



# **Fundamental Physics for Food Technology and Innovation (4011106)**

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# Newton's Laws of Motion

## *"Newton's Laws and Their Applications in Food Industry"*

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# Overview of topics to be covered:

- A. Introduction
- B. First law-law of inertia
- C. First Law Applications
- D. Second Law - Force and Acceleration
- F. Second Law in Practice
- G. Third Law - Action and Reaction
- H. Third Law Applications
- I. Summary

# Introduction

- Physics principles govern many food processing operations
- Understanding force and motion is crucial for:
  - *Food mixing and blending*
  - *Fluid flow in pipes*
  - *Separation processes*
  - *Material transport*



Figure 1: Food processing equipment motion

# First Law - Law of Inertia

- "An object at rest stays at rest, and an object in motion stays in motion unless acted upon by an external force"
- Applications in Food Technology:
  - *Mixing of ingredients*
  - *Separation of particles in centrifuges*
  - *Transport of food materials on conveyors*



Figure 2: Centrifuge separation food industry

# First Law Applications

- Examples in Food Processing:
  - *Continuous mixing systems*
  - *Fluid flow in pipes*
  - *Particle settling in storage tanks*
- Key Considerations:
  - *Product viscosity*
  - *Flow resistance*
  - *Material properties*



Figure 3: Food mixing system industrial

# Second Law - Force and Acceleration

- $F = ma$  (Force equals mass times acceleration)
- Food Industry Applications:
  - *Mixing force requirements*
  - *Pump pressure calculations*
  - *Material handling systems*



Figure 4: Food pump system industrial

# Second Law in Practice

- Common Examples:
  - *Pump pressure for liquid foods*
  - *Force required for dough mixing*
  - *Conveyor belt power requirements*

- Calculation Example:

Force needed to move 100 kg of flour at 2 m/s<sup>2</sup>:  $F = 100 \text{ kg} \times 2 \text{ m/s}^2 = 200 \text{ N}$



Figure 5: Industrial dough mixer

# Third Law - Action and Reaction

- "For every action, there is an equal and opposite reaction"
- Applications:
  - *Extrusion processes*
  - *Compression in packaging*
  - *Impact forces in cutting operations*

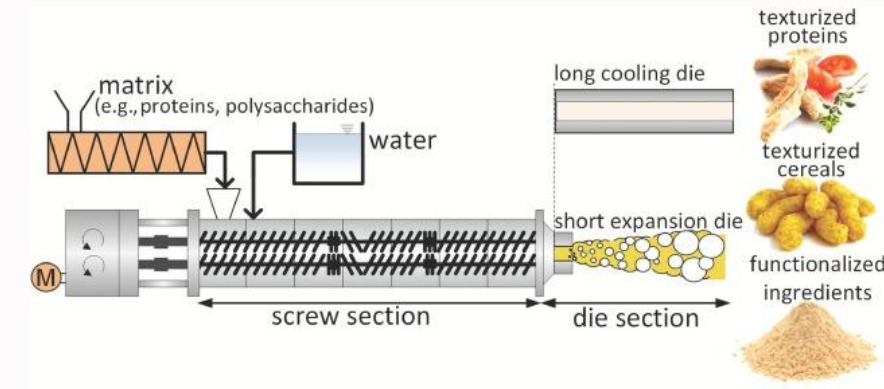


Figure 6: Food extrusion process

# Third Law Applications

- Practical Examples:
  1. *Extrusion of pasta and snacks*
  2. *Sealing forces in packaging*
  3. *Cutting resistance in food processing*
- Design Considerations:
  - *Material properties*
  - *Equipment specifications*
  - *Safety factors*



Figure 7: Food packaging machine industrial

# Summary

- Key Points:
  - Inertia affects mixing and separation
  - Force calculations crucial for equipment design
  - Action-reaction important in processing operations
- Industry Applications:
  - *Equipment design*
  - *Process optimization*
  - *Quality control*



Figure 8: Food processing equipment modern



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