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ENSURING COMPLIANCE OF DRINKING WATER QUALITY WITH REGULATORY REQUIREMENTS

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INTRODUCTION

Water supply is one of the main sectors of technology aimed at increasing the standard of living and increasing the well-being of the population, the development of industry and agriculture. Providing the population with drinking water in the required amount is of social and sanitary hygienic importance, preventing people from suffering from water-borne epidemic diseases.

For modern cities and various industries, a huge amount of water is required that meets the requirements of the state standard (MEST) or technology. The solution of this important problem for the national economy requires a careful selection of the source of water supply and the erection of water treatment buildings.

The prosperity of cities and towns of the Republic, the development of industry and agriculture are inextricably linked with the creation and functioning of water supply systems.

Not a single branch of the national economy can do without water. In modern cities, where the household economy is complex, water is used in large quantities for the needs of urban residents, for irrigation of urban areas, fields and other purposes.

Therefore, the design of drinking water treatment stations, the selection of installations, and the calculation of their parameters are one of the urgent problems of the present stage.

Until 1899, water was supplied to the city of Almaty (Verny) through ditches. The first aqueduct in the city was built of wood in 1901. At the beginning of 1934, the Vodokanalization trust was established. In 1935, the buildings of the water supply system began to be built and operated. From 1936 to 1949, water extraction and treatment facilities were built on the big Almaty River. In 1957, the development of the Almaty underground water extraction cone began. In 1970, 125 wells were operated at this water outlet, combined with 18 water outlets, and in 1974, the first 50 wells were commissioned at the Talgar underground water outlet. This year, a complex of water intake and treatment facilities was put into operation in Medeu zhatkalan.

The dirty water was maturing much later than it was being pumped into the aqueduct. The first dirty water export collector was built of wood in 1933. The export of dirty water began as planned in 1935. Sewage began to be sent to the filter sites. At the same time, systems for removing dirty water began to use iron and concrete pipes. In 1939, the length of the dirty water disposal systems was 38.7 km., and in 1959–91 km., In 1970–545.4 km., In 1976–783.4 km., In 1981 -898 km., In 1992–1219.9 km. reached. In 1981, a complex of tap water treatment buildings was put into operation.

The purpose of the general water supply system is to extract water from a natural water source, purify it in accordance with the requirements of consumers for water quality, deliver it to the territory of the water supply facility and distribute it to consumers with the necessary pressure, sufficient water consumption.

The productivity of the water supply for municipal and drinking water supply of the settlement, depending on local conditions, should be provided, first of all, with drinking water in the areas where residential buildings and public buildings are located and the needs for water necessary for the household, as well as for the needs of the settlement for landscaping and washing streets, economic, drinking water at enterprises, etc.

Water supply is the use of natural water. Its natural reserves are limited, as are other minerals. To do this, we must treat water with common sense and economy.

1. Water consumers and their water requirements

At first, water clarification was carried out by settling in periodically working sediments and simply filtering in filters. In the middle of the XIX century, Chemical Technology of water treatment was introduced for the purpose of water disinfection, and then began to use various compounds for coagulation of water impurities. This made it possible to switch to continuously working precipitators and fast filters. At the end of the XIX century, the lime-soda method of softening water became known.

When designing water supply systems, it is necessary to determine for what needs of the dwelling water and in what volume, in what quality it is consumed. To do this, it is necessary to cover the entire volume of water consumers and determine their requirements for the volume and quality of water.

Water is used for different needs, but all of them can be classified into four groups:

1) water consumption for household drinking water needs of the population. This group also includes the costs of water consumed by workers during their working hours.

2) water consumption for cleaning settlements and industrial facilities, washing lawns, green areas and streets.

3) water consumption for production needs (production of products, evaporation, washing of products, etc.) in industrial facilities.

4) water consumption for fire extinguishing.

The water used for drinking water needs of the population, the economy should be clean and transparent. It should not contain bacteria that transmit infectious diseases, harmful and unpleasant to the taste and smell.

