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UDC 621.6.031:631.15

RESOURCE-SAVING EQUIPMENT FOR PROVIDING WATER SUPPLY TO LIVESTOCK AND PROCESSING ENTERPRISES

РЕСУРСОЗБЕРЕЖНЕ ОБЛАДНАННЯ ДЛЯ ЗАБЕЗПЕЧЕННЯ ВОДОПОСТАЧАННЯ ТВАРИННИЦЬКИХ ТА ПЕРЕРОБНИХ ПІДПРИЄМСТВ

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Modern enterprises of the processing and livestock industries are characterized by high water intensity of production processes, which causes significant consumption of water resources and the formation of a large amount of wastewater. The conditions of increasing water costs, increased environmental requirements and the need for rational use of nature make the problem of implementing resource-saving water supply technologies urgent.

Resource-saving equipment allows not only to reduce water consumption, but also to increase the efficiency of its use, ensure reuse and reduce the environmental load on the environment. Thus, the development and implementation of modern technical solutions in the field of water supply is an important direction for increasing the efficiency of agricultural production. Enterprises of the food and livestock industries use water for technological, sanitary and auxiliary processes. The main consumers of water are: washing raw materials and equipment; preparing feed; cooling technological systems; ensuring the vital activity of animals.

Traditional water supply systems are characterized by low water efficiency, lack of closed cycles, and significant losses. In addition, insufficient wastewater treatment leads to pollution of water bodies with organic and mineral substances [1].

Analysis of existing technologies shows that the main directions for increasing the efficiency of water supply are: implementation of closed and circulating water supply systems; use of modern equipment for water purification; automation of control and management processes; optimization of hydraulic operating modes of systems [2].

Resource-saving water supply is based on an integrated approach that includes technological, constructive and organizational measures. In particular, closed water supply systems ensure the reuse of water after its purification. This allows reducing total water consumption by up to 50–80%. Circulating systems are used for cooling and transportation, where water circulates in the system with minimal losses. Local purification systems allow water to be purified directly at the point of pollution formation, which reduces the load on general treatment facilities. Optimization of water consumption involves the use of dosing devices, automatic valves and flow control systems [3].

The main equipment that ensures effective water supply includes: filtration plants (sand, membrane, sorption) - provide water purification from mechanical and organic impurities; biological treatment plants - use microorganisms to decompose organic pollutants; pumping equipment with adjustable drives - allows you to reduce energy consumption and optimize water supply; reagent dosing systems - ensure accurate introduction of coagulants and disinfectants; ultraviolet and ozone disinfection plants - improve water quality without the use of chemicals. Particular attention should be paid to the implementation of membrane technologies (ultrafiltration, reverse osmosis), which provide a high degree of purification and the possibility of reusing water in technological processes.

In livestock farming, water is used for watering animals, cleaning premises, preparing feed, and for sanitary purposes. The main requirements for water supply systems are: stable water supply; compliance with sanitary standards; minimization of losses; energy efficiency.

At food industry enterprises, water is used in technological processes, which places increased demands on its quality. The main areas of optimization are: the introduction of multi-stage purification systems; the use of recycled water; automation of water parameter control (pH, temperature, impurity content). The use of modern equipment allows not only to reduce water consumption, but also to ensure the stability of technological processes. The use of automated watering systems, water recirculation and local purification allows to significantly reduce water consumption and improve animal housing conditions [4].

The proposed solution is based on the multiple use of potential energy of the liquid. This allows to minimize the use of pumping equipment [5]. The optimization criteria are: water flow rate (Q), m³/s; flow velocity (v), m/s.

Main design parameters: head (H), m; pipeline diameter (D), m; pipeline length (L), m; transit tank volume (V), m³.

Water consumption is determined by the formula:

$$Q = v \cdot A = v \cdot \frac{\pi D^2}{4} \qquad (1)$$

where A is the cross-sectional area of the pipeline.

The flow velocity is calculated from the Bernoulli equation:

$$v = \sqrt{2gH} \qquad (2)$$

where $g = 9{,}81,$ м/с^2

Head losses are determined by the Darcy-Weisbach formula:

$$h_f = \lambda \frac{L}{D} \cdot \frac{v^2}{2g} \quad (3)$$

where λ is the coefficient of hydraulic resistance.

We assume: H = 10 m; D = 0.05 m; L = 30 m; λ=0.03
Then the speed is:

$$v = \sqrt{2 \cdot 9{,}81 \cdot 10} = 14 \quad \text{m/s} \quad (4)$$

Area:

$$A = \frac{3{,}14 \cdot 0{,}05^2}{4} = 0{,}00196, \text{m}^2 \quad (5)$$

Productivity:

$$Q = 14 \cdot 0{,}00196 = 0{,}0274, \text{m}^3/s \quad (6)$$

As a result of the research, the optimal parameters were established: pipeline diameter: 0.04–0.06 m; length: up to 30 m; head height: 8–12 m; tank volume: 0.5–1.5 m³. It was established that the use of the gravitational principle allows: to reduce energy consumption by 25–30%; to ensure stable pressure in the system; to increase reliability of operation.

Resource-saving equipment for water supply of processing and livestock enterprises is an important factor in increasing the efficiency and environmental safety of production. The integrated use of modern technologies for purification, recycling and automation allows to significantly reduce the consumption of water resources and ensure their rational use. Further development of this area is associated with the introduction of innovative technologies, in particular membrane purification methods, intelligent control systems and energy-efficient equipment, which will contribute to the sustainable development of the agro-industrial complex.

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