

Dairy Plant Automation

Dairy Plant Automation – Study Notes

1. Overview

Aspect	Description
Goal	Increase productivity, product consistency, food safety compliance, and reduce labor costs.
Scope	From raw milk reception to final packaging and dispatch.
Key Drivers	1. Rising demand for dairy products 2. Strict hygiene & traceability regulations 3. Need for energy efficient operations 4. Competitive pressure on margins. • Level 1 – Basic control – PLC based control of individual machines. • Level 2 – Integrated line – SCADA/HMI linking multiple PLCs, basic data logging.
Typical Automation Levels	• Level 3 – Plant wide MES – Manufacturing Execution System for scheduling, quality, and traceability. • Level 4 – Enterprise integration – ERP/MES/SCADA data flow for supply chain optimization.

2. Core Process Areas & Automation Solutions

Process	Main Equipment	Automation Functions	Typical Sensors / Actuators
Raw Milk Reception	Bulk tanks, filtration, pasteurizer inlet	• Flow rate control • Temperature verification • Automatic sampling	Flow meters, RTDs/PT100, level probes, ultrasonic sensors
Standardization & Blending	Mixing tanks, proportioning valves	• Precise ratio control (fat, solids not fat) • Real time composition analysis	Inline NIR or MIR analyzers, mass flow meters, servo valves

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Process	Main Equipment	Automation Functions	Typical Sensors / Actuators
Pasteurization / UHT	Plate heat exchangers, flash heaters	• Temperature profiling • Hold?time assurance • Fault detection (leak, fouling)	Thermocouples, pressure transducers, fouling sensors
Homogenization	High?pressure homogenizer	• Pressure set?point control • Energy consumption monitoring	Pressure transducers, vibration sensors
Cooling & Storage	Plate coolers, insulated tanks	• Rapid cooling to 4?°C • Temperature uniformity control	RTDs, level sensors, cascade control loops
Fermentation (Yogurt, Cheese)	Fermenters, ripening rooms	• pH & temperature set?points • Automatic inoculation dosing	pH probes, dissolved?oxygen sensors, dosing pumps
Separation & Clarification	Centrifuges, micro?filters	• Speed control, overflow detection • Clean?in?Place (CIP) integration • Synchronised line	Vibration sensors, flow meters
Packaging	Aseptic filler, bottling line, labeling, case packer	• speed • Fill?level verification • Vision inspection for defects • Recipe?based cycle control	Linear encoders, load cells, machine?vision cameras
CIP / SIP (Cleaning / Sterilization)	CIP tanks, steam generators	• Real?time monitoring of temperature, flow, concentration	Conductivity probes, steam pressure transducers, flow meters

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Process	Main Equipment	Automation Functions	Typical Sensors / Actuators
Utility Management	Boilers, chillers, compressed air, water treatment	• Energy optimised scheduling • Predictive maintenance alerts	Power meters, vibration analysis, infrared thermography

3. Typical Control Architecture

1. **Field Level** – Sensors & actuators (I/O modules, smart devices).
2. **Control Level** – PLCs / PACs (deterministic