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Рукописи статей попередньо рецензуються провідними спеціалістами відповідної галузі.

Для викладачів, наукових працівників, аспірантів, докторантів і студентів вищих навчальних закладів, керівників підприємств харчової промисловості.

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The journal was designed for professors, tutors, scientists, post-graduates, students of higher education establishments and executives of the food industry.

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INTENSIFICATION OF BIOCHEMICAL PURIFICATION OF OIL WASTEWATER PROCESS BY ACTING ON BIOCENOSIS ACTIVITY

The question of the intensification of biochemical purification of oil wastewater by using yeast autolysate has been considered. The stimulating effect of yeast autolysate on kinetics of purification process and quality of active sludge from the standpoint of the possibility of its utilization have been also studied.

Key words: *wastewater, yeast autolysate, active sludge, biochemical purification.*

Environmental protection became law by the Ukrainian constitution and its compulsory execution is one of the major tasks of this country.

Human impact on the biosphere of the Earth led to the emergence of negative phenomena that caused the degradation of ecosystems and the global ecological crisis [1].

Water is one of the most important components of the environment. It constantly interacts with soil, forest resources, with the atmospheric air and affects their quality.

Water ensures the existence of people, animals and plants. Water as a structural component, solvent and carrier of nutrients, is involved in all biochemical processes [2].

One of the categories of drains that pollutes the water is wastewater formed on board the ships and at all enterprises including food industry plants. For their purification local wastewater purification installations must be fitted.

The problem of oil wastewater purification is solved quite slowly. Until now passengers and cargo ships are not equipped with oil wastewater purification installations. Only a number of ships has imported installations of biochemical wastewater purification [4]. In some ports, there are onshore ballast water purification plants operating on the principle of sedimentation and therefore not satisfying modern requirements to the quality of purified waters. Attempts to use oil separators for separation process based on a mechanical principle have not been successful yet.

The mechanical principle of separation is unacceptable at low levels of oil in water, as the latter is in a highly emulsified and dissolved state. It is necessary to search more relevant principles. When there is quite a little oil in water it is obvious that one needs to abandon the principle of its selection, and use the principle of destruction (oxidation). To do this, chemical or biochemical methods can be used. A chemical method can not be used in practice as it causes additional pollution.

Thus, the biochemical method should be used. For purification of ship and industrial wastewater it has been already applied. The solution of this problem depends only on design and construction of sewage treatment plants. Water purification technology has been developed by the biochemistry department (NUFT) under the guidance of Professor Gennady Nikitin and a number of settings to clean the ship oil wastewater has been also constructed. In 1975 in Kiev River Port, the plant of biochemical bilge water purification first has come into operation. In PCB MDRF the floating purification plant project has

been created. According to this project in the Dnipro basin two head samples with capacity of 50 m^3 of purified water per day have been built and put into operation. Small-scale biochemical systems are being introduced too.

Constructions with created purification devices use the traditional scheme «airtank-settling tank». It is relatively large and that is significant disadvantage in conditions of industrial enterprises. It is necessary to search methods of intensification of biochemical purification process to reduce the volume of an airtank and a settling tank. There are two possible directions of intensification — improving the constructive design of installations and the acceleration of biotechnological processes.

Vital activity stimulation of active sludge by adding enzyme-containing substances is one of the known methods of intensifying the process of biochemical treatment of wastewater. However, the former studies of stimulating activity of biologically active additives with rather positive effect were not commonly used in practice under conditions of powerful urban and industrial sewage treatment plants due to their high cost price. We have used, though less efficient but more available stimulating additive — yeast extract (autolysate).

