MANUFACTURER OF HIGH POWER MICROWAVE AND RADIO FREQUENCY DIELECTRIC HEATING SYSTEMS
For the Advance Composites Industry

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Established in 1939 as an RF industrial heating company.

We are a premier builder of high power MW and RF systems for heating materials with inherently poor thermal characteristics (good insulators).

Our expertise is in commercializing new applications, and enhancing existing processes.
Thermex Background

Privately owned
Profitable Blue-Chip Co.
30-50 employees

Areas of strength
- Application development and Commercialization
- Engineering / Design
- Complete in-house manufacturing capability
- Technical Support
Thermex Markets

- CERAMICS
- ENGINEERED WOOD PRODUCTS
- AUTOMOTIVE
- AEROSPACE
- RUBBER
- FOOD
- TEXTILES
- PLASMA
- RENEWABLE FUELS
- OIL FROM SHALE
- MICROWAVE CHEMISTRY
Thermex Capabilities

- CONTINUOUS DUTY HIGH POWER RF GENERATORS UP TO 1600KW.
- MICROWAVE POWER SOURCES UP TO 100KW
- LABORATORY / PILOT SYSTEMS
- BATCH OVENS
- CONVEYORIZED OVENS
- LARGE PRESS APPLICATIONS
- SPECIAL PROCESS APPLICATORS
- WAVEGUIDE COMPONENTS
The Thermex MW and RF Heating Technology

The following is a brief explanation of the dielectric heating process as well as the interaction between the material to be heated and the equipment applying the energy.
The dipole is a molecule which exhibits a unique characteristic where one end is positive and the other is negative.

When subjected to a electric field, a dipole tends to reorient itself.

The amount of deflection is measured by the angle $\theta$, which is proportional to the strength of the electric field.
Heat is created at the point of each dipole molecule interstitially spaced in the material matrix.

Heat comes from friction generated between the moving and fixed molecules.
Heating

- The quantity of energy dissipated in the material as heat is given by the Power Formula.
- Material properties determine how well and how evenly the product will heat.
- HF equipment can affect the product only with frequency and RF voltage.
Power Formula

\[ P = 1.41 \ F \ E^2 \ \varepsilon'' \]

- **P**: Power dissipated in material (watts).
- **F**: Frequency of generator in megahertz. The number of times per second the rotation of the molecule changes direction.
- **E^2**: RF voltage across the material. The electrical force applied to the molecule to induce movement.
- **\varepsilon''**: The power factor. The critical element which determines how much heat is developed in the material.
Electrical Energy converted to Heat

- The amount of electrical energy converted to heat in the material is determined by:
  - Material properties which determine how well and how evenly the product will heat.
  - HF equipment which can effect the product only with frequency and the electric field.
Heat is a Function of frequency and electrical field

- The higher the frequency, the faster the dipole will oscillate and the more frictional heat will be generated.

- The stronger the electric field, the greater the torque exerted on the dipole and the greater the rotation producing more frictional heat.
TECHNOLOGY BENEFITS

- Greater Yield – Uniform heating reduces product deficiencies.
- Higher Production Throughput – Heat is generated within the product up to 40 times faster than conventional methods.
- Instant Start/Stop of Process Heat
- Higher Efficiency – Reduced energy consumption up to 50% as compared to conventional methods.
- Environmentally Sound Approach – Provides a clean non-polluting process.
RF and MW Heating Benefits for Advance Composites.

- Large Thick Structures can be molded and cured which is difficult using traditional heating methods.
- High degree of product reliability in manufacturing processing.
- Reduced cost: Decrease the manufacturing time and increase manufacturing efficiency.
- Competitive Advantage over your competitors using traditional heating methods.
Advance Composite MW and RF Applications:

- Most Fiberglass and Aramid Composites: Carbon Fiber Under Development
- Thermosets:
  - Phenolics
  - Epoxy
  - Vinly Ester and Polyesters
- Thermoplastics:
  - Quick heating and rapid consolidation
- Pultrusion
- Filament Winding
- Honeycomb Manufacturing
- Pre Heat
- Curing
- Post Cure
Curious? Thermex can Help!

Supply the following information to get your project of the ground:

- Description of your product and manufacturing process
- Specific Heat of Solids
- Specific heat of Liquids
- Percent solids and liquids in the material
- Bulk Density
- Final Product dimensions and dimensions of material input
- Initial Temperature of the material
- Cure Temperature of the material
- Maximum allowable temperature of the material
- Production Requirements: Production Rate
- Supply a Material sample and THERMEX will determine if it can be manufactured via MW and RF heating
- Cost Savings $$$$$$$$$$$$$
COMPOSITE HONEYCOMB

- Bonding of Nomex sheets with printed adhesive lines.
- Books are pressed with a 800 Ton press. Adhesive is cured by application of RF.
- Books are cured in 20 minutes, not 24Hrs as with hot press
Thermex Product Examples

100KW Ceramic Heater

90 KW Conveyer Dryer

30KW Oven
Need More Information?

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