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MAIN TECHNOLOGICAL METHODS OF WATER TREATMENT

Axmedova Feruza Isanovna., Mirzayev Murod Namazovich., Nurmurodova Visola Jamol qizi
Samarkand state architecturial and civil engineering university

Abstract

The water supply and sewage sector has an important place in the city economy. It is important from a sanitary-hygienic point of view to provide the city population with quality and required quantity of water, to discharge the waste water generated in the cities and to clean it at the required level in the treatment facilities before releasing it back into the water bodies.

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Introduction

Currently, great importance is attached to the prevention of pollution of water bodies. Wastewater from households and industrial enterprises is cleaned in certain facilities and then discharged into water bodies. At the same time, it pollutes water bodies to a certain extent. In recent years, our state has implemented a number of practical measures aimed at improving the sanitary conditions of water bodies.

Main part

Water treatment facilities are one of the main elements in the water supply system and are inextricably linked with other facilities. Treatment stations are selected depending on the location of the water supply facility. Water treatment stations are often located close to the water sources that supply consumers with water, and therefore they are not far from the first stage of the pumping station. In the practice of water preparation, there are technological drawings with and without reagents, according to the level of purification, the number of technological processes and the number of stages in them, with and without pressure. Before deciding on the structure of the treatment facilities, it is necessary to determine the technological drawing of the water treatment process, as well as the type, number and indicators of the treatment facilities

In the case of residential water supply (according to the water quality of the water source), the water treatment scheme can be implemented in one-stage or two-stage or multi-stage scheme. The water transferred from the first station of the pumping station is first transferred to the mixer, from which the reagent solution for coagulation of water is sent, and the reagent and water are mixed together in the mixer. Water is sent from the mixer to the reaction chamber, in these structures, the small particles in the water become larger and form fragments, after which the water first passes through a horizontal clarifier, and then through a filter. The filtered water is transferred to the clean water reservoir through pipes. Chlorine is added to the pipe that carries water to the fresh water tank to neutralize the water.

In some cases, chlorine can be injected into the water twice: before the mixer and after the second filter. When choosing a single-stage water treatment scheme, you can use filtration or suspended sediment clarifiers for water treatment. In water treatment plants, water flows from one structure to another through pipes or pipes. Therefore, the mutual arrangement of structures is affected to a certain extent by the value of pressure loss in pipes and structures. Therefore, the structures are placed in relation to each other, taking into account the value of the pressure loss in the pipes and the structures themselves. In some cases, water can pass from one structure to another under pressure at water treatment stations. In such a scheme, the second stage of the pumping station will not be needed, that is, after the water is cleaned at the treatment station, it can be directly delivered to consumers. Depending on the level of water purification, you can use a complete or partial purification diagram. It is possible to use the water for drinking water preparation from the complete water treatment plan, and for technical water preparation from the partial water treatment plan.

A very small colloidal and separated substance in water is called coagulation, which causes particles to stick together and enlarge under the influence of molecular attraction. There are mainly two types of coagulation in the treatment of natural waters. Free volume coagulation in reaction chambers and contact coagulation in a bed filled with granular materials or in a mass of suspended solids. As a result of coagulation, small substances in the water become larger and form fragments, as a result, the possibility of the turbidity to separate from the water and sink to the bottom of the equipment increases. In order to clarify and decolorize the water, they are passed through the clarifier and filters, in order to speed up and increase the efficiency of this process, substances that need to be retained in the water are coagulated. Chemical reagents-coagulants are added to water in order to create a process of coagulation in small colloidal and separated substance particles in water. At present, reagents commonly used in coagulation include aluminum sulfate salt A12(8O4)3, iron bridge FeSO4, and iron chloride FeSl3. When aluminum sulfate salt A12(SO4)3 is added to purified water, as a result of its deesterification, sulfate anion is formed with aluminum cation A1 2(SO4)3 —>2 Al3+ + 3SO42-.

After that, as a result of hydroisolation of aluminum ion, it forms precipitated aluminum hydroxide.

$A1^{3+}+3\ N_2O > Al(OH)_3+\ ZN^+$

Hydrogen cation has the opposite effect in the indicated process. Hydrogen ion forms carbonic anhydrite together with bicarbonate ions in water

$N+NO_3 > SO_2 + N_2O,$

If the natural alkalinity of the water is lacking in this reaction, then it is necessary to additionally alkalize the water. Lime or soda is used for this. When iron cuprate FeSO4 is added to water as a coagulant, it forms iron II hydroxide in water, which itself reacts with dissolved oxygen to form iron III hydroxide, the oxidation process is faster when the pH of the water is not less than 8 .

Therefore, it is necessary to add slaked lime to the water. In some cases, chlorine is added to accelerate the oxidation process. Often, when it is necessary to soften the treated water, iron oxide is mainly used as a coagulant in the water.

The amount of coagulant added to the purified water is determined according to the instructions of KMK 2.04.02-97. The amount of coagulant for colored waters is determined by the following expression.

$$D = 4\sqrt{K}$$

K - color of water to be treated, degrees.

