СІЛЬСЬКОГОСПОДАРСЬКІ НАУКИ

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INNOVATIVE WATER PURIFICATION SYSTEM

The results of this study are concerned creation of innovation combined system for water purification. The mode of its action is based on specially organized circulation of water through technological units. The main operative tool in created system is the advanced flotator (the bubble films-extractor). It is hydraulically linked with the granular filter. Both these devices provide an increased degree of water purification when initiating circulating regime of well aerated water treatment inside the system. By other words the overall efficiency of the circulating ensemble which consists of flotator and granular filter is much higher than are able to show flotator and granular filter at their series connection for water purification in a direct flow mode.

Innovation, purification, synergy, system, water

Water purification is carried out by combined method. This method includes a set of physical, physic-chemical and microbiological processes of removal and destruction of water admixtures. All these processes are well studied and widely used on modern water treatment plants. But in created system the listed processes are organized to perform their functions within circulating regime of filtering and flotation flow of well aerated water inside of the technological modules of special design. This transformation provides the new status of the water treatment system. It becomes self-adjusting and self-regulating with extended ability of water purification.

The step by step illustration of admixtures removal mechanisms of treated water in this system depicted in fig. 1.

At the processes of purification fixed water volumes by means of created system, the residual concentration of i-type contaminants in treated water can be reduced to any required level. This it is because kinetics of water purification at the specified condition obeys the law of inverse exponent upon the time.

The basic mechanisms of impurities removal from water flow through the sand or other suitable filtration material are known. The coarse impurities are collected by filter's surface and have been blocking some pores inside of filtration bed. Colloidal particles are form coagulum inside the filter according phenomena of inertial and no-inertial hetero-coagulation. But in the circulating system distinguishing feature of functioning granular filter in conjunction with bubble-film extractor is the following:

Water is continuously enriched with oxygen of air in flotator unit and then directed into the space of granular filter. This initiates the reproduction of aerobic heterotrophs (biofouling) in the body of filter. As result, greater amounts of the products of microbial metabolism are discharged into the flow of water which is

treated. Most of these products are surface active substances which act as flocculants. They interact with other admixtures of water and then removed from water by means the bubble-film extraction. Due to this the concentration of initial admixtures in water becomes lower.

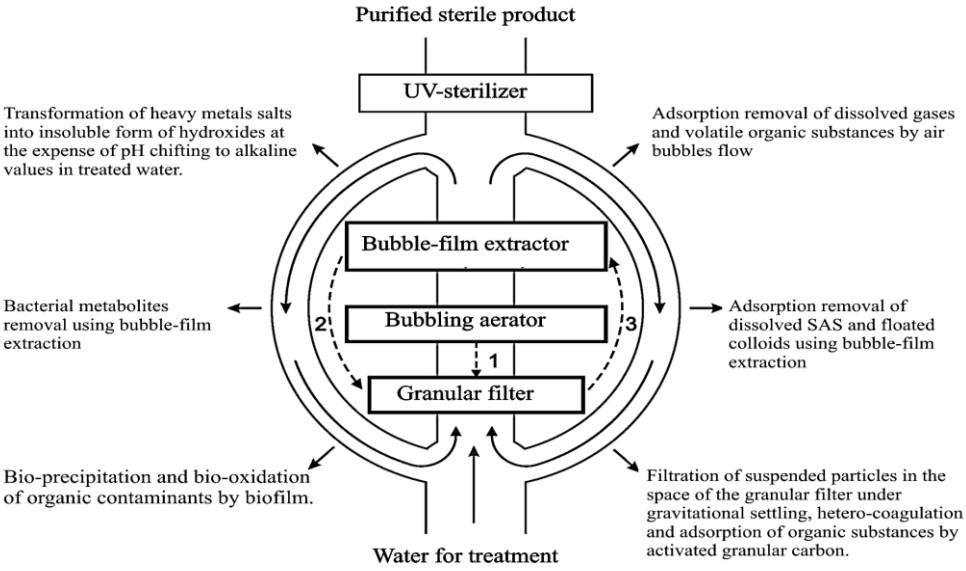

Fig. 1. Topography of the processes of impurities removal at the flow of purified water through the functional subunits (bubble-film extractor, bubbling aerator and granular filter) of created water purification system

The solid arrows show the direction of water circulation.

The dotted arrows show the resulting feedbacks.

Saturation of water with oxygen of air and synchronous withdrawal of surfactant-inhibitors of microbial metabolism through the bubble-film extractor initiates the farther growth of biomass inside the filter body. So the sand filter is transformed into the effective bio filter. As result, the positive feedbacks are realized between the functional units inside the filtration-flotation system as it shown in fig. 1. First and second feedbacks are directed from the bubble film extractor towards the filter. The third feedback is directed from the filter towards the bubble film extractor. The strength of these feedbacks depends upon the kind and age of bacterial colonies in bio fouling, and the degree of water contamination by impurities which are the nutrients for bacteria.

First of all the biofouling absorb from the water flow the organic substances that are easily decomposed by enzymes of bacterial cells. When the concentration of these substances is reduced, the biofouling digests more complex organic compounds. Due to this the concentration of biodegradable contaminants in water flow becomes lower at the filter outlet. At the same time the waste products of bio fouling, such as carbon dioxide, endogenous surfactants, and no decomposed fragments of dead bacterial cells, saturate water at the filter output. But the bubble-film extractor removes these substances from the treated water with a high efficiency.

