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ENERGY OF HEAT EXCHANGER DEVICES INCREASE EFFICIENCY

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Annotation

Ensuring the efficiency and economy of heat exchange devices in food production enterprises is one of the important tasks. The purpose of heat exchange devices is to increase the thermal efficiency of the device by optimizing the hydrodynamic regimes of the technological flows in the pipes. By increasing the efficiency of heat exchange devices operating in food industry enterprises, while maintaining product quality, without harming the environment, production of quality products using energy-saving technological processes is one of the main tasks.

Key words

Heat exchange, convective, flow core (core), electric motor, heat conductor, pipes, optimization

Introduction. In order to deeply study the hydrodynamics of technological flows in the pipelines currently used in the food industry and to reduce energy consumption, the development of scientific and practical bases of the hydrodynamics of technological flows is an urgent scientific and technical issue.

Of the President of the Republic of Uzbekistan "intended for the years 2022-2026 Development strategy of the new Uzbekistan" Republic of Uzbekistan Implementation of tasks specified in the President's Resolution No. PQ-3682 of April 27, 2018 "On measures to further improve the system of practical implementation of innovative ideas, technologies and projects" and other regulatory and legal documents related to this activity this dissertation research serves to a certain extent.

Uzbekistan is a leading country in the production of fruits and vegetables, and in recent years, the production of canned products through their processing has been developing on a large scale. In 2022, Uzbekistan plans to allocate 400 million dollars to support the fruit and vegetable industry. In recent years, the work of enriching the technological equipment of the food industry with modern new technologies and providing it with energy-saving and safe technologies has been intensively carried out in our republic.

One of the main tasks is to produce high-quality products without harming the environment and using energy-efficient technological processes while maintaining product quality by increasing the efficiency of heat exchange devices used in food industry enterprises.

From the analysis of the literature, it became clear that the development of scientific and practical bases of the hydrodynamics of technological flows in order to deeply study the hydrodynamics of technological flows in the pipelines used in the food industry and reduce energy consumption is an urgent scientific and technical issue. By optimizing the hydrodynamic regimes of heat exchange devices in pipes and pipeline equipment, it becomes possible to reduce the power of the electric motor used for the transfer of raw materials with the help of pumps.

It is known that at least 2 environments with different temperatures are involved in heat exchange processes. A high-temperature medium that transmits its heat energy is called a heat conductor, and a low-temperature medium that receives heat energy is called a cold conductor.

Conductors should be chemically resistant to heat and cold, should not corrode their devices and should not form hard, porous, thick walls.

Therefore, when choosing heat or cold conductors, it is necessary to pay great attention to indicators such as process temperature, price, and areas of their application.

The higher the turbulence of the liquid mass and the faster its particles are mixed, the more intense the heat exchange by convection.

Thus, convective heat exchange, mechanical transfer of heat and fluid movement are strongly dependent on hydrodynamics.

The fluid participating in the heat exchange process consists of two layers, that is, the boundary layer and the core of the flow.

The core of the flow takes place during the time of heat transfer in both convection and heat conduction methods. Such heat exchange is convective heat exchange is called.

The transfer of heat from the surface of a solid to a liquid (or gas) or from a liquid (or gas) to the surface of a solid is called heat transfer.

Energy passes from the surface of the wall through the boundary layer by the method of heat conduction.

From the boundary layer, energy is transferred to the liquid core mainly by convection. The process of heat energy transfer from the wall surface to the liquid is greatly influenced by the flow mode. Heat exchange is more intensive in the turbulent flow of the liquid than in the laminar one.

