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PURIFICATION OF OIL WASTEWATER

Abstract

The given article discusses the problem of treatment of oil wastewater. It is known that the problem of oil wastewater treatment is topical nowadays, because as a result of various technical and technological processes the formed oil wastewater is not utilized properly. The article provides the information of pollution of oil wastewater which is produced by the food enterprise, and also the ways of its purification. The objective of research is the intensification of the process of biochemical treatment. Scientific novelty of the research lies in biosorbtion of oil gas-liquid countercurrent mode and oxidation in an airtank-clarifier.

Key words: oil wastewater, pinotank, airtank-mixer, airtank-claritier, biochemical purification.

I. Introduction

Nowadays the society faces an important environmental problem, the essence of which lies in the fact that development and transformation of natural resources and systems are accompanied by environmental degradation.

Every food enterprise as a result of washing equipment, car tanks, infiltration of technical oils into water produces oil wastewater.

II. Problem Setting

As oil products in wastewater are in the form of soluble or emulsified state, it does not allow to solve completely the problem of removing these contaminants from wastewater by mechanical and physical and chemical methods. Therefore, to ensure compliance with water quality standards one must develop more sophisticated methods of sewage purification from all fractions, and the most reliable of these is the utilization of dissolved and digestible fractions by biochemical purification [1].

Contaminants of oil wastewater differ from domestic wastewater pollution and contain mainly less oxidable substances. Of course, such waste needs a specific approach both to the way of its purification and to the content of treatment facilities to remove the mentioned above contaminants, especially using the cheapest and most efficient way of biochemical purification [2, 5].

We have identified key indicators of oil wastewater by food companies, and proved that they are suitable for biochemical purification, namely: the concentration of oil products is 80 mg/dm^3, BOD - 130 mgO_2/dm^3, COD - 300 mgO_2/dm^3, suspended substances - 125 mg/dm^3, pH 6.9 - 7.3, nitrogen of ammonium salts - 36 mg/dm^3, nitrites - 298 mg/dm^3, nitrates - 0.25 mg/dm^3. The problem of treatment of oil wastewater has been drawing the attention of researchers for a long time. However, the development of methods and devices for improving sewage treatment was not proper until the objective necessity and, therefore, measures for legal regulation stimulated a new wave of research in this area.

Under the strict following the biochemical treatment technology almost complete removal of oil products has been obtained that is not achieved by other known methods (mechanical, physical and chemical) [4]. Purified water meets the requirements also for other parameters (BOD, COD, suspended matter, pH, concentration of pathogenic microorganisms, etc.).

Existing settings, in which the process of biochemical treatment occurs, are distinguished by apparatus design, however, the technological features of the scheme units do not meet the level of design solutions due to the process of complete oxidation of a single stage without taking into account the peculiarities of this type of wastewater pollution. This became the main reason for lack of efficiency of oil wastewater treatment in such settings [3].

III. Results

Thus, the most promising is the further development and improvement of biochemical purification method, namely the reduction of wastewater processing time, raising the reliability and stability of buildings exploitation and increasing the purification effect by creating the flow diagrams using modifications of the process, that take into account the peculiarities of oil wastewater contamination content. All these measures are linked with the objective of the intensification of treatment process in general.

Intensification of aeration facilities exploitation for biochemical purification is carried out by improving the conditions of contact of reacting phases (impurities, activated sludge, oxygen) to improve mass-exchanging processes and thus increase the rate of the process: the deepening of oxidation by using oxygen-enriched air mixture or pure oxygen instead of air, accelerating the process of biochemical oxidation by influencing the activity of microbial cells due to physical factors such as electrostatic or electrodynamic field, and also by the instrumentation design. Of course, the greatest effect can be obtained by using a set of measures or a combination of at least some of them depending on local conditions.

We have suggested a combination of an airtank-clarifier with a pinotank to intensify the process of biochemical treatment of oil wastewater. This structure includes the first stage – a pinotank of gas-liquid countercurrent mode in which during a short time period the processes of biosorbtion are taking place, and the second stage – a clarifier of aeration, drainage and suspended layers areas, the latter of which will ensure the maintenance of sludge with sorbed contamination, where the process of oil products oxidation takes place.

To determine the benefits of the block of biochemical oxidation the research was done to identify key indicators of oil wastewater pollution removal at this setting and an airtank-mixer. Duration of treatment of wastewater is 1 and 6 hour, respectively. The results are shown in Table 1.

Table 1 Comparison of main indicators of purification of oil wastewater process in a single-stage air tank-mixer and a block of the biochemical oxidation

Ingredients of pollution and purification process parameters	Airtank-mixer			Block of biochemical oxidation		
	Incoming water	Purified water	Efficiency of treatment,%	Incoming water	Purified water	Efficiency of treatment,%
Concentration of oil products, mg/dm^3	80,0	9,23	88,50	80,0	1,16	98,55
Concentration of pollutants according to BOD, mgO_2/dm^3	130,0	22,86	82,42	130,0	17,00	86,92
Concentration of pollutants according to COD, mgO_2/dm^3	300,0	32,86	89,05	300,0	20,00	93,33
Rate of pollutants removal according to:						
Oil products, $mg / (g \cdot h)$	4,67			25,25		
BOD, $mgO_2/(g \cdot h)$	5,21			28,50		

The results given in Table 1, show the experimental confirmation of a positive impact of the pinotank on the process of impurities removal. For example, the efficiency of removal of oil products increased from 88.50% to 98.55%. In our opinion the factor that caused the raising efficiency of wastewater treatment is the pinotank itself where biosorbtion process of oil products in foam layers is taking place.

Also under investigation of the block of biochemical oxidation mode it was observed that nitrate concentration increased from 5.65 mg/dm^3 to 10 mg/dm^3, indicating the intensive process of nitrification.

IV. Conclusions

As a result of research the following parameters of wastewater treatment have been chosen. They are follows: the concentration of activated sludge and the rate of removal of impurities made it possible to obtain a high degree of purification from oil products (upto 98.55%) at low duration of wastewater treatment. The research results have showen that in the course of biochemical treatment of oil wastewater it is purposeful to remove beforehand emulsilied oil products through biosorbtion by active silt in gas-liquid countercurrent (in a pinotank). This development is of essential social and environmental significance as the removing of oil products from wastewater allows to reduce ecological stressing on the environment.

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