Some industries will have to supply water with a certain quality. For example, high-hardness water is not used in evaporation boilers, as the calcium and magnesium salts contained in the water adhere to the walls of the boiler, reducing its coefficient of beneficial effect. Water spent on cooling aggregates or installations is desirable to be cooling[1].

If high sanitary requirements are imposed on the purity of water used in the food industry, it is desirable that the water supplied to light industries does not contain ions that can affect the color of products.

Generally speaking, it is difficult to find any natural water sources that meet the requirements of industrial enterprises.

And in settlements and industrial places, there are no requirements for cleanliness, water used for washing streets.

2. Sources of water supply and their characteristics

The ability to correctly choose natural water sources in solving the problem of water supply to settlements and industrial enterprises is a very responsible and complex problem, since it affects not only the operation and quality of the water supply system, but also the number of buildings in the system, causing their cost of construction and operation.

Natural water sources that can be used in water supply can be classified into two groups. Surface water sources – rivers, lakes, reservoirs, seas; underground water sources – Artesian waters, Springs.

When choosing water sources, you should first find out what the water is used for. In systems intended for the household economy of residents, it is better to use underground water sources. They have many advantages in terms of quality. If they are unable to supply water to settlements for various reasons, then surface water sources are used.

At the same time, when choosing water sources, it is necessary to take into account which of them the most information is obtained. The resulting water source must provide the address with water at any time. As a rule,

[1] Kunispaev E. I. Zeolite is a mineral of the XXI century. Materials of the international exhibition-conference “Su arnasy”. Almaty : 2007.

water sources that dry out in summer and freeze in winter cannot be accepted in water supply systems[2].

Surface waters have their own characteristics. They contain a lot of different substances. They are characterized by turbidity, an abundance of microorganisms with organic matter and a small amount of salts. Since rainwater, runoff during snowmelt, and contaminated water flowing on its own are added to surface water sources, their sanitary quality will be low. The quality of reservoirs comes from river, sea water, at least a little cleaning. But, due to the rapid growth of algae under the influence of sunlight, the water in the storerooms is sometimes colored.

When considering natural water sources, in addition to knowing their quality only at the present time, it is important to take into account that their quality and character will change in the future.

3. Basic methods to improve the quality of natural waters

Water used for human needs is usually characterized by qualitative indicators, that is, by the types and concentration of impurities in the water. Therefore, when assessing water quality, not only the nature of impurities, but also the physico-chemical State plays a huge role.

Household and drinking water should be safe for human health, have good organoleptic indicators and be suitable for living. The quality of domestic drinking water is given in the document "drinking water" GOST 2874-82, the main indicators are given in table 1.

Table 1

Drinking water quality

Quantity of substances	According to the drinking water standard
Chlorides ($C1^-$)	1,5 mg/l
Sulfates (SO_4^{2-})	1000 mg/l
Iron Fe^{2+}, Fe^{3+}	350 mg/l
Residual chlorine content	500 mg/l
Mercury	0,3 mg/l
Lead	0,3–0,5 mg/l

In technological processes of water treatment, the concept of dispersion reflects the size of particles of impurities in water. Mixtures smaller than 10–7 in size form real solutions with water, these systems are single-phase homogeneous. Natural and wastewater are in most cases a heterogeneous system consisting of at least two phases. The state of different phase

[2] The Drinking Water Program for 2002-2010.

dispersibility of water mixtures, which allows classifying mixtures. Currently, the classification proposed by academician L. A. Kulsky is widely used, which is based on the physical and chemical conditions of substances, determined by their dispersibility. This principle made it possible to divide a wide variety of mixtures with differences in composition, physical and chemical characteristics of natural and wastewater into four groups[3].

The first group of impurities, the size of which ranges from 10–1–10–5, consists of hundreds of particles in water that form suspensions and emulsions. This group includes various plankton organisms, as well as bacteria.