Shell-and-tube heat exchangers are the most common and widely used type in various sectors of the economy. This device consists of a cylindrical shell and perforated grids with heating pipes attached to its two ends. The pipe wrap divides the entire volume of the heat exchanger into two parts: 1) pipe space; 2) space between pipes. Perforated bars are fixed to the cylindrical shell by welding. The cover is fixed to the device shell using a bolted joint. Pipes are installed in the cylindrical shell and caps for the entrance and exit of heat conductors. When heat is directed by one of the conductors, such as a liquid, into the tube cavity, it passes through the tubes and exits the cap outlet. Another heat transfer flow, for example, steam, is directed to the space between the tubes, the heating tubes give their heat to the outer surface, and turn into a liquid state (condensate) and are discharged from the lower tube of the shell. The process of heat exchange between environments is carried out through the walls of pipes.

The main goal of the work is to determine the pressure difference in the process of transferring a given liquid through a pipe with the help of a pump or to calculate the consumption and speed of the liquid in the conditions where the pressure difference is known. Fluid movement occurs through channels, pipes and technological equipment of different profiles. The movement of real liquids in horizontal pipes is expressed by various variables. Optimization of this process leads to great economic efficiency.

Heat (amount of heat) is an energetic characteristic of the heat exchange process, which is determined by the amount of energy transferred or received during the process. Bodies participating in the process of heat exchange are called heat carriers or heat conductors.

Heat transfer is the science of heat energy propagation processes.

Heat exchange processes include heating, cooling, condensation, evaporation, and evaporation. Devices designed to carry out these processes are called heat exchangers.

It is known that at least 2 environments with different temperatures are involved in heat exchange processes. A high-temperature medium that transmits its heat energy is called a heat conductor, and a low-temperature medium that receives heat energy is called a cold conductor.

Heat and cold conductors should be chemically resistant, should not corrode their devices and should not form a hard, porous, thick layer on its walls. Therefore, when choosing heat or cold conductors, it is necessary to pay great attention to indicators such as process temperature, cost and their areas of application.

In steady processes, the temperature field of the device does not change over time. In unstable processes, the temperature changes over time. In continuously operating devices, processes are stable, and in intermittent (periodic) operating devices, processes are unstable. In addition, unstable processes occur when periodically operating devices are started and stopped, as well as when operating modes are changed. The main kinetic characteristics of the heat transfer process are the average temperature difference, the heat transfer coefficient and the amount of heat transferred.

Acceleration of heat processes leads to an increase in the productivity of equipment, an increase in their size, and a reduction in the cost of production enterprises. This, in turn, reduces the costs of operating and repairing heating equipment, increases the amount of products per worker, etc. When heating processes are accelerated, the time required to heat the material decreases, but this should not lead to a decrease in the quality of the product.

Based on the above information, experimental work was carried out in the double-pipe heat exchanger "pasteurizer" in order to study the possibilities of increasing the temperature of the raw materials coming out of the "pipe-in-pipe" heat exchanger using special stirrups instead of turbulizers. The principle scheme of the device is presented in Fig. 1.

