

Introduction to Dairy Plant Technology

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An overview of the key concepts, processes, and equipment used in modern dairy processing facilities.

1. What Is a Dairy Plant?

Aspect	Description
Definition	A facility where raw milk is transformed into a range of safe, stable, and market-ready dairy products (milk, cream, cheese, yogurt, butter, powders, etc.).
Core Objectives	• Preserve nutritional value • Extend shelf-life • Ensure microbiological safety • Achieve consistent product quality
Typical Scale	Small-holder plants (< 10 t/day) ? Large integrated complexes (> 10,000 t/day).

2. Main Stages of Dairy Processing

1. Milk Reception & Preliminary Checks

- **Sampling & Testing:** temperature, pH, fat, protein, bacterial count, antibiotic residues.
- **Cooling:** rapid reduction to 4°C (often 2°C) to inhibit microbial growth.

2. Standardization & Adjustment

- **Fat & Solids-Not-Fat (SNF) Adjustment:** blending skimmed and cream milk to meet product specifications.
- **Addition of Ingredients:** vitamins, minerals, stabilizers, cultures, enzymes.

3. Heat Treatment

- **Pasteurisation:** 72°C for 15s (HTST) or 63°C for 30min (LTLT).
- **UHT (Ultra-High-Temperature):** 135–150°C for 2–5s ? extended shelf-life (up to 6 months).

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- **Sterilisation/Retort:** $>120^{\circ}\text{C}$ for longer periods for canned dairy.

4. Separation & Clarification

- **Centrifugal Separators:** split cream from skim milk.
- **Clarifiers / Filters:** remove sediments, spores, and stray fat globules.

5. Homogenisation

- **Purpose:** break fat globules to $1\text{--}5\mu\text{m}$, preventing cream separation and improving mouthfeel.
- **Typical Pressure:** $15\text{--}25\text{MPa}$ ($2,000\text{--}3,600\text{psi}$).

6. Fermentation / Coagulation (Product-Specific)

- **Yogurt & Cheese:** inoculation with starter cultures, addition of rennet, controlled temperature & pH.
- **Butter:** churning of cream to aggregate fat globules.

7. Aging / Ripening (Cheese)

- Controlled temperature ($4\text{--}15^{\circ}\text{C}$) and humidity ($80\text{--}95\%$).
- Development of flavor, texture, and rind.

8. Packaging

- **Primary:** aseptic cartons, PET bottles, glass, plastic tubs, foil-wrapped cheese blocks.
- **Secondary/Outer:** cartons, shrink-wrap, pallets.

9. Cold Chain & Storage

- **Refrigerated Warehouses:** $0\text{--}4^{\circ}\text{C}$ for fluid products, -18°C for frozen or powdered forms.
- **Logistics:** insulated trucks, temperature-monitored distribution.

3. Core Equipment & Their Functions

Equipment	Primary Function	Typical Process Parameters
Milk Cooling Tank	Rapidly lower milk temperature after reception	$2\text{--}4^{\circ}\text{C}$, flow rate $0.5\text{--}2\text{m}^3/\text{h}$