Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 1246 - 1252
Received 05 March 2021; Accepted 01 April 2021.

Analysis of the Effectiveness of Traditional Technologies for the Purification of Natural Waters for Drinking Purposes

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Abstract. Preparation of drinking water for household and drinking purposes from surface water bodies with a limited flow rate and water quality formed under the influence of natural and anthropogenic factors is one of the priority tasks. Methods of pre-treatment of water are considered, their role in increasing the efficiency of water purification processes is confirmed. The improved technologies of water treatment are considered and the results of their industrial approbation are presented.
Key words: surface water body, anthropogenic load, pretreatment of water.

Introduction

The safety of drinking water supply has become one of the main components of the overall environmental safety of the population of the Republic of Uzbekistan. Centralized and autonomous water supply, aimed at meeting high requirements for the quality of the supplied water and complete satisfaction in it, should cover not only technical and economic, but also environmental factors.

There is a significant amount of groundwater reserves with a relatively stable composition and a higher sanitary level than water from surface sources. The prospective need for household and drinking water supply can be fully satisfied by groundwater. About 40% of the population continues to use water for drinking that does not meet hygienic requirements[1,2,3,4,5,6,7]. Providing the population with high-quality drinking water is one of the main state tasks, which has acquired particular relevance in connection with the deterioration of the general environmental situation observed almost everywhere and excessive pollution of water bodies and water supply sources.

Any water on full knowledge, the environmental indicators of our lives, so the tire would not be possible. Every prospective technologist should know the following, scientific information about water.

Natural waters are diverse in their composition, quality and quantity: salty seawater, fresh streams and springs (rivers, underground wells, etc.), snow - rainwater, mineralized, in some cases even hot, groundwater[8,9,10,11,12].

In areas with a shortage of fresh water, the problem of providing small settlements with drinking water is especially acute. In these cases, an alternative to the high-cost organization of imported drinking water can be justified from a sanitary and hygienic economic point of view, the use of small freshwater lakes fed by spring groundwater with a limited flow rate, and reservoirs formed as a result of regulation of small watercourses as sources of household and drinking water supply. At the same time, when using such water sources, the selection and justification of the technological scheme of water treatment and the search for the necessary investments for the purchase of expensive equipment and reagents is

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a complex scientific and practical task[13,14,15,16,17,18]. To solve it, it is required to analyze the dynamics of changes in the quality of the source water; to determine the possibility of using the most rational water treatment technologies for small water pipelines; substantiate less energy-consuming methods and facilities for water treatment at the first stage of its purification; determine, on the basis of field studies, the initial data for the design of industrial water treatment plants and carry out a feasibility study.

It is possible to bring the indicators of drinking water in accordance with the standards using flow-through or storage systems that are sold in ordinary stores.

This is a simple and relatively inexpensive method of cleaning, requiring only periodic replacement of cartridges. Flow-through filters can be built directly into the water supply. Modern automatic monitoring and control systems inform the user about cartridge contamination or include a cleaning mechanism to restore filtering capacity. Household installations remove hardness salts, excess chlorine, iron, manganese, dissolved gases, heavy metals, and some microorganisms.

Simple and affordable ways to purify drinking water, which will help get rid of calcium and magnesium ions, ferrous iron, hydrogen sulfide, and dangerous bacteria. Boiling is carried out in an enamel or glass container for 15 minutes.

After that, the water is allowed to settle and cool naturally. Impurities, when heated, transform into insoluble compounds and form a precipitate, which must be drained. It is necessary to store boiled drinking water in a sealed container to protect it from dust.

Methods of research

Water is poured into a small, clean container and left for several hours. The lid is not used to allow the chlorine to escape freely[19]. After that, the upper layers of water can be used for cooking, and the lower ones are better to drain. This cleaning method removes insoluble iron salts, solid impurities, sand, and rust particles. It is impossible to defend water for a long time, since bacteria begin to multiply in it, therefore the method is used only in case of weak pollution of the source.

But it is also important to know that even a stream or river may not have the same composition and properties in different places (across the river, of course).

Therefore, the ancient Greek scientist and philosopher Heraclitus (in the 5th century BC) stated that it is impossible to fall into the water of a river of the same composition twice, that is, a person who bathes always falls into the water of a new composition and quality the equation can be written as

$$C_{м} = \frac{1000 * R_{м}}{Q},$$

In some natural waters, various microorganisms and algae, planitons are a source of insoluble organic compounds. During the summer months, under conditions conducive to the growth of plankton, it was found that water contains a lot of insoluble organic compounds.

The formation of insoluble organic matter in water occurs in two ways:

1. Heavy rains (floods) or rising temperatures melting a lot of ice and snow, and as a result of large streams of water washing away surface organisms, various biocenoses;

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2. With the development of plankton in the water itself, certain favorable conditions are created.

