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ENVIRONMENTAL PROBLEMS OF DOMESTIC AND DRINKING WATER SUPPLY SOURCES

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Abstract
Ecological safety of water supply systems - the state of protection of the natural environment and vital human interests from the possible negative impact of economic and other activities, natural and man-made emergencies, and their consequences on the complex of engineering structures for the intake, purification and supply of water to consumers. Uninterrupted water supply for the needs of industry, population and agriculture for the required quality needs to improve the operational and technological characteristics of water supply systems. Water intake is the most significant element of the water supply system. The technical and economic indicators and the reliability of the water supply system depend on its operational characteristics and design solution.
At the same time, issues of improving the operation parameters of water intake facilities, efficiency and increasing their reliability without causing damage to the ecology of the regions to acquire the greatest importance.

Keywords: Water supply of cities, environmental safety of water supply systems, engineering structures, natural and man-made emergencies, water purification and supply.

Introduction

The water supply of cities, as a particularly important strategic life support structure, is a defining component of human health protection, national security and the socio-economic development of the state. At the same time, in many regions of Russia, the normative quality of drinking water is not observed due to the lack of economically acceptable treatment technologies. The unsatisfactory technical condition of water supply networks leads to bacterial and chemical pollution, as well as significant losses, which leads to a rise in the level of groundwater, flooding of urban areas and destruction of underground buildings [1-4]. Hydraulic structures and chlorine facilities of water supply complexes have a high technogenic risk of emergencies with the development of environmentally hazardous processes [5-7].
There is a significant contradiction between the increased requirements of municipal water management systems for the quality of source water and their negative impact

on the environment when wastewater is discharged from wastewater treatment plants. The solution to this contradiction necessitates a comprehensive analysis of the environmental safety of water supply enterprises, which has a complex interdisciplinary character [8-13].

One of the most important and little-studied issues is the maintenance of a constant supply of drinking water to consumers while ensuring environmental safety and the necessary level of civil protection of urban areas and the population.

An analysis of previous basic studies shows that work in this area is carried out, as a rule, on individual examples without their proper systematic study. Therefore, the environmental safety of water supply systems is characterized by insufficient knowledge and the absence of a single agreed basis, taking into account various hazard factors. This is an urgent problem not only in the Russian Federation but also in many foreign countries. For its successful solution, it is necessary to find new theoretical and methodological approaches, relying on the foundation laid by scientists from related scientific fields.

In this regard, the dissertation solves an urgent scientific and applied task of substantiating the theoretical foundations for reducing the technogenic risk in the field of environmental safety of water supply systems, developing and searching for measures to improve the environmental safety of water supply systems. This will improve the living conditions of the population and the state of the environment. Therefore, the development of measures to improve the environmental safety of water supply systems is an urgent task [14-19].

The practical significance of the work is that the proposed measures will increase the reliability and efficiency of the environmental safety of water supply systems.

LITERATURE REVIEW

The methodological approaches of this work in the field of studying and improving water management facilities were based on the work of such domestic and foreign scientists: V. N. Azarov, A. D. Bolsherotov, V. V. Kozin, V. A. Petrovskovsky, G. A. Khorunzhey, A. G. Shmal, V. V. Denisov, V. V. Gutenev, L. N. Fesenko, V. A. Volosukhin, N. I. Kulikov, Yu. I. Vdovin, N. I. Bogdanov, A S. Obrazovsky, M. G. Zhurba, A. M. Kurganov, G. Ceballos, T. Fidelis, B. Haworth, B. Hjoerland, T. Richard, D. Thiloi and many others [17-23].

Materials and Methods

Sources of water supply- natural (surface and underground) waters used for cultural, household and drinking, agricultural and industrial water supply. Pollution of surface water sources may be the result of the discharge of domestic and industrial wastewater, mass bathing, shipping, timber rafting, etc.

