Fundamental Physics for Food Technology and Innovation (4011106)

Kittipong Siengsanoh (Ph.D.Physics)

Department of Physics.
Faculty of Science and Technology.

Work and Energy in Food Technology

"Physical Principles and Applications"

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Overview of topics to be covered:

A. Basic concepts of work and energy

B. Energy transformation in food processing

C. Applications in food technology

Work - Basic Concepts

- Definition: Work is the product of force and displacement
- Mathematical expression:

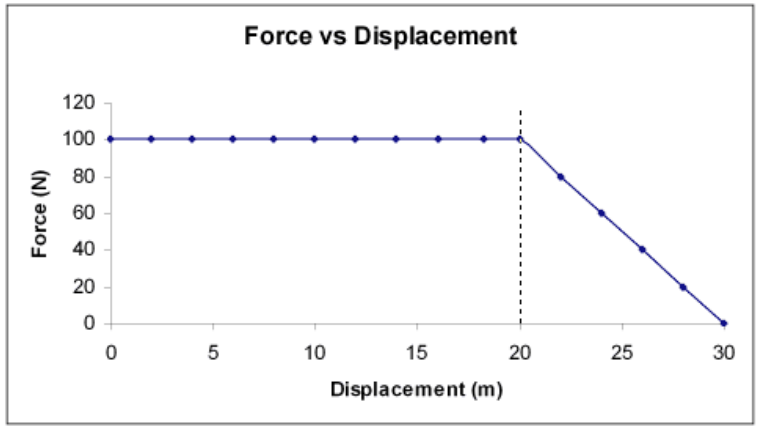

Figure 1: Force displacement diagram

$$W = F \times d$$

Where: W = Work (Joules, J) F = Force (Newtons, N) d = Displacement (meters, m)

Energy Types in Food Processing

- Mechanical Energy
- Thermal Energy
- Electrical Energy
- Chemical Energy

Figure 2: Energy types food processing

Conservation of Energy

- First Law of Thermodynamics
- Mathematical expression:

$$\Delta E = Q - W$$

Figure 3: Thermodynamics food processing

Where: ΔE = Change in internal energy Q = Heat added to system W = Work done by system

Applications in Food Processing

- Mixing and kneading (mechanical energy)
- Heating and cooling (thermal energy)
- Freezing processes
- Drying operations

Figure 4: Food processing operations

Energy Efficiency in Food Industry

- Energy audit concepts
- Energy saving opportunities
- Sustainable processing Common

Figure 5: Energy efficient food processing

Practical Examples

- Case studies:
  - Energy consumption in baking
  - Work done in meat grinding
  - Power requirements in mixing

Figure 6: Food processing equipment energy use

Problem-Solving Example

- Problem: Calculate the work done by a mixing paddle Given:

Force = 50 N

Radius of rotation = 0.3 m

Number of rotations = 100 Solution steps provided

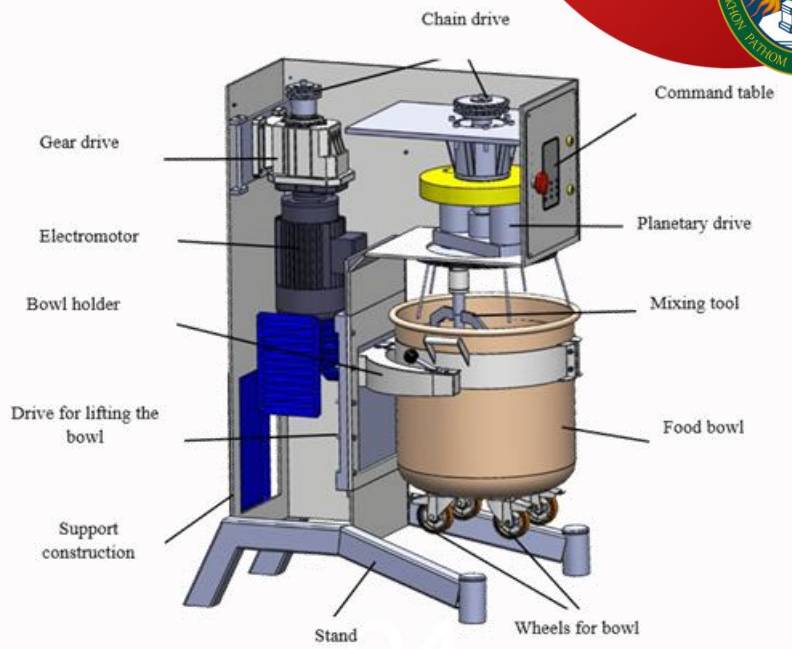

Figure 7: Industrial mixer force diagram

Summary

- Relationship between work and energy
- Important applications in food technology
- Energy efficiency considerations

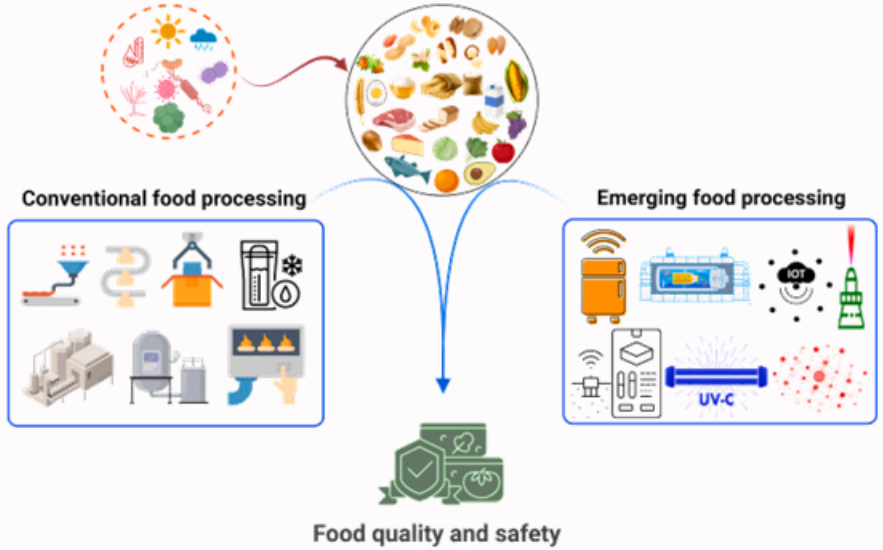

Figure 8: Food processing overview

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