Decomposition of organic compounds in the aquatic environment results in the formation of more stable substances, such as humus, which multiply in the soil layers. They can be colored and colorless, fragrant and odorless. Of course, depending on the qualitative and quantitative indicators of all types of substances in water, natural waters can also be painted in different colors. An indicator specific to humus-type organic matter and determining water quality is also known, H_2 which is that the amount of C is much lower than that of C:H=1:10. Such substances are permanganate, dichromate. can be rapidly oxidized by active chlorine etc. Under natural conditions, under the influence of biological factors, their oxidation is much more difficult.

Natural water - depends on the dissolved salts in it. Depending on the content of different salts (degree of mineralization), waters are classified as follows, ie divided into types:

- fresh water, the amount of salts in it is up to 1 g (l);
- brackish water, the amount of salts in them is 1 -25 g (l);
- salt water, the amount of salts in which is more than 25 g (l).

The problem of clean water is caused by the increase of anthropogenic factors in nature, ie the pollution of the environment with various wastes as a result of the activities of many industrial enterprises, agricultural crops, utilities, including pollution of water bodies with sewage. is the most pressing issue at the moment.

The main components of natural waters.

Natural water - N2O, i.e. pure - is never found in the form of water. When it comes to the composition of natural water, of course, it means that gases, liquids and solids are dissolved in it. So far, it has been determined that in natural waters occur elemental compounds that make up about half of the table of the Mendeleev periodic table. In addition to the methods of natural composition, there must be complex essential substances, which now cause the discharge of various effluents into water bodies. Natural waters, which are usually considered "pure" for consumption, are also known and can be used only after preparation and processing. Once the effluent is mixed with the waste, it can be used after unconditional semi-cleaning processes have been completed. So, in order to use water in practice, of course, it is necessary to know exactly its composition. All types of components mixed with water are of two types: insoluble and dissolved.

According to the available scientific data (Alyokin, 1970), dissolved compounds in water can be considered to be mainly ions, mineral salts, residues of organic and biogenic substances, and gases. There are also a lot of insoluble compounds.

Impurities are in tap water, and it is difficult to find equipment for cleaning, you can buy products in plastic bottles. The manufacturer must indicate on the packaging the composition of the product and the standard by which it was manufactured. It is difficult to guarantee the safety of such products: it is impossible to say from which source the water was taken and how the drinking water was purified. But for occasional use, this option is fine. It is necessary to pay attention to the expiration date and not to violate the storage conditions.

At city water treatment stations, drinking water is subjected to complex multistage purification. In general, the process can be divided into two stages:

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Mechanical filtration - removal of solid impurities, flakes, fibrous inclusions using filter grids.

Chemical treatment - water is passed through sedimentation tanks, subjected to coagulation, clarification, demineralization, reagents for softening and disinfection are dosed.

Clarification. This is the initial stage of cleaning, which is often required when taking from wells, lakes, and other open sources. Turbidity and suspensions in the water indicate the presence of organic impurities: humic and fulvic acids, colonies of microorganisms. At the stage of clarification, chlorine-containing salts and coagulants are added to the stream. An active oxidizing agent destroys organic compounds in water and provokes precipitation. Insoluble agglomerates are subsequently more easily retained by mechanical filters.

Coagulation. The technology is aimed at removing colloidal suspensions from water, which are not always visible to the naked eye. Aluminum salts are used as coagulants, which cause adhesion of organic molecules, destroy the shells of microorganisms, forming heavy flakes with impurities. Then the stream is directed to the settling tanks.

Defending. At water treatment stations, special containers are provided, inside of which water is poured at a low speed. The lower layers move more slowly than the upper ones, so contaminating solids and flocs of coagulated compounds have time to precipitate. From the bottom of the tank, the settled masses are removed through the drain hole.

Filtration. To purify drinking water, filters with sorbent loading are used. Previously, activated carbon cartridges were widely used, but today they are gradually being replaced by powdered and granular backfills. The main difference is that it is not water that passes through the load, but the sorbent is poured into it and mixed. This method of water treatment is simpler and more efficient than traditional filtration, it allows you to remove chemical impurities, heavy metals, organic suspensions and surfactants.

Disinfection. Special treatment is necessary to eliminate the epidemic hazard of water. Removal of pathogenic bacteria can be carried out by chemical and physical methods, but chlorine is still the most effective disinfection technology. Oxidant atoms retain their activity as the flow moves, disinfecting the inner walls of the pipeline.

Demineralization. Removal of manganese and iron from water is important for underground sources, especially those located near ore deposits. Demineralization is carried out by the method of aeration - saturation of the air flow with oxygen. Water is supplied to special columns, where it is bubbled or sprayed through nozzles. As a result, unwanted impurities are oxidized and form insoluble compounds. Further, the water is purified using mechanical filters.

Softening. Hardness is due to the high concentration of calcium and magnesium salts. To soften water, filters with ion-exchange resin are used, when passing through which metals are replaced by hydrogen or sodium ions, which are safe for human health. The method is expensive, therefore it is not used at all water treatment plants. In most urban apartments, drinking water is characterized by increased hardness, requiring the installation of local ion-exchange filters.