The second group of impurities is made up of colloidal impurities and high molecular weight organic substances with a size of 10–5–10–6.

The third group of impurities is represented by molecular solutes, viruses and bacteriophages, as well as gases dissolved in water-oxygen, carbon dioxide, etc., the size of which ranges from 10–6–10–7.

The third group of impurities consists of substances with a size of less than 10–7, dissociating into ions in water.

Mixtures of the first and second groups form heterogeneous systems, and the third and fourth group are homogeneous systems.

Mixtures of each group have their own characteristics, therefore, to separate them from water, certain technological methods are required. In water treatment, if necessary, pollutants are transferred from one phase dispersal condition to another.

Due to the increase in dispersibility, the selected arrangement of systems and groups is very effective from a technological point of view, since water treatment usually begins with the separation of large dispersed and colloidal-dispersed impurities contained in it.

Methods for separating mixtures of the first and second groups are the most common and are widely used in all treatment facilities of industrial, municipal wastewater, as well as at industrial wastewater treatment stations. The processes of separation of Molecular and Ionic impurities (groups 3–4) from water belong to special methods of purification and are used as an addition when necessary to the main technological complex of treatment facilities.

The first group of water pollution includes substances ranging from small to large particles, bacterial and biological pollution also belong to this group. The extraction of these impurities, that is, water bleaching, is carried out using the following methods:

[3] Zhurba M. G. Application of filtering theory in engineering calculations. Water supply and sanitation equipment. M. : 1993. № 7.

1) method in which no reagent is used;
2) reagent method.

Bleaching or slight bleaching of water is done by settling the water in settling tanks and bleaches, filtering through granular materials, grids, microfilters, drum grids, etc.

To speed up the process of settling fins, the coagulation method is used, for which special reagents – coagulants are added to the water. As a result, large aggregates are formed on the surface of which impurities are adsorbed, as well as tissues that quickly settle and together with them precipitate particles of the mixture. The bleaching process is completed by the filtration process in rapid filters or by the contact coagulation method in contact bleaches.

In the process of bleaching the water, the water is disinfected sporadically, that is, it gets rid of some of the bacteria.

Complete disinfection of water is most often carried out by reagent methods – chlorination, ozonation–. Disinfectants (oxidizers) kill microorganisms[4].

The second group of mixtures consists of hydrophobic and hydrophilic colloidal systems, high molecular weight substances and SBAZ. To separate these impurities and decolorize the water, it is treated with sorbents and oxidants (chlorine, ozone). At this point, the color of the water decreases, microorganisms are destroyed, and hydrophilic colloids are destroyed.

The main reagents that allow the separation of colloidal particles in water include coagulants (aluminum sulfate, ferric chloride, sulfate, etc.). Most of the combined alumina coagulants and pollutants can be isolated. In this case, the coagulation process takes place in a wide range of PH and temperature.

Methods of aeration, oxidation, adsorption allow you to separate the third group of impurities from water, which belongs to molecular solutions.

The extraction of gases dissolved in water and volatile organic substances (light gasoline, organic sulfur compounds, low molecular weight esters, carbonyl compounds, etc.) is carried out by aeration of water or treatment with certain chemicals.

Many substances included in this group are isolated using active coal, and impurities dissolved in water molecular interact with the well-developed surface of coal and are attached to it. Hydrophobic compounds, such as petroleum hydrocarbons, chlorinated hydrocarbons, aromatic hydrocarbons and their derivatives, are best absorbed by coal.

[4] Kereybayeva G. H. “Tabigi zhane agyndy sulardy tazartu technologiyasynyn negizderi”. Oku kuraly. Almaty : KazUTU, 2008, 160 bet.

The separation of the fourth group of impurities, which are electrolytes, is carried out by binding ions to less soluble or completely insoluble compounds using reagents added to water. The reagent must be selected depending on the value of the solubility product of the compounds being formed.

