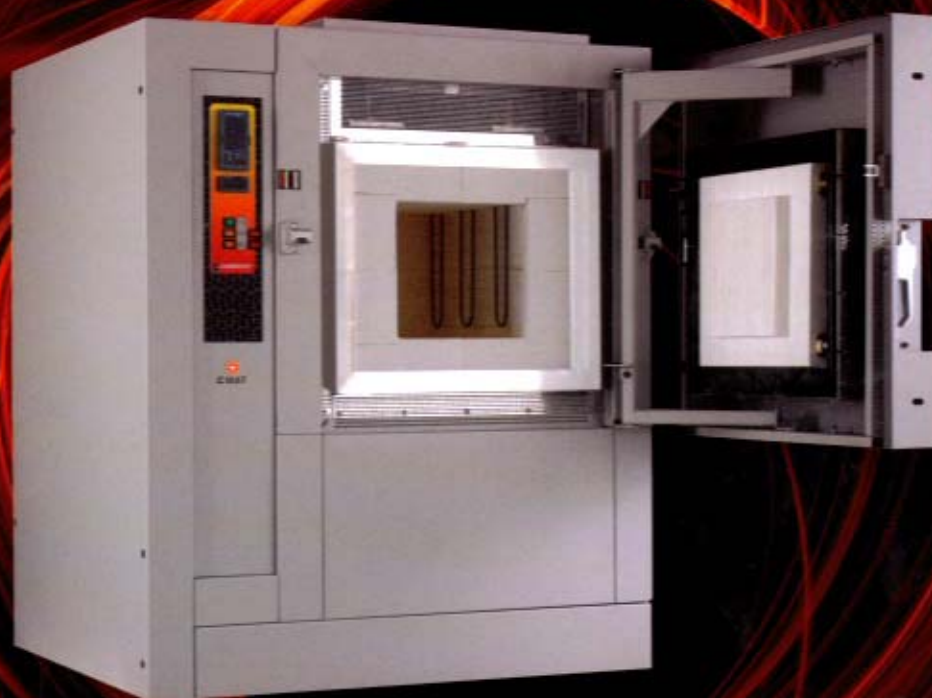




Microwave Assist Technology Furnace

MRF 16/22



CMAT[®]

BACKGROUND

The MRF 16/22 CMAT furnace blends Carbolite's 70 years of expertise in the design and manufacture of traditional furnaces, with leading edge technology developed under licence from C-Tech*.

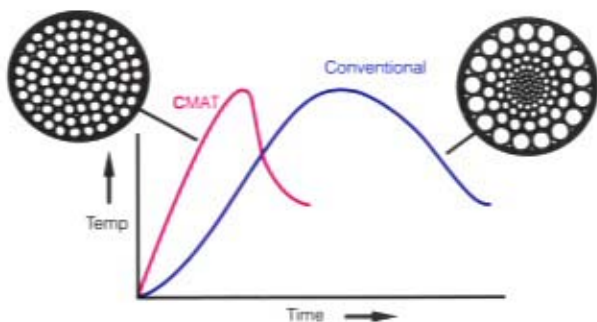
Microwave Assist Technology (MAT) combines the effect from traditional free radiating elements with the volumetric heating effect of a microwave field. The success of this initial research led to a patent being filed by C-Tech Innovations Ltd.

Since 1993 C-Tech Innovation worked at scaling up MAT technology for use in the production of ceramics. They were successful in proving the potential for significant cost saving by reducing the energy required to process samples with the added benefits of improvement in qualities such as densification and crystalline structure.

HOW MAT WORKS

Conventional free radiating elements heat the outside of a sample, with the deeper parts only heating more slowly through conduction. Microwave only heating methods, heat the susceptible components of a sample throughout its volume, making it hotter than the surrounding atmosphere. Without any external source of radiant heating the outer surface loses heat to its surroundings, becoming cooler than the centre of the sample. In both cases these thermal gradients put the sample under stress and can cause damage during heating and cooling.

Traditionally this has been overcome by extending the process time so that the heating rate remains slow. The disadvantages of this are that not only are cycle times extended and more energy is required, but as the exterior surface is heated for longer, unwanted physical and chemical changes can be produced. This can result in sintered materials developing a coarser less desirable crystalline structure on the exterior before the desired densification takes place in the interior.

