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APPLICATION OF POROUS DRAINAGE IN FILTERS WITH FLOATING LOADING

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The analysis of existing drainage systems in filters with floating media is conducted, their main weaknesses are identified. Designs of drainages based on porous polymer are offered, which will increase the reliability of their work.

Keywords: *rapid filter, drainage, floating media.*

ПРИМИНЕНИЕ ПОРИСТЫХ ДРЕНАЖЕЙ В ФИЛЬТРАХ С ПЛАВАЮЩЕЙ ЗАГРУЗКОЙ

В. И. Прогульный, М. В. Рябков

Проведен анализ работы существующих дренажно-распределительных систем скорых фильтров с плавающей загрузкой, выявлены основные недостатки дренажно-распределительных систем скорых фильтров с плавающей загрузкой. Предложены конструкции дренажей на основе пористого полимербетона, позволяющие повысить надежность их работы.

Ключевые слова: *скорый фильтр, дренаж, плавающая загрузка.*

ЗАСТОСУВАННЯ ПОРИСТИХ ДРЕНАЖІВ В ФІЛЬТРАХ З ПЛАВАЮЧОЮ ЗАСИПКОЮ

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Проведено аналіз роботи існуючих дренажно-розподільних систем швидких фільтрів з плаваючою засипкою, виявлено основні недоліки дренажно-розподільних систем швидких фільтрів з плаваючою засипкою. Запропоновано конструкції дренажів на основі пористого полімербетону, що дозволяють підвищити надійність їх роботи.

Ключові слова: *швидкий фільтр, дренаж, плаваюча засипка.*

At present, almost all schemes of natural water purification include filters. The correct operation of these facilities depends not only on water quality, but also economic indicators of treatment.

One of the promising methods of improvement of filters is replacement of heavy filter media on the floating media. Floating media allows:

– to increase filtration rate;
– to simplify the process of washing;
– to reduce flow rate of washing water;
– to refuse from additional pumps and tanks of washing water.

The most suitable for the practice of the floating media are foamed polystyrene granules of brands PSV and PSV-S, and their modifications [1].

According to research by V. O. Orlova [2] filters with floating media are expedient for using in single-step reagent schemes of water clarification. Investigations of M.G. Zhurba [3] have shown that filters with floating media can be used in two-stage water purification schemes as a second stage of purification after basins or clarifiers with a layer of suspended sediment.

At present, more than 100 designs of filters with floating foamed polystyrene media (FFM) are developed, which differ in: field of application; technological capabilities; diversity of structural elements; terms of placement of foamed polystyrene media in the filter case [1].

The most common design is the design of filters FFM-1 with upward flow of water and FFM-3 and FFM-4 with a downward flow of water. Their schemes are shown in Fig. 1.

Description of the filter FFM-1 with upward flow of water. At filtration contaminated water is supplied to the under-drainage system 2, is distributed over an area of the filter and passed through the filter media 1, and then it is diverted into a collecting channel. To prevent the emersion media upper drainage system 3 is mounted. When washing, water from the space above the media is fed down and collected with the under-drainage system 2, and is discharged outside the filter.

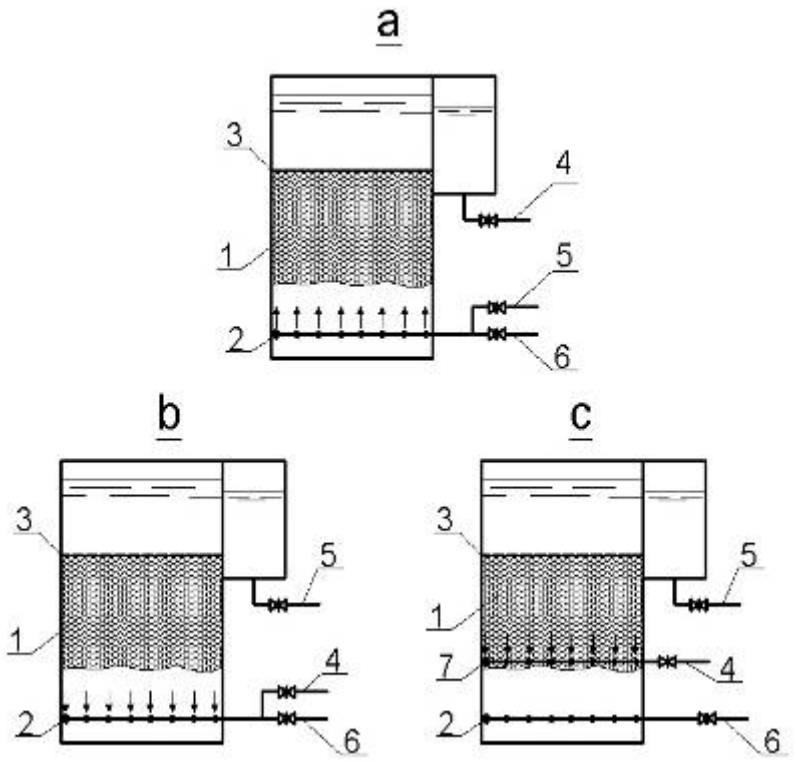

Figure 1 – Schemes of filters with floating media designs: a – FFM-1;
b - FFM-3; c – FFM-4;
1 – floating media; 2 – underdrainage system; 3 – upper drainage system;
4 – outlet conduit of purified water; 5 – supply line of contaminated water; 6 – outlet conduit of wash water; 7 – average drainage system.