As we said above, when the natural alkali is low in the purified water, lime or soda is added in order to make the coagulation process successful and to increase the amount of alkali, their amount is determined as follows:

$$D_i = K_i\ (D_k\ /\ I_k - I_o) + 1;$$

- D_k - maximum amount of anhydrous coagulant during alkalization, mg/liter;
- I_k - equivalent mass of anhydrous coagulant in mg/mg.eq.
- $A1_2(SO_4)_3 = 57$; $Fe\ S1_3 = 54$; $Fe_2\ (SO_4)_3 = 67$.
- K_i – coefficient, for lime = 28, for soda = 53,

- I_o - is the minimum water alkalinity in mg.equiv/l.

If the calculated value is negative, then additional alkalinization of water is not required.

Flocculants can be used to improve the efficiency of the coagulation process and water treatment facilities. Flocculants are high molecular weight substances that can be mineral or organic.

At the water coagulation stations of the treatment stations, reagent facilities and measuring devices are built. Coagulants delivered to water treatment plants can be in dry form or in the form of a concentration of compounds. Coagulants can be cleaned and added to the water until it reaches the clarifier or suspended sediment clarifiers. Coagulants are added to the treated water in the form of a mixed solution or powder, small granules. Reagents in dry cases can be placed in special containers or stored in special containers of high-concentration mixtures. Currently, it is common to store coagulants in liquid form. For this, coagulant pieces are placed in large containers and a mixture with a concentration of more than 30% is prepared. When necessary, the concentrated mixture is transferred to the distribution tank, where the required amount of water is mixed and brought to the required concentration, after which it is added to the water through the metering device. Aluminum sulfate salt is brought dry in the form of lumps to the treatment stations, and the layers are 1.5-2 m high and are stored in the reserve.

Reserve coagulants are placed in special containers for dissolution and dissolved in water until their concentration reaches 10-17%. After that, they are cooled and sent to consumable tanks, mixed with water until the concentration reaches 4-10%, the coagulant solution with this concentration is added to the water through the measuring devices.

When the coagulants are dissolved in the tanks, air is introduced to improve their dissolution efficiency, they can be mixed using mechanical mixers and continuously circulated using pumps. Coagulant melting and distribution capacities can be made of plastic or wood for small devices, reinforced concrete for large devices.

In order for reagents added to water to have a qualitative effect, it is necessary to ensure their quick and complete mixing with water. This is done with the help of a special device - mixers.

After the reagent solution has passed through the quantifiers, it is sent to the head of the mixer or to the pipe that delivers water to them. Existing mixers are divided into two according to the nature of their operation: hydraulic, that is, reagents are made using the flow of water, and mechanical, that is, mixing is made with the participation of moving mechanisms. The first group of mixers includes devices with vertical barriers, holes and water flow.

Perforated mixers are structures in which vertical barriers are installed inside a reinforced concrete or metal frame. Usually three barriers are installed. The distance between the barriers is equal to the width of the mixer. The flow rate of water in the mixer after the last barrier is 0.6 m/sec and the average flow rate is 1 m/sec. The sum of the total area of the holes in one block is ω= q/v, the surface of each hole is ω = ω1/n, where the number of p-holes, the diameter of the holes in practice is 20-100 mm. The pressure lost in the holes of each barrier is h = y20 / (μ2·2g), where μ is the consumption coefficient a equal to 0.65-0.75. The water level in front of the barrier should be such that all openings in the barriers are under water. In perforated mixers, the reagent mixes well with water. Barrier mixers are rectangular mixers in which several slotted barriers are installed in a row. These slits are built in order to change the direction and speed of the water flow. The flow rate of water in the trench is 0.6 m/sec and in the cracks is 1 m/sec. The distance between the obstacles is equal to twice the width of the track.

Vertical (rolling) mixers are cylindrical or rectangular in plan, and their lower part is in the form of a cone or pyramid. Purified water is sent through a pipe placed in the lower part, reagent solution is sent through a pipe placed in the cone part. Mixing is carried out due to the change in the speed of the water flow. When the water comes out of the pipe, the flow rate changes due to the transition from the narrow part of the mixer to the wide conical part.

The mixed water flows through a drain located at the top of the mixer. The speed of water flow on the narrow surface of the conical part of the mixer is 1 m/sec, and on the cylindrical part is 25 mm/sec. The time of water in the chamber is 1.5-2 min. The slope of the cone part is 30-45°. Such mixers are used for softening and softening water. In some devices, reagents are mixed with water without special devices, i.e., by sending reagent solutions directly to water intake pipes of pumps or water transmission pipes to treatment facilities.

In mechanical mixers, mixing of water with reagents is done by forced mixing. Usually they are cylindrical or rectangular in plan, the height is twice as large as the width. In this case, the ratio of the diameter of the device to the diameter of the mixer can be equal to 2-6 values. Propeller, turbine, blade mixers are used for mixing. Since they are placed on a vertical axis, they create a radial and rotational flow. The number of mixers on the axis is determined by the depth of the mixer. Water in mechanical mixers 0.75 min. from to 5 min.

Conclusion

Rapid development of industrial and agricultural enterprises is one of the factors of sewage pollution in water bodies. In addition to discharging large amounts of waste water into water bodies, maintaining their purity is one of the important tasks of the national economy. Therefore, by choosing the right method of wastewater treatment, it is possible to ensure that the water discharged into water bodies meets the requirements of sanitary standards.

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