



Fundamental Physics for Food Technology and Innovation (4011106)

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Magnetic Fields and Faraday's Law

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Overview of topics to be covered:

- A. Introduction to Magnetic fields
- B. Magnetic Fields in Food Industry Applications
- C. Faraday's Law of Induction
- E. Applications in Food Processing
- F. Electromagnetic Induction in Food Quality Testing
- G. Safety Considerations
- H. Review & Key Points

Introduction to Magnetic Fields

- A magnetic field is a region where magnetic forces can be detected
- Represented by magnetic field lines (B)
- Unit: Tesla (T)
- Key properties:
 - *Lines never cross*
 - *Direction: North to South pole*
 - *Density indicates field strength*

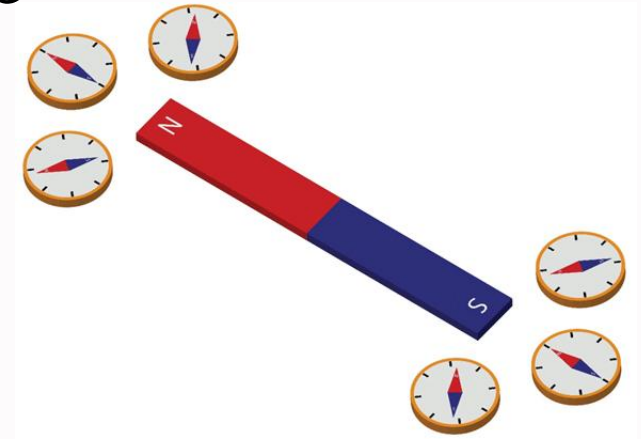


Figure 1: Magnetic field lines compass

Magnetic Fields in Food Industry Applications

- Metal detection systems
- Magnetic separation of contaminants
- Quality control processes
- Food packaging inspection



Figure 2: Magnetic metal detector food industry

Faraday's Law of Induction

- The fundamental equation:

$$\varepsilon = -N(\Delta\Phi/\Delta t)$$

Where:

- ε (*epsilon*) = induced electromotive force (EMF) in volts (V)
- N = number of turns in the coil
- $\Delta\Phi$ (*delta phi*) = change in magnetic flux
- Δt (*delta t*) = change in time
- Negative sign indicates Lenz's law

Faradays Law of Induction

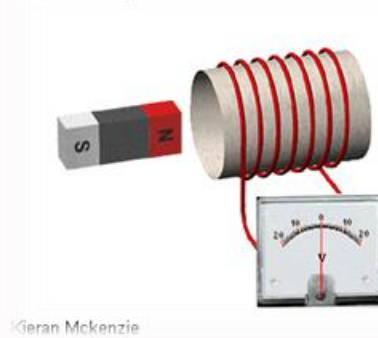


Figure 3: Faraday's law of induction diagram

Applications in Food Processing

1. Induction Heating

- *Rapid heating*
- *Energy efficient*
- *Precise temperature control*

2. Common Applications:

- *Sealing systems*
- *Sterilization equipment*
- *Package heating*



Figure 4: Induction heating food processing

Electromagnetic Induction in Food Quality Testing

- Non-destructive testing methods
- Metal detection systems working principle
- Contamination detection
- Quality assurance processes



Figure 5: Electromagnetic food testing equipment

Safety Considerations

- Magnetic field exposure limits
- Equipment shielding requirements
- Operating procedures
- Industry standards compliance



Figure 6: Electromagnetic safety food industry

Review & Key Points

- Magnetic field basics
- Faraday's law fundamentals
- Industrial applications
- Safety protocols
- Quality control implementation

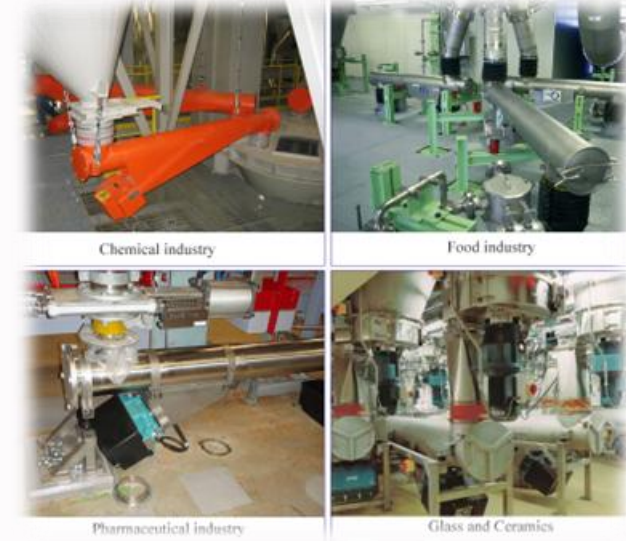


Figure 7: Electromagnetic applications
food industry summary



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