DETERMINATION OF HEAT- AND MASS TRANSFER COEFFICIENTS IN SMALL-SIZE APPARATUSES OF RECYCLED WATER COOLING

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INTRODUCTION

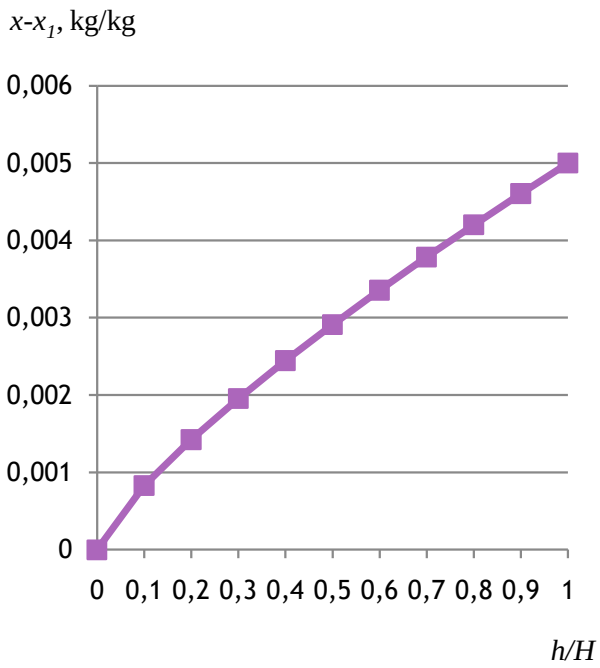
- The main directions of rationally using of water sources and a protection of water-reservoirs of pollution is decreasing of water amount use from sources, a wide implementation of water cycles, creating of closed systems with full extraction and re-using of chemical products, caught during water clearing.
- At use of recycling water supply at production process a quality of realized production depends on quality and temperature of recycling water. In the practice of industrial water supply, the treatment of circulating water is carried out at separate water treatment facilities - cooling towers [1, 2].
- At present there are some constructions of fan small-sized apparatus for recycled water cooling, which according to the phase motion in the proposed classification are referred to as countercurrent. There is suppose a making of constructions of small-sized colling tower with a cross current and sprinklers for them, also a carry out of an experimental research for determination of determine the main parameters responsible for the efficiency of work, namely the depth of cooling and the coefficients of heat and mass exchange. An increase of efficiency of supposed cooling towers constructions is explained by that air flow is "twisted" and thereby a time of contact of air flow and water flow is increase.
- At a tangential supply of cooling air flow there is take place a twisted movement of gas phase in the bottom part of cylindrical small-size cooling tower. The rate of rotary motion is decreased as move of air flow to up on cooling tower, and vertical parameter of the rate is increased. There is no any motion of air flow in top part of the cooling tower and it moves vertically to up progressively.
- Such type of movement of air flow allows to decrease a vertical parameter of the rate, what results to increase of interacting phases contact time

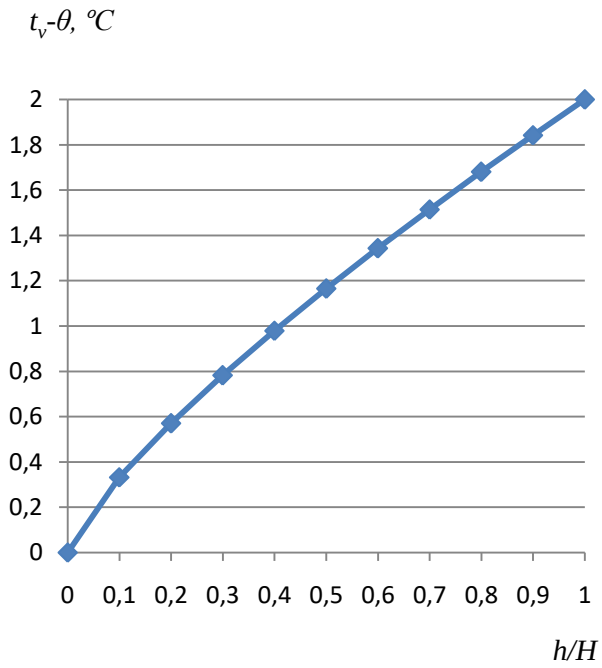
MATERIALS AND METHODS

- There is the method of calculation to determine of hydroaerothermal parameters. As it shown from the analysis of experimental data for developed designs of cooling towers, that moisture content *x* and temperature of air in the volume along the height of the sprinkler changes according to the power law (and not according to the linear, as it was believed by other researchers).

RESULTS AND DISCUSSION

$$\beta_{xv} = \frac{G_ж C_ж \Delta t}{K\left\{\frac{(t_{в2}-\theta)(C_{вс}+C_п x_1'')}{b+1} + (r+C_п\theta)\left[(x_2''-x_2)+(x_1''-x_1)\frac{a}{a+1}\right] + C_п\frac{(x_2''-x_1'')(t_{в2}-\theta)}{a+b+1}\right\}}$$





RESULTS OF RESEARCHES ON LABORATORY EQUIPMENT OF THE MINI COOLING TOWER WITH TWISTED AIR FLOW SYSTEM

№ experience's	1	2	3	4	5	6
Irrigation density q, m^3/m^2hour	2	4	6	8	10	12
Air temperature on inlet , ºC	14.2	14.2	14.2	14.2	14.2	14.2
Air temperature on outlet ºC	15.3	16.8	16.9	17.0	17.2	16.8
Air humidity φ_1, %	60	60	60	60	60	60
A humidity on cooling tower outlet φ_2, %	77	78	79	79	80	80
Change of air enthalpy, J/kg	15130.5	17150.3	17418.1	17611.7	18048.5	18048.5
Temperature of the water on inlet , ºC	27.5	27.6	27.5	27.5	27.6	27.5
Temperature of the water in outlet , ºC	20.0	18.9	18.0	17.8	17.7	17.7
Thermal power W	6930.0	7946.4	8778.0	8962.8	9147.6	9055.2
Heat exchange coefficient α_v, W/m^3K	1534.4	1552.2	1688.3	1704.8	1708.5	1708.5
Mass exchange coefficient , kg/m^3 s	1.53	1.54	1.68	1.70	1.70	1.70

RESULTS OF RESEARCHES ON LABORATORY EQUIPMENT OF THE MINI COOLING TOWER WITH COUNTERCURRENT SYSTEM

№ experience's	1	2	3	4	5	6
Irrigation density q, m^3/m^2hour	2	4	6	8	10	12
Air temperature on inlet , ºC	14.2	14.2	14.2	14.2	14.2	14.2
Air temperature on outlet ºC	16.3	16.3	16.4	16.5	16.6	16.4
Air humidity φ_1, %	60	60	60	60	60	60
A humidity on cooling tower outlet φ_2, %	75	75	75	76	77	77
Change of air enthalpy, J/kg	17168.9	17168.9	18028.5	18444.1	18366.6	18028.5
Temperature of the water on inlet , ºC	27.5	27.5	27.5	27.5	27.6	27.5
Temperature of the water in outlet , ºC	21.5	20.2	19.6	19.4	19.6	19.6
Thermal power W	5544.1	6837.6	7392.1	7207.2	7114.8	7207.2
Heat exchange coefficient α_v, W/m^3K	1081.7	1334.2	1359.4	1359.4	1356.7	1356.4
Mass exchange coefficient , kg/m^3 s	1.08	1.33	1.35	1.35	1.35	1.35