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OPTIMIZATION OF DRINKING WATER QUALITY ASSESSMENT USING CORRELATION ANALYSIS

ОПТИМІЗАЦІЯ ОЦІНКИ ЯКОСТІ ПИТНОЇ ВОДИ ЗА ДОПОМОГОЮ КОРЕЛЯЦІЙНОГО АНАЛІЗУ

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Introduction

In today's world, the issue of water resources is becoming increasingly relevant, as growing water consumption in industry, agriculture, and households leads to a significant reduction in the amount of fresh water available for use. The pollution of water sources by chemicals, heavy metals, and other toxic elements poses a threat to public health and ecosystems as a whole. This problem is especially acute in countries with developed industries or intensive agriculture, such as Ukraine, where a significant portion of water resources do not meet sanitary and hygienic standards.

According to recent data, about 70 % of Ukraine's water resources show some deviations from the established water quality standards. The situation is particularly critical in the southern and eastern regions, such as Mykolaiv

Oblast, where surface and groundwater contain elevated concentrations of pollutants. Low water quality is often caused not only by industrial impacts but also by inefficient water treatment and supply systems, creating risks for both public health and the environment [1, 3].

One of the key aspects of water quality control is ensuring its safety and compliance with hygienic requirements. To achieve this, it is necessary to conduct daily monitoring of water quality, particularly for those indicators that may negatively impact human health. Timely and accurate water quality analysis can prevent ecological and epidemiological issues, making the development of new rapid analysis methods an important aspect of this field [2, 4, 6].

Research Objectives

Ensuring the population has access to high-quality drinking water is the primary objective of many water supply organizations and scientific institutions engaged in water resource research. This requires the continuous search for new, more efficient methods of assessing water quality. Since existing analysis methods are often time-consuming and expensive, there is a growing need to develop faster and simpler techniques that can deliver accurate results.

The objective of this research is to determine the potential of using correlation and regression analysis for the rapid and reliable assessment of the chemical indicators of drinking water quality. The primary goal is to create a methodological approach that allows for quick analysis based on mathematical calculations without lengthy laboratory tests [7, 8, 10].

Additionally, the research includes comparing the obtained results with practical laboratory data to validate the accuracy of the correlation equations. This will enable the use of the developed methods in the future for monitoring water quality in situations with limited access to laboratory facilities or in emergency scenarios.

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Research Results

The research established that there is a strong correlation between various chemical indicators of drinking water. Using the Statistica 6.0 program, we identified five key relationships between water hardness and concentrations of nitrates, nitrites, sulfates, manganese, and pH levels. These indicators are critical for determining water quality, as their exceedance can indicate problems with water supply and treatment systems [11, 14, 15].

During the research in the village of Vynohradne, it was found that water hardness has the greatest influence on the concentration of sulfates and nitrates. Analysis of long-term data showed that these two indicators have a high correlation coefficient with water hardness, allowing the use of the derived regression equations to predict their concentrations. This greatly simplifies the monitoring process and enables real-time results.

Furthermore, it was determined that the proposed correlation equations can be used for the rapid assessment of drinking water quality. Comparing the obtained results with laboratory research data confirmed their accuracy. This demonstrates the effectiveness of the method and allows it to be applied in water supply systems.

Data Analysis

The obtained data indicate that the developed regression equations are highly reliable and can be used to predict the concentrations of chemical substances in water. For example, the correlation coefficient for manganese and water hardness was 78 %, indicating a high probability of accurately determining manganese concentration without the need for laboratory analysis. This allows water supply organizations to quickly respond to changes in water quality.

Another important indicator is sulfates, for which a correlation coefficient of 78 % was also determined. This allows for a highly probable prediction of their concentration based on water hardness data. Such a capability significantly simplifies the water supply monitoring process and reduces the time and cost associated with laboratory research.

A general analysis of water quality indicators in the village of Vynohradne indicates that the concentrations of nitrates, nitrites, and pH remain within normal limits, while exceedances in other indicators may suggest the need for improvements in water treatment systems.

Conclusions

The research conclusions confirm the effectiveness of using correlation analysis for determining drinking water quality. The developed regression equations allow for the rapid and accurate determination of concentrations of various chemical substances such as manganese, sulfates, nitrates, and nitrites, which is critical for the operational monitoring of water quality in water supply systems.

The proposed method can be used to analyze water quality in situations with limited access to laboratory facilities or in scenarios that require an immediate response to changes in water quality. Additionally, this method can be useful in emergency situations such as industrial disasters or accidents at water supply systems.

Overall, the research results demonstrate that the use of correlation analysis for determining water quality is a promising approach that allows

for reliable and fast monitoring. This will help improve water quality control systems and ensure the safety of water supply for the population.

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