

## DETERMINATION OF THE OPTIMAL DECISION PROCESS OF HIGH-SPEED FILTRATION AND WATER SUPPLY

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**Abstract.** *This article describes the principle of operation of quick filters in water supply and the cycles of operation of quick filters, one and two-layer filters, water treated with reagents, filtration through quartz sand, as well as recommendations for determining the size of the filter.*

**Keywords:** *water supply, quartz sand, filtration, Rapid filter, size filter, single and double-layer filters, reagents, speed filtration, filter material.*

### ОПРЕДЕЛЕНИЕ ОПТИМАЛЬНОГО РЕШЕНИЯ ПРОЦЕССА ВЫСОКОСКОРОСТНОЙ ФИЛЬТРАЦИИ И ПОДАЧИ ВОДЫ

**Аннотация.** *В данной статье описаны принцип работы быстродействующих фильтров в водоснабжении и циклы работы быстродействующих фильтров, одно- и двухслойных фильтров, воды, обработанной реагентами, фильтрации через кварцевый песок, а также даны рекомендации по определению размера фильтр.*

**Ключевые слова:** *водоснабжение, кварцевый песок, фильтрация, Репид-фильтр, размерный фильтр, однослойные и двухслойные фильтры, реагенты, скорость фильтрации, фильтрующий материал.*

### INTRODUCTION

In the Law of the Republic of Uzbekistan on the supply of drinking water and the discharge of wastewater, Article 24 of Chapter 6 of ORQ-784 of 22.07.2022, preparation and supply of drinking water and drinking in drinking water facilities It is envisaged that the technological stages of water preparation, preparation of drinking water will be carried out taking into account the quality of water in the water body, the capacity of the facility and its geographical location.[1-2].

To calm the water turbidity in the above decision; water purification and disinfection; aimed at the preparation and delivery of drinking water in accordance with the requirements of sanitary rules, norms and hygiene regulations, state standards.

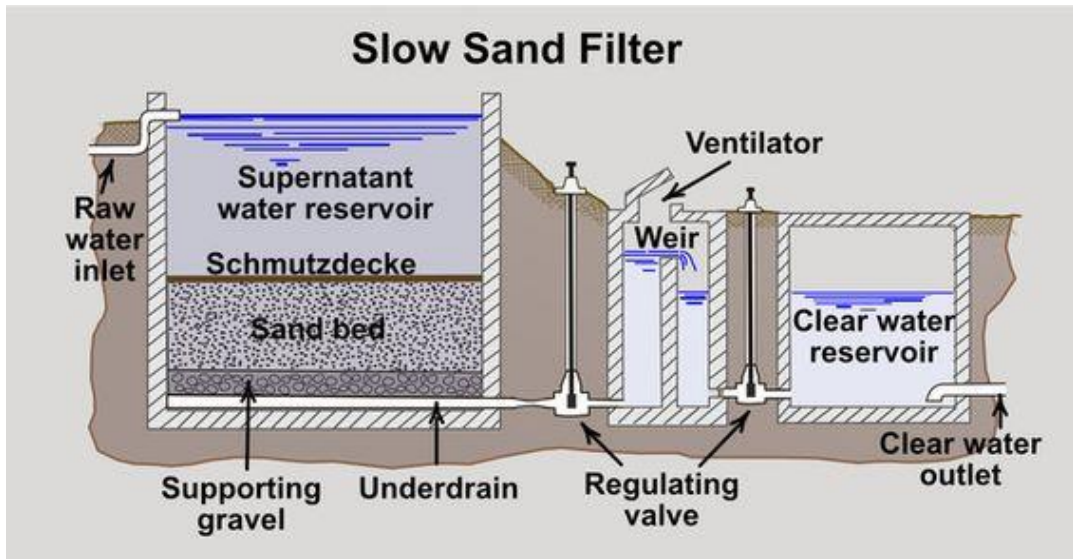
Providing clean water to every resident remains one of the priority tasks of the government and businessmen. In practice, more rapid filters are used for water purification. This is because the principle of operation of rapid filters is based on filtering water treated with reagents through quartz sand.[3-4]

Since floating substances in water are stuck to filter sand particles due to the viscosity property caused by the effect of the reagent, the process of filtering effluents prone to viscosity is carried out in rapid filters.[5-6]

### MATERIALS AND METHODS

The process of passing purified water through a layer of filtering material is called filtration. Filtration is done to clarify the water, i.e. to trap the floating particles in the water. It is

assumed that the filter material consists of a porous medium with small particles, and sand (quartz) is usually used as the main filter material.

