ENGINEERING FORMULATION AND MATHEMATICAL FORMULATION OF THE PROBLEM OF ENERGY EQUIVALENCE OF WATER SUPPLY SYSTEMS

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ABSTRACT

One of the main circulations of today’s water supply system is the emergence of various circulations in the long-term maintenance of the network, the system allows for shortcomings in the calculation of the volume and the rapid growth of the population, and as a result of this, the pipes lead to rapid failure.

Given the fact that the master’s thesis comes from these circulations and the rapid wear of the pipes, it is aimed at calculating the system and solving the problems in the design of this system with the most optimal one.

Due to these circulations in the water supply, the ways of solving the problems in the system using different methods, the distribution of the flow in the water supply system with the help of modern programs were clearly summarized.

Key words: Annular, knots, ring.

An equivalent procedure can be implemented using various criteria, including energy, cost, metric, etc. In the problems of analysis and synthesis of the aging state, the energy equivalent in hydraulic models is used to determine the conditions for changing the structure of the graph . is included, so it is most suitable as a modeling object. In many cases, it turns out to be infinite and semi-infinite, and the transition becomes a mandatory element of modeling.

As part of the simulation of emergency regimes of water supply systems, the authors of the works Khasilev V. Ya., Sumarokov S. V., Chupin V. R. "tried to combine the linear elements of the structure graph into one (equivalent) element. A number of subjective criteria. In addition, urban water supply The use of several equivalent conditions according to the energy criterion in the analytical problems of the broken state of supply systems leads to the development of the so-called equivalence principle, which is based on a certain energy equivalent.

$$\sum_{j=1}^{m_z}\sum_{i=1}^{N_{psi}}\int_0^{Q_{ij}} S_{ij}Q_{ij}^{\alpha}dQ_{ij} = \sum_{j=1}^{m_z}\int_{j=1}^{Q_{je}} S_{je}Q_{je}^{\alpha}dQ_{je}$$

here, Sij, Qij is the coefficient of hydraulic resistance and the calculated consumption index of the section Npsi; Sie, Qie are the same for equal division; mz - energy node set; α is the coefficient of non-linearity in the formulas of engineering hydraulics.

Non-stationary problems can be solved on the basis of the energy functional using qualitative multiplication of equivalence. The conditions of Krikoff's first law determine the mathematical model of the arbitrary distribution in the network. Therefore, any transformations of the original function are shown equally in the model.

The method of water consumption is variable and characterized by non-stationary hydraulic processes. For non-stationary work, the conditions of qualitatively several equivalents do not conflict with the main problems of the formalization and can be written clearly, since the equivalence procedure does not require solving variational problems. At the same time, costs can be determined numerically as functions of unknown time.

Note that the combination of modeling and equivalence at the iterative level leads to the complexity of the algorithm, and in both scenarios, solving steady-state water flow problems with steady flow distribution in both scenarios is of practical importance in separating equivalence and flow distribution problems.

Since the energy is represented by an additive function, the energy equivalence condition is formulated at the level of the energy functional for the real and equivalent and can be expressed by the following expression:

$$\int_0^{\tau}\sum_{j\in J_{\pi(\varphi)}^{zr}UJ_{\pi(\varphi)}^{mf}UJ_{\pi R}^{zr}UJ_{\pi R}^{mf}} q_j d\tau = \int_0^{\tau}\sum_{j\in J_{\eta(\varphi)}^{zr}UJ_{\eta(\varphi)}^{mf}UJ_{\eta(p)}^{zr}UJ_{\eta(p)}^{mf}UJ_{\eta R}^{zr}UJ_{\eta R}^{mf}} q_j d\tau$$

$$\int_0^{\tau}\sum_{j\in J_{\pi(\varphi)}^{mr}} q_j d\tau = \int_0^{\tau}\sum_{j\in J_{\pi(\varphi)}^{mf}} q_j d\tau$$

$$\int_0^{\tau}\sum_{j\in J_{\pi R}^{mr}} q_j d\tau = \int_0^{\tau}\sum_{j\in J_{\pi R}^{mf}} q_j d\tau$$

