

SECTION XIII. AUTOMATION AND APPLIANCES MAKING

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JUSTIFICATION OF THE CHOICE OF MEASURING ELEMENTS AND ACTUATORS AS MEANS OF AUTOMATION OF THE TEMPERATURE CHAMBER DURING THE PRODUCTION OF BLACK CHOCOLATE

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The tempering process is the most important stage in the development of an automated process control system for the production of dark chocolate. After all, thanks to him, the process of heating and cooling chocolate is carried out and obtaining a stable crystalline structure of fats, which ensures shine, rigidity and preservation of its shape.

Therefore, to ensure the stability of this process, compliance with regulations and standards, achieving control and optimization of the operation of the tempering chamber, it is necessary to select measuring elements and actuators as a means of automating the installation [1-2].

To measure the temperature of the chocolate mass in the tempering chamber and the horizontal cylinder, we select the temperature measuring transducer GENE BRE 8050 100 G 1/2 DN 6 mm -200+600 °C. Resistance thermometers are temperature sensors that operate on the principle of changing the electrical resistance of a metal as a function of temperature. A platinum resistance thermometer having an ohmic resistance of 100 ohms at 0 °C is known as a PT100 or RTD. The limit of their operation is from -200 to 600 °C, and the limits of operation errors are regulated by DIN EN 60751 standards. A positive distance when measuring temperature is 30 m [3].

When choosing a level sensor for measuring the level of liquid chocolate in a tamper chamber tank, the main factors are: the chemical composition of the chocolate, the temperature, the design of the tank, the way the sensor is mounted, the measurement accuracy and range. The most effective type of sensor that meets these requirements is the ultrasonic liquid level sensor. It measures the level by sending an ultrasonic signal into liquid chocolate and receiving an echo from the surface of the liquid. We choose the ultrasonic wireless liquid level sensor for 100 m Kronos UZI-TS, 0-15 m, 433 MHz, LCD - allows you to monitor the liquid level in a closed container. The main components of this sensor include an ultrasonic radio sensor and a monitor-receiver, and data transmission between devices is carried out thanks to a radio signal, at a maximum distance of no more than 100 m. empty container. As well as a notification about the need to change the batteries when they are low [4].

When choosing a pressure sensor to measure it in liquid chocolate of an inclined pipe, it was necessary to take into account such factors as: type of pipe and its dimensions; viscosity and density of the liquid; liquid temperature; measuring pressure range; sensor accuracy and reliability. Therefore, a Keli P3300 piezoelectric sensor was selected, which measures pressure based on a change in electric current in a piezoceramic element that responds to pressure changes. Distinctive features of Keli P3300 are high accuracy and response speed, which allow measuring pressure even at high fluid flow rates in the pipe [5].

Among the actuators, we choose the normally open solenoid valve of the ZW series, due to the application for water, liquid, gas, oil, acidic and alkaline media both in the food industry and in other fields. Rated power 18 W, nominal inlet diameters 50 mm and 1 inch, respectively, maximum operating pressure 8 bar, membrane valve type [6].

In addition to the above means of automating the tempering process, we use a crane-pump for liquid products of the APV W + Series 25/210 type. Thanks to its features of pumping liquids, including liquid chocolate masses, with high accuracy and speed.

As well as its main characteristics, ideal for supplying liquid chocolate masses: increased liquid dosing accuracy (up to 0,5 %), high productivity (up to 85 m³/h), good hygiene (manufactured from materials that meet food safety standards, smooth surfaces for easy cleaning after use) high strength, durability, simple design, ease of control from the remote control or local control [7].

For this crane-pump, an electric motor was selected, characterized by high efficiency and reliability WEG W22. Thanks to the high degree of protection IP55 and the high efficiency of the IE3 class, it is possible to reduce energy consumption and improve the efficiency of the power supply process. Also WEG W22 has a wide range of powers and voltages. The optimal model for the tempering process is the use of the WEG W22 IE3 Premium Efficiency model with a power of 4 kW and a voltage of 400 V [8].

References:

- [1] Lukashuk V.A., Fedik L.Y. (2023). Determination of the quality of the chocolate mass prepared for tempering as a control object during the production of black chocolate // The driving force of science and trends in its development: collection of scientific papers «SCIENTIA» with Proceedings of the IV International Scientific and Theoretical Conference, July 14. Coventry, United Kingdom: European Scientific Platform. 85-88. (ISBN 979-8-88955-773-9. DOI 10.36074/scientia-14.07.2023)
- [2] Lukashuk V.A., Fedik L.Y. (2023). Selection of the functional scheme of automation of the technological process of tempering during the production of black chocolate // Advanced discoveries of modern science: experience, approaches and innovations: collection of scientific papers «SCIENTIA» with Proceedings of the IV International Scientific and Theoretical Conference, August 11, 2023. Amsterdam, The Netherlands: European Scientific Platform. 108-110. (ISBN 979-8-88955-771-5. DOI 10.36074/scientia-11.08.2023)
- [3] Перетворювач температури вимірювальний GENE BRE 8050 100 G 1/2 DN 6 мм -200 +600 °C. Armatura.net.ua. Removed from https://armatura.net.ua/peretvoruvach-temperaturi-vimiruvalniy-genebre-8050-100-g-1-2-dn-6-mm-200-600c/?gclid=CjwKCAjwo7iiBhAEEiwAslxQEbwziuc8dgu5a9115qS8r08fPTkRYVQ6Vm3P7bUeF4gkWTFZnd3cLRoCmoYQAvD_BwE
- [4] Датчик рівня води (рідини) ультразвуковий бездротовий на 100 метрів Kronos UZI-TS, 0-15 м, 433 МГц, LCD. Removed from <https://tehbezpeka.ua/ua/p1080918976-datchik-urovnya-vody.html>
- [5] Датчик тиску Keli P3300. Removed from <https://vesmaster.com.ua/pages/tenzodatchiki>
- [6] Клапан електромагнітний нормально-закритий ZW прямої дії (сідлової). УкрАкваТех. Removed from <https://ukrkvateh.com.ua/ua/p740357294-klapan-elektromagnitnyj-normalno.html>
- [7] W+ Series (IEC) - Centrifugal Pumps. Removed from <https://www.spxflow.com/apv/products/w-series-iec-centrifugal-pumps/>
- [8] W22 IE3 Premium Efficiency 0.75 kW 4P 80 3Ph 220-230-240/380-400-415//460 V 50 Hz IC411 - TEFC - B3R(E). WEG. Removed from <https://www.weg.net/catalog/weg/Bl/en/Electric-Motors/Low-Voltage-IEC-Motors/Severe-Duty/TEFC/W22-%28Cast-Iron%29/W22-IE3-Premium-Efficiency-0-75-kW-4P-80-3Ph-220-230-240-380-400-415-460-V-50-Hz-IC411-TEFC-B3R%28E%29/p/12913689>