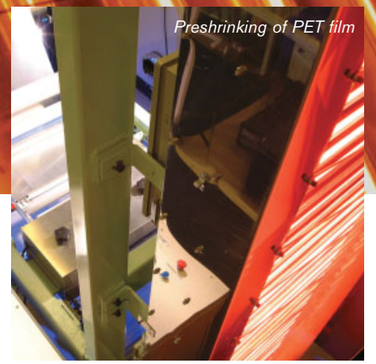



Rivet heater


Small surface emitter


Plastic heating
with an Omega emitter


Plastic welding


Preshrinking of PET film


Curing paint on plastic bumpers

Targeted Heating – the innovative Infrared Technology

There is a real challenge in those processes where only very small or curved surfaces, corners, edges or specific contours of a product need to be heated.

Contour emitters are individually formed to replicate corners or edges of work pieces and so allow targeted bending processes or localised activation of adhesives.
Small surface emitters heat complex geometries.
Omega emitters and **Rivet heaters** are perfect for hot staking, hot riveting or tube forming.
All of these emitters are matched to the particular process in terms of shape, size and spectrum. Heat is totally targeted where it is required. Not the car door, only the plastic hot rivet, not the complete lining only the corner is heated. Consequently, energy losses are as small as possible. Heraeus provides solutions which fit into your process and are completely tuned to your requirements.


Contour infrared emitter activating adhesive on a rubber sleeve


Welding of glass-filled polypropylene cylinders

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