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IMPROVED FLOW SHEET OF DAIRIES WASTEWATER TREATMENT

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ABSTRACT

Purposefulness of using the improved flow sheet of dairies wastewater treatment has been substantiated. Inclusion into the scheme of a floater facilitates the dissolved organic substances removal, whose number in the wastewater has risen due to the increase of the output of fermented milk products at the dairies.The use of submerged biofilter disks as a basic structure of biological treatment promotes more intensive degradation of organic pollutants because it combines elements of traditional biofilter and aeration tanks.

ПОКРАЩЕНА ТЕХНОЛОГІЧНА КАРТА ОБРОБЛЕННЯ СТІЧНИХ ВОД МОЛОКОЗАВОДІВ

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У статті обґрунтовано доцільність використання удосконаленої технологічної схеми очищення стічних вод молокозаводів. Доведено, що включення у схему флотатора сприяє видаленню нерозчинених органічних речовин, кількість яких у стічних водах зросла у зв'язку із збільшенням випуску кисломолочної продукції на молокозаводах, а використання зануреного дискового біофільтра як основної споруди біологічного очищення сприяє інтенсивнішій деструкції органічних забруднень тому, що він має ознаки традиційного біофільтра й аеротенка.

Ключові слова: *стічна вода, молокозавод, аеробна ферментація, активний мул, біофільтр, біоплівка.*

Among European countries, Ukraine has one of the highest indicators of negative human pressure on the environment. Nowadays only some of food enterprises have local treatment plants. Usually wastewater is released into the sewerage network or water reservoirs, which subsequently pollutes the environment, and therefore can be regarded as "an environmental crime".

Dairy industry is a priority branch of food industry. Dairy factories have so serious environmental problem — wastewater, which contains insoluble and soluble organic and mineral substances.

It should be noted that wastewater of dairy factories differs in number and indicators of pollution: chemical oxygen demand (COD) is 1000 … 5000 mg O_2/dm^3, biological oxygen demand (BOD) is 700…3700 mg O_2/dm^3, total nitrogen content ranges from 20 to 170 mg /dm^3, the changes in the pH range from 4.5 to 8.5, the temperature of the flow ranges from 15 to 35 ° C. Fat content in wastewater of workshops that produce cream, butter and cheese is 200 ... 400 mg /dm^3.

The dispersed phase of total sewage waters flow of dairies contains, mostly, fats, particles of coagulated protein, organic acids, milk sugar (lactose), mass fraction of which ranges from 0.04 ... 0.25%.

The concentration of wastewater pollutants depends on the production assortment of a dairy factory. Thus, wastewater of enterprises, producing milk drinks and fermented milk products (yoghurt, kefir, boiled fermented milk, cheese mass) is lowly-concentrated (COD 1500 mg O_2/dm^3), and factories, whose main products are butter and cheese, are characterized by the formation of concentrated wastewater with COD to 5000 mg O_2/dm^3 [1].

To treat non-concentrated wastewater aerobic fermentation can be used as the main stage of biological treatment. For butter and cheese making enterprises there is no other option, than using the integrated anaerobic-aerobic treatment technology with the application of methane fermentation in the first stage of the biological degradation of contaminants. In recent years, the phase-dispersive composition of wastewater enterprises of the dairy sector has changed. This can be explained by the increasing demand for fermented-milk products, accordingly the wastewater increases the content of insoluble organic particles compared to the concentration of soluble compounds.

The increase in wastewater of the number of suspended solids led to the search of new solutions for dairies wastewater treatment, as a low level of effectiveness of initial precipitation does not solve the problem of extracting insoluble organic particles.

The existing treatment facilities of dairy factories work ineffectively because of the inadaptability of designs and biocenoses to the composition of wastewater. Thus, aerobic fermentation of sewage water causes a "swelling" of active sludge due to development of filamentous bacteria (Sphaerotilus etc.). The reasons for this phenomenon include also overloaded aerotanks with pollution, a significant carbohydrate content in wastewater, lack of air and a low pH of the environment.