For the separation of the fourth group of impurities, ion exchange reactions taking place on the surface of a solid ion exchange resin are also used.

This method is effective in cases where the released ions can be retained in the sorbent and replaced with ions that are harmless to further use in water.

Ions in water can be separated by many methods, such as evaporation, turning into ice, extraction, electrodialysis, etc.

So, all impurities that pollute reservoirs and wastewater are included in the four groups of classification proposed by L. A. Kulsky.

The use of this principle of classification when designing water treatment stations makes it possible to identify the main elements of treatment plants, to collect them, as well as to select reagents and impurities that allow you to separate the entire set of impurities in water.

When designing a complex of treatment facilities, the types of Main and auxiliary equipment are determined according to the selected method of water treatment. The volume of individual buildings is calculated depending on the time required for the passage of physico-chemical processes in the treated water. During the continuous operation of these buildings, the volume is calculated by finding the time of stay of the treated water in different elements (apparatuses) of the technological scheme at such a speed that allows the treatment process to proceed normally[5].

Treatment facilities that ensure the operation of most of the above – mentioned processes include mixers, reaction chambers, clarifiers (bleachers) and filters.

The development of technological schemes to improve the quality of natural waters requires a lot of details. First, the purpose for which the water is used is determined, that is, consumers requirements for physical, chemical and bacteriological indicators of water are assigned and the quality of the water supply source at different times of the year, the possibility and degree of its contamination by domestic and industrial wastewater are taken into account.

If drinking water is taken from an open reservoir, the water is transparent, discolored and decontaminated. And if groundwater is used as

[5] Krivoshein D. A., Kukin P. P., Lapin V. L. Engineering protection of surface waters from industrial effluents. Textbook. M. : Higher School, 2003. 344 p.

a source of drinking water, decontamination is sufficient. Water used for domestic drinking purposes should be completely purified, and technical water supplied to some production facilities should not be thoroughly cleaned.

When designing treatment buildings, the main and additional units are selected depending on the accepted method of water treatment. Calculates the volume of individual installations by the time required for the course of physico-chemical processes occurring in the treated water.

Depending on the presence of impurities, they can be reagent and non-reagent.

By adding reagents, the water cleaning process can be significantly simplified. For example, if hundreds of substances precipitate in 2–4 hours with the help of reagents, then without reagents, turbidity remains for days.

When water is treated with reagents, the buildings are small in size, the cost is cheaper, but the problem of operation becomes more difficult.

The reagent-free method is used when the color of the treated water does not exceed 50 degrees and for water supply to small settlements.

Reagents are supplied in such a way that the water treatment is completed inside the designed treatment plants, so that the treated water meets the requirements of consumers, and the water does not change its properties further. To do this, reagents are introduced at the beginning of treatment plants and, with the help of special devices, ensure full and rapid mixing of the reagent in the entire volume of water. Only in some processing methods (again, removal of bacterial contamination, corrosion, fluoridation) are reagents added to distilled water.

Depending on the flow of treated water in treatment buildings, technological schemes are classified as self-flowing and pressure (pressure) systems. In the first type, Open buildings are used, water flows by itself.

4. Prospects for the development of the State Municipal Enterprise "Holding Almaty Su"

Today, the main reserves of the state municipal Enterprise "Holding Almaty Su" are worn out, and it requires not only current and capital repairs, but also modernization. The main water pipes in use today were built between the 1950s and 1990s. Over the past 15 years (1991–2006) 60 km at their own expense. water pipes are built, that is, 4 km per year. and in the previous years, 50–75 km per year. 1) to be invested with state funds.

117 km of water pipes should be updated immediately and 1000 entries in apartment buildings (10km.), 25km sewer collectors.

