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INVESTIGATION OF THE INFLUENCE OF A SPECIFIED WATER FLOW RATE IN THE HOT WATER SUPPLY SYSTEMS OF MULTI-APARTMENT RESIDENTIAL BUILDINGS ON THE MATERIAL CHARACTERISTIC OF A PIPELINE NETWORK

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The article deals with the influence of the amount of water consumption by one consumer per hour of maximum water consumption in the hot water supply system of multi-apartment residential buildings on the diameters of pipelines of a water supply network. It is shown that with an increase in the values of this flow rate, the material characteristic of the hot water pipeline network monotonically increases what leads to an increase in capital costs. However, this effect is negligible. The conclusions made in this article can be used for discrete optimization of the diameters of the pipelines of centralized hot water supply systems of multi-apartment residential buildings.

Capital expenditures for the construction of centralized hot water supply systems for multi-apartment residential buildings are directly dependent on the pipeline section diameters selected during the design process. In their turn the diameters depend on the water volume that is pumped through the pipelines per unit of time. Determining water consumption in the design process is a difficult task if the goal is to perform a discrete optimization of the costs of construction and operation of a hot water system. The situation is aggravated by the fact that there is no unambiguous interpretation of this issue in the technical regulatory legal acts that regulate design.

Obviously, an increase in water consumption leads to an increase in the diameter of the pipelines. In this case, the area of their cross-section increases in proportion to the increment of the squared diameter. This allows us to expect that the total pressure loss in the system will decrease or at least not increase.

In accordance with the new construction standards of the Republic of Belarus, when performing the hydraulic calculation of pipelines of hot water supply systems, it is necessary to take the values of the estimated water consumption based on the actual data of water consumption for at least the two-year preceding period. In the absence of such data on the projected object and similar objects, the hydraulic calculation should be performed according to the method based on the probability of simultaneous operation of devices for supplying water to consumers [1].

To compare the standard and actual water consumption by one consumer per hour of maximum water consumption, field studies were performed on a group of multi-apartment residential buildings in Novopolotsk (the Republic of Belarus), the results of which are presented in Table 1.

Table 1. – Water consumption per hour of maximum water consumption per inhabitant, $q^h_{hr,u}$, *l / hour*

Object	Number of consumers, persons	Jan.	Feb.	Mar.	Apr.	May	June	Sep.	Oct.	Nov.	Dec.
1	206	9,3	8,9	9,1	10,0	9,4	9,1	10,3	10,1	9,3	9,8
2	113	7,6	5,1	8,2	9,3	9,5	7,3	7,3	8,5	8,0	7,3
3	197	8,6	12,4	8,4	10,6	8,6	10,5	8,9	8,9	9,4	9,0
4	189	9,5	7,6	9,8	9,0	11,0	9,4	10,3	8,6	9,2	9,7

As a result, the average actual value of water consumption by one consumer per hour of maximum water consumption was 9.1 *l / hour*, while the standard value is 10.0 *l / hour* [1, 2].

To determine the degree of influence of the amount of water consumption by one consumer per hour of the maximum water consumption, $q^h_{hr,u}$, in the hot water supply system of multi-apartment residential buildings on the diameters of the pipelines of the water supply network, a hydraulic calculation of the pipeline network was performed for three variants of such flow, l/h: 8, 10 and 12. A 100-apartment residential building with 200 water faucets was accepted as the design object. The hydraulic calculation was performed with the help of a technique based on the probability of simultaneous operation of the equipment for supplying water to consumers [2]. When designing the pipeline network, polypropylene pipes were used. The choice of diameters was made based on the speed of water movement through the pipes (up to 1.5 m/s). The calculated diameter values were rounded to the nearest standard values specified in the polypropylene pipes catalogues. For the selected pipe diameters, pressure losses were determined in all sections of the network, and pressure losses were correlated in all directions of water

movement. For the purpose of simplification, only the hydraulic calculation of the hot water pipelines was performed, since the diameters of the other circulation lines practically do not depend on the amount of water consumption by one consumer per hour of maximum water consumption. As a result of the calculations performed, the diameters of the pipelines were determined, which in different sections of the network for all three variants of water consumption by one consumer per hour of maximum water consumption ranged from 25 to 60 mm.

The estimation of material costs was carried out by determining the material characteristic of the pipeline network, which was calculated using the formula:

$$M = \sum_{i=1}^{i=N} d_i \cdot l_i, \ \text{m}^2, \quad (1)$$

i – the network section number; N – is the total number of all sections in the network; d_i and l_i – the diameter of the section and the length of the network section, respectively, m.

It is established that the change in the accepted water consumption by one consumer per hour of the maximum water consumption per inhabitant from 8 to 12 liters / hour leads to a monotonous increase in the material characteristic of the network (fig.1).

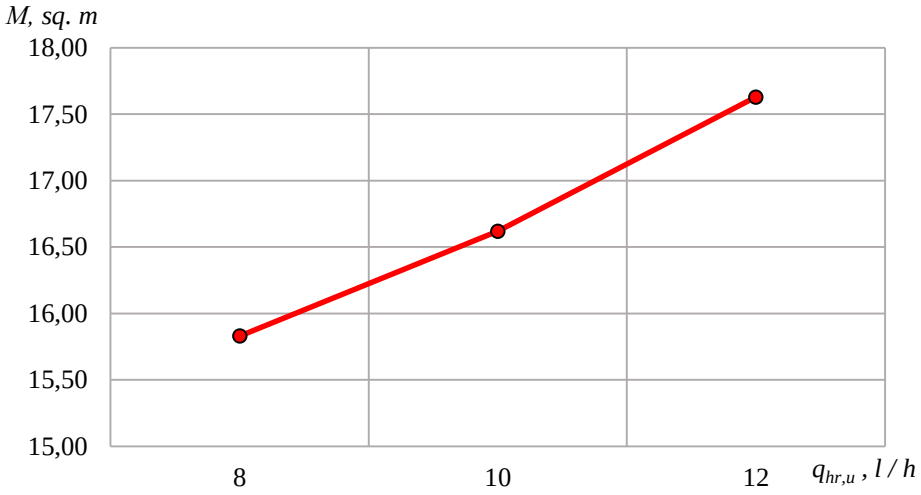

Fig.1. – Dependence of the material characteristic of the network on the water consumption by one consumer per hour of maximum consumption

Conclusions. It is established that the material characteristic of the pipelines of the hot water supply system increases with the increase in the calculated water consumption by one consumer per hour of the maximum water consumption from 8 to 12 liters, which leads to an increase in capital costs during construction. The relative limits of such a change for the considered design example are determined.

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