

# Introduction to Dairy Plant Technology

## Introduction to Dairy Plant Technology

Key concepts, main equipment, process flow, and quality considerations

### 1. Overview of Dairy Plant Technology

- **Definition:** The engineering discipline that designs, operates, and optimizes facilities for processing raw milk into safe, stable, and market-ready dairy products.
- **Objectives**
  - Preserve nutritional and sensory quality of milk.
  - Extend shelf-life through pasteurisation, sterilisation, and packaging.
  - Ensure food safety and regulatory compliance.
  - Maximise yield and minimise waste and energy consumption.

### 2. Typical Dairy Plant Layout

| Area                                                          | Primary Functions                                  | Typical Equipment                                                                |
|---------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------|
| Receiving & Storage                                           | Raw milk intake, cooling, bulk storage             | Milk reception tank, plate-heat exchangers, refrigerated storage silos           |
| Pre-treatment                                                 | Removal of debris, standardisation of fat & solids | Cream separator, clarifiers, skim milk pumps                                     |
| Heat Treatment                                                | Pasteurisation, UHT, sterilisation                 | Plate/steam-heat exchangers, batch pasteuriser, HTST (high-temp short-time) unit |
| Homogenisation                                                | Reduce fat globule size for stability              | High-pressure homogeniser                                                        |
| Standardisation & Fortification                               | Adjust fat/protein, add vitamins/minerals          | Inline mixers, dosing pumps                                                      |
| Fermentation / Culturing (if producing yoghurt, cheese, etc.) | Inoculation, incubation                            | Fermenters, temperature-controlled vats                                          |

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| Area                       | Primary Functions                                     | Typical Equipment                                              |
|----------------------------|-------------------------------------------------------|----------------------------------------------------------------|
| Separation & Concentration | Produce whey, cheese curd, milk powder                | Ultrafiltration, reverse osmosis, evaporators, spray dryer     |
| Packaging                  | Fill, seal, label, and store finished product         | Aseptic filling lines, retort machines, carton/ bottle fillers |
| Utilities & Support        | Steam, chilled water, compressed air, waste treatment | Boilers, chillers, water treatment plant, effluent system      |

## 3. Core Processing Steps

### 3.1 Raw Milk Reception & Cooling

1. **Sampling & Testing** – microbial count, somatic cell count, temperature, composition.
2. **Rapid Cooling** – bring milk to 4°C within 2h of milking to inhibit bacterial growth.
3. **Storage** – insulated stainless steel tanks with agitation to prevent cream separation.

### 3.2 Clarification & Standardisation

- **Clarifiers/filters** remove sediments and somatic cells.
- **Cream Separator** splits milk into cream and skim; recombination sets target fat level (e.g., 3.5% for whole milk).

### 3.3 Heat Treatment

| Method                      | Temperature & Time | Typical Use                               |
|-----------------------------|--------------------|-------------------------------------------|
| Low Temp Long Time (LTLT)   | 63°C for 30min     | Traditional pasteurisation, small batches |
| High Temp Short Time (HTST) | 72°C for 15s       | Continuous bulk pasteurisation            |
| Ultra High Temp (UHT)       | 135–150°C for 2–5s | Sterile, shelf stable milk                |
| Batch Sterilisation         | 121°C for 15min    | Canned dairy, some cheese milks           |

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## 3.4 Homogenisation

- **Pressure:** 15–25 MPa (150–250 bar).
- **Result:** Fat globules reduced to 0.5–2 µm, preventing