Fundamental Physics for Food Technology and Innovation (4011106)

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Coulomb's Law and Electric Fields in Food Technology

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Overview of topics to be covered:

A. Introduction to Electrical Phenomena
B. Fundamental Concept - Electric Charge
C. Coulomb's Law - Basic Principles
E. Electric Fields in Food Systems
F. Practical Applications in Food Technology
G. Electric Charge Interactions in Food Molecules
H. Case Study - Electrostatic Technologies in Food Processing
I. Mathematical Modeling
J. Conclusion and Future Perspectives

Introduction to Electrical Phenomena

- What are electrical charges?
- Importance in food technology
- Basic electrical properties of matter

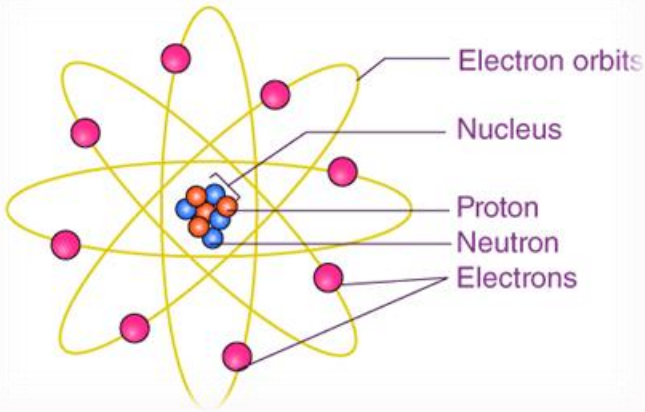

Figure 1: Atomic structure

Fundamental Concept - Electric Charge

- Definition of electric charge (Q)
- Types of charges: Positive and Negative
- Basic unit: Coulomb (C)
- Fundamental equation:

Q = number of electrons × elementary charge

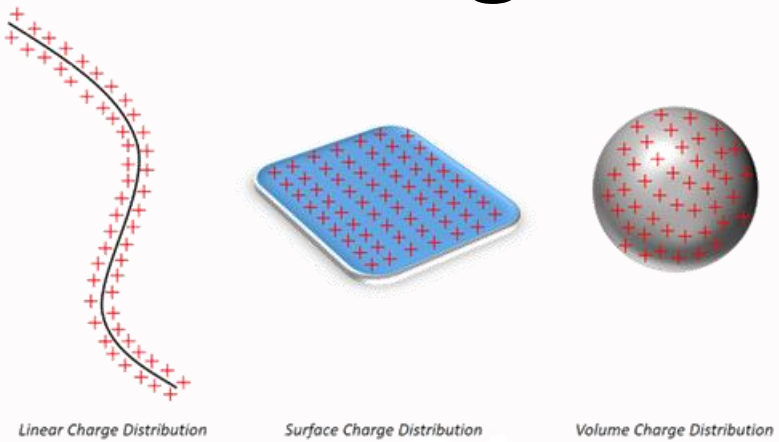

Figure 2: Charge distribution

Coulomb's Law - Basic Principles

- Mathematical representation:

$$F = k(q_1q_2/r^2)$$

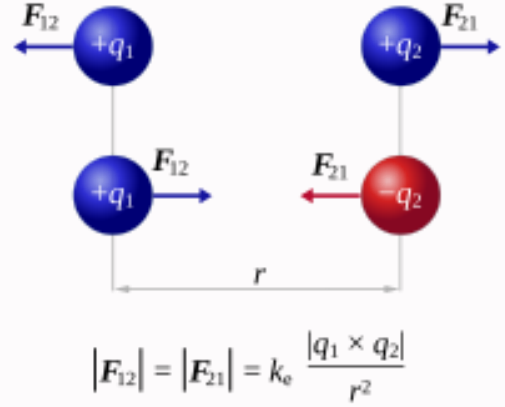

Figure 3: Force between charges

Where:

- *F = Electrostatic force*
- *k = Coulomb's constant (8.99 × 10⁹ N·m²/C²)*
- *q1, q2 = Magnitude of charges*
- *r = Distance between charges*

Electric Fields in Food Systems

- Definition of electric field
- Equation: E = F/Q
- Applications in food processing:
  - *Electrostatic precipitation*
  - *Food particle separation*
  - *Moisture control*

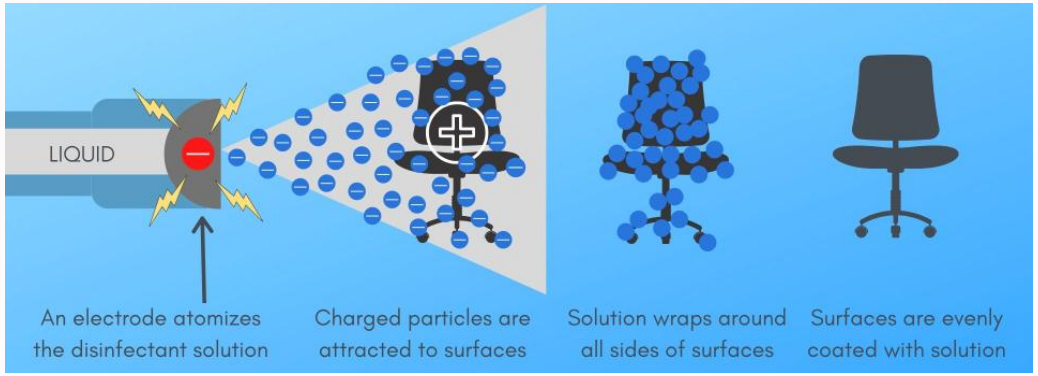

Figure 4: Electrostatic technology

Practical Applications in Food Technology

- Electrostatic spraying in food preservation
- Charge interactions in food packaging
- Moisture and particle behavior in food processing

Figure 5: Food preservation technology

Electric Charge Interactions in Food Molecules

- Protein charge interactions
- Ionic bonding in food systems
- Electrostatic stabilization of emulsions

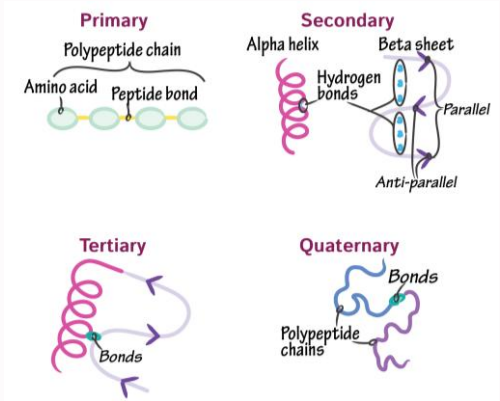

Figure 6: Protein structure

Case Study - Electrostatic Technologies in Food Processing

- Electrostatic coating of foods
- Particle separation techniques
- Moisture control mechanisms

Figure 7: Food processing technology

Mathematical Modeling

- Advanced Coulomb's Law calculations
- Computational methods in food science
- Simulation of charge interactions

Figure 8: Mathematical modeling

Conclusion and Future Perspectives

- Emerging technologies
- Research directions
- Interdisciplinary applications

Figure 9: Future food technology

References.

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