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FEATURES OF INCREASING THE HEAD IN INTERNAL WATER SUPPLY NETWORKS

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Abstract: If necessary, an increase in the pressure in living quarters in the internal water supply system is achieved using a constantly operating pump that provides maximum flow-pressure parameters. It is obvious that the network operation of a separate pump provides a certain increase in pressure in the subsequent house network, however, all the unevenness of the pressure characteristic at the entrance to the house is transferred to the further system. As a result, pressure drops on cold water appear on collapsible devices, which are incompatible with the concept of high-quality water supply, and in terms of temperature conditions when mixed with hot water, they are unsafe. Therefore, this article is devoted to the study and solution of the problem of increasing the pressure in internal water supply networks associated with the design and operation of internal water supply systems: overgrowing of pipes during long-term operation; decrease in performance or failure of booster pumps (if installed); It is possible to correct the situation if there are local control tanks (reservoirs) in attics or roofs of buildings.

Key words: increase in pressure, organoleptic properties, uneven water consumption, variable drive, mathematical model, peripheral sites, individual buildings, mathematical models.

摘要：如有必要，可以使用提供最大流量压力参数的持续运行的泵来增加内部供水系统中生活区的压力。很明显，单独泵的网络运行在随后的鸡舍网络中提供了一定的压力增加，然而，鸡舍入口处压力特性的所有不均匀性都会转移到进一步的系统中。因此，在可折叠设备上出现冷水压降，不符合优质供水的概念，而且在与热水混合的温度条件下，它们是不安全的。因此，本文致力于研究和解决与内部供水系统设计和运行相关的内部供水管网压力增加问题：长期运行期间管道过度生长；增压泵性能下降或故障（如果已安装）；如果阁楼或建筑物屋顶有本地控制罐（水库），则可以纠正这种情况。

关键词：压力增加，感官特性，不均匀的用水量，变量驱动，数学模型，外围站点，个别建筑物，数学模型。

1. Introduction.

In residential buildings, an increase in the pressure for the internal water supply system is achieved using a constantly running pump that provides maximum flow-pressure parameters. It is obvious that the operation in the nominal ("network") mode of a separate pump provides a certain increase in pressure in the subsequent house network, but all the unevenness of the pressure characteristic at the entrance to the house is transferred to the further system. As a

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result, pressure drops on cold water appear on collapsible devices, which are incompatible with the concept of high-quality water supply, and in terms of temperature conditions when mixed with hot water, they are unsafe. Therefore, this article is devoted to the study and solution of the problem of increasing the pressure in internal water supply networks associated with the design and operation of internal water supply systems: overgrowing of pipes during long-term operation; decrease in performance or failure of booster pumps (if installed); insufficient design value, free head recommended by Building regulations 2.04.01-97 "Internal water supply and sewerage of buildings" (equal to 2 m for washbasins and sinks, 3 m for showers -3 m. appendix 2 to Building regulations), especially in the presence of gas water heaters and other plumbing fixtures that require a water pressure of up to 15 m.

In all these cases, replacement or new installation of booster pumps is required, or replacement of pipelines and fittings of the in-house cold water supply system, or both at the same time. Most often, utilities have to solve the problem of increasing the pressure in domestic cold water supply systems by installing booster pumps, including in houses in which this was not provided for by the project. In addition to the above reasons, such a need has recently often arisen in connection with a decrease in pressure in urban water supply lines in cities of Uzbekistan, including micro district and intra-quarter water supply networks [1,2.3].

2. Methods.

Solving the problems of insufficient pressure in residential buildings using a pump that is constantly operating in a network mode is technically outdated, economically ineffective and incapable of providing a comfortable water supply with a given characteristic (stable pressure) is very important.

Pressure instability in the external network worsens the operating conditions of booster pumps installed in individual buildings or groups of buildings. A change in the characteristics of the system, up to a significant shift in the top of the characteristic along the axis of the pressure, leads to a constant change in the required geometric pressure (static component).

In such cases, the pumps operate with a low efficiency, can go beyond the permissible limits of parameter, which leads to excessive consumption of electricity and leads to premature wear of the equipment. In most of the houses built until the end of the 90s in Tashkent, cantilever pumps of the K type (without frequency controllers (WFC) were used, and this provision fully applies to them. Equipping an installed separate WFC pump reduces power consumption, but does not exclude work outside the recommended supply zone, especially taking into account the combination of backwater surges at the inlet and the hourly irregularity of water consumption [1,4,5,6].

