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ENERGY SAVING COOLING SYSTEM FOR LIVESTOCK FARMS

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Analysis of trends chillers for farms of all ownership showed that very promising is the creation of a combined refrigeration systems with high rotor-governmental aerodynamic diffuser and cold accumulators with Ice accumulating as body. Such systems mounted outdoors have advantages that are not existing refrigerating machine. Preliminary tests have shown that the consumption of electricity during the winter period is reduced to 10 times through the use of natural (natural) cold, the cold accumulator allows 2 ... 3 times lower installed capacity rechargeable refrigeration units, thus increasing the reliability of cooling systems, reduced loss of milk It retained its quality [1, 3-5].

The purpose of research - development of energy-saving cooling system for livestock farms.

Materials and methods of research. Natural cold accumulator is a tank with chilled water or ice, that ensure the accumulation and storage of natural or artificial cooling. The design of the battery enables it to work in all range of ambient air temperatures throughout the year. The proposed installation of combined action, working on energy-saving technology, can operate throughout the year in almost all regions of the country. It is capable of producing cold storage for agricultural products: fruits, vegetables, flowers and other plant products. This significantly saves production area, as attaching located outdoors. It is much more environmentally friendly than its counterparts running on traditional technology.

Upon cooling the milk plant can operate as a flow with heat exchangers, and capacitive type. Better economy and instant cooling is achieved when working with a

flow-type heat exchangers, so the technology built using these exchangers considerably more effective.

The results of research. FGBNU VIESH together with the Moscow specialized combine refrigeration (MSKHO) developed a new type of combined modular cooling system with rotary spray devices using both natural cold and artificial.

Energy-efficient refrigeration system for accumulating a modular cooling technology of livestock products is shown in Fig. 1.

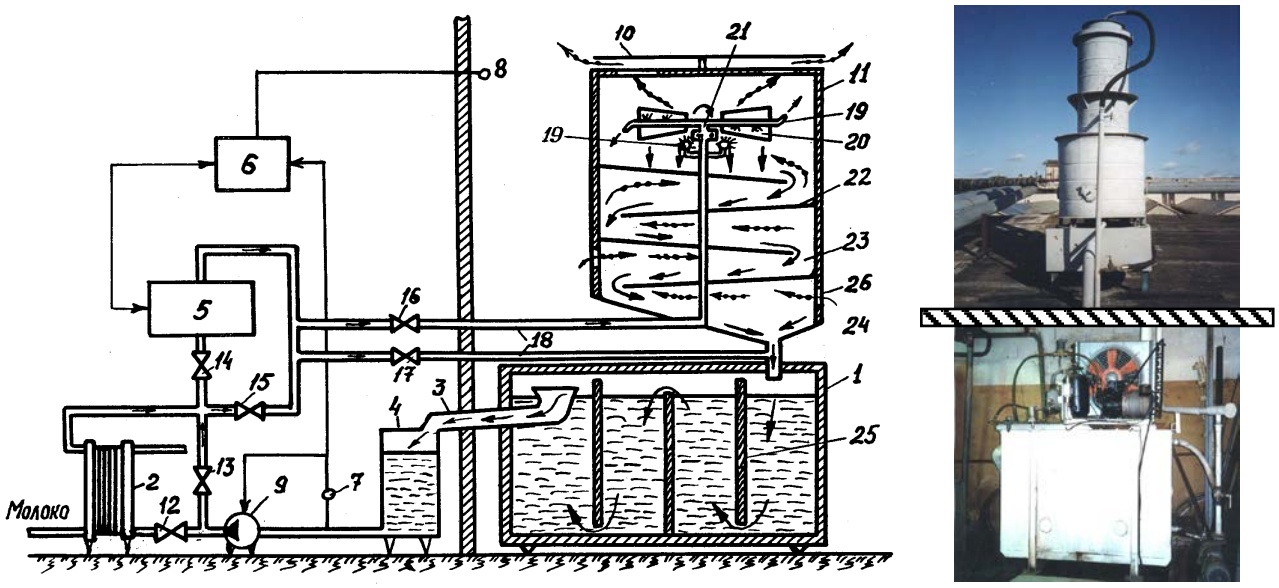

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Fig. 1. The storage refrigeration plant for modular cooling technology of livestock products:

