

Overview of Dairy Plant Technology

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(A concise, structured guide for students, trainees, and plant personnel)

1. Introduction

- **Definition:** Dairy plant technology encompasses the equipment, processes, and control systems used to transform raw milk into a wide range of safe, high-quality dairy products (e.g., fluid milk, cheese, yoghurt, butter, ice-cream).
- **Goal:** Maximize product yield and quality while ensuring food safety, regulatory compliance, and operational efficiency.

2. Core Process Stages

Stage	Primary Objectives	Typical Unit Operations	Key Parameters
2.1 Receiving & Pre-conditioning	Accept raw milk, verify quality, adjust temperature	Milk reception tanks, flow meters, temperature sensors, pre-coolers	Milk temperature (4°C), flow rate, bacterial count, fat/protein content
2.2 Standardization & Separation	Adjust fat/protein levels; separate cream	Separator (centrifuge), standardization valves, blending tanks	Fat % (e.g., 3.5% for whole milk), skim/cream ratio
2.3 Pasteurisation / Heat Treatment	Destroy pathogenic and spoilage microorganisms	Plate heat exchangers, tubular heat exchangers, HTST (High-Temp/Short-Time), UHT (Ultra-High-Temp) units	Temperature/time (e.g., 72°C/15s for HTST), Listeria/thermo-tolerant bacteria log reduction
2.4 Homogenisation	Reduce fat globule size & stable emulsion	High-pressure homogenizer (15–25 MPa)	Particle size <1µm, pressure, temperature
2.5 Cooling & Storage	Bring product to safe storage temperature	Plate coolers, glycol-chilled water baths, insulated storage tanks	4°C, uniformity

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2.6 Fermentation / Culturing (optional)	Develop flavour, texture, functional properties	Fermenters, inoculation systems, temperature? controlled vats	pH trajectory, incubation time (4–24?h), temperature (30–45?°C)
2.7 Coagulation & Curd Handling (cheese)	Form curd, separate whey	Rennet addition, calcium chloride, cheese vats, curd cutters	pH (??6.2 ? 5.2), temperature (30–38?°C), coagulation time
2.8 Aging / Ripening (cheese)	Develop flavor & texture	Ripening rooms, controlled humidity & temperature	8–12?°C, 80–95?% RH, time (weeks–months)
2.9 Packaging	Protect product, extend shelf?life, provide information	Aseptic fillers, flow packers, vacuum packers, labeling stations	Fill volume, headspace, oxygen transmission rate
2.10 Cleaning?In?Place (CIP)	Remove residues & microbes without disassembly	CIP loops, heat exchangers, pumps, chemical dosing (alkaline & acid)	Temperature (70–85?°C), flow rate, chemical concentration, contact time

3. Major Equipment Types

1. Heat Exchangers

- Plate, tubular, scraped?surface.
- Design based on required heat duty, fouling potential, and product viscosity.

2. Centrifuges / Separators

- Continuous flow, high?speed (up to 20?000?rpm).
- Used for cream?skim