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WATER CLEANING PRESSURE FILTER DEVICES OPTIMAL CONSTRUCTIONS WORKING EXIT

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Abstract

One of the current problems of today is the purification of drinking water and the supply of high-quality drinking water to the population. It is established in Article 24 of Chapter 6 of the Decree of the Republic of Uzbekistan No. ORQ-784 dated 22.07.2022 on drinking water supply and wastewater disposal. According to the resolution, it is envisaged to carry out the preparation and supply of drinking water and the technological stages of drinking water preparation in water facilities, taking into account the quality of water in the water facility, the capacity of the facility and its geographical location. In finding optimal solutions for the technological processes of drinking water preparation in water facilities, proposals and considerations were made on the optimal selection of materials used as fillers in rapid filters and the provision of high-quality and required drinking water to the population.

Keywords: Quick filters, fillers, standard, size, pressure, granularity, loading.

Abstract: One of the pressing problems of our time is the purification of drinking water

Introduction

In the current era of market economy reforms in our country , great importance is attached to providing the needs of the population and all sectors of the national economy with clean drinking water.

Jump during the economy stabilization and intense Special attention is paid to solving the problem of development, priority development of engineering communications of production infrastructure. Uzbekistan Republic President's "The population clean The Decree "On Improving the Supply of Drinking Water and Natural Gas " provides the population marriage well-being further increase, one row large water construction of facilities and main networks, ensuring their uninterrupted operation measure events working exit such as current implement issues increase shown [1,2].

The purpose of the research is to determine the effectiveness of using filter devices filled with local materials in natural water purification technology, to improve filter design, and to develop recommendations for their use in the climatic conditions of Uzbekistan.

The object of the research is to study the grain size composition, mechanical strength, chemical resistance and technological properties of samples of local raw materials and industrial waste, and to determine the optimal technological parameters of water treatment processes in filter devices filled with local raw materials.

Scientific novelty of the work is that in the climatic conditions of Uzbekistan, natural water purification is possible using local raw materials prepared The cleaning capabilities of filter devices filled with fillers are being investigated for the first time . The main conclusions obtained based on the processing of the research results The relationships between technological parameters are used in the design of water treatment plants.

Style and materials. As the dispersed particles in the filtered water are trapped in the pores of the filter layer, the hydraulic resistance of the filter layer increases. The hydraulic resistance reaches such a value that the energy of the water flow in the upper part of the layer is not enough to overcome it. As a result, the filtration rate decreases or the particles stuck in the pores of the layer break off and pass into the purified water (filtrate) along with the water flow. In this case, it is necessary to wash the filter (clean the filter layer), or in other words, put the filter into regeneration mode.
Regeneration is derived from the Latin word regeneratio , which means restoration. In water treatment technology, the restoration of the original properties of the filter layer is achieved by artificially injecting water flow in the opposite direction to the direction of filtration. In regeneration processes, the speed of the water flow is 5-10 times higher than the speed in the filtration process. The main purpose of washing the filter is to clean the filter layer from particles trapped in its pores. The water flow transmitted from bottom to top increases the volume of the filter layer. This condition is called "expansion of the filter layer". The regeneration efficiency of the filter is directly related to the degree of expansion of the layer.
Typically, cleaning processes in pressure filter units take place overnight. 1-2 times will be done. That's why for filtering in the process filtration period It is of great importance to reduce and simplify the cleaning process of the filter bed. In many cases, the cleaning process of the filter bed is accelerated by sending a stream of compressed air to it or using additional mechanical mixers. The regeneration processes of the filter bed are considered in a separate report [1,2].
One of the main factors determining the efficiency of water purification filter devices is the filter layer **.** The filter layer must meet a number of requirements. The material used as the filter layer must have a porous structure, be chemically stable to the effects of the

water being filtered, and be mechanically strong. During the filtration process, chemical elements The layer should not pass water through the composition.

Fine-pored meshes, various gauzes, dispersible materials (sand, crushed coal, bentonites, crushed rocks), and ceramic bodies are used as a filtering layer.

In addition, cotton, wool, and synthetic fabrics are also used. In some cases, a thin porous sedimentary layer formed on the surface of the filter layer also acts as a filter layer.

Different types of water filtration process additional materials may also be used possible. Specifically : activated carbon , crushed asbestos, crushed ceramics such as from fillers Water is used . Filtration of small particles in water in a filtration machine of the filler layer above partly porous It can stick to the walls and form a layer.