$$\int_0^{\tau}\sum_{j\in J_{\eta(\varphi)}^{mr}} q_j d\tau = \int_0^{\tau}\sum_{j\in J_{\eta(\varphi)}^{mf}} q_j d\tau$$

$$\int_0^{\tau} \sum_{j\in J^{mr}_{\pi(p)}} q_j d\tau = \int_0^{\tau} \sum_{j\in J^{mf}_{\pi(p)}} q_j d\tau$$

$$\int_0^{\tau} \sum_{j\in J^{mr}_{\pi R}} q_j d\tau = \int_0^{\tau} \sum_{j\in J^{mf}_{\pi R}} q_j d\tau$$

where Si is a coefficient that takes into account pressure losses along the length of the pipe and local losses, depends on the length, diameter and curvature of the pipe in the network sections; r - real elements (sections); f - approximate elements (sections).

The sections of the network represent the time function in terms of hydraulic parameters, since Si = Si(Qi) and Qi = Qi(t). They reflect the response of subscribers to structural or parametric fluctuations. According to (2.15), the characteristic Si = Si(Qi) cannot be determined, therefore, the characteristic should be determined from the measurement data. Therefore, it can be assumed that Si = const, and the sets of equivalence conditions can be written as:

$$\sum_{i\in I^{mr}} \frac{\rho L_i}{F_i}\cdot\frac{Q_i^2}{2} = \sum_{i\in I^{mf}} \frac{\rho L_i}{F_i}\cdot\frac{Q_i^2}{2}$$

$$\int_0^{\tau}\left[\sum_{j\in J^{mr}_{\pi\varphi}} \int_0^{q_j} (z_j + H_j)dq_j\right]d\tau = \int_0^{r}\left[\sum_{j\in J^{mr}_{\pi\varphi}} \int_0^{q_j} (z_j + H_j)dq_j\right]d\tau$$

$$\int_0^{\tau}\left[\sum_{j\in J^{mr}_{\pi R}} \int_0^{q_j} (z_j + H_j)dq_j\right]d\tau = \int_0^{r}\left[\sum_{j\in J^{mr}_{\pi R}} \int_0^{q_j} (z_j + H_j)dq_j\right]d\tau$$

$$\int_0^{\tau}\left[\sum_{j\in J^{mr}_{\eta\varphi}} \int_0^{q_j} (z_j + H_j)dq_j\right]d\tau = \int_0^{r}\left[\sum_{j\in J^{mf}_{\eta\varphi}} \int_0^{q_j} (z_j + H_j)dq_j\right]d\tau$$

$$\int_0^{\tau}\left[\sum_{j\in J^{mr}_{\pi\varphi}}\int_0^{q_j}(z_j+H_j)dq_j\right]d\tau=\int_0^{\tau}\left[\sum_{j\in J^{mr}_{\pi\varphi}}\int_0^{q_j}(z_j+H_j)dq_j\right]d\tau$$

$$\int_0^{\tau}\left[\sum_{i\in J^{mr}_{\eta p}}\int_0^{q_i}(Z_i dq_i\right]d\tau=\int_0^{\tau}\left[\sum_{i\in J^{mf}_{\eta p}}\int_0^{q_i}(Z_i dq_i\right]d\tau$$

$$\int_0^{\tau}\left[\sum_{i\in I^{mr}}\int_0^{Q_i}S_iQ_i^{\alpha}dQ_i\right]d\tau=\int_0^{\tau}\left[\sum_{i\in I^{mf}}\int_0^{Q_i}S_iQ_i^{\alpha}dQ_i\right]d\tau$$

$$\sum_{i\in I^{mr}}\left(S_i\int_0^{\tau}\int_0^{Q_i}Q_i^{\alpha}dQ_id\tau\right)=\sum_{i\in I^{mf}}\left(S_i\int_0^{\tau}\int_0^{Q_i}Q_i^{\alpha}dQ_id\tau\right)$$

Nevertheless, all conditions (2.9) - (2.16) cannot be satisfied, because Qi=Qi(t), qj=qi(t) are unknown functions of time. Energy equivalence problems and flow distribution problems are solved by numerical methods that complicate the algorithm.

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