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STUDY OF THERMAL REGIME water tower

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Research Shows Heat treatment water tower in winter. We consider upgrading water tower designs using heating cables.

Water supply, water flow, tower Rozhnovskoho, heat treatment

Urgency of the problem stems from the well-known fact that activities such as human and animal life is impossible without water. People and animals can be for weeks without food, but without water - only 2-3 days. Therefore, violation of a water network with towers Rozhnovskoho leads to serious consequences. Especially dangerous thawing of the network for the harsh winters of recent years for the Kiev area when negative minimum temperature reached a maximum of -25 - 32 ° C, in the south-eastern part of our country - more than -40 ° C. It is known that at low temperatures below 4 ° C, the water volume begins to increase by about 10% during freezing - pressure in a confined space reaches 250 MPa [1]. Under the influence of high pressure, the gap (thaw) pipes and most stable tower. Unfrozen water system usually can not be repaired and requires complete replacement.

Despite the fact that the phenomenon of defrost water systems are well known and well-known disastrous consequences of these phenomena, as shown by the literature and patent search, the problem of protection of thawing water network is far from a satisfactory practical solution.

In agriculture, the various technological needs require quite a lot of water. Therefore, the organization secure uninterrupted supply of agricultural consumers is odnyeyu the most important tasks of agricultural production.

Currently, most water systems in rural areas organized using relatively cheap metal water towers Rozhnovskoho. Their major shortcoming is the icing inside of the walls in the winter season.

This first disrupted automatic water level (level sensor), reduced storage capacity of the tower and ultimately it is the mechanical destruction [3]. As shown by the use of Tower Defense icing through its insulation in some farms inefficient, because it requires significant additional costs thereby reduce to zero tower Rozhnovskoho main advantage - its cheapness, and the accelerated erosion of the walls of the tower at potryaplyanni between insulation and moisture. It is also difficult to detect and eliminate possible upodalshomu flowing. However, there are cases of substantial increase the stability of the water tower to the icing by fuller use of warm water coming from the well.

It should also be noted that in recent years has declined as rural population and the number of farm animals, that water consumption has fallen, and the towers were designed and put into operation before. In the towers began the

process of stagnant water, and the loss of water quality, and in the winter the water freezes and as a result - failure of the towers.

Thus, prevention of excessive icing Rozhnovskoho towers are now a problem.

The purpose of research - the study of temperature water tower at low ambient temperatures ..

Materials and methods research. Used method of heat flow through a cylindrical wall, differential and integral calculation methods.

Studies. Heat flow through the cylindrical wall calculated by the expression:

$$Q = \frac{\pi l (T_в - T_{пов})}{\frac{1}{\alpha_1 d_{зов}} + \frac{1}{2\lambda_{ст}} \ln \frac{d_{зов}}{d_{вн}} + \frac{1}{2\lambda_л} \ln \frac{d_{вн}}{d_{вн.л}} + \frac{1}{\alpha_2 d_{вн.л}}} \quad (1)$$

where Q - heat flow, W; l - height of the cylinder, m, TV - tower water temperature, ° C; Tpov. - Ambient temperature, ° C - heat transfer coefficient from the wall to the air - heat transfer coefficient from water to ice walls - thermal conductivity of the steel wall - thermal conductivity of the wall of ice; dzov - outer diameter of the steel wall, m; dvn - inner diameter steel wall, m; dvn.l - inner diameter wall of ice, c

On the other hand, the energy that must flow into the tower every second of water from the well, we find the expression:

$$Q = c\rho V \Delta T, \tag{2}$$

where c - specific heat of water, kJ / kg □ C - water density, kg/m3; V - volume of water that entered the tower with holes per second, m3 / s, ΔT, the temperature difference between the water in the tower and in the hole, □ C.

Heat balance equation can be written as:

$$-CldT = (T_1 - T_{пов})\alpha_1 S_1 dt \tag{3}$$

$$-CldT = 2\pi\lambda_{ст} l \frac{T_2 - T_1}{\ln \frac{R_1}{R_2}} dt \tag{4}$$

$$-CldT = (T_{воды} - T_2)\alpha_2 S_2 dt \tag{5}$$

where C - heat mass of water in the cylinder height of 1 m, J / (m • ° C) - time, s; T1 - temperature of the outer wall, ° C; T2 - temperature of the inner wall, ° C; dT - temperature change of water during dt, ° C; R1 - radius of the outer surface, m; R2 - radius of the inner surface of m; S1 - exterior wall area, m2; S2 - the inner surface of the wall area, m2.

