THEORETICAL STUDY OF THE EFFICIENCY OF THE WATER SUPPLY SYSTEMS WITH A FAN COOLING TOWER UNDER HIGH OUTSIDE TEMPERATURES

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At present the outdoor temperature in the summer rises up to 35 °C and higher. This complicates the operation of the water coolers and leads to undercooling of the circulating water in the cooling tower. As a result, a violation of the technological process of operation of the main equipment (refrigeration units, compressor stations, condensers, induction melting furnaces, etc.) is possible. Such extreme environmental conditions especially affect the efficiency of cooling towers with a long service life.

A research rationale has been proposed to study the operating parameters of an existing circulating water supply system at high outdoors temperatures. The system is consisted of a water-cooled heat exchanger, a fan cooling tower, tanks for warm and chilled water, and pumps. The methodology has four steps.

Step 1. Determination of the maximum temperature of cooling water at which the operation of the heat exchanger and, accordingly, the entire technological complex is possible.

Step 2. Calculation of the height of the cooling tower filler, which is necessary to ensure a given heat removal (i.e. actual cooling ability of the fan cooling tower at given conditions).

Step 3. Analysis of the cooling ability of cooling tower at various parameters of the outdoor air.

The methodology makes it possible to obtain the actual enthalpy, and hence the temperature of the water at the outlet of the filler of the considering standard cooling tower.

Step 4. Analysis of the possible ways of enhancement the efficiency of the cooling tower at extreme parameters of outdoor air.

Investigations show that the efficiency of the cooling tower is influenced by air flow and water spray rate. Air flow can be adjusted using a variable frequency drive or tilting the fan blades.

When examining the influence of water spray rate there are several factors to be considered. Firstly, an increase in water spray rate should not lead to “flooding” of the filler. Secondly, an increase in water flow rate should not lead to an increase in the irregularity of the local density of water spray rate, especially when full-spray nozzles oriented downstream are used. Thirdly, with an increase in water flow through the cooling tower, the water flow through the heat exchanger should not be increased. This can be achieved, in particular, by draining excess chilled water into a warm water tank, thereby diluting and lowering its temperature, which, in turn, should somewhat improve the operating conditions of the cooling tower. A similar solution is also possible when installing an additional cooling tower.

In this way the methodology makes it possible to predict the operating mode of the cooling tower and the main technological equipment for arbitrary parameters of the outdoor air.