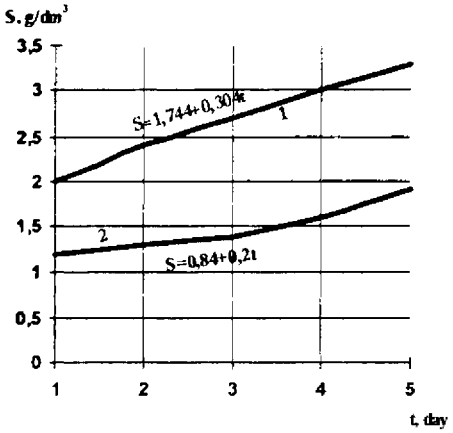

Fig. 1. **Kinetics of active sludge concentration growth (S) in the course of sludge reserve growth in experiment with yeast autolysate additives:**
1. with yeast autolysate additives;
2. without yeast autolysate additives

The objective of this research was not only to study the stimulating effect of yeast autolysate on the kinetics of oil wastewater by active sludge, but also the quality of active sludge from the point of its possibility to be utilized.

Kinetics of biochemical oxidation of oily wastewater pollution with the autolysate additives was studied by changing the mass of sludge. The results of study are shown in Fig. 1—4. The experiment was carried out at the reactor-mixer model.

The kinetics growth of sludge dry matter concentration, shown on Fig. 1, proves an increase of the growth rate of biomass with the addition of yeast autolysate by (0,304 – 0,2) / 0,2 · 100 = 528. The additive dose affects proportionally the autolysate growth of biomass. Fig. 2 and 3 show the quantitative characteristics of this influence. The experiment was to determine values of biomass concentration and its relative increase in 24 hours of growth period in the logarithmic growth phase with different doses of autolysate additives. The limiting dose was 2 sm^3/dm^3 additive, since the excess of this quantity caused worsening of treatment efficiency. The relative increase in active sludge in a control experiment, i.e. without the addition of autolysate, was 1,45 % (for one day sludge concentration has increased from 0,828 to 0,840 g/dm^3), but with the addition of 2 sm^3/dm^3 autolysate, this value amounted to 3,95 % that is, increased by 2,72 times.

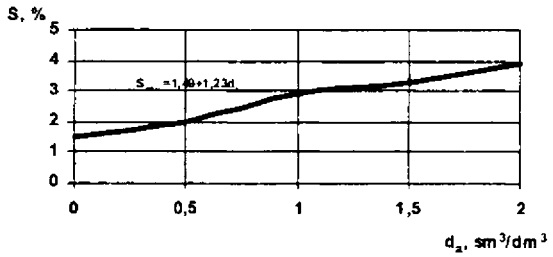

Fig. 2. **Dependence of relative increase of active sludge for a 24 h growth period upon yeast autolysate additive dose**

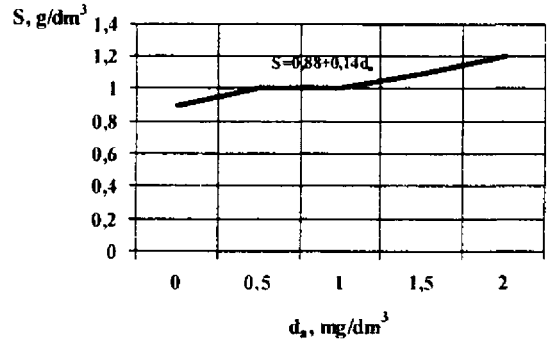

Fig. 3. **Dependence of active sludge concentration obtained in a 24 h growth period upon yeast autolysate additive dose**

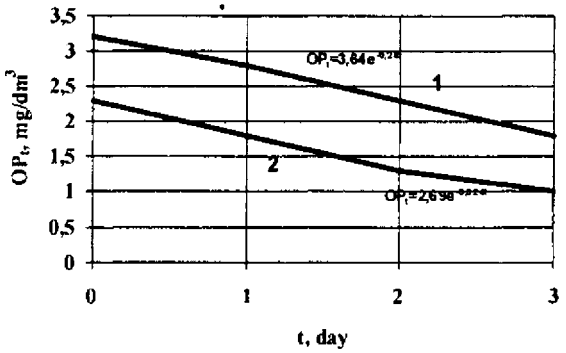

Fig. 4. **Change of oil concentration in purified water during fitting period of a 12 h aeration:**
1 — without yeast autolysate additive;
2 — with yeast autolysate additive (2 sm³/dm³)

The growth rate of the sludge concentration in the control experiment was 0,5 mg / (dm³ · h), and in the case of 2 sm³/dm³ autolysate additive — 11,7 mg / (dm³ · h), that is increased by 23,4 times. Considering extremely low quantity of organic mass in the yeast autolysate additive, even at its maximum dose of 2 sm³/dm³, such a sharp increase in the rate of biomass growth was unlikely to occur due to the increasing the intensity of the process of removal of oil by cells under intensifying effect of autolysate as a source of nutrition and biostimulator.

Catalytic role of yeast autolysate may be partially explained through enrichment of the culture medium by different groups of vitamins contained in the autolysate. We carried out the analysis of these groups, the results are shown in Table. As can be seen from these data, B group vitamins prevail in the culture medium.

Vitamin composition of yeast autolysate, active sludge and sludge-rich mixture

Name of medium	Content of vitamins, mg/dm³ according to groups					
	B_1	B_2	B_5	B_6	B_7	B_{12}
Fresh yeast autolysate	12.8	106.3	1187	15.0	1.66	3.21
Active sludge	1.1	35.0	40	1.1	0.27	1.56
Autolysate-enriched sludge mixture	11.2	35.0	125	12.5	0.50	2.34

Quantitative evaluation of the effect of yeast autolysate additive on oxidation of hard oxidized substances — oil products is presented through dependence in Fig. 4.

The exponential multiplier of the dependence of oil concentration in purified water on aeration time by adding yeast autolysate increased from 0.24 to 0.324 day^{-1}, that is by 35 %. It means that in order to obtain the given water quality through intensification process by biostimulator, flow time can be reduced by 35 %.

Stimulation of purification process using yeast autolysate as the cheapest and most available product — biostimulator, of course, has less impact on the process than the rational constructive design. However, the additional decrease of oil concentration by 11—12 % should not be neglected, moreover the application of this stimulator will not require additional equipment or make more complicated the operation of the setting. Fig. 4 shows the curves to improve the quality of purified water in terms of oil contamination index during the adjustment of the setting during a 12 h aeration period. The graph shows that by addition of yeast autolysate the rate of improvement of water quality (decrease rate of residual oil products concentration) is higher than without the addition of biostimulator.

From the point of view of the kinetics of both chemical technological processes the final concentration of sludge of the growing sludge period is the initial concentration for using in flow-through mode (2 g/dm^3).

Implementation of the method of biostimulation under production conditions can be carried out with dry soluble autolysate, prepared in spray dryers. Yeast autolysate, preserved in such a way, retains its nutritional value, its storage, preparation and dosage will not cause any difficulties and are easily carried out at purification settings.

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Интенсификация процесса биохимической очистки нефтесодержащих сточных вод путем воздействия на активность биоценоза

Рассмотрен вопрос интенсификации биохимической очистки нефтесодержащих сточных вод с помощью дрожжевого автолизата. Изучено стимулирующее влияние дрожжевого автолизата на кинетику процесса очистки и на качество активного ила с точки зрения возможности его утилизации.

Ключевые слова: *сточная вода, дрожжевой автолизат, активный ил, биохимическая очистка*

О.І. Семенова, Н.О. Бублієнко, Є.С. Смірнова, Т.О. Шилофост, А.В. Пастушенко

Інтенсифікація біохімічного очищення нафтовмісних стічних вод шляхом впливу на активність біоценозу

Розглянуто питання інтенсифікації біохімічного очищення стічних вод за допомогою дріжджового автолізату. Вивчено стимулюючий вплив дріжджового автолізату на кінетику процесу очищення і на якість активного мулу з точки зору можливості його утилізації.

Ключові слова: *стічна вода, дріжджовий автолізат, активний мул, біохімічне очищення.*

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