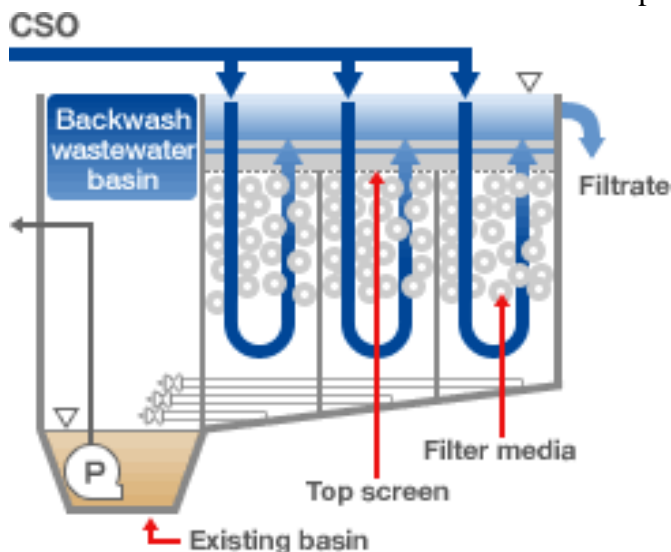


A drainage device is installed under the filter, and a retaining material of fine gravel or small stones is laid on top of the drainage. Fine gravel is placed on top of the drainage in the order of increasing size downwards, and on the retaining material, the filter material, i.e. sand particles, is placed in the order of fineness from bottom to top. Taking into account that the filter works in the state of being quenched with water during the filtration process, the efficiency of the filter is determined by the filtration speed..

The cycle of using the filter consists of the following operations: Water purification (filtering); - Softening (steam or moist air); - Return (water or water-air); - It is done by pouring the first filter into the drain [7-12].

## RESULTS

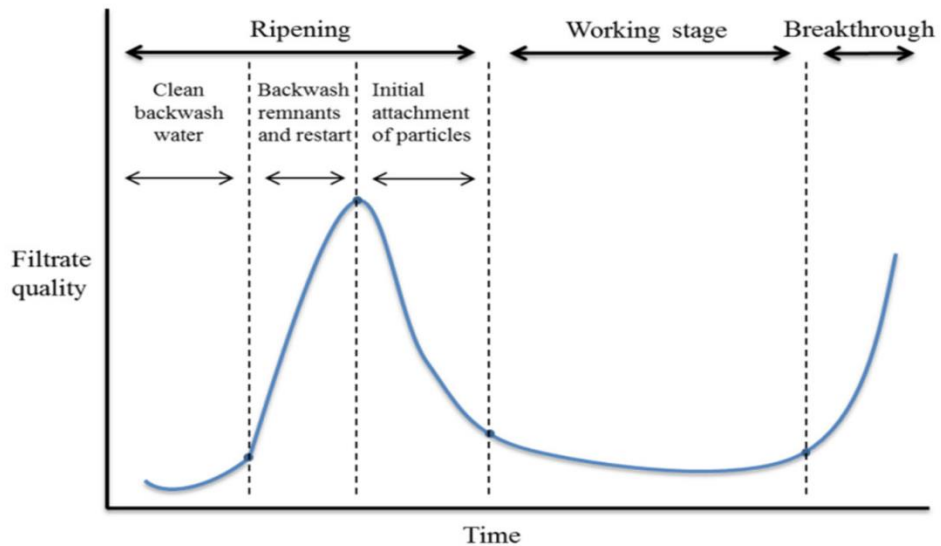
Rapid filters: In practice, rapid filters are used for water purification. The principle of operation of rapid filters is based on filtering water treated with reagents through quartz sand. Floating substances in water are stuck to filter sand particles due to the property of viscosity created by the effect of the reagent. In rapid filters, the process of filtering effluents prone to viscosity is carried out. Quartz sand is used as the main filter material for rapid filters.[13-14]



From the water purification process, we can divide the filters into single and double layer filters. Due to the increase in the size of the particles in the upper layers of the filter, the retention of dirt is 2-2.5 times higher than that of ordinary sand filters. In turn, the filtration speed increases to 9-10 m/h and, accordingly, the period of operation is extended. Due to its low weight, the anthracite layer remains unchanged even after washing.