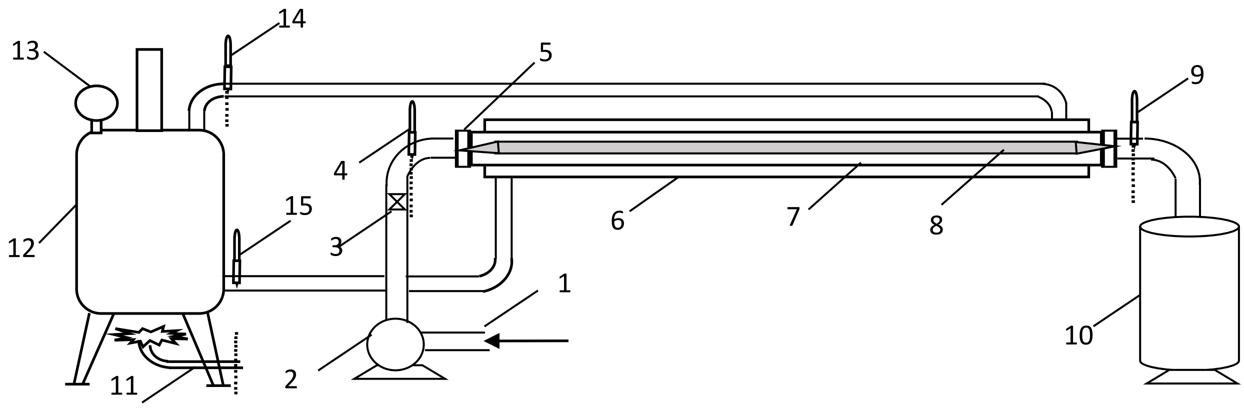

Figure 1. Schematic diagram of the "pipe-in-pipe" heat exchange experimental device.

1 – pipe for raw materials; 2 – centrifugal pump; 3 – tap for adjustment of consumption of raw materials; 4 – thermometer for measuring the initial temperature of raw materials; 5 – nut for installing the turbulizer; 6 – external pipe of the heat exchanger; 7 – internal pipe of the heat exchanger; 8 – stergen (turbulizer); 9 – thermometer for measuring the final temperature of raw materials; 4 – container for raw materials; 11 – gas burner; 12-steam boiler; 13 – monometer

for measuring vapor pressure; 14 and 15 – thermometers for measuring steam temperature.

The experimental device is completely made of stainless steel, the inner diameter of the steam moving pipes is dich = 12 mm, the outer pipe diameter of the double-pipe heat exchanger is D = 50 mm, the inner pipe diameter is d = 20 mm, the length is L = 1000 mm, and the following series works continuously. The required amount of water (10 liters) is poured into the steam boiler 12 and the gas is ignited from the burner 11 and the water is heated. Its pressure is measured by 13 manometers, and its temperature by 14 and 15 thermometers. When the temperature rises to 120 ^{o}C, 2 pumps are activated and raw material movement is ensured through 1 pipe. The consumption of raw materials in the internal pipeline of the device is controlled by 3 taps in order to create different hydrodynamic regimes. The temperature at the entrance to the device is measured using 4 thermometers, and the exit temperature is measured using 9 thermometers. Heat-treated raw materials are collected in 10 containers.

The results obtained in the process of heating water with hot water steam in the "pipe-in-pipe" experimental heat exchanger are presented in Fig. 2.

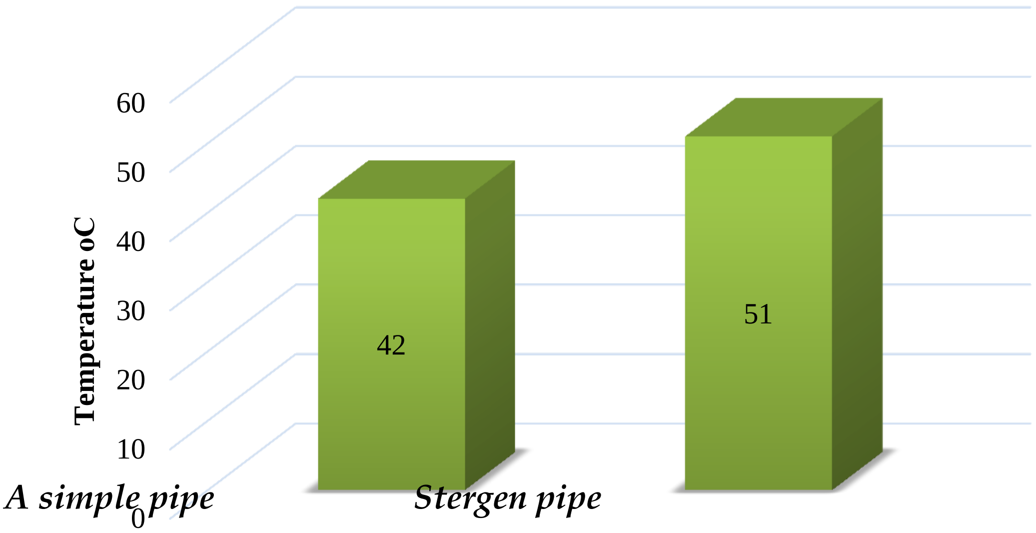

Figure 2. Temperature change of the stream leaving the double-pipe heat exchanger.

