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ПОВТОРНЕ ВОДОКОРИСТУВАННЯ НА ХАРЧОВИХ ПІДПРИЄМСТВАХ В УМОВАХ ВОДНОЇ КРИЗИ: ВИКЛИКИ ТА МОЖЛИВОСТІ

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WATER REUSE IN FOOD ENTERPRISES IN THE CONDITIONS OF WATER CRISIS: CHALLENGES AND OPPORTUNITIES

Water is a critically important component of food production, but today this vital resource is under threat. The water crisis is already a real problem for many countries around the world, which creates an urgent need for the rational use of water resources. In accordance with the concept of sustainable development, wastewater generated in food enterprises should be considered not only as waste that needs to be quickly disposed of, but as an additional source of water and energy. This approach allows enterprises not only to reduce the environmental load, but also to achieve significant economic benefits [1, 2].

The main goal of modern water management policy is the introduction of innovative water treatment technologies that are technically and technologically efficient, environmentally safe and economically feasible. Such technologies allow enterprises to organize water reuse, significantly reduce the withdrawal of fresh water from natural sources, reduce the cost of centralized water supply and drainage, and also obtain products with added value due to the recovery of resources from wastewater [1, 2].

Today, this modern trend is being actively implemented at food enterprises around the world. Examples are:

- Carlsberg brewery (Denmark). In 2021, a production wastewater treatment system was installed here, which allows the reuse of purified water for its own needs. The complex application of ultrafiltration, reverse osmosis, biotechnology and advanced oxidation processes allows for high-quality water to be obtained. As a result, the enterprise reduced the withdrawal of drinking water by 50%. In addition, the use of an anaerobic bioreactor allows for the production of biogas, which is used to generate electricity, and the sludge formed is transferred to agricultural enterprises as fertilizer. By 2030, Carlsberg plans to further reduce water withdrawals and reduce its specific production costs [3].

- PepsiCo’s plant (Mexico). Mexico is a water-scarce country, and water management is therefore a priority here. For example, in 2022, the plant did not withdraw any drinking water from the centralized network at all, using locally treated wastewater for all needs. The company has also implemented projects to collect and treat rainwater, condense atmospheric moisture, and even water vapor from potato chip production. Overall, PepsiCo has increased water efficiency by 67% at its plants since 2015 and plans to reduce operational water use by 50% by 2030 [3].

Due to the relevance of the issue, the purpose of this scientific work was to develop a technology for treating wastewater from a regional fruit and vegetable canning plant for water reuse. The choice of canning plant is not accidental, as this industry is characterized by significant water consumption and the generation of large volumes of wastewater. Changing approaches to water use at such enterprises is extremely necessary, since the increase in wastewater tariffs significantly increases the cost of production.

At the first stage of the study, an analysis of water consumption at the enterprise was conducted, which showed that the volume of wastewater is up to 90% of the total water consumption. Wastewater flows from workshops and administrative buildings, mixed with stormwater, are discharged into the city network. It is clear that the implementation of

centralized wastewater disposal, like centralized water supply, requires significant financial costs from the enterprise.

During the experimental study, the chemical composition of samples of the mixed wastewater flow from the enterprise was determined. At different times of the year, they were collected at the point of discharge into the centralized sewage network of the settlement. Standard methods and certified laboratory equipment were used to perform the experimental studies. Analysis of the experimental results allowed us to conclude that during the year the values of pH, dry residue, suspended solids, ammonium, nitrates, nitrites, total iron, phosphates, sulfates, sulfides, chlorides, fats, oil products, SPAR, heavy metals (copper, cadmium, nickel, lead, chromium, zinc), BOD5 and COD fluctuate and for some indicators these changes are quite significant. It was also noted that a number of indicators exceeded the permissible concentrations. In general, we can talk about a significant level of pollution of the cannery wastewater.

Taking into account the quantitative and qualitative characteristics of wastewater, a technology for its decentralized purification directly at the enterprise is proposed. The technological scheme follows the key water treatment processes. Wastewater treatment begins with filtration, accumulation, averaging, neutralization, filtration and removal of sand and fat. To remove organic substances and nitrogen, it is proposed to use an anaerobic membrane bioreactor. This will effectively purify water and obtain biogas as an additional resource. To remove phosphorus residues, it is proposed to use coagulation with ferric chloride. Further, to bring water to the required quality indicators, it is proposed to sequentially apply the processes of chemical oxidation, sorption purification, mechanical filtration, nanofiltration, deaeration, conditioning of the chemical composition and disinfection.

It is assumed that such a complex scheme will allow obtaining water suitable for both technical and technological needs of the cannery.

Despite the obvious advantages, the implementation of local wastewater treatment technologies still has certain problems that inhibit their wider application. One of these factors is the social perception of treated wastewater as “dirty” even after treatment. This is due to concerns about the quality and safety of such water, as well as its possible impact on food products and human health. There are also gaps in legislative documents that regulate the conditions, technologies and equipment for organizing water reuse at the enterprise, requirements for the quality and safety of the treated water, as well as methods for substantiating economic efficiency. These factors hinder the rapid scaling of such a practice.

The development of new and improvement of existing technologies for local wastewater treatment of food enterprises is a relevant and multi-vector topic for scientific research. This is an important step towards solving the water crisis, ensuring sustainable development and increasing the competitiveness of the food industry. Dissemination of information about successful scientific developments and positive experiences is key to overcoming existing challenges and accelerating the transition to more rational water use.

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