Fig. 2.

Diagram of filter operation process.



The filter works as follows: Water is fed into the pocket 5, from which it enters the space above the filter material through the tube 4 and forms a water column. Under the influence of gravitational forces, the water passes through the filter material 3 and is cleaned of suspended particles. Then a layer of gravel 4 passes and is removed using drainage devices 5.

The permeability of the filter is determined by the filtration speed ( $F$ , i.e. the speed of vertical movement of water along the filter layer, m / h):

$$\omega_f = \frac{Q_F}{F_F} \quad [1]$$

where  $Q_F$  is the amount of water passing through the filter, m<sup>3</sup> / hour;

$F_F$  – filter area, m<sup>2</sup>.

When washing, the filter is turned off, the washing water is fed from below through the drainage device and passes through the layer of gravel and sand in the opposite direction. The wash water is then discharged through pipe 4 and the wash water discharge pipe [15-17].

When cleaning filters, purified water is supplied at a speed several times higher than the filtration speed. The reverse flow of water shakes the sand and intensively washes away pollution in almost 5 ... 7 minutes. Experience with quick filters shows that they need to be cleaned 1-2 times a day, and sometimes more often..

#### Filter size determination

The area of one filter is determined by the following formula:

$$F_{1f} = \frac{F_{umum}}{n} m^2 \quad [2]$$

here

$F_{total}$  - required total filter area, m<sup>2</sup>;

$n$  - the number of parallel filters, pcs.

The number of parallel filters is determined by the relationship

$$n = 0.5 \cdot \sqrt{F_{umum}} \quad [3]$$

and the required total area of filters according to the formula:

$$F_{umum} = \frac{Q_{sut}}{\omega_f \cdot 24 - 3,6 \cdot q \cdot \tau_1 \cdot m - \omega_f \cdot (\tau_2 + \tau_4)} \quad [4]$$

here

$Q_d$  - calculated daily water demand of the supplied object, m<sup>3</sup>/day;

$\omega_f$  – filtering speed ( $\omega_f = QF/FF$ ), m<sup>3</sup>/hour;

$q$  is the calculated intensity of filter washing, l/(s(m<sup>2</sup>));

$t_1$  is the duration of washing one filter, (=0.09...0.11 hours);

$t_2$ – duration of interruptions in filter work, (=0.33 hours);

$t_4$  is the time to restore the first filter after the next wash, (= 0.17 hours);

$m$  is the number of times one filter is washed per day.

Depending on the nature of the material of the filter layer and its height, the calculated filtration speed is determined according to the recommendations of QMQ.

The use of quartz sand for quick filters and as the main filtering material, today in water supply for economic and drinking purposes, a 0.7 m thick layer of  $d=0.7-0.8$  mm sand is often used. Gravel, which is used as a retaining layer, prevents filter layer particles from passing into the drainage system. During the filtration process, if the water level in the filter is higher than the water level in the tank, the water can flow through the filter itself. If it is the other way around, then water is sent under pressure, and at this time the filter works on the principle of a closed pressure vessel [18-20].

## DISCUSSION

Washing the filter is performed in the opposite direction, i.e. from the bottom to the top with a relatively large flow of water, as a result of which the speed of the water supplied for washing the filter is several times higher than the speed of filtration. The washing water stirs up the sand and washes away the impurities that have settled in it. The resulting water is collected using a special trough and thrown into the sewer. As for the working cycles of the fast filter, the 1st curtain is 10-20 minutes, the 2nd filter is 8-12 hours of normal operation, the 3rd filter washing is 5-7 minutes, and the number of filters is less than 2 should not be. Taking into account the rocks filling the filter, it is planned to send water consumption from 6 to 15, even 18 l/s per square meter of surface to wash it.

## CONCLUSION

As for the principle of operation of rapid filters in water supply, the filter material enters the space above and forms a water column. Under the influence of gravitational forces, the water passes through the filter material and is cleaned of suspended particles. Then the gravel layer passes and is removed using drainage devices. In the process of filtering water, if the water level in the filter is higher than the water level in the tank, the water can flow through the filter itself, and work was done to determine the size of the filter.

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