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EFFICIENT COOLING SYSTEM MILK ON THE FARM USING REFRIGERANTS WITH A LOW FREEZING POINT

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The researches on the choice of refrigerants with a low freezing point for cooling milk on the farm are carried out. Proposed as a coolant in the cooling units use Ecosol-40. Developed and investigated cooling of milk on farms, reduce operating costs and improve the reliability of the equipment.

The cooling system, milk, refrigerant, milk cooler.

In connection with the entry into WTO, modern technology makes ever greater demands on the maintenance regimes not only to cool the milk on the farm, but at all stages of the cooling process in the production of dairy products in the dairies.

The purpose of research - the development of systems using refrigerants with a low freezing point, which provides efficient cooling of the milk on the farm.

Materials and methods of research. From the analysis of the existing technology can distinguish four different cooling systems with cooling tanks [2].

First, one of the most simple and cheap compared to the other option, when used coolant storage tank with direct cooling. However, such a scheme may freezing to the inner surface of the milk tank, which is unacceptable.

The second option - PKHM with batteries ice. Cooling tank wall is made with milk ice water. In this case excluded freezing the milk to the walls, cooling is faster because PKHM turn right at the moment the milk in the coolant storage tank. Furthermore, the use of ice packs will significantly reduce power consumption as is frozen ice can be at night, with minimal load in electricity when the cost of electricity is 3-4 times lower than during the day. However, when filling the tank secondary problem arises from changes in the properties of milk by mixing hot and cold milk, as in the first embodiment, which reduces its quality.

In a third embodiment, the coolant storage tank is equipped with a battery of cold-flow cooler. In this case, provided the quick cooling of milk and eliminates the hassle of changing its properties by mixing of warm and cold milk.

The fourth option is different from the systems on ice (2nd and 3rd choices) that the purpose of energy conservation in the flow coolers, where is the first stage of cooling milk used running water (ground or water), which can then be used for watering animals or for industrial needs. However, in this case it is necessary to take into account that the plate coolers are very sensitive to water quality.

For the purpose of rapid cooling of milk and maintain the quality of research carried out by replacing the ice water alternative refrigerants. Thus, the institute cold and biotechnology St. Petersburg National University, studies of water-electrolyte propylene glycol coolants with a temperature of -3 ... +2 ºC. According to the authors, the use of these refrigerants will increase the service life of the equipment, will improve the quality of milk due to its faster cooling and prevent the development of micro-organisms in it. [1]

The results of research. In conjunction with VIESH MSUEE conducted research on the choice of refrigerants with a low freezing point. Given the relatively low cost and thermal properties as a coolant in the cooling units was chosen Ecosol-40 [5]. It has a relatively low viscosity, including at low temperatures, which improves the circulation and thermal conductivity in the applicable systems. Specific heat Ecosol such as a milk (3.8-3.9 kJ / kg • C). Furthermore, when the temperature decreases in volume Ecosol and, therefore, rupture of pipes is eliminated. In the sanitary certificate issued by the State Sanitary and Epidemiological Center, indicated that the degree of human exposure to the substance is Ecosol safe. It also features a low corrosive to various metals (ten times less than that of the known anti-freeze), non-toxicity, explosion, poor combustibility.

To evaluate the effectiveness, VIESH conducted laboratory tests. Tested two schemes rapid cooling milk using Ecosol. In the first embodiment, in addition to the conventional battery system with ice, the ice freezing process which takes place on the surface of evaporators (tubular or plate) PKHM descended into the water tank

was installed heat-insulated water tank, a heat exchanger mounted therein, which is circulated by Ecosol, outside air cooled.

In laboratory tests of the plant controlled by water temperature and the mass of the battery ice cold Ecosol temperature at the inlet and outlet of the heat exchanger and the temperature of the outside air. When the outdoor temperature -9 ... -11 °C the cooling water to +2 °C was about 3 hours.

In the second embodiment, a conventional cooling system with batteries ice was added to another refrigerant flow of milk established before the existing early warm milk flow, in which a coolant circulates Ecosol cools outdoor air.

It is known that the feature of plate cooler milk milking machines is the pulse mode of supplying milk slubber, adjustable volume which usually varies stepwise, e.g. in domestic installations ADM 8 UDM-100 UDM-200 in the range 5, 10, 15 l, or set only one value, for example in the milking plant «Unicala» company De Laval. During a pause between the insertion milk pump milk is cooled by forced movement of coolant and stationary milk cavity. This does not lead to subfreezing milk as a coolant flow in the main cooler is ice water with a temperature of 0.5 ... 2 °C. In a further flow-through cooler as the cooling agent used Ecosol-40, the temperature of which was dependent on the ambient outdoor air in the winter and reached negative values.

The calculations and preliminary laboratory tests have shown that the exclusion of milk in subfreezing space of the auxiliary coolant pump on and off Ecosol should be agreed with pulse-switching milk pump milking machine at an ambient temperature no higher than -5 °C. When outdoor temperature is above -5 °C chilled water pump control is carried out on a different algorithm.

In this embodiment, the cooling system operates as follows. At night, when the cost of electricity is 3-4 times lower, turn the refrigeration unit, which is frozen ice on the evaporator and cools in the tank ice accumulator water to a temperature of 0 ... 2 °C. When the desired amount of ice accretion thickness of which is controlled by a sensor, cooling unit automatically shuts down - ice accumulator fully operational.

Since the beginning of milking the pump ice water, which ensures its circulation through the primary coolant flow. At an ambient temperature below the temperature of the cooled milk automatically coolant pump (Ecosol-40) of the other circuit, which provides pre-cooling of milk in the additional flow cooler.

Conclusions

Studies have shown that the use of the proposed cooling system can improve reliability and reduce operating costs. In this case, energy costs are reduced by 1.5-3 times, depending on the region where the equipment is installed for rapid cooling of milk.

References

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