ANALYSIS OF THE CONDENSING-AND-COOLING UNIT OPERATION WHEN THE OUTDOOR AIR TEMPERATURE INCREASES

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Fan cooling towers are designed considering the most adverse atmospheric conditions. Now the climate is changing towards warming. Preliminary calculations carried out by the authors showed that cooling towers are incapable to provide the specified heat removal during almost a third of the summer period in the climatic conditions of Kharkov (while the standards give the outside air parameters exceeding limit from 1 to 10 days, depending on the purpose settings). So, any heat technology complex where a cooling tower is used operates when the designed parameters are exceeded.

The object of this research is the condensing-and-cooling unit of a vacuum evaporator, consisting of a contact barometric condenser and a fan cooling tower.

The higher outdoor air temperature the less water-cooling degree in cooling towers, so the water enters condensers at a higher temperature. To ensure heat removing when a given steam flow rate is condensed, the amount of water supplied to the condenser must be increased. However, the maximum allowed value of water flow must be determined for the condenser, considering the probability of hydraulic impact, vibrations and flooding increases when water flow rate grows.

Typically, the plan area and the number of sections for fan cooling towers are designed based on the recommended specific heat load. The analysis of the basic equations for fan cooling towers calculation shows that the volumetric mass transfer coefficient and, thus, the intensity of water cooling, strongly depends on the sprinkling density. Significant water cooling occurs in the drip part of the cooling tower, that is, from the nozzles to the fill. Increasing the water pressure in the nozzles raises the water flow in the cooling tower, which leads to a decrease of the droplets size (and, accordingly, to an enlargement of the contact surface between the drops and air) and to an increase in the spray angle of the centrifugal nozzles, which contributes to a more uniform distribution of a drops across the drip part of the cooling tower. If it is necessary to increase the water flow above the critical one for a given condenser diameter, a storage tank should be used for excess cooling water. The warm water from the condenser is first drained into the tank and then fed into the cooling tower.

The intensifying of the cooling processes in the cooling tower by changing the fan blades angle was also analyzed. A series of preliminary aerodynamic calculations of the cooling section for the given standard fill was carried out in order to determine the maximum air flow rate at various angles of the blades inclination. It is shown that a greater angle leads to a growth in air flow, which increases the cooling potential of the cooling tower.

In general, the results of the work can be recommended for implementation in the practice of condensing-cooling units operating.