Beverage (Carbonated Drinks) - Pasteurisation/Sterilisation

EMERSON Process Management

Pasteurisation/Sterilisation is the fourth unit in this seven step overview of beverage (carbonated drinks)

Pasteurisation/Sterilisation Process Description

Thermal product treatment is an essential process step between blending and filling. This inactivates micro-organisms that would otherwise cause spoilage of the product and reduce shelf-life.

Pasteurisation lines are based on the well-proven principle of product heating, using a heat exchanger, after which the required pasteurisation temperature is held for a defined period in a holding tube to achieve the desired thermal effect. Product is then cooled prior to filling.

The detailed design of the process and exact pasteurisation temperature/holding time is dependent on the microbiological and physical characteristics of the end-product and the requirements of the chosen packaging and filling machine. Several heat exchanger types are available including plate heat exchangers (PHE), straight and corrugated tubular heat exchangers. For low viscosity beverages without fibres or particles, the PHE is the best solution. It has a compact design which can include a high regenerative capacity to reduce energy requirements and improve production economy, by using the outgoing hot product to pre-heat the incoming feed.

For a medium to high viscosity beverage with or without fibres or particles, a tubular heat exchanger is normally chosen. Compared with a straight-walled tube solution, the corrugated version has a larger heat transfer surface. The corrugations also result in increased turbulence, which enhances heat transfer and helps prevent laminar flow in higher viscosity products. The increase in heat transfer coefficient also leads to a reduction in the required surface area compared with straight tube heat exchangers.

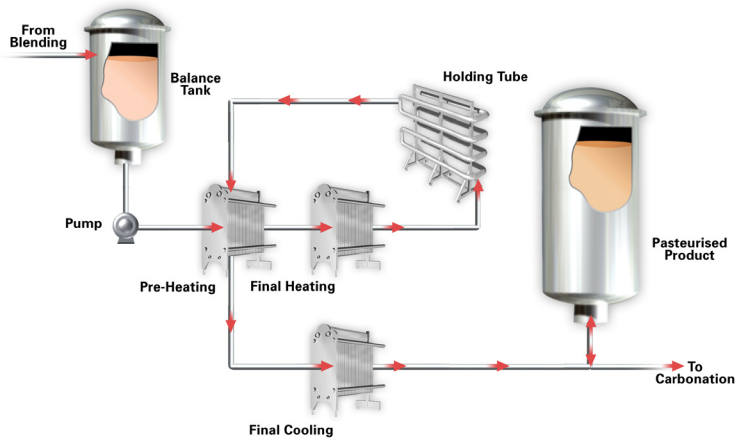
Pre-heating is achieved by using product that has already been fully heated and passed through the holding step to pre-heat the incoming product. Final heating is achieved using an intermediate hot water system heated by saturated steam. This method lowers the temperature difference between the product and heating media, and prevents burning or fouling.

Focus on the reduction of operating costs leads to the demand for long running times and the ability to maintain sterility during filler stops. If the filler stops, the pasteuriser is bypassed and the product is returned to the pasteuriser balance tank, which has sufficient capacity for all the pasteuriser contents. It is normal to recirculate the product only for a limited time, to prevent over-processing, after which the product is pushed into the balance tank with water. When filling recommences, product from the balance tank pushes this water to drain. The interface between beverage and water is detected by means of a conductivity sensor which signals the filler to re-start.

Temperature control is fully automatic, and if a low pasteurisation temperature is detected, the valve to the filler is closed and the product is diverted back to the balance tank.

Pasteurisation takes place under pressure when the required pasteurisation temperature approaches the product boiling point, controlled by a back-pressure valve. In order to avoid possible leakage from the service side to the product side of the pasteuriser, the product pressure is always maintained at a higher level than the heating/cooling media pressure.

Select Critical Control Points of Pasteurisation/Sterilisation



Beverage Flow – Pasteurisation

Accurate measurement of beverage flow is required to ensure the correct thermal holding time is achieved and the heat exchanger thermal profile is kept in balance.

Beverage Temperature

Temperature must be measured at various points through the process for both process control (eg final heating temperature control) and temperature alarm monitoring.

Steam Measurement – Pasteurisation

Accurate steam measurement helps to identify poor performance of the heat exchanger, predict possible malfunction and optimize energy usage.

Steam Flow – Pasteurisation

Plate heat exchangers use saturated steam to heat the re-circulating sugar solution. Steam flow control maintains consistent plate heat exchanger temperature, optimizes end product quality and avoids unnecessary energy usage.

Services Temperatures

Services temperatures must be measured at various positions, for both process control and temperature alarm functions.

Product Flow Pressure

Product pipeline pressure measurement ensures the necessary system over-pressure to prevent boiling and maintains product pressure above that on the service side of the heat exchanger.

