THE IMPORTANCE OF IMPROVING WATER QUALITY

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Annotation:

This article analyzes the importance of improving the quality and enhancing the safety of drinking water supplied to the population. It emphasizes the need for a set of measures to implement advanced technologies and water purification methods, including studies of the composition of pollutants specific to each water supply source. A comparative analysis of the quantitative composition of the main classes of organic substances in the water of open reservoirs during winter and flood periods is presented.

Key words: chlorination,health,vocational education,nutrition,lifestyle,aldehydes and ketones, quality improvement

Introduction:

Currently, almost two-thirds of Uzbekistan's population receives water from surface water sources. State sanitary-epidemiological control authorities report that in 50% of cases, drinking water supplied from these sources, even after treatment and disinfection, fails to meet certain parameters of the national standard. This is due to the increasing degradation of the water composition in surface sources, which are also commonly used as natural receivers of treated or untreated wastewater [4]. As a result, water is heavily polluted with heavy metals, detergents, pesticides, biogenic elements, phenols, organochlorine compounds, and other substances.More than 2,000 organic compounds have been identified in natural waters, including over 700 in drinking water [2].

According to the literature, a number of compounds identified in drinking water have experimentally established carcinogenic and mutagenic activity. These include substances entering the water from industrial and agricultural sources, as well as compounds formed during water treatment [3]. Chlorination of surface waters containing even small amounts of organic compounds produces chlorine-containing toxic, mutagenic and carcinogenic substances. It is assumed that 20 to 35 out of 100 cases of cancer (mainly colon and bladder) are caused by the consumption of chlorinated drinking water [1].

Purpose of the study

The goal of this study is to examine the composition of organic compounds in the river in the area influenced by the open Republican water intake. These studies served as a preliminary stage in a set of activities aimed at improving technology and introducing effective methods for purifying water from various pollutants, including anthropogenic ones.

Materials and methods

The analysis of organic substances in the water was carried out using gas chromatography–mass spectrometry based on methods patented under numbers 420 and 456 by the Environmental Protection Agency [7,8]. The first method is designed to analyze volatile compounds and involves purging volatile components of the analyzed mixture with helium and adsorbing them on silica gel, followed by desorption into the chromatograph column. The second method, used for analyzing non-volatile substances, involves extraction of organic substances with methylene chloride, drying over sodium sulfate, evaporation, and analysis of the concentrate by gas chromatography–mass spectrometry. Chemical analysis was performed using Perkin-Elmer instruments and equipment.

Results and discussion

According to the research conducted during the winter and flood observation periods at the operating open water intake point in, about 230 organic compounds of diverse chemical nature were identified. Considering repeatability, 175 organic compounds were detected in the water during the winter period and 144 during the flood period.

For data systematization, all identified organic compounds were grouped into classes. The figure shows that in the winter period, halogenated aromatic and terpene hydrocarbons, as well as alcohols and ethers, predominated. In the flood period, aliphatic hydrocarbons, aldehydes, and ketones were dominant. The total concentration of organic compounds in winter water was 11.65 mg/L, and in flood water — 10.85 mg/L.

To assess the health risks of the detected organic compounds, they were compared with sanitary standards in effect in the Republic [5]. Of the 230 identified organic compounds, 13 substances exceeded the maximum permissible concentration (MPC), while 165 substances had no established sanitary-hygienic MPC standards.

Organic compound	MPC for water bodies of domestic and drinking water use, mg/L	Winter period		Flood period	
		Concentration of pollutants, mg/L	the frequency of exceeding the maximum permissible concentration	Concentration of pollutants, mg/L	Concentration of pollutants, mg/L
Acetaldehyde	0,2	0,08	-	0,08	-
1,2-Dichlore etilen	0,0006	0,008	13,0	0,008	13,0
Chloroform	0,06	0,035	-	0,2	3,3
Diethyl ether	0,3	0,6	2,0	-	-
Nytrometan	0,005	0,035	7,0	-	-
Cyclohexan	0,1	0,2	2,0	-	-
Chlorobenzene	0,02	0,035	1,8	-	-
1,3-D chlore benzene	0,002	0,003	1,5	-	-
Benzaldehyde	0,003	0,008	2,6	0,003	1,0
Heptanol	0,005	-	-	0,008	1,6
Phenol	0,001	0,003	3,0	0,003	3,0
Dyphenil	0,001	0,003	3,0	0,003	3,0
Dimethyl Phthalate	0,3	0,008	-	0,008	-
Di-n-butyl phthalate	0,2	1,4	7,0	0,4	2,0

Table 1. Composition of Organic Compounds Exceeding the MPC of Sanitary-Hygienic Standards

Table 1 presents data on the qualitative and quantitative composition of organic compounds in water that exceed the maximum permissible concentrations (MPC) of sanitary-hygienic standards. As shown in the presented data, in the river water during the winter period, the MPC of pollutants was exceeded 10 times by 1.5 to 13 times for the following substances: acetaldehyde, diethyl ether, nitromethane, cyclohexane, chlorobenzene, 1,3-dichlorobenzene, benzaldehyde, phenol, diphenyl, and di-n-butyl phthalate. During the flood period, the normative content of organic substances in the water exceeded the MPC by a factor of 1 to 13 for 7 substances: 1,2-dichloroethylene, benzaldehyde, heptanol, phenol, diphenyl, and di-n-butyl phthalate.

A special group was allocated for the identified organic compounds that, according to the list of the Environmental Protection Agency, belong to the class of particularly hazardous pollutants. The data show that in the winter water sample, the standards were exceeded for 4 substances: 1,2-dichloroethylene (by 13 times), chlorobenzene (by 1.8 times), 1,3-dichlorobenzene (by 1.5 times), and di-n-butyl phthalate (by 7 times). In the flood water sample, the standards were exceeded for 3 substances: 1,2-dichloroethylene (by 13 times), chloroform (by 3.3 times), and di-n-butyl phthalate (by 2 times).

The conducted studies have shown that under the conditions of constantly increasing anthropogenic pressure, the water in open water bodies...

Practice has shown that existing traditional water treatment facilities and the classic technologies used in them are no longer capable of ensuring the required drinking water quality.

Conclusion: All this points to the need to reconsider the range of existing water treatment technologies and to introduce methods capable of neutralizing the growing anthropogenic factor while ensuring the safety and harmlessness of drinking water supplied to the population. In this context, deep water purification can be achieved through the use of oxidizing agents, such as ozone, and sorbents, commonly activated carbons. The implementation of these methods requires further research and testing.

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