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CLEANING OF SEWAGES WITH USE OF PINOTENK

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Annotaion. *Utilization of hydrocarbons contained sewages is a difficult process, but possible as compared to cleaning of household flows. Oil products in sewer water are in the dissolved and emulsified condition. For the removal of such contaminations fraction it is expedient to use the process of biosorption before a bioscrubbing. The exception of oil products from effluents is expedient to carry out in pinotenk, that is a device with gas-liquid reflow. Processes of biosorption of contaminations and their partial oxidization by the organisms of active silt are taking place in pinotenk.*

Keywords: *pinotenk, bioscrubbing, biosorption, active silt.*

Introduction. Cleaning of sewages is one of main questions for today, as any branch of industry does not exists without the use of water. Next to industrial and domestic contaminations of sewages it is possible to distinguish the separate group — hydrocarbons contained flows. Contaminations of these sewages (products of oil-processing) are mainly in the soluble condition or as small including, that does not allow to apply the specific method of cleaning. There are many different methods of cleaning, and their choice depends on a concentration and content of contaminations in sewer water; from the further setting of sewages. By the most effective method for cleaning of hydrocarbons contained sewages is biological [1]. But for passing of bioscrubbing process it is necessary to apply the previous exception of oil-processing products. It can be carried out using of physical and chemical methods, namely floatation and sorption. Sorption methods consist of organic and inorganic contaminants secreting on natural and synthetic sorbents, using of ion-selective materials. Floatation is a process of molecular adhesion of contaminating substances particles to the surface of distribution of two phases: water and air, water and a hard substance. The process of cleaning of sewages from fusible substances (solvents, oil products) by using of floatation consists in formatting systems "particles of contaminations and phials of air", that emerge on a surface and are utilized [3, 4, 5, 6].

Intensification of aeration building operation for the biochemical cleaning is provided with the improvement of reactive phases contact conditions (contaminations, active silt, oxygen) with the aim of intensification of mass exchange processes and, accordingly, increase of process speed: deepening of oxidization process using of oxygen-rich air mixture or clean oxygen instead of air, acceleration of biochemical oxidization process by influence on activity of microbal cages by physical factors, for example, by the electrostatic or electrodynamic field. Certainly, the best effect can be got with using of the complex of these measures or even combination some from them depending on local conditions. Structural figuration of reactor for the biochemical oxidi-

zation of contaminations can provide the possibility of application of practically all enumerated measures on intensification of process. Providing the contact conditions of reactive phases in the foamy layers of gas-liquid counter flow with increased pressure of gas phase in the aeration camera combines with oxygen-enriched air or supplying of clean oxygen. Accepting the combined aeration building as aerotank-sump or aerotank-clarifier, where structural elements in zones of recycling stream motion are made as lamellar electrodes and with supplying them with certain potential, we get an opportunity to provide the electrostimulation of the active silt activity.

Materials and methods. The object of research is the hydrocarbons contained sewer water. Sewer water that contains oil-processing products characterized by next indexes: concentration of oil-processing products is 80 mg/dm^3, BOD — 130 мgO^2/dm^3, COD — 300 mgO^2/dm^3, hanging up substances — 125 mg/dm^3, pH — 6,9–7,3, nitrogen ammoniacal salts — 36 mg/dm^3, nitrites — 0,298 mg/dm^3, nitrates — 0,25 mg/dm^3. Correlation of biological oxygen demand (BOD) and chemical oxygen demand (COD) of these sewages is 0,43, that shows the possibility of oxidization of contaminations by the active silt organisms, although the speed of oxidization is lower than one during the cleaning of domestic sewages [2]. Therefore, we propose the combination of biosorption process, that passes in pinotenk and oxidization process with the use of hanging up layers of active silt in aerotank-clarifier.

Researches were carried out on the laboratory setting of the combined reactor that includes pinotenk and aerotank-clarifier [7, 8].

Pinotenk is a column with horizontal perforated by metallic plates, on that there is a small layer of water with a silt that is blown through by an intensive blast on the chart of counterflow. A foamy layer appears on the surface of the plates. It has the developed surface of contact between reactive phases, due to what the process of oxidization of contaminations by active silt flows with high speed. Such contacting conditions are friendly to the biosorption of the emulsified oil-processing products by the active silt, that is given by airlift from the hanging up layer of aerotank-clarifier, distributed for the surfaces of plates and contacts with contaminations of liquid and oxygen of air on all surface of contacting phases.

