



UNIT 5

ROLE OF TECHNOLOGIES



Dielectric heating, infrared heating, and irradiation are all methods of heating used in various industrial and scientific applications. Each method relies on different principles and technologies to achieve the desired heating effect.

Dielectric Heating

Principles:

Electric Field Interaction: Dielectric heating uses a high-frequency electric field to heat materials. When an alternating electric field is applied, the polar molecules within the material try to align themselves with the field. As the field alternates, the molecules continuously reorient, causing friction and thus generating heat.

Polarization: The process primarily works on materials with polar molecules, such as water, which have a significant dipole moment. Non-polar materials do not heat effectively using this method.

Penetration Depth: The depth of penetration of the electric field into the material is a critical factor and depends on the frequency of the field and the dielectric properties of the material.

Applications:

- Drying and curing of materials (e.g., wood, textiles)
- Cooking (e.g., microwave ovens)
- Medical therapies (e.g., diathermy)

Infrared Heating

Principles:

Electromagnetic Radiation: Infrared heating uses infrared radiation, which is part of the electromagnetic spectrum with wavelengths longer than visible light but shorter than microwaves. This radiation is absorbed by the surface of materials and converted into heat.

Surface Heating: Infrared heating primarily affects the surface of a material. The energy is absorbed by the surface molecules, causing them to vibrate and generate heat, which then conducts inward.

Wavelength and Absorption: Different materials absorb infrared radiation at different wavelengths. The efficiency of heating depends on the match between the emitted wavelength of the infrared source and the absorption characteristics of the material.

Applications:

- Industrial drying and curing (e.g., paint, coatings)
- Food processing (e.g., toasting, baking)
- Space heating and comfort heating
- Medical therapies (e.g., heat lamps)

Irradiation

Principles:

Ionizing Radiation: Irradiation typically involves the use of ionizing radiation, such as gamma rays, X-rays, or electron beams. These high-energy photons or particles penetrate materials and deposit energy, causing ionization and excitation of atoms and molecules.

Penetration Depth: The depth of penetration depends on the type and energy of the radiation. Gamma rays and X-rays can penetrate deeply into materials, while electron beams have more limited penetration.

Interaction with Matter: The ionizing radiation interacts with the atomic structure of the material, breaking chemical bonds and

creating free radicals, which can lead to heating and other effects, such as sterilization or material modification.

Applications:

- Sterilization of medical equipment and food products
- Preservation of food by killing bacteria and pests
- Material modification (e.g., cross-linking of polymers)
- Radiation therapy for cancer treatment