The larger the porosity of the filter layer, the more particles in the water will be trapped. of water to the speed Depending on the type of filter, more water enters the filter layer, and according to technological requirements, the granularity of the filter layer and its hydraulic resistance must be small.

water treatment plants, it is mainly used as a filling layer of the filter device . widely uses river or quartz sand.

pressure filters, water is pumped above the filter packing layer . The height should not be less than 1.5 -2.0 m.

The waters filtering in the process The granular materials that make up the backfill layer are diverse . to be , their form and dimensions different to be possible . If filter of fillers dimensions If it is the same, it is called a one-dimensional filtering layer, and if it is different, it is called a multidimensional filtering layer.

The filtration process depends primarily on the hydraulic pressure of the water, the thickness of the filter layer (L), the size and shape of the granular filter material (a), the porosity of the filter layer (μ), the speed of water flowing through the pores of the layer (U), and the viscosity of the water (μ) .

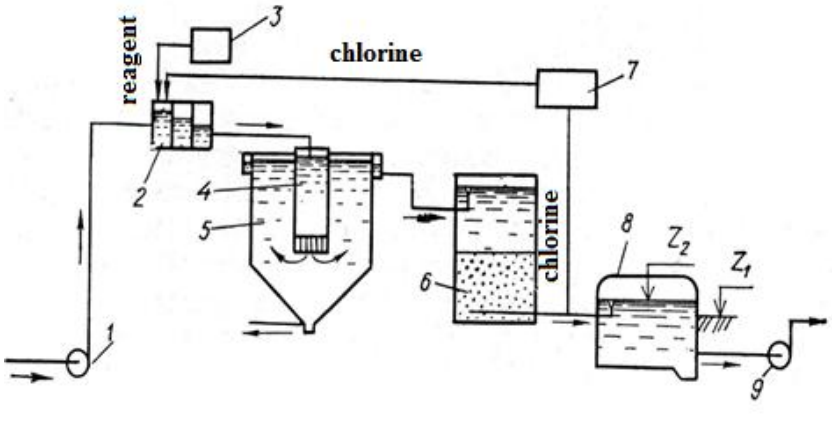

Figure 1. Natural the waters cleaning technological scheme.

1- Pumping unit for transferring natural waters; 2- Water mixing device with reagents; 3- Regent farm; 4-coagulant using child harvest to do device; 5-water to listen structure;

6th speed filter device; 7-water disinfection device; 8-purified the waters storage reservoir; 9-water to the consumer transmitter pump aggregate.

Filters m- filter of the layer porosity According to the theory of dimensions , the coefficient of hydraulic resistance (η) of a granular filtering layer with a height H and a hydrodynamic pressure difference ΔR at the initial stage of the filtration process should depend on the Reynolds number (Re) according to the hypothesis of Prof. D. Mins, i.e.

$$\eta = \frac{\Delta P}{L} * \frac{L}{\rho * U^2} (1)$$

$$Re = \rho \frac{U}{\mu} (2)$$

In the formula ΔP- filter in the layer water pressures difference, m.water.surface;
L- height of the filtering layer, m;
ρ- density of water, kg|m ^{3}; μ- of water viscosity;
l - filter in the layer pore gap tubules length, m;
V- in the layer pore from the void flowing transient water velocity, m ^{3}/m ^{2}.hour;
In the technological calculation of filter devices, the total cross-sectional area of the layer is taken as the filtering surface. In fact, the water flow is the surface of the granular particles on the surface of the filtering layer [3,4]. between pore from the void to oneself typical real "SHE IS" quickly laminar in order flowing will pass. Granular materials between The free volume is defined by the following expression:

$$m = \frac{w_b}{w} (3)$$

Filtering speed « ϑ » with filter layer flowing from its pores The actual "U" velocity of the transient is given by the following simple ratio : is expressed as:

$$U = \frac{\vartheta}{m} (4)$$

in the formula m-filter of the layer porosity.
porous medium. It is known from the hydraulics course that the hydraulic radius is expressed as the ratio of the cross-sectional area of the water flow to the wetted perimeter. In the case we are considering, The total value of the cross-sectional areas of the filter layer and the pore spaces is the cross-sectional area of the water flow passing through them; the total value of the perimeters of the cross-sectional surfaces of the filter material grains is the wetted perimeter. The total value of the cross-sectional areas of the filter layer and the intergranular spaces is proportional to the porosity of the material (m), and the sum of the perimeters of the cross-sectional surfaces of the grains is proportional to the specific surface area of the material (ω) is proportional. That is, for spherical grains:

$$l = \frac{m}{\omega} (5)$$

$$\omega = \frac{6*(l-m)}{d} \quad (6)$$

In a filtering layer, the total value of the cross-sectional areas of the intergranular voids is always smaller than the total cross-sectional area of the layer .