a - functional-block diagram; b - a general view of the installation; 1 - insulated tank; 2 - plate heat exchanger; 3 - inclined tube; 4 - an intermediate tank (HPE); 5 - rechargeable chiller; 6 - the control unit; 7 - water temperature sensor; 8 - ambient air temperature sensor; 9 - the water pump; 10 - the screen; 11 - a hollow cylinder; 12-17 - controlled valves; 18 - feeding tube; 19 - rotary atomizer; 20 - aerodynamic plates; 21 - hollow bearing means; 22 - sloping surface; 23 - slotted holes; 24 - a drain pan; 25 – partition

Installation used for cooling all year round.

Depending on the ambient temperature may follow-ing modes. At an ambient temperature higher than 2? C unit works in the mode of accumulation and use of artifi-

cial cold, and at a temperature below 2? C - mode of accumulation and use of natural cold. Modes of operation of the plant selected by the control unit 6 as indicated by the air temperature sensor 8 is installed insulated rooms.

In accumulation mode artificial cold water from the second intermediate tank 4 the water pump 9 is supplied through controlled valves 13 and 14 in the chiller 5, where it is cooled to the set temperature (less than 2? C), then through the conduit 17 enters the valve end sections insulated tank 1. The water expelled through the upper and lower portions of the partitions 25, at the inclined pipe enters the surge tank 4 and the cycle is repeated. Insulation keeps for one cycle a constant water temperature at the outlet of the tank 1. Artificial cold accumulates in between milkings and during the night. In some designs settings can be installed rechargeable refrigeration evaporators in the tank 1.

The mode of use of the accumulated artificial cold water from the intermediate reservoir 4 the water pump 9 is supplied through a controllable valve 12 in the plate heat exchanger 2, which draws heat from the milk, then through controlled valves 15 and 17 through conduit enters the outer section of the tank 1. In this case, the back portion water is fed through a controllable valve 14 in rechargeable refrigerating machine 5, these further threads are connected to the piping system 17 and through a controllable (16 closed) into the tank 1. In this case the temperature of the outlet water tank 1 is lower than the temperature of the return water outlet flow heat exchanger 2. This allows a 3 ... 4 times to reduce the installed capacity rechargeable chiller.

In the use of natural cold accumulated circulating water after the heat exchanger 2 is fed through controlled valves, whether 15, 16, feed tube 18 and hollow bearing device 21 to a rotary atomizer 19. When feeding circulating water at atomizer 19, due to the reactive force of the water it is driven in rotation movement around the hollow cylinder 21. To increase heat transfer within the hollow cylinder 11 installed inclined surface 22, which allow to increase the path of the water and the spray area. The atomized water falling on the upper inclined surface 22 merges through a slotted opening 23 between the inclined surface and the inner side of the hollow cylinder on the second inclined surface, etc. Thus, water passes all the inclined surfaces 22 and flows through

the drain pan 24 at the extreme section of the tank 1. In the sprayer 19 are aerodynamic plates 20 which at rotation atomizer taken (sucked) from the lower air slot openings 26 and feed it towards the water spray, rapidly cooling it. Thus, air is fed through the inclined surface towards the space sprayed water further through the openings between the hollow cylinder 11 and the screen 10 in the environment. Thereby, heat transfer is enhanced by spraying water and increases the rotation speed of the atomizer 19.