In case of using high-loaded and trickling filters it can cause an intensive siltation of the load. All this leads to low efficiency of purification process.

In connection with above-mentioned disadvantages of treatment facilities it was necessary to develop the technological scheme of biological wastewater treatment of dairy factories that considers the specificity of their pollution.

The need for flotators inclusion into the technological scheme explains the possibility of decrease of BOD, COD indicators, of ammonia nitrogen in wastewater during insoluble organic particles removal as the dirty layer. Going

through the process in defoaming tanks and the separator, the dirty layer is getting dehydrated and can be fully utilized as an additive for food, as it contains valuable biologically active substances.

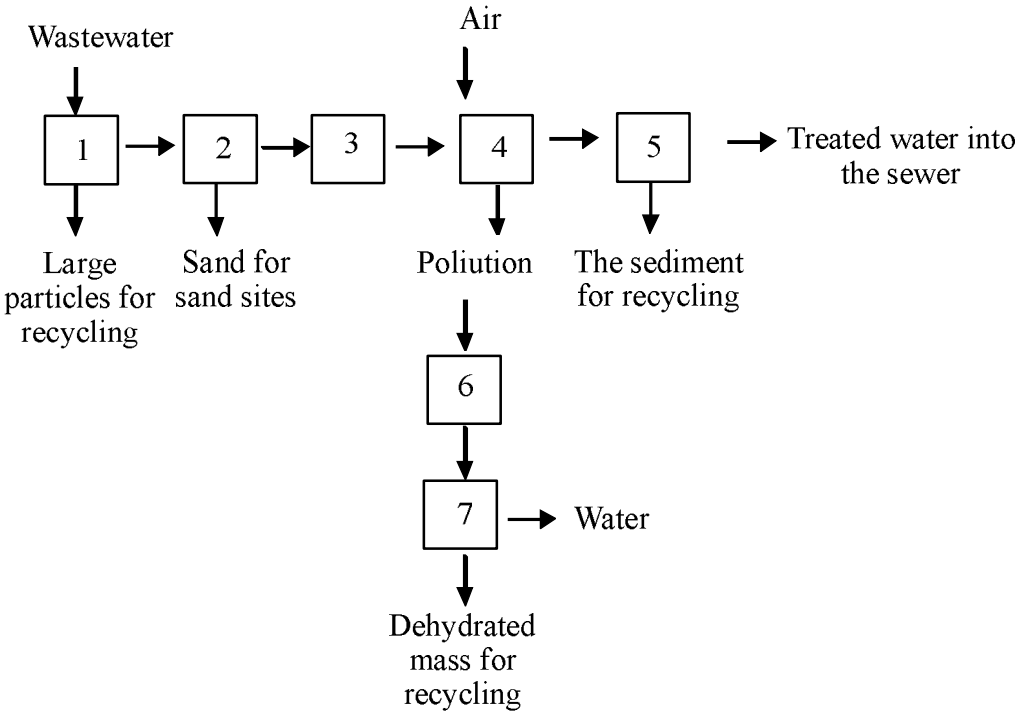

Fig.1. Technological scheme of wastewater treatment at dairy factories:1 — gratings; 2 - sandtrap; 3 - flotator; 4 — submerged biofilter; 5 — secondary settling tank; 6 — tank for defoaming; 7 - separator.

The basis of the flotation process is the attachment of polluted particles to bubbles of air, which is forcibly injected into the machine. The result is a layer of foam which is removed from the flotator. The collected foam is eventually destroyed to a liquid form, which is full of pollution — flotomass.

The efficiency of flotation depends on several factors. The most important are the probability of collision of particles with bubbles and their attachment to each other, the strength of sticking, the number and size of bubbles, matching the size of the bubble and particle, area of particles and bubbles contact, etc.

As the number of bubbles increases the distance between them and particles, decreases causing the probability of their collision. Having the same volume of gas phase in the system, the greater the total surface of bubbles is, the greater is their number and the smaller is the size of each bubble. However, it is necessary to keep in mind that the minimum size of the bubbles has to match the size of pollution particles, or otherwise a dirty layer will not rise to the surface of the liquid or the process will be very slow.