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In filtration technology, the porosity of a filter layer is not the porosity of the grains of the material that make it up, but the fraction of the void volume between the grains of the filter material. In other words, the ratio of the void volume between the granular material to the volume of the filter layer is called the void volume fraction (or layer porosity) and is denoted by M:

$$M = \frac{w - w_3}{w} = \frac{w_b}{w} \qquad (7)$$

w-volume of the filtering layer; w_3 -volume occupied by granular particles in the layer; w_b - empty volume in the filtering layer.

The total surface area of naturally shaped particles is greater than that of similar spherical particles of the same size. The ratio of the surface area of a non-spherical particle to the surface area of a similar spherical particle is the shape coefficient of the filtering material. It is called.

$$a = \frac{f_T}{f_{sh}} \qquad (8)$$

she is without natural shaped particles surface surface as follows can be expressed as:

$$\varpi = \frac{6*(l-m)*a}{d} \qquad (9)$$

in the formula f_T -natural of a particle real surface;

f_{sh} - natural to the size of the particle equal fellow surface area of a spherical particle; d is the diameter of a similar spherical particle.

In calculations, the coefficient (a) depending on the shape of the grains of natural filtering material can be taken as follows:

river sands for a=1.17;

chopped edged sands for- a=1.5-1.67; for crushed anthracite a=1.5-2.52.

Usually fast filter on devices granular different layers The filter material is passed through sieves of different sizes, separated into certain fractions, and filled into the filter device in a prescribed manner [5,6]. Accordingly, the surface area of the grains per unit volume for each fraction is expressed by the following formula:

$$\omega_i = \frac{6*P_i*a*(l-m)}{d_i} \qquad (10)$$

In the formula d_i - certain in the faction grains dimensions;

R_i - filter layer in the composition certain faction weight.

Size in unity all factional grains surfaces total surface:

$$\omega = \sum \omega_i = 6*(l-m)*a*\sum \frac{P_i}{d_1} \qquad (11)$$

$\sum \frac{P_i}{d_1} = \frac{1}{d_{ekv}}$ that expressing, equation following to look we bring:

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$$\omega = \frac{6*(l-m)*a}{d_{ekv}}(12)$$

in the formula d $_{eq}$ - filter layer grains equivalent diameter.
Filtering material for found SHE IS,l and ϖ expressions (11) and we put it into formula (12):

$$\eta = \frac{\Delta P*m^2*d_{ekv}}{L*\rho*v^2*6*a*(l-m)}(13)$$

$$Re = \frac{\rho*v*d_{ekv}}{6*\mu*a*(l-m)}(14)$$

$\frac{\Delta\rho}{L}$- size filter in the layer water pressure decrease represents, namely:

$$i_0 = \frac{\Delta P}{L-\gamma} \quad \text{or} \quad \frac{\Delta P}{L} = i_0 * \gamma \qquad (15)$$

In the formula γ =1000 kg|m ^{3} -of water volumetric weight.
To this according to (1) the formula following to look to bring possible:

$$i_0 = \frac{6*a*(l-m)*\rho*v^2}{m^3*\gamma*d_{ekv}}(16)$$

Based on the results of research conducted by Prof. DM Mins and his students, the drag coefficient for laminar flow (Re<2.0) can be expressed as follows:

$$\eta = \frac{51}{Re} \qquad (17)$$

This formula fast filter on devices of water linear function law represents. Re and η of the values found above , and γ = 1000 kt| m ^{3} into account received in the case all sizes one kind (υ -m ^{3} /m ^{2} ·sec; dm.; μ-kg·sec/m ^{2}), in scale After simplifying the expression, we can reduce formula (1.18) to the following form:

$$I = 0.188 * \mu\left(\frac{v^2*(l-m)}{d_{ekv}^2*m^3}\right) * v \qquad (18)$$

The technological content of formula (18) is that at the initial stage of the filtration process, the decrease in water pressure in the layer changes proportionally to the increase in filtration rate and the decrease in porosity of the filtering layer. In addition, as the viscosity of the filtered water increases (i.e., as the water temperature decreases), the decrease in pressure in the layer increases.
(16) the formula following simpler in appearance expression possible.

$$i_0 = S_{0v}(19)$$

In the formula $S_0 = 0.188\frac{\mu*v^2}{d_{ekv}^2} * \frac{l-m}{m^3}$ -filter processes at first filter layer comparison resistance that is maintained.
In this, mainly, L thick filter in the layer The pressure drop can be expressed as:
h $_o$ =S $_o$ ·L· υ =S· υ (20)
In the formula S*S $_o$ ·L - filter my friend hydraulic resistance.

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The principle of operation of fast filters is aggregative stability. based on particle trapping [3.5].