The nature of pollution and its degree are determined by the qualitative composition and quantity of wastewater from irrigation systems, untreated or insufficiently treated household faecal and industrial wastewater, storm drain water from the surface of agricultural fields, settlements, etc.

Water sources can be contaminated with organic and inorganic substances, they can get helminth eggs, protozoa and intestinal infections. The most common chemical contaminants are petroleum products, phenols, synthetic surfactants, pesticides, aliphatic and aromatic amines, and heavy metal salts [21–25].

In domestic and drinking water supply, the most used is fresh water from underground and surface water sources, and only in some cases, in agreement with the sanitary and epidemiological service, underground water with a mineralization of up to 1.5 g / l. At the same time, all quite widely use brackish groundwater and salty (sea) water, desalinated and conditioned to meet the requirements and norms of SanPiN.

Sanitary protection of water bodies is controlled by several interrelated regulatory documents: GOST 2874-82 “Drinking water. Hygienic requirements and quality control”; GOST 2761-84 “Sources of centralized utility and drinking water supply. Hygienic, technical requirements and selection rules”; "Rules for the protection of surface waters from pollution by sewage" (1974); "Rules for the sanitary protection of coastal waters of the seas" (1975), etc.

Water can be used for domestic and drinking water supply without pre-treatment if it is of appropriate quality at the source following the requirements and standards of GOST. In case of non-compliance of water with hygienic requirements, special water treatment is necessary to bring it up to the requirements of standards.

For domestic and drinking water supply, the suitability of water supply sources is approved based on a sanitary assessment of the locations of water intake facilities, an assessment of the quantity and quality of water, a sanitary assessment of surface water supply sources with the territory adjacent to the upstream and downstream of the water intake and the conditions of occurrence and formation of groundwater, a forecast of sanitary the state of water sources, etc. Sanitary protection zones for water supply sources are organized to ensure an appropriate level of drinking water quality, the main purpose of which is to protect water supply sources, water supply facilities and the surrounding area from pollution. They include a restricted zone and a strict regime zone [1].

Sanitary and epidemic services organize their sanitary certification for dynamic observations and accounting for water supply sources. Sanitary passports contain basic information about water supply sources with full characteristics of their sanitary conditions and indication of possible causes of pollution, developed action plans for the improvement and protection of water sources, as well as the results of microbiological and chemical analyzes of water.

Self-purification of reservoirs. Self-purification is due to the activity of organisms: various invertebrates, algae, bacteria and higher aquatic plants. Factors

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characteristic of self-purification of various water bodies are diverse and numerous. They can be conditionally divided into three main groups: chemical, biological, physical. The physical factor of self-purification of water bodies is the UV radiation (ultraviolet) of the sun. Water disinfection is carried out under the influence of solar energy. This effect of the disinfection process is based on the direct detrimental effect of solar UV rays on the enzymes of the protoplasm of microbial cells and protein colloids. UV - radiation from the sun affects not only common types of bacteria, but also viruses and spores.

The most significant among the chemical factors of self-purification of water bodies is the oxidation of inorganic and organic substances. Most often, estimates of self-purification of water bodies are given by the total content of organic substances (determined by COD - chemical oxygen demand) or in relation to easily oxidized organic matter (determined by BOD - biochemical oxygen demand).

Yeast fungi, molds and algae take part in the process of self-purification of the reservoir. Permanent inhabitants of water bodies - bivalve mollusks - are orderlies of rivers. They filter out suspended particles by passing water through them. In plants, the smallest animals, organic remains enter the digestive system, and inedible substances settle on the layers of mucus covering the surfaces of bivalve mantles. As the level of pollution develops, the mucus moves to the ends of the shells, and it is thrown into the water. Its lumps look like a complex concentrate for feeding various microorganisms, which complete the chain of biological water purification.

