

TECHNICAL REPORT



TEMPERATURE CONTROL SYSTEMS IN THE FOOD INDUSTRY

An uninterrupted cold chain, a sufficiently high temperature during processing, and a constant temperature during fermentation – it is evident that temperature is an essential part of many processes in the food industry. However, in addition to these apparent applications, there are many other processes where the temperature is important. They range from testing and calibrating flow sensors, to pre-temperature-conditioning individual ingredients when developing new recipes, to maintaining a constant temperature in water baths. Without precise temperature management in the manufacturing and processing procedures, chocolate, for example, would lose everything we love it for.

TEMPERATURE CONTROL SYSTEMS FOR THE CALIBRATION OF FLOW SENSORS

In the food industry, liquid ingredients and products are transported through pipelines. Depending on the temperature of the foodstuff, its viscosity changes and thus also its flow rate. Flow sensors, therefore, measure the flow rate of the food to ensure consistent flow. This not only helps to optimize production output, but is also necessary, for example, to coordinate the systems in filling or portioning. External influences, such as deposits on the measuring sensors, can lead to their measuring accuracy decreasing over time or the defined measuring tolerances changing. To ensure precise measuring results and thus also optimum process control, the flow sensors must be calibrated regularly. High-precision temperature control systems are used for this purpose. They enable precise calibration and control of the flow sensors. The calibration conditions should be as close as possible to the actual application, as the measuring accuracy also depends strongly on the ambient conditions.

STRESS TESTS OF FLOW SENSORS

Before measuring sensors can even be used in the manufacturing process, they have to undergo numerous suitability tests. These also include temperature stress tests in which the flow sensors are subjected to substantial alternating temperatures. Highly dynamic and fastacting temperature control systems simulate alternating low and high shock temperatures. The extreme temperature differences stress the material and thus also the precision of the measurement electronics. Only a flow sensor whose measuring tolerance is not significantly influenced by the substantial temperature fluctuations can be used in the food industry.

TEMPERATURE CONTROL WHEN DEVELOPING NEW RECIPES

In addition to such technical areas of application in production plants, temperature control systems also perform valuable tasks in the laboratories of the food industry. The high pressure to innovate demands continuous further and new development even from long-established companies in the food industry. For this reason, work is continuously being carried out on new recipes and products, as well as on optimizing taste and processing. To ensure 100 % reproducibility, all parameters are regulated according to laboratory standards. The temperature of the ingredients at the time of addition not only determines the binding behavior and consistency of the product. It also influences the release of aromas and thus the taste. To optimize a recipe and for a consistent result, precise pre-conditioning of the ingredients, as well as a precisely constant water temperature are therefore essential. Due to the wide range of requirements, highly variable temperature control systems are mainly used here. They are characterized by a wide working temperature as well as flexible and sophisticated connection and control systems.

TEMPERATURE CONTROL APPLICATION IN THE FOOD INDUSTRY USING CHOCOLATE AS AN EXAMPLE

The base of chocolate consists of cocoa mass, cocoa butter, sugar, and milk. Each variety of chocolate has its own mixing ratio, which is regulated by law. Spices and aromas are also added. The specific recipes, as well as the duration and temperature control of individual process steps, are among the bestkept company secrets.

The ingredients are first mixed in a kneading mixer. The mass then passes through a rolling mill where its consistency is refined to particle sizes of 0.02 mm. The mass is then stirred and kneaded (conched) in special stirring equipment (conche) for several days at temperatures between +55 °C and +90 °C. This process causes the bitter substances of the cocoa to evaporate, and the chocolate acquires its perfect consistency and full aroma.

After conching, the chocolate mass is cooled down, whereby a specific temperature curve must be maintained for each variety of chocolate. This is necessary because the chocolate forms crystalline structures during cooling and hardening. Depending on the temperature, up to six different crystal shapes are created.

Only one of these crystal shapes produces the perfect chocolate: a pleasant color and a shiny surface, good hardness and breaking properties as well as a delicate melting consistency. This crystal shape is stable in dark chocolate up to +34.5 °C, while the five unwanted crystal shapes melt starting at a temperature of +27 °C. The chocolate mass is therefore reheated according to a precisely defined temperature profile. The ideal processing temperatures for dark chocolate are between +31 °C and +32 °C (milk chocolate: +29 °C - +30 °C; white chocolate: +27 °C - +28 °C). The crystal shape that is stable and desired at this temperature ensures that the reliquefied mass takes on the same crystal structure when it cools down again. For this reason, the temperature control application in chocolate production is also referred to as pre-crystallization.

Since, in addition to the final temperature to be reached, the temperature sequence also has a significant influence on the crystallization, fast-reacting, and precisely adjustable temperature control systems are used in chocolate production. They enable complete process automation and ensure a consistently high quality of the chocolate.

CONCLUSION

Temperature control systems are used at many points in the production process in the food industry. They not only optimize and calibrate the production systems but also guarantee a consistently high quality of the end products. Chocolate production has been enormously simplified since the development of state-of-the-art temperature control systems with precisely adjustable temperature windows and temperature curves.

PRESTO temperature control systems and circulators of the CORIO series are used in numerous food processing plants. That is why our team of experts in the food industry has extensive experience. With their know-how, they can adapt our devices perfectly to your requirements, so that expensive custom-made products are not necessary. Feel free to contact