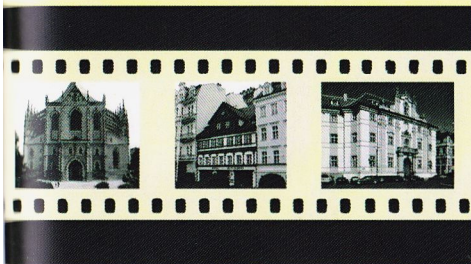




MATERIÁLY

IX MEZINÁRODNÍ VĚDECKO-PRAKTICKÁ KONFERENCE



VĚDA A TECHNOLOGIE: KROK DO BUDOUCNOSTI – 2013

27.02.2013 - 05.03.2013

Díl 23
Ekologie
Zeměpis a geologie
Chemie a chemická
technologie



Praha
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THE TREATMENT OF WASTE WATER FROM OIL HYDROCARBONS

Amongst all the wastewater categories, those which pollute water basin are mostly of crude oil refining nature. They are formed on vessels and at all enterprises, including food processing plants. Their cleaning process needs establishing of the local sewage treatment plants. Moreover, the tempos of oily wastewater treatment are very slow.

Wastewater is formed at every company, including the food industry, through equipment and automobile tanks washing and technical lubricants soaking.

Such waste water should not be mixed with other types of wastes, so they need to be cleaned separately.

This Term paper presents the results of research on the treatment of industrial wastewater from petroleum hydrocarbons.

The investigations allowed to estimate the phase pollution structure and to systemize the succession and types of processes taking place at the biochemical decomposition of oil under aerobic conditions under the influence of natural water basin microorganisms.

The following processes are taking place under these conditions: dispersion of petroleum products in water, their adsorption into suspended solids, dispersions in water, agglomeration of fractions due to coalescence and sedimentation.

Moreover, mostly all of the petroleum products fractions yield to the biochemical oxidation which, in its turn, is held with different speed [1].

As soon as the petroleum products in wastewater are in soluble form or in the form of small fractions, the problem of treatment cannot be solved in full.

That is the reason why, in order to ensure the compliance with water quality standards it is necessary to develop more sophisticated ways of wastewater treatment

from all pollution fractions, therefore, the most reliable of them is the utilization of dissolved and digestible fractions by means of biochemical oxidation.

The proper observance of biochemical treatment technology provides virtually complete removal of petroleum products, which cannot be achieved by any other known method (mechanical and physico-chemical).

Purified water meets the requirements and other parameters: BOD (Biochemical oxygen demand), COD (Chemical oxygen demand), suspended solids, pH, concentration of pathogenic bacteria etc.).

Thereby, the most promising method is the further development and improvement of biochemical treatment, eliminating of its defects, which can be achieved by means of reduced time of the wastewater processing, improving of the reliability and stability of treatment plants as well as increase of the cleaning effect by creating flow sheets using a modification of the process, taking into consideration the characteristics of the wastewater of crude oil refining nature [2].

According to the statistical treatment of the wastewater of crude oil refining nature, the pollution concentration for COD