The presence of detergents in wastewater of milk processing plants that cause resistance of foam, a significant amount of fat components which are characterized by hydrophobicity, increase essentially the effectiveness of this method of treatment.

A rotating biological contactor is proposed to be installed as the basic structure of biological treatment. Similar submerged biofilters have the same features as

traditional biofilters and aerotanks. They are characterized by some advantages: compactness, low power capacity, simplicity and reliability in exploitation. In addition, they do not require large changes in the height during the movement of water, they endure salvo incomings of wastewater. In rotating biological filters silting of the spatial load construction is not intensive [2].

Rotating submerged biofilters consist of disks of diameter 1 ... 5 m which are mounted on a horizontal shaft that rotates. Disks can be made of metal, plastics, asbestos cement, textiles, their thickness is 1 ... 10 mm, the degree of immersion of disks into wastewater is 0.3 ... 0.45 diameter. On the surface of the disks organisms' biocenoses are fixed and developing, which form biofilms. When a part of the disk surface with biofilm submerges into wastewater the sorption of insoluble and soluble pollutant components on its surface occurs.

During the dise rotation the biofilm gets on the surface, due to this an intensive uptake of oxygen, the oxidation of adsorbed compounds and wastewater direction occur. A part of the biofilm breaks out from the discs surface and remains in wastewater in a suspended state like flakes of an active sludge.

Thus, the oxidation of organic pollution is carried out both by a biofilm on the surface of the biofilter discs, and by an active sludge in the wastewater flow.

Biofilm is a complex biocenosis represented by organisms of different systematic groups — bacteria, protozoa, fungi, algae, some multicellular organisms (rotifers, worms, insect larvae, water mites). The chemical composition of wastewater affects the formation of biocenoses, the concentration of organic wastewater pollution, their temperature, pH value, the amount of soluble oxygen, biofilter operating conditions, etc. The major role in the removal and oxidation of wastewater compounds is played by bacteria [3].

Preceeded by the submerged rotating biofilter the silty water gets to the secondary precipitation tank, where it is separated. The active sludge can be used as fertilizer.

Conclusion

In recent years, the phase and disperse composition of dairy factories wastewater have changed. For extracting from wastewater insoluble organic particles the use of a flotator, and for the oxidation of pollutants - a rotating biological contactor have been proposed that will give the opportunity to avoid shortcomings of the traditional treatment technologies.

Literature

1. *Лукашевич Є.А.* Розробка біотехнології очистки стічних вод і виробництва біогазу на відходах молочних заводів: автореф. дис. ... канд. техн. наук: 03.00.20 / Лукашевич Євген Анатолійович. — НУХТ. — К., 2003. — 20 с.

2. *Левандовський Л.В.* Природоохоронні технології: підруч. / Л.В. Левандовський, Н.О. Бублієнко, О.І. Семенова. — К.: РВЦ НУХТ, 2013. — 258 с.

3. *Семенова О.І.* Індикаторні організми аеробного активного мулу очисних споруд харчової промисловості / О.І. Семенова, Н.О. Бублієнко, Т.Л.

Ткаченко, О.С. Пантелеєнко // Наукові праці Національного університету харчових технологій. — 2010. — № 33. — С. 52—54.

УЛУЧШЕННАЯ ТЕХНОЛОГИЧЕСКАЯ КАРТА ОБРАБОТКИ СТОЧНЫХ ВОД МОЛОКОЗАВОДОВ

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В статье обоснована целесообразность использования усовершенствованной технологической схемы очистки сточных вод молокозаводов. Доказано, що включение в схему флотатора способствует удалению нерастворенных органических веществ, количество которых в сточных водах возросло в связи с увеличением выпуска кисломолочной продукции на молокозаводах, а использование погруженного дискового биофильтра как основного сооружения биологической очистки способствует интенсивной деструкции органических загрязнений благодаря тому, что он имеет признаки традиционного биофильтра и аэротенка.

Ключевые слова: *сточные воды, молокозавод, аэробная ферментация, активный ил, биофильтр, биопленка.*