In the natural accumulation of the cold alarm ambient temperature sensor 8, the water from the intermediate container 4, the water pump 9 is supplied through the valves 13, 15, 16 in the dispenser 19 where intensively cooled and then enters the outer section of the tank 1, and then, displacing the remainder of the heating water, through the lower and upper portions of partition walls 25 and an inclined pipe 3 flows into the intermediate container 4. Then the cycle is repeated. The water temperature in the tank 1 while cooling the milk accumulation and artificial and natural cold sensor 7 is monitored.

If rotating parts spray freeze and lose the possibility of rotation due to heavy frost, the heating water (reverse refrigerant after cooling the milk) flows into the holes dispensers and "unfreeze" them. In this case, aerodynamic surface to the defrost spray holes slight no function. Thus, regulation is achieved by a natural setting, and its performance is maintained under all operating conditions.

Energy-efficient refrigeration system for accumulating a modular cooling technology of livestock products unified with the set season action. Factor of unification is 85%.

It is found that the installation of this type are more efficient in production lines for milk processing. Capacity Battery coolant is determined by the rate of 3 m3 / t of cooled milk for pre-cooling with tap water up to 12 ... 15? C. Operating experience of pilot schemes shows that this plant provides cooling of milk with high reliability to a temperature of 4 ... 6? C when the outdoor temperature is more than + 2? C. At lower outdoor temperature and the formation of ice crust and ice cooling capacity (cooling capacity) increases significantly.

Performance coolant pump, and hence the cooling time, control valve located on the bypass pump coolant.

Capacity intermediate tank storage-regulatory capacity (HPE) 4 is determined from the condition that after stopping the coolant pump 9 HPE must accommodate the water remaining in the pipe after the cooling process. In addition, HPE 4 should be enough coolant to the next start-up occurred when flooded pump 9. On the basis of this condition, you can use HPE capacity of about 200 liters, enough to fill the coolant system. In accumulating refrigeration unit for modular cooling technology required power refrigeration unit 5 is dependent on its mode of operation in conjunction with the cold accumulator. The cycle of the plant consists of three stages. The first step is to cool the milk by the cold reserve in the cold accumulator. In this refrigerant in the system "warm" and cold reserve in the battery is reduced. Therefore, immediately after the step of cooling the milk should be included rechargeable chiller 5 and doohladit refrigerant to the desired temperature. Cooling capacity rechargeable chiller 5 should provide chilled water cooling to the desired temperature in between milkings. Hours rechargeable chiller 5 is set depending on the daily work on the farm (half board or full board milking).

Assuming the mixing of warm and cold water in the cold re-accumulative in the cooling process, the temperature of water at the end of the cooling cycle is close to 6? C, dramatically increases the required amount of battery (experimental studies). This can be avoided if the tank battery to split partitions into special sections and use the principle of displacement of the battery and chilled water spattering reverse refrigerant, using the forced cooling of its counter flow of cold air.

Preliminary experimental studies have shown that the use of IP-rotor aerodynamic spray unit improves the efficiency of the plant by 15 ... 20% due to the intense emission of heat into the atmosphere from entering the coolant after heating process of milk cooling. At low outside temperatures the installation considerably increases the cooling capacity.

Using the built-in rechargeable evaporator refrigeration system in the battery allows you to get in the process of accumulation of water-ice mixture and thereby increase further hladoproizvoditel of-installation and reliability.

The advantage of this type of plant is:

relatively lower metal consumption due to improved race-dusting and increase aerodynamic efficiency rotary atomizers, improved housing design battery cold;

increased cooling capacity by increasing the area of the spray at 10 ... 15 times.

Conclusion

1. To cool the agricultural companies of all forms of ownership perspective combined refrigeration systems modular type uses natural (natural) cold. Units are equipped with high-performance aerodynamic rotor type sprinklers, cold accumulators are used as the body accumulating ice and ice water.

2. Using a natural cold milk cooling and storage of artificial cold reduces the need for agriculture to scarce water-cooling refrigeration units, go to environmentally sound technologies and to obtain significant energy savings.