Services Pressures

Services pressures must be monitored and recorded, to maintain product pressure above that on the service side of the heat exchanger.

Improving Beverage Efficiency	Recommended Product Solution
Beverage Flow – Pasteurisation **Control Point Challenge:** Accurate measurement of beverage flow is required to ensure the correct thermal holding time is achieved and the heat exchanger thermal profile is kept in balance. **Solution:** Magnetic flow meters offer a cost effective and low maintenance method to accurately measure the flow rate of beverage throughout the carbonation stage.	**Rosemount Magmeter**  • Accuracy to 0.25% • Cost effective water measurement • Simple configuration and start-up • Full diameter with low pressure drop and no added shear or turbulence • Low/no maintenance – no moving parts
Beverage Temperature **Control Point Challenge:** Control of the beverage temperature is required at the final heating section outlet, and final cooling outlet. Temperature control is achieved by controlling the flow rate and/or temperature of the services (steam, water). Monitoring of beverage temperature is required to confirm or record correct temperature profile and critical alarm points (eg holding tube outlet), **Solution:** Reliable and accurate temperature measurement is achieved by replacing direct-wired sensors to the control system by sensor-mounted temperature transmitters using 4-20mA with HART protocol. RTD Pt-100 offers the highest accuracy and linearity and the use of transmitters provides a clean signal to the temperature controller.	**Rosemount 644 Temperature**  • Universal RTD/Thermocouple • 4-20mA + HART • 0.03°C accuracy • 2 year stability • Direct mount sensor
Steam Measurement – Pasteurisation **Control Point Challenge:** Accurate steam measurement helps to identify poor performance of the heat exchanger, predict possible malfunction and optimize energy usage. **Solution:** Steam can be accurately and repeatably measured using Vortex or Differential Pressure (DP) flow meters. For best performance, use temperature and/or pressure compensated Vortex or DP flow meters. Both technologies offer the lowest permanent pressure loss, maximizing energy efficiency.	**Rosemount Mass Probar**  • 1% mass flow rate accuracy • Five year stability • Real-time fully compensated mass flow • HART output • P/DP/T measurement in a single unit **Rosemount Vortex 8800MV**  • Volumetric flow accuracy up to 1.35% of rate • P and T compensated mass accuracy to 1.6% of rate. • T compensated mass accuracy of 2-3% of rate • Low installed cost • Rangeability to 30:1

More Solutions on next page

Improving Beverage Efficiency	Recommended Product Solution
Steam Flow – Pasteurisation **Control Point Challenge:** Steam flow control maintains consistent plate heat exchanger temperature, optimizes end product quality and avoids unnecessary energy usage. **Solution:** Accurate steam flow control is achieved by highly reliable general purpose control valves.	**24000SVF Control Valve**  • Sizes: 1/2 through 2 inches • Ratings: ANSI Class 150 or 300 • Body Materials: Steel and 316L stainless steel • Flow Coefficients: Maximum Cv from 0.001 to 62 • Rangeability (Flow Coefficient Ratio): 100 to 1 **GX Control Valve**  • Sizes: FN15 to DN150 • Ratings: PN 10/16/25/40 • WCC, LCC, 316L, CW2M • Flow Coefficients: Maximum Cv from 0.04 - 389
Services Temperatures **Control Point Challenge:** Temperature measurement of service streams at various points to confirm and record the correct temperature profile and act as alarm points. **Solution:** Pipeline mounted RTD Pt-100 068 series with direct mounted transmitter offers good accuracy and fast response time	**Rosemount 644 Temperature**  • Hygienic RTD/Thermocouple • 4-20mA + HART • 0.03°C accuracy • 2 year stability • Direct mount sensor
Product Flow Pressure **Control Point Challenge:** Accurate control of the product pressure by means of a back-pressure valve prevents boiling and maintains product pressure above that on the service side of the heat exchanger. **Solution:** Hygienic pressure transmitters provide accurate vessel hydrostatic head measurement using 4-20mA with HART protocol direct to the control system. Either a direct mount transmitter or a remote pipeline seal (dependent upon accessibility).	**Rosemount 3051S**  • dP with remote seals • +/- 0.065% accuracy • 4-20mA + HART • Tuned capillary system • 5 years stability
Services Pressures **Control Point Challenge:** Services pressures must be monitored and recorded, to maintain product pressure above that on the service side of the heat exchanger. **Solution:** Hygienic pressure transmitters provide accurate vessel hydrostatic head measurement using 4-20mA with HART protocol direct to the control system. Either a direct mount transmitter or a remote pipeline seal (dependent upon accessibility).	**Rosemount 3051S**  • dP with remote seals • +/- 0.065% accuracy • 4-20mA + HART • Tuned capillary system • 5 years stability