Bringing particles in natural waters to an aggregate stable state can only be achieved by chemical treatment. For rapid filter devices to work effectively, they must be supplied with natural waters that have undergone preliminary chemical treatment. This description of the principle of operation of rapid filters operating at high speeds was named after the scientist D. Mins' hypothesis and made a significant contribution to the development of the theoretical foundations of the filtration processes of natural waters in rapid filter devices [7,8].

As the dispersed particles in the filtered water are trapped in the pores of the filter layer, the hydraulic resistance of the filter layer increases. The hydraulic resistance is determined by its to the value enough, of the layer upper The energy of the water flow in the part is not enough to overcome it. As a result filtering speed decreases or layer porosity stuck particles interrupted water The water is transferred to the purified water (filtrate) along with the flow. In this case, it is necessary to wash the filter (clean the filter layer), or in other words, to transfer the filter to the regeneration mode. Regeneration is derived from the Latin word "regeneratio" , which means "restoration". In water treatment technology, the restoration of the original properties of the filter layer is achieved by filtering the water flow in the opposite direction to filtration. In regeneration processes, the speed of the water flow is 5-10 times higher than the speed in the filtration process The main purpose of washing the filter is to clean the filter layer from particles trapped in its pores. From bottom to top transferred water flow filter increases the volume of the bed. This condition is called bed expansion . The efficiency of regeneration is directly dependent on the degree of expansion of the filter bed. Typically, regeneration processes in rapid filter devices are performed 1-2 times per day. Therefore, great importance is attached to reducing and simplifying the regeneration period. In many cases, the cleaning processes of the filter bed are accelerated by sending a stream of compressed air to it or using additional mechanical mixers. Figure 1 shows a diagram of a rapid filter device. Such filters right with beans, new in the form of, using prefabricated reinforced concrete elements is being built.

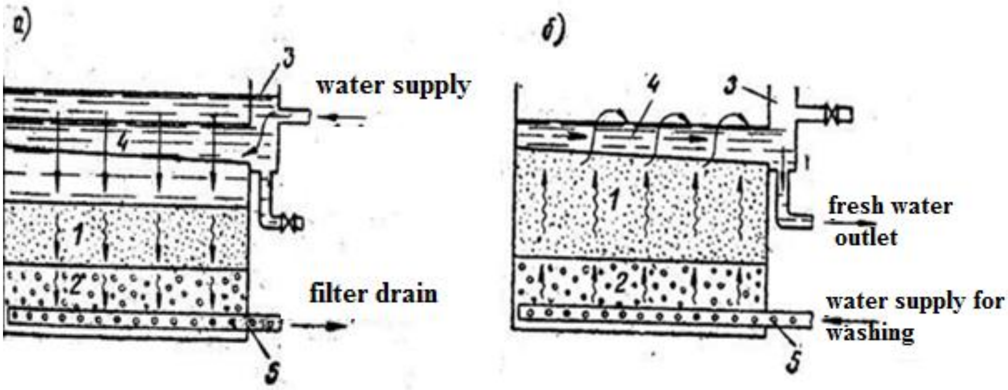

Figure 2. Quick filter device Principal scheme.

a-filtration process; b-washing (regeneration) process of the filter layer; 1-filter layer consisting of a device; 2-holding layer consisting of a slurry layer; 3-water transmitter network; 4-water distribution pipe; 5-drainage network;

The schematic diagram of the instant filter device is shown in Figure 2. The filter is fed into the shaft and flows from top to bottom through a sand filter layer and a gravel retention layer. The filtered and purified water (filtrate) is transferred to the consumer or clean water storage tanks using a drainage network installed at the bottom of the device.

To wash (regenerate) the filter layer, the filter is stopped by connecting the valves in the appropriate networks.

Washing water (regenerate) It flows from the bottom up through the gravel retention layer and the sand filter layer and is discharged to the external network using a branch.

During the regeneration process (see Figure 2.b). The water filtration system value compared to the filtering process several times larger is accepted [9,10].

Conclusion

Bringing particles in natural waters to an aggregate stable state can only be achieved by chemical treatment. For rapid filter devices to work effectively, they must be supplied with natural waters that have undergone preliminary chemical treatment. Since the possibility of using sand samples prepared from raw materials as a filtering material is being studied for the first time , and since technical and economic data expressed in figures are insufficient, the economic efficiency is estimated at can be calculated.

The economic efficiency of using local filtering materials can be calculated as the sum of the savings in purchasing and transporting materials and the savings in increasing the efficiency of filtering devices .

Filter material price him/her working release with related expenses , sifting , sorting , enrichment and transportation expenses defines .

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