From the diagram in Fig. 1, it was found that water with an initial temperature of t_1q 20 ^{o}C moving in the inner pipe of the double-pipe heat exchanger, its temperature at the outlet of the pipe increases to t_2q 42 ^{o}C during normal movement. By installing a stern on the inside of the pipe, the movement of the moving water flow is accelerated, the pipe covers the heat surface due to the increase in the wetted perimeter, and the temperature of the flow with an initial temperature of t_1q 20 ^{o}C at the exit from the device increases to t_2q 51 ^{o}C. This heat exchanger makes full use of the heat of water vapor with a temperature of $tq_1 20$ °C moving in the outer pipe, and a temperature rise of 9 °C is provided compared to the conventional method.

During the experiments, the effect of heating current consumption (G, l/min) on the temperature at the outlet of the pipe was also studied in a normal pipe (without a boom) and in a pipe with a boom. The results of the experiment are presented in Figures 3 and 4.

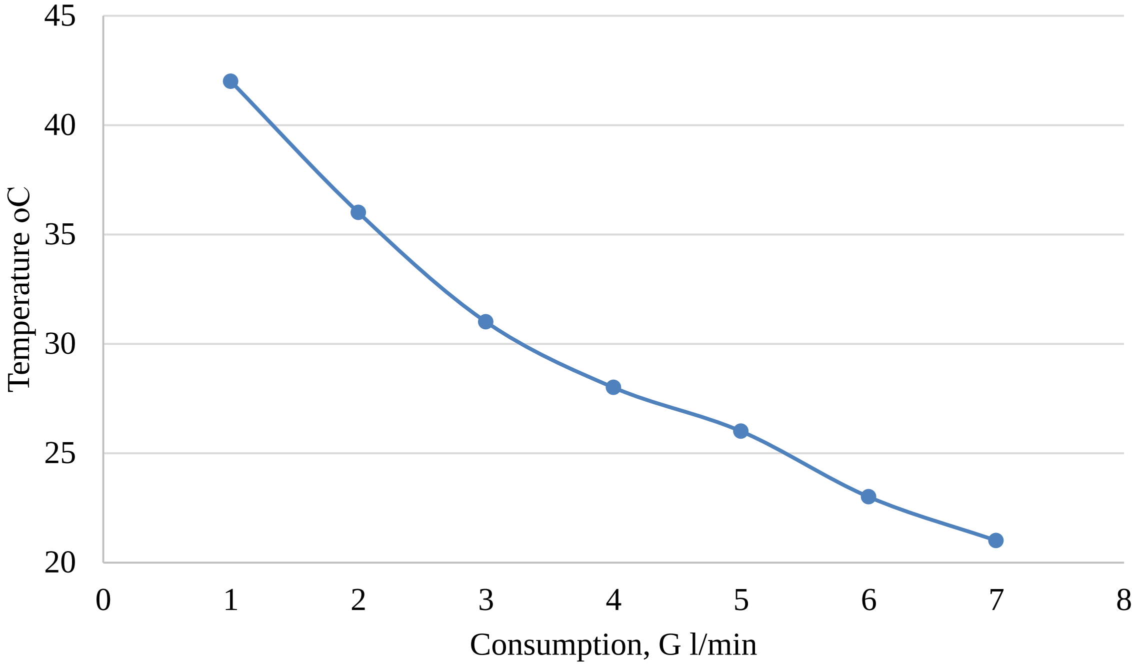

Figure 3. Dependence of the temperature change in a normal pipe on consumption.

The data of the diagram in Fig. 3 shows that the mass consumption of the heated flow in the inner tube is G, l/min. when the temperature was 42 °C, the flow rate was G, 7 l/min. It was found that its temperature decreases to 21 °C as it increases to.