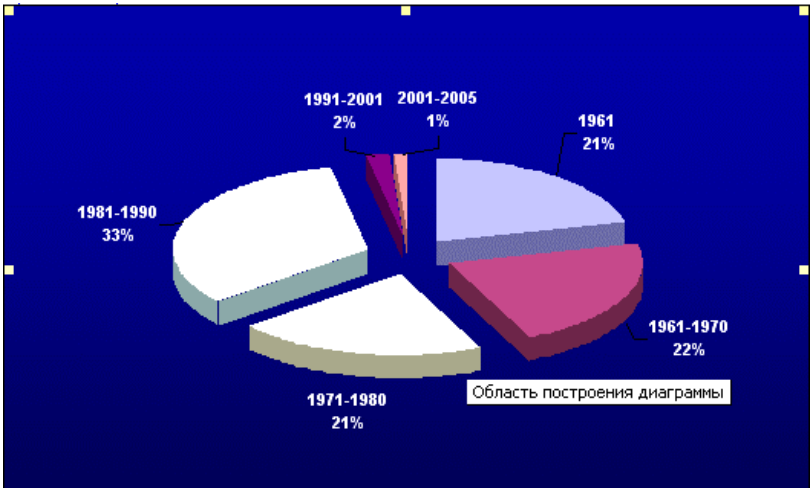

Fig. 1. Construction of water pipes

At the same time, due to the increase in construction in the city, an additional 300 thousand m3 of water is required per day. Water sources supply the required amount of water, but in order to supply the required volume of water, the pressure in old water pipes will have to be increased, which will lead to technical losses. Every 10 m of pressure results in a loss of 8 %. Biological treatment buildings provide the intake and treatment of waste water. But to achieve this goal, we need to build 84 km of water supply.

The amount of funds required for the implementation of the annual program for development, modernization of the State Enterprise “Holding Almaty Su” is 5,806 million tenge. If the institution received such a volume of funds, the effect would be as follows: the volume of flows would decrease, and then the cost of electricity would decrease.

5. Water quality analysis

Drinking water should be epidemic safe, chemically harmless and have positive organoleptic properties. The quality of water is determined by its composition and properties before entering the water pipeline. Microbiological indicators of drinking water must comply with the requirements of table 2.

But the data provided in the table is not enough to choose a rational water treatment scheme. The volume of water color does not allow us to consider the optimal way to eliminate color and find out the required dose

of coagulant. To reliably design sedimentation tanks, you need to know the kinetics of weight sedimentation. Knowing the potential for filtration of a given water, it is necessary to approach the choice of filter type with a significant argument, and so on[6].

Table 2

Microbiological standards of water quality indicators

Indicators	Standard	Test method
The number of microorganisms in 1 cm^3 of water, not more	100	GOST 18963-73
The number of bacteria of the Escherichia coli group in 1 dm^3 water (coli index), not more	3	GOST 18963–73

6. Determination of daily water consumption

The design of the water supply of an object (City, district, industrial enterprise or its complexes) begins with the calculation of the amount of water used and the determination of the flow regime of the promising period.

The volume of water consumption of the facility is determined in cubic meters. All water supply buildings are calculated at the end of the reporting period from the condition of maximum water supply, and technical and economic indicators-from the condition of average speed.

Since each object has water consumers of different categories, the consumers of the category are determined individually.

When designing water supply systems, it is necessary to determine what needs, in what quantity and in what quality water will be consumed.to do this, it is necessary to fully cover the types of water consumers and meet their requirements for the volume and quality of water.

The cost is divided into different needs, and the cost does not depend on the characteristics of the installed sanitary and technical device of the building, the location of the population, and climatic conditions. Given that the daily water consumption of the city's population is not uniform, it is customary to describe the daily consumption: average daily; use the most water per day; use the least water per day.

Water, of course, is used for different needs, but covering all this, it can be classified into four groups:

[6] Togabaev E. T., Toibayev K. D. Water Supply and sewerage. Almaty : Kazgas, 1998. 184 p.

1) water consumption for household and drinking water needs of the population. This group also includes the costs of water consumed by workers during their working hours.