Transforming equation (3) - (5) and integrating, we obtain:

$$t = K \ln \frac{T_{поч} - T_{пов}}{T_{кін} - T_{пов}} \tag{6}$$

where Tpoch - initial water temperature, ° C; Tkin - final water temperature, ° C;

$$K = -\frac{c\rho R_2^2}{2}\left(\frac{1}{\alpha_1 R_1} + \frac{\ln \frac{R_1}{R_2}}{\lambda_{ст}} + \frac{1}{\alpha_2 R_2}\right). \tag{7}$$

In relation (6) we can determine the cooling water in the water tower t of Tpoch to Tkin. In Fig. 1 shows the dependence obtained from equation (6) in [5].

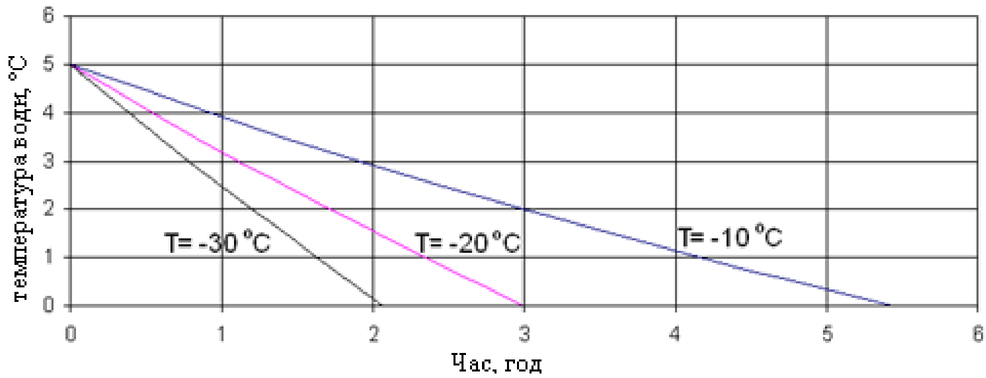

Figure. 1 Dependence of water temperature on time

In Fig. 2 shows the obtained graphs of the thickness of ice formed on the inner wall of the water reservoir tower, from time to time.

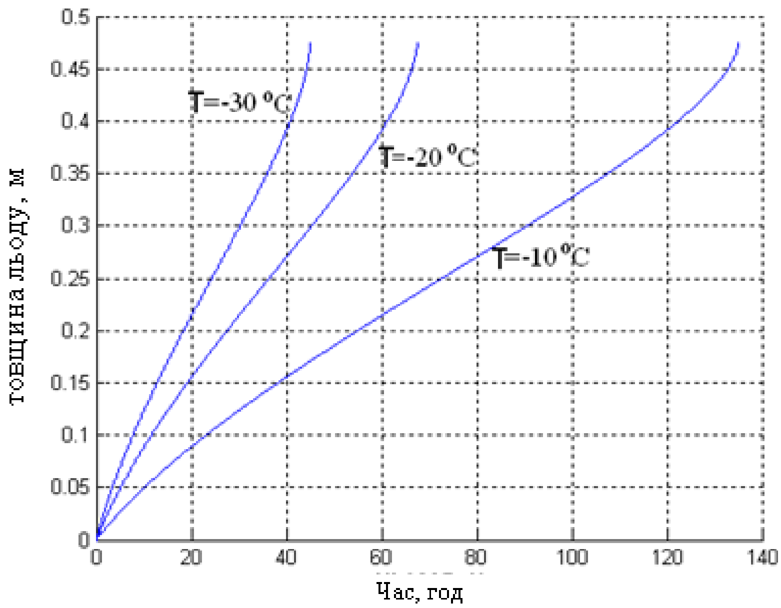

Figure. 2 Dependence of the thickness of the ice that formed on the inner wall of the water reservoir tower and then

A method of protecting water tower with heating cables [2]. To achieve this goal it is necessary to water tower for an additional tangent to the cylindrical inner tank with her hand placed heating cable temperature 65 ° C - 110 ° C. Cabling is carried on an insulating bar at the top of the tower, with a secure lid, reach for water.

Conclusions

1. The analysis of the water towers Rozhnovskoho in the winter of the year found that air temperature -10 ° C temperatures in the tower will be 5 ° C over 5.5 h, and ice thickness over 140 hours to about 45 inches and under - 30 ° C temperature in the tower will be 5 ° C over 2 h, with the exact same very thick ice will reach within 40 minutes.

2. Theoretically found that the intensity of ice formation can be reduced significantly, reducing the time of the tower in container of the same volume of water (stagnation) by providing water circulation in the cavity of the tower.

3. Increase its resistance to icing can be achieved by upgrading the design of water tower, namely the use of heating cables, which are located tangent to the circle inside the tower.

4. The economic benefits by reducing the frequency of failures when using heating cables and as a result increase reliability of supply is 5194 USD. one tower at prices 2012

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