Description of filters FFM-3 and FFM-4 with a downward flow of water. At filtration contaminated water is supplied to the space above the media, then passed through the filter media 1, and collected with the under-drainage system 2 in the FFM-3 or average drainage system 7 in the FFM-4. The washing process is the same as that of the filter FFM-1 with upward flow.

Under-drainage distribution systems in filters with floating media are made of perforated asbestos cement or plastic pipe with a diameter of orifice 10 mm [4]. Upper-drainage distribution systems are made of lattice overlapped with a steel or brass mesh [2].

Problematic part of such filters, as well as any other, is a drainage-distribution system (DDS) [5-6]. Operating experience of known drainage-distribution systems in rapid filters with floating media is shown that they have a number of disadvantages, the main among which are:

– large metal consumption of upper-drainage system and as a result high cost of filter;
– low durability of metal elements of DDS;
– filtrate deterioration due to corrosion of metal parts;
– the probability of removal of filter media grains, with an increase of the washing rate;
– high altitude of under media space.

To solve these disadvantages the traditional metal perforated drainage pipes, lattices and meshes are proposed to replace with drainage of nonmetallic materials without gravel layers. In the case of correct operation, the durability of these drainages can be increased up to 30 years or more. As a result, reliability of the system is increased, and the overhaul period is increased in 5 times.

The most promising material, which is widely used in recent years in drainages of rapid filters is porous polymer concrete which is made on the basis of crushed granite and epoxy resin ED-16 and ED-20, which is allowed by the Ministry of Health of Ukraine for use in drinking water supply. Epoxy resins of these brands have a high strength and resistance to aggressive influence of water [7], which is treated with reagents.

Aggregate size of polymer concrete is selected to provide sufficient capacity of drainage and prevent the entrainment of filter material.

The reliability of such structures has been repeatedly proved not only in laboratory conditions, but also on the existing water treatment plants [8].

In filters with upward flow of water FFM-1 upper-drainage system can be made of porous polymer concrete slabs that are stacked on a supporting structure, which is a reinforced concrete girders, and the under-drainage distribution system can be made as a porous of polymer concrete gutter type. The scheme of such a filter is shown in Fig. 2.

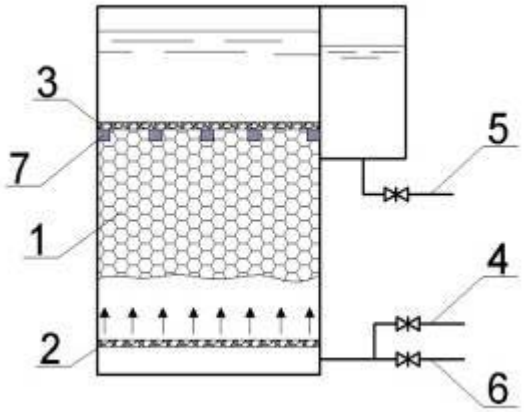

Figure 2 – The circuit of filter with floating media with upward flow of water:
1 – floating media; 2 – under-drainage system, which is made of porous polymer concrete slabs;
3 – upper-drainage slab of porous polymer concrete; 4 – supply line of contaminated water;
5 – outlet conduit of purified water; 6 – outlet conduit of wash water; 7 – support beams

The proposed devices have several advantages over existing designs:

– prevent the entrainment of the filter material by washing and filtration;

– have no metal elements;

– allow to decrease the height under media space, and, accordingly, the construction height of the filter;

– improve the reliability and continuity of filters.

One of the main questions that arise when considering the possibility to use porous polymer concrete drainage in filters FFM is their colmatation of suspension or filter media and selection of aggregate size of the porous of polymer concrete. As shown in work [9] the colmatation of filter media grains is greater.

In connection with this task further research is to study the dynamics and the degree of colmatation of the porous polymer concrete by foamed polystyrene media, as well as the selection of aggregate size.

Conclusions

- the experience of drainage-distribution system in filters with floating media is studied;
- their basic disadvantages, the main among which are large metal structures, susceptibility to corrosion, increase resistance during the operation are revealed ;
- construction of drainages based on porous polymer concrete, which are increasing the reliability of filters and their durability are suggested.

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