Upon completion of the water treatment complex and analysis of the main parameters, the flow is fed into the distribution network. It should be understood that even if the sanitary indicators of drinking water are in full compliance with the normative values, when moving

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in old pipelines, it is re-contaminated. Therefore, it is recommended to carry out the analysis in accredited laboratories and seek help in the selection of filters from specialized companies.

The quality of drinking and natural water is assessed by a number of chemical, physicochemical and sanitary-bacteriological indicators, which are determined by appropriate analysis.

Results

Based on the results of the analysis, the following issues will be addressed:

1. The nature and level of water pollution is determined.

2. The epidemiological and toxicity levels of water are determined.

3.Determine the application of a water-appropriate treatment method and its suitability for a particular type of use.

4. Management of water treatment processes and control of operation of treatment facilities.

5.Evaluation of the efficiency of treatment facilities and treatment plant.

A thorough analysis of the water involves determining the equilibrium parameters. Most of them are the detection of trace elements and toxins for living organisms. Such substances include lead, mercury, arsenic, fluorine, tetraethyl lead, petroleum products, pesticides, radioactive substances. Daily water quality control determines the following indicators: turbidity of water, color, odor and taste, pH, temperature, ionic composition, hardness, alkalinity, amount of gases, nitrogen compounds, manganese, sulfates, chlorides, silicates, dry matter, oxidation index and bacterial contamination is detected.

The turbidity of the water and the amount of suspended particles determination. The degree of turbidity of the water is determined by comparing the test sample with a standard solution. The standard solution is prepared by adding a SiO_2 suspension to distilled water. The turbidity index is measured in mg / l.

The color of waters depends mainly on the humic substances they contain and the trivalent iron compounds. Humic substances are formed during the decay of plants, and as a result of their dissolution in water, the water turns yellow. Humic compounds are humic acids (52-58% carbon, 3.3-4.8% hydrogen, 34-39% oxygen).) and filvoxic acids (45-48% carbon, 5-6% hydrogen, 43-48% oxygen).

The color of water is measured in degrees. The color index is determined by comparing a water sample with a standard solution. The standard solution is prepared from a mixture of chlorine platinum potassium K_2PtCl_6 and cobalt chloride CoCl2 salts. The color of water corresponding to the color of a standard solution containing 0.1 mg of platinum in 1 ml of water is estimated to be 1 degree of coloration.

The color of drinking water should not exceed 20 degrees.

The turbidity of river water is higher than that of groundwater. The magnitude of the turbidity depends on the suspended particles in these waters, ie mud, sand, plankton, plant debris. The turbidity of river water can be several thousand mg per 1 liter of water.

The turbidity of drinking water should not exceed 2 mg / l. The amount of insoluble and colloidal particles in water can be determined by the clarity index. Clarity is measured in glass cylinders 30-50 cm high. In this case, the height of the water layer (in cm) when the text is written in a certain font is called the font clarity of the water.

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A filtration method is used to detect suspended particles in water. In this case, the water is filtered and the filter is dried at 105C˚. The difference in the weight of the filter measured before and after filtration indicates the amount of suspended particles in the water. In practice, it is possible to quickly determine the amount of insoluble particles in water by plotting the relationship between the clarity index and the amount of suspended particles.

Odor and taste are included in the organoleptic characteristics of water. The odor of natural water depends on the aromatic substances in it. Waters containing inorganic substances have the odor of hydrogen sulfide. The smell of water affects some organisms, for example; may be related to mogul and actinomycetes. When water is treated with chlorine, the water smells of chlorophenols.

The odor of water is evaluated on a five-point scale or on a "boundary check," i.e., the degree of dilution until the odor disappears. The temperature must also be indicated. The smell of drinking water should not exceed 3-4 points.

The taste of water depends on the substances that come naturally in the composition or as a result of contamination with wastewater. In organoleptic analysis, only the taste of drinking water is checked. The taste of water is expressed as salty, sweet, bitter, sour. In addition, the water may have alkaline, metallic and other flavors. To determine the taste of the water, take a sample of 10-15 ml of water in the mouth for a few minutes and then spit it out. The temperature is also indicated in the analysis. Often drinking water has no taste at all. The taste of groundwater can be salty and bitter, depending on the amount of salts it contains. The pH of domestic and drinking water should be 6.5-9.5. The pH of natural water sources is kept within this range.

The temperature of natural waters can range from 0o to 25oC. The water temperature is measured using a thermometer at the time of sampling. The temperature of drinking water should be around 7-15oC.

Conclusion

The essential role of water pretreatment aimed at removing algae and oxidizing organic contaminants before subsequent coagulation and flocculation of water is shown. Improved technological schemes for the preparation of drinking water from low-power water sources are proposed, depending on the range of concentrations of contaminants, and their effective field of application is determined.

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