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Features of Increasing the Pressure in the Internal Water Supply Networks of Various Buildings

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Abstract: *The article discusses ways to solve the problems of insufficient pressure in residential buildings using a pump constantly operating in the network mode is technically outdated, so the search for economically inefficient and unable to provide comfortable water supply with a given characteristic (stable pressure) is very relevant.*

Keywords: *water taps, uneven pressure, internal water supply and sewerage of buildings, utilities, pressure instability, pump, tanks, pressure, network failure, internal water supply systems, frequency converter, water supply and distribution systems.*

Introduction. In residential buildings, an increase in pressure for the internal water supply system is achieved using a constantly running pump that provides maximum flow and 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, however, all the unevenness of the pressure characteristic at the entrance to the house is transferred to the further system.

As a result, water-folding devices show pressure drops in cold water that 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 work is devoted to the study and solution of the problem of increasing pressure in internal water supply networks associated with the design and operation of internal water supply systems: overgrowth of pipes during long-term operation; performance degradation or failure of booster pumps (if installed); insufficient design value, free head, recommended building codes and regulations - BCandR 2.04.01-97- «Internal water supply and sewerage of buildings» (equal to 2 m for washbasins and sinks, 3 m for showers -3m. annex 2 to BCandR), especially in the presence of gas water heaters and other plumbing fixtures that require water pressure up to 15 m.

Material and Methods. 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 house cold water supply systems by installing booster pumps, including in houses where 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 the urban water supply pipelines of the cities of Uzbekistan, including micro-district and intra-quarter water supply networks.

Solving the problems of insufficient pressure in residential buildings using a pump constantly operating in the network mode is technically outdated, economically inefficient and unable to provide comfortable water supply with a given characteristic (stable pressure) is very relevant.

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 peak of the characteristic along the pressure axis, leads to a constant change in the required geometric pressure (static component). Pumps in such cases operate with low efficiency (WLE), can go beyond the permissible limits of the parameters, which leads to excessive consumption of electricity and leads to premature wear of the equipment. In most houses built until the end of the 90s in Tashkent, console pumps of the K type were used (without frequency regulators for supplying (FRS)), and this provision fully applies to them. Equipment of the installed separate pump FRS reduces power consumption, but does not exclude operation outside the recommended supply zone, especially taking into account the combination of pressure surges at the inlet and hourly uneven water consumption [1].

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

However, organizations operating internal water supply systems do not take measures to reduce the unevenness of water withdrawals from the external network, avoid installing tanks on attics or roofs of buildings.

Results. Refusal to use tanks is associated primarily with an insufficient level of reliability in terms of their tightness and serviceability of valves, as well as the high cost of full-fledged control and automation systems. On the other hand, utilities, with the funds 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 integrity. Accordingly, fears of possible flooding of the downstream premises and, as a result, the costs of subsequent repairs lead to the denial of the "reservoir" technology by the public utilities, that with such a scheme, taking into account the requirements for the quality 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.

Thus, ensuring the reliability and efficiency of internal water supply systems and its efficient 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 storeys is different even within a block, it is advisable to use in-house pumping stations to increase pressure. The optimal result for various flow and pressure parameters of consumption can be obtained by choosing the right type of installations. Due to significant fluctuations in water consumption per house per unit of time, the use of a variable frequency drive (VFD), as a rule, it is effective in terms of reducing energy consumption by "adjusting" pumps to changes in system characteristics [2]

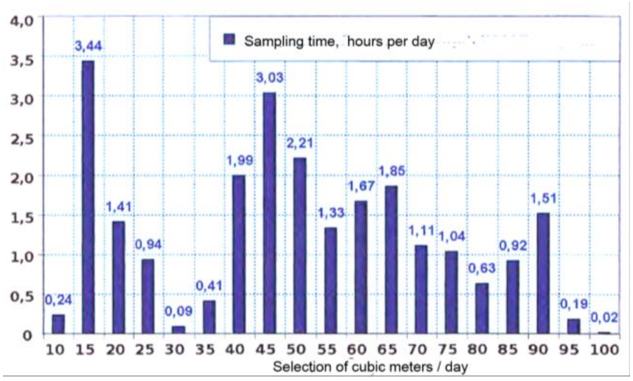

Fig.1. Results of frequency analysis of time series of water consumption

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 HydroPro 2 with a frequency converter (WFC), having the following ranges of parameters (per working pump) at rated frequency: flow Q from 1,2 before 4,5 m /h and pressure 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 pressure and the actual flow rate [2,3].

Statement of the problem of optimizing the increasing components of the water supply and distribution system (WDS) at the level of district, quarterly and internal networks. Taking into account the presented material of the article, it seems appropriate 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 the final lifts, 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 and distribution system (WDS) of the city as a whole, and on the other hand, would make it possible to formally analyze possible design schemes for the peripheral network, including the distribution of the required pressure parameter between pumping units this network, as well as determining the optimal number of pumping units within the nodes (Fig. 1).

Such a model is based on the use of the regularities of hydraulic and energy interaction of the corresponding elements of the WDS. The theory of WDS modeling is described in the works of N.N. Abramov and V.Ya. Khasilev, etc. The first WDS models developed in the early 1960s were based on the Lobachev-Cross method. In the 70s, in the works of VNII VODGEO under the leadership of L.F. Moshnin, the calculation of the steady flow distribution in engineering networks, which is the basis of WDS modeling, received a theoretical basis. In subsequent works, a mathematical apparatus was proposed for constructing and solving systems of equations that describe a model of a water supply network. With the participation of these scientists, universal models of complex systems of spatial structure with many pumping stations, reservoirs, flow and pressure regulators were developed [4,5].

Conclusion. Such systems are a suitable object of study within the framework of the theory of hydraulic circuits (hereinafter referred to as THC) and can be studied without connection with water intake and treatment facilities. Further in the work, a hydraulic circuit (c.c.) is understood as a proper mathematical model of a real hydraulic system, including two components: a circuit design scheme (the geometric structure of the system and a picture of possible flows) and a set of mathematical relationships that describe 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 medium by elements and their changes in time. The use of the above methods makes it possible to save water resources and electricity spent to maintain the needs of consumers with drinking water during various periods of their use within 15%.

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