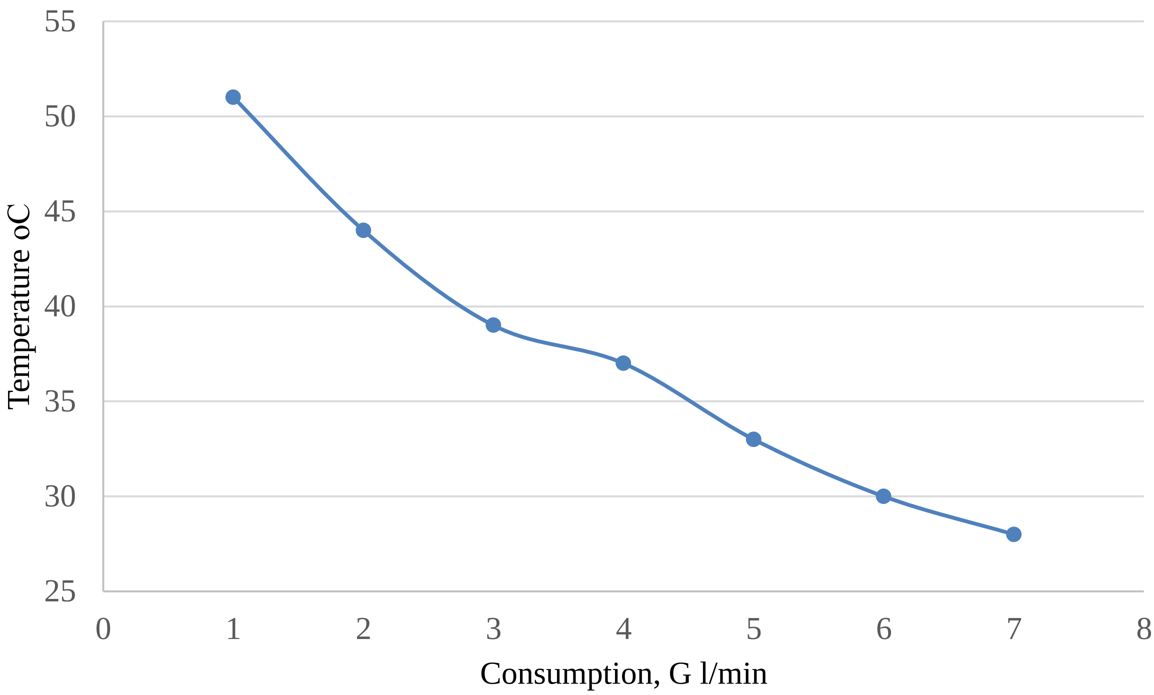

Figure 4. Dependence of the temperature change in the pipeline where the stern is installed.

From the data presented in Figure 4, it was observed that when the flow rate in the heated pipe is Gq_1 l/min, its temperature increases from 20 °C to 51 °C. However, with increasing consumption, it was found that the temperature of the heated flow at the outlet of the pipe decreases to 28 °C.

From the data in Figures 2 and 3, it can be seen that at a constant heat capacity (tq 120 °C) in the external pipe, the temperature of the flow exiting the pipe in the pipe with a stirrer is 9 °C higher at a consumption of Gq_1 l/min, consumption Gq 7 When it reaches l/min, it increases to 7 °C.

Conclusion: The results of the experiments carried out in the "pipe-in-pipe" heat exchange device show that during the heat treatment of food products in tubular devices, the possibility of ensuring full contact of the flow with the heated surface of the pipe by installing a stirrer inside the pipe in which the heated raw materials are moving is created, the heat exchange process of the device accelerates. Due to the increase in the speed of the flow, the accumulation of the soot mass, which is formed from organic compounds and affects the thermal efficiency of the device due to its low thermal conductivity, is prevented.

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