2) water consumption for cleaning settlements and industrial facilities, washing lawns, green areas and streets, that is, for improvement.

3) water consumption applied to production needs in industrial facilities.

4) water consumption for fire extinguishing.

5)Water, in addition to these, is also used for water needs of water supply systems.

6) water consumption for household and drinking water needs of the population[7].

7)The water used for drinking water needs of the population, the economy should be clean and transparent. It should not contain bacteria that transmit infectious diseases, harmful substances and unpleasant taste and smell.

7. Water disinfection

The decontamination process is the most important condition for domestic and drinking water. Installation of chlorination points at water supply treatment points is carried out under the following conditions: 1) water protection from the River, 2) chlorine is introduced in two stages.

Calculation of hourly water consumption for water chlorination:

In advance: Д'$_{хл}$=0.6 mg/l (SNaR,146).

$$\frac{Q_{таул} \cdot Д'_{хл}}{1000 \cdot 24} = \frac{216000 \cdot 0.6}{1000 \cdot 24} = 5.4кг / сағ \quad (1)$$

Second time: Д''$_{хл}$=0. 3 mg/l.

$$\frac{Q_{таул} \cdot Д''_{хл}}{1000 \cdot 24} = \frac{216000 \cdot 0.3}{1000 \cdot 24} = 2.7кг / сағ \quad (2)$$

Total chlorine consumption:

$Q_{хл}$=5,4+2,7=8, 1kg / h or 194. 14 kg / day.

Two vacuum chlorinators are installed in the Apparatus Room, chlorine is 8.1 kg/h, one is reserve. In addition to chlorinators, intermediate containers are installed. The number of flow and chlorine containers is 2.

[7] Regulatory and methodological collection on the protection of Water Resources. Almaty, 1995.

CONCLUSIONS

The research work provides for the design of a water treatment station in Almaty.

During the project, the amount of water consumption was calculated, the necessary buildings of water supply systems were selected. The mode of operation of elements of the water supply system, types of water supply buildings, locations and calculations of installations are carried out. Also, the project of treatment buildings – mixers, the project of tissue formation chambers, settling tanks, filters and methods of water decontamination are considered, the main parameters of the installations are calculated.

Water it is a source of life that uses it from private sectors to large industries. The used water enters the sewer network, passes several treatment levels and flows into the Sorbulak River.

Two types of water supply are compared, water supply from the Big Almaty River and water supply from groundwater. Water supply from the Big Almaty River is more effective than groundwater supply.

In the first case, water flows independently (it will need to process water, i.e. sedimentation, decontamination, processing, etc.), it does not need electricity, but costs for materials, wages of workers, workshop and operational costs and additional depreciation.

In the second case, water must be pumped out from under the ground using pumps, this method does not require water purification, that is, the cost of materials is zero. But in order to supply water to consumers, it must be removed from the ground, so that electricity costs are more, as well as wages for workers, shop and general operational needs, as in the first case, and depreciation.

Of course, we can say that the second case is better, water purification occurs naturally, which does not require as much material costs as in the first case, but according to economic calculations, it is the most expensive way.

Currently, the solution of the problems of the enterprise is becoming public issues, because from the work of the State Enterprise “Holding Almaty Su” The Life of the city of Almaty and its residents is solved.

SUMMARY

The purpose of the general water supply system is to extract water from a natural water source, purify it in accordance with the requirements of consumers for water quality, deliver it to the territory of the water supply facility and distribute it to consumers with the necessary pressure, sufficient water consumption.

The productivity of the water supply for municipal and drinking water supply of the settlement, depending on local conditions, should be provided,

first of all, with drinking water in the areas where residential buildings and public buildings are located and the needs for water necessary for the household, as well as for the needs of the settlement for landscaping and washing streets, economic, drinking water at enterprises, etc.

Water supply is the use of natural water. Its natural reserves are limited, as are other minerals. To do this, we must treat water with common sense and economy.

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