Sources of pollution. The main cause of pollution of water sources is the discharge of insufficiently treated and untreated wastewater from enterprises related to public utilities, agriculture, and industry into water bodies. Irrational management of farming in villages also leads to pollution of water sources: the residues from pesticides and fertilizers subsequently washed out of the soil end up in the reservoir and, therefore, pollute it. In numerous production processes, water losses (due to leaks and evaporation) are small; in industry, a significant amount of water is consumed in total, while part of which is not subjected to any type of treatment or its irretrievable losses are carried out.

In rural areas, complexes engaged in animal husbandry belong to the source of pollution of the reservoir. The source of pollution of any reservoir with dangerous and harmful substances is the discharge of sewage from ships [2].

ZSO (zones of sanitary protection) of water sources. Despite the fact that there are various systems for water treatment, it is necessary to approve a number of actions and measures that are mutually exclusive on the scale of pollution of water bodies. For these purposes, specially designed ZSOs (sanitary protection zones) are established. The concept of WSS is understood as territories specially allocated, surrounded by water sources, in which strictly developed regimes are necessarily observed, with the aim of protecting water supply facilities, reservoirs and adjacent territories from pollution.

This zone is divided into three types of belts according to the legislation [3]:
1) the territory of the strict regime zone;
2) the territory of the restricted zone;
3) the territory of the observation zone.

Zones of sanitary protection of surface water bodies. First belt (territory of the strict regime zone) - a site in which there are locations for water intake, including the head structures of water pipelines. This section includes the water area adjacent to the water intakes for at least 100 meters below the water intakes and at least 200 meters upstream. Paramilitary guards are also posted there. Prohibit the temporary stay of outsiders and their accommodation, and construction. Within the boundaries of the first belt of medium-sized surface water sources, as a rule, they include the opposite bank, the strip of which is 150-200 meters. This type of belt includes the entire section of the water area and the coast on the other side of the water source - 50 meters in the case of a reservoir width of fewer than 100 meters. In the first belt, in the case of a width of more than 100 meters, a strip of water area up to the territory with a fairway - of up to 100 meters is included. When water intakes from lakes, and reservoirs, the first belt includes coastal strips not less than 100 meters from water intakes in all directions. The water areas of the first belt should be marked with buoys.
Second belt (territory of the restricted zone) - a site, the use of which for industrial enterprises, farming in the countryside and construction work is completely unacceptable or is permitted under generally accepted conditions. Mass bathing and descents of all types of sewage are limited here.
On open water sources, the length of the belts upstream is determined by the distance above which the influx of pollutants will not affect the water quality at the points of intake. Here, the upper points of these boundaries are determined by the expiration of time, during which the pollutants entering here, when approaching water intakes, are subject to elimination following the results of self-purification processes. This time period is set from 3 to 5 days. Due to the fact that these types of self-cleaning processes are strongly slowed down in winter, the territories of the restricted zone should be removed from water intakes in such a way that water runs from the upper boundary of the zone section to the water intake provide a bacterial self-purification time of at least 5 days.
The lower boundaries of the second belt, taking into account the wind reverse flow of water, are at least 250 meters from the water intakes. The territory of the observation zone is the third belt, which includes all settlements in the district associated with this water source.
Environmental safety - a property of the natural and technical system "natural aquatic environment - water management complex - agricultural water supply system" to ensure the protection of water intakes in agricultural water supply systems from negative factors associated with the ingress of ichthyofauna, traction bottom and

suspended sediments, floating objects, sludge and freeze-up during selection estimated water flow from the water body to the water intake, from toxic blue-green algae and the phenomenon of fouling of technological equipment with zebra mussel.

Conclusion

Based on the systemic principle of the leading role of the whole in the development of the formulated concept of "environmental acceptability" as an important factor in the creative process of generating new ideas, the research results substantiate several conceptual statements that should contribute to the creation of more advanced design solutions and technologies for more rational use of water resources.

The proposed systematic approach to solving the vital problems of ensuring the environmental safety of water intakes of water management systems will ensure an uninterrupted supply of the required estimated flow rates of high-quality water to consumers under any conditions and operating modes of agricultural systems.

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