It is possible to correct the situation if there are local control tanks (reservoirs) on attics or roofs of buildings. In this case, it would be advisable to use unregulated pumps that are turned on and off depending on the water level in the tank, with a choice of filling periods when the external network is not overloaded. The reservoirs would not only improve the working conditions of the external water supply systems, but would also guarantee (due to the water supply) the uninterrupted water supply.

3. Results and discussion.

4. **1.** Organizations operating internal water supply systems do not always take measures to reduce the unevenness of water withdrawal from the external network, avoid installing containers in attics or roofs of buildings. Therefore, the refusal to use reservoirs is associated, first of all, with an insufficient level of reliability in terms of their tightness and serviceability of valves, as well as with the high cost of complete control and automation systems [7,11].

5. 2. On the other hand, utilities, with the means at their disposal, cannot ensure an increase in the culture of operation of internal water supply systems, as well as regular monitoring of the state of house systems, incl. tightness and serviceability [8,10].

6. 3. Fears of possible flooding of downstream premises and, as a consequence, the costs of subsequent repairs lead to the denial of the "reservoir" technology by the utilities, which with such a scheme, taking into account the quality requirements of the water supplied to the consumer, problems may arise due to prolonged contact of water with air, which can worsen its organoleptic properties and bacteriological state [9,15].

Thus, ensuring the reliability and efficiency of internal water supply systems and its effective use, under conditions of variable pressure in the external network and with a natural significant unevenness of water consumption in residential buildings, at this stage of their development lies in a different plane.

In a city where the building density is uneven, consumption fluctuates, the number of storey's even within a block is different, it is advisable to use in-house pumping stations to increase pressure. The optimal result for various flow and pressure consumption parameters can be obtained by choosing the correct type of installation. Due to significant fluctuations in water consumption per house per unit of time, the use of a variable frequency drive (VFD), as a rule, is effective in terms of reducing energy consumption by "adjusting" the pumps to changing the characteristics of the system [2,13,14].

To solve the problem of increasing the pressure, taking into account the nature of water consumption in houses, it is necessary to install a small-sized automatic pumping unit Gidro Pro 2 with a current frequency converter (CFCT), which has the following parameter ranges (per one operating pump) at a nominal frequency: supply Q from 1.2 to 4, 5 m / h and head H from 38 to 13 m; power consumption N = 0.55 kW. The installation provides after itself a constant pressure of 66 m, regardless of the existing fluctuations in the inlet head and the actual flow rate [16,2,3,17].

Statement of the problem of optimization of the booster components of the water supply and distribution system (WSDS) at the level of district, quarter and internal networks. Taking into account the above material of the article, it seems expedient to develop a mathematical model that would allow optimizing the parameters of the booster pumping equipment of the peripheral sections of the network (NS of final ascents, as well as intra-house pumping). Computer implementation of such a model can become the basis for design studies during construction and reconstruction. The results of such an approach, on the one hand, could be integrated into the problem of optimizing the water supply system of the city as a whole, and on the other hand, it would make it possible to formally analyze possible design schemes of the peripheral network, including the distribution of the required pressure parameter between the pumping nodes of this network, as well as determining the optimal the number of pumping units within the nodes (Fig.1.) [18].

This model is based on the use of the regularities of the hydraulic and energy interaction of the corresponding elements of the Water supply and distribution systems (WSDS). The theory of WSDS modeling is presented in the works of N.N. Abramov and V.Y. Khasilev, and others. The first WSDS models, developed in the early 1960 s, were based on the Lobachev-Cross method. In the 70s, in the work of Research Institute Water supply and geology under the leadership of L.F. Moshnin, a theoretical basis was obtained for the calculation of the steady-state flow distribution in engineering networks, which underlies the modeling of the WSDS [6,7] .

Figure 1. Results of the frequency analysis of the time series of water consumption.

In subsequent works, a mathematical apparatus was proposed for constructing and solving systems of equations describing a model of a water supply network. With the participation of these scientists, universal models of complex systems of spatial structure with foot pumping stations, reservoirs, flow and pressure regulators were developed [4,5].

Such systems are a suitable object of research within the framework of the theory of hydraulic circuits (hereinafter referred to as - Warm gas center) and can be studied independently of water intake and treatment facilities. Further in the work, a hydraulic circuit (GC) is understood as the actual mathematical model of a real hydraulic system, including two components: the design circuit of the circuit (the geometric structure of the system and the picture of possible flows) and a set of mathematical relationships describing the interdependence of the quantitative characteristics of the circuit elements, and also the laws of flow and distribution of flow rates and pressures of the environment by elements and their changes in time[19,20].

4.Conclusions.

The application of the above methods makes it possible to save water resources and electricity spent to maintain the needs of consumers for drinking water in different periods of their use within 15%.

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