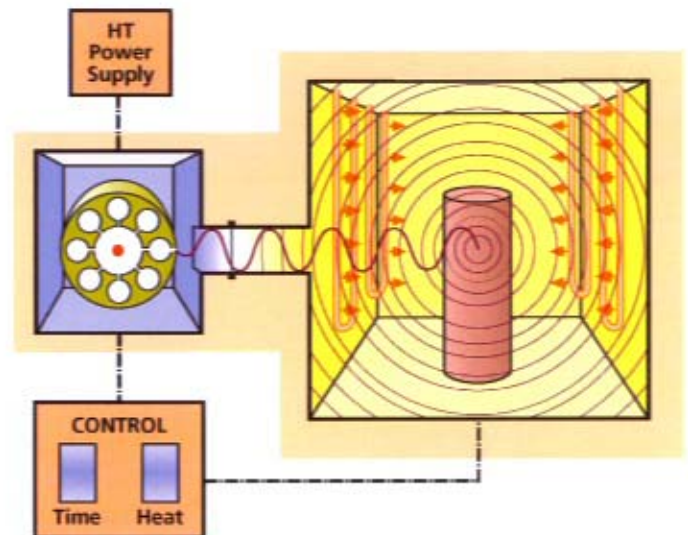


Comparison of conventional & Cmat Sintering

Microwave Assist Technology (MAT) provides the ability to balance radiant and microwave heating effects, offering the potential to heat susceptible materials, faster and more uniformly, with consequential savings in energy consumption and the production of materials properties that cannot be achieved by other means.

Advantages of MAT

- ✓ Greater energy efficiency
- ✓ Faster sample heating
- ✓ More uniform heating
- ✓ Improved material properties



In North America the technology is licensed via Ceralink Inc. **

* C-Tech Innovation Ltd
Capenhurst Technology Park
Capenhurst
Chester
CH1 6EH

** Ceralink Inc
Rensselaer Technology Park
105 Jordan Road
Troy, NY 12180
USA

The Carbolite MRF 16/22 CMAT Furnace makes Microwave Assist Technology available to the non-specialist researcher. So far the unique effects obtained from combining radiant heating and direct sample heating using microwave energy, have only been explored using 'one-off' custom built, hybrid devices.

The MRF 16/22 CMAT furnace is designed to offer consistently repeatable results between users.

The combination of low thermal mass insulation, molybdenum disilicide elements and a 1.8kW microwave source provides rapid efficient heating.

Both heat sources are independently controlled, either manually for continuous running or combined into an automated program with up to 20 segments. The program can be run once or cycled repeatedly. Within each segment the operator can set microwave energy levels to either pulse or be applied continuously at any percentage of the maximum output.

More advanced control options are available to allow the storage and recall of multiple programs, data output or graphical recording.

The MRF 16/22 has the following safety features; safe external temperatures, independent over-temperature protection as standard, a dual safety interlocked door and microwave containment meeting industrial and commercial standards with emissions <math> < 5\text{mW/cm}^2 @ 50\text{mm}</math> as defined in BS EN 60519-6:2002 part 6.1.

BALANCED CONTROL

Some materials are more susceptible to microwave heating than others. An effect determined by their dielectric potential. A sample material's dielectric potential may also be temperature dependent, with the result that they require radiant heating to the point where the material becomes susceptible to microwave energy. The highly flexible control system of the MRF16/22 CMAT furnace is invaluable to balance the combined effects of radiant heating and microwave heating.

Standard features

- ✓ 1600°C Maximum operating temperature
- ✓ 20 Segment programmable PID control
- ✓ Over-temperature protection
- ✓ Independent control of microwave & radiant heating
- ✓ Manual or programmable control of both heat sources
- ✓ Double safety interlock cuts power on door opening
- ✓ Meets industrial and commercial safety limits for microwave containment



MRF 16/22 + Stand

OPTIONS

specify at time of order

- ◆ Multiple program controller
- ◆ RS232 or RS485 communications
- ◆ Fixed or wheeled stands

Model	Max Temp (°C)	Max Power (kW)	Radiant Heating Power (kW)	Micro Power (kW)	Micro Freq'y (MHz)	Dimensions		Volume (Litres)	Max Distributed Load (kg)	Net Weight (kg)
						External HxWxD (mm)	Internal HxWxD (mm)			
MRF 16/22	1600	12	9	1.8	2450	1090 x 910 x 925	232 x 245 x 396	22	7.5	290

*(220-208V Delta, 220-240V Delta, 380-415V 3-PH +N)