Thus, there appears a synergy between the bio-filter and flotator (bubble-film extractor) in the closed loop flotation and filtration. By other words the bubble-film extractor and granular filter provide each other with additional water treatment possibilities, when operate in the recirculation mode. The growth of bio fouling in the

space of the granular filter initiates increasing the concentration of biosynthetic flocculants in water. Thereby occurs improving the effectiveness of bubble-film extraction. On the other hand the bubble-film extraction provides saturation the treated water by atmospheric oxygen and removal of different surface-active substances (the products of bacterial metabolism, bacterial rests, etc.).In such a way, it strengthens the operation efficiency of bio-filter.

The created system allows one to purify water from admixtures, which belong to the different classes in accordance with their dispersion degree, and nature as depicted in fig. 1.

Sterilization of water at the outlet of system can be carried out by ultraviolet light using bactericidal bulbs of suitable capacity as shown in fig. 1, or by other means.

An operational feedback mode in the described system allows qualify it like the resource-savings innovation.

At present the prospects for practical application of this system is seen in different directions. They are: purification of tap water in megalopolises, purification of rain water and melt snow water anywhere, final processing of sewage water, etc

The block- scheme of combined filtration and flotation device which implements the principle of recirculation water treatment («rotating wheel») is shown in fig. 2.

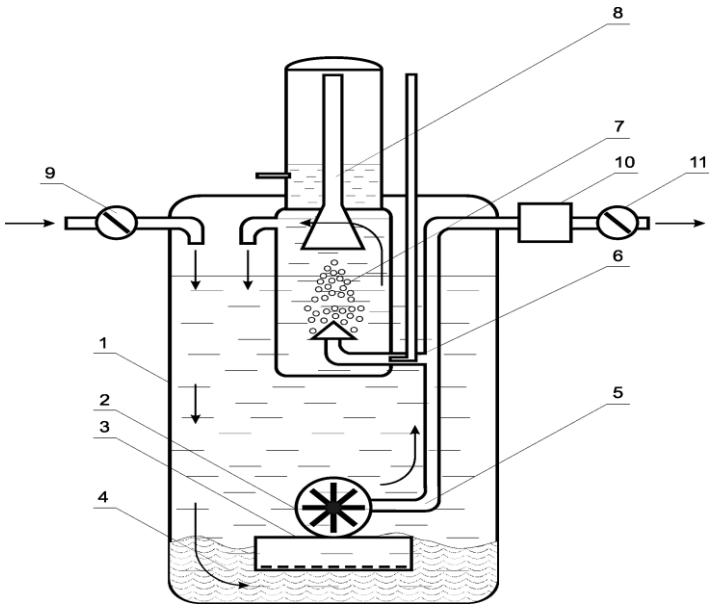

Fig. 2. The block-scheme of the circulating filtration-flotation device 1 – unit case, 2 – centrifugal pump, 3 – drainage device, 4 – sand, 5 – pump inlet line, 6 – ejector, 7 – bubbling compartment, 8 – bubble-film extractor, 9 – water inlet, 10 – UV sterilizer, 11 – water outlet

In this device the processes of filtration, bio filtration, bubble aeration (exchange absorption) and bubble-film extraction are realized in a space of unit case 1. The centrifugal pump 2 is used to ensure the circulation of treated water. The pump 2 is connected with a drainage unit 3 and generates the water flow through the space of granular filter material 4, which consists of quartz sand or mixture of quartz sand and granular mesoporous activated carbon. The discharge line 5 directs the water flow after the pump through the ejector 6 into the bubble-film extraction module. This module consists of bubbling compartment 7 and the real bubble-film extractor 8. In 6

the air is injected to form the water-air mixture, which is supplied into the bubbling compartment 7. The impurities collected at air bubbles surface are removed from the flotation space through the bubble-film extractor. And treated water enriched with oxygen in the bubbling compartment 7 then pumped through the filter. The process of filtration and flotation are repeated as long as the concentration of impurities in treated water is reduced to the required level [1, p. 108].

References:

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ВПЛИВ ЗМІН КЛІМАТУ НА ШКІДЛИВІСТЬ КОМАХ-ФІТОФАГІВ ПШЕНИЦІ ОЗИМОЇ У ЛІСОСТЕПУ УКРАЇНИ

Потепління кліматичної системи є незаперечним фактом, і починаючи з 1950-х років зміни, що реєструються, є безпрецедентними в масштабах від десятиліть до тисячоліть. Сталося потепління атмосфери і океану, запаси снігу та льоду скоротилися, рівень моря підвищився, концентрації парникових газів зросли. Глобально усереднені сукупні дані про температуру поверхні суші і океану, розраховані на основі лінійного тренду, свідчать про потепління на 0,85 [0,65-1,06] ^{0}C за період 1880-2012 рр.

Вважається, що потепління буде сприяти оптимізації екологічних чинників для комах, що призведе до збільшення їх чисельності та поширення. В умовах підвищених температур недостачу вологи комахи вимушені будуть компенсувати збільшенням ненажерливості, щоб отримувати зв’язану у харчовому субстраті вологу. Таким чином, в умовах потепління шкідливість комах-фітофагів повинна зростати [1, с. 314-334]. В цьому зв’язку обґрунтування прогнозу ризиків фітосанітарного стану посівів озимини в Лісостепу України з метою підтримання ефективності хімічних систем захисту рослин надзвичайно актуально.

Найбільш показово кліматичні ефекти будуть проявлятися в умовах Лісостепу України, яка є проміжною зоною за агроекологічним районуванням. Відомо, що в Лісостепу на посівах пшениці озимої сформувався сталий шкідливий ентомокомплекс, втрати урожаю від якого на середину XX ст. оцінювалась в 7%, що визначало доцільність хімічного захисту культури [3].