Pinotank as an adsorption device stipulates straight proportional dependence of efficiency of removing the oil-processing products on time of processing. This dependence in totality with reverse dependence between analogical parameters in aerotank-clarifier gives an effective line proportional dependence, but in a considerably less measure. At the same time in the block of aerotank-clarifier from pinotenk straight proportional influence of concentration of active silt on efficiency of removing oil-processing products is more expressed, than in aerotank-clarifier. It is explained by that active silt returns from aerotank-clarifier in pinotenk and is full used as an adsorbent of oil-processing products. Thus, the pre-condition that devices of biochemical oxidizationfor for cleaning of hydrocarbons contained sewages must be equipped with the device for intensification of adsorption process is confirmed. The cross-coupling sewer liquid staying time and concentration of active silt in the block of biochemical oxidization increases x4 the influence on efficiency of removing oil-processing products than with using of aerotank-clarifier. Quantitatively and physically this influence

compensates the reduction of the influence of staying time in the block of biochemical oxidization on efficiency of oil-processing products removing, caused by opposite influence of the indicated factors separately in pinotenk and aerotank-clarifier.

Results and discussion. The determinations of dissolved oxygen concentration on the different levels of pinotenk and the concentration of contaminations after BOD5 in the tests selected for the same levels were made. The results are presented on the Figure 1.

These results testify that silt mixture that goes out of pinotenk in aerotank-clarifier is practically oxigenated, and contaminations (for BOD5) in a sewer liquid are partly transferred from a liquid phase on the flakes of silt that is given by airlift from the zone of hanging up layer of aerotank- clarifier in pinotenk. No doubt, some part of contaminations that are in the soluble condition and easy oxidabled substances are used by a silt as a feed. Silt mixture that is oxigenated in pinotenk requires less time for staying in aerotank-clarifier. It explains high efficiency of sewer water cleaning with the small duration of its cleaning in aerotank-clarifier.

A hanging up layer in the aerotank-clarifier serves as a zone of division of silt-water mixture and as a reactor of oxidization. The zone of placing of laminarisators (above a hanging up layer) provides, from one side, increase of efficiency of clearing up of the cleared water, and from other — this is the main appointment, — stabilizes work of setting at dynamic violations.

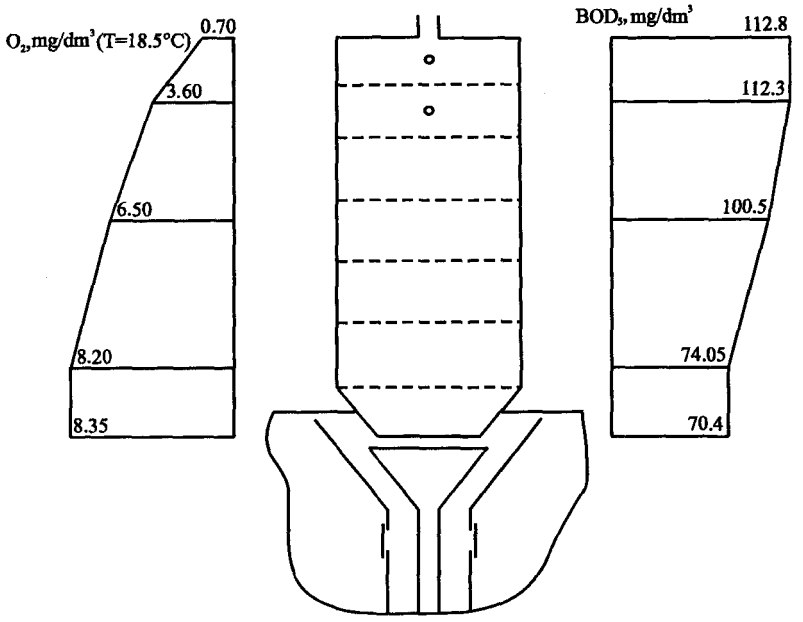

Figure 1. Distribution of concentration of O_2 and BOD_5 is on the height of pinotenk

The results of experience on determination of hanging up layer role and zone of laminarisators role in removing of dissolved, colloid and hanging up contaminations

are presented in the Table 1. Obtaining of the samples BOD5 and the concentration of hanging up substances and sampling places are presented in the Table 1.

Table 1.

The results of experience on determination of hanging up layer role and zone of laminarisators role in contaminations removing

Sampling place	With laminarisators		Without laminarisators	
	BOD_5, mgO_2/dm^3	Hanging up substances, mg/dm^3	BOD_5, mgO_2/dm^3	Hanging up substances, mg/dm^3
Zone of suspend water	32,15	40,50	32,1	40,30
Above a hanging up layer	18,55	20,00	24,3	16,20
Above laminarisator	-	13,00	-	-
Exit	-	7,3–8,7	-	-

On the plates of pinotenk the foam layer is formed. The conditions of gas-liquid counter flow provide a grinding of liquid drops in interplates space and thus develop surface contacting liquid and oxygen. Such conditions are favorable for contacting biosorption of the emulsified oil-processing products by the active silt, a silt that is given by airlift from the hanging up layer of aerotank-clarifier is distributed for the surfaces of piattis and contacts with a muddy liquid and with oxygen of air on all surface of contacting phases.

The phials of air saturate the fluid inside the aerotank-clarifier zone of aeration, at that time, as even at intensive recirculation in the degassing zone they are absent. Therefore, the zone of degassing provides the effective removing of phials from fluid, creating good conditions for further technological processes of separation and clearing up of silt-water mixture.

The concentration of suspension is observed in the lower part of laminarisators. The equable motion of these particles downward and along on plates is noticed visually.

The sharp rise of the hydraulic loading (3X) leaded the beginning of bearing-out of suspension, but destruction of hanging up layer was not observed. The bearing-out of suspension during the overload took place in that part of laminarisators that was under a collapsible tray. It is explained by some toxicity of streams in a protective zone that takes place only during considerable overloads and appropriate, to our opinion, for the small-scale installations. Normal loads could not cause the phenomena of suspensions bearing-out even in small-scale setting.

Conclusions. The obtained researches showed that the proposed technology can be successfully used for cleaning of hydrocarbons contained sewages with different origin.

Due to the use of pinotenk as first degree of cleaning in the block of biochemical oxidization, cleaning indexes get better considerably, namely efficiency of exception of oil products increased from 93,2% to 98,5%, that to our opinion, explained by the

process of biosorption, that flows in foamy layers. In addition speed of exception after oil products increased from 15,58 mg/(g per hour) to 25,25 mg/(g per hour).

References:

1. Biotreatment of oily wastewater by rhamnolipids in aerated active sludge system / H.Z.Zhang, X.W. Long, R.Y. Sha [et al.] // Journal of Zhejiang University. Science. B. — 2009. — Vol. 10, № 11. — P. 852 — 859.

2. Khalilova H. H., Mamedov M. K. Method of water purification from oil contamination. — Chemistry and technology of water, 2008. — Vol. 30. — № 3 — P. 339–344.

3. Muravyov A. G. Guidelines for the determination of water quality indicators by field methods. — St. Petersburg: Krismas, 2004. — 248.

4. Pashayan A. A.,Nesterov A. V. Analysis of existing methods for cleaning oil wastewater // The contribution of scientists and experts in nat. economy: materials of region. scientific and techn. conf. — Bryansk, 2005. — P. 74–77

5. Patent 75309 Ukraine, IPC S02F 11/02 (2006.01). Aerotank-clarifier / Semenov O. I., Tkachenko T. L., Bublienko N. O., Shylofost T. O.; the owner of the National University of Food Technologies. — № u 2012 06205; appl. 23.05.2012; publ. 26.11.2012, Bull. Number 22.

6. Shcherbinin A. M. Experimental research on biosorption sewage treatment // Herald of TGASU. — 2003. — № 2. — P. 36–42.

7. Shcherbinin A. M., Shamanayev Sh. Sh. On the Mechanism and Model of Biosorption Wastewater Treatment // Herald of TGASU, 2003. — № 2. — P. 30–36.

8. Treatment of oil wastewater / O. I. Semenova, N. O. Bublienko, T. L. Tkachenko [and others] // Scientific works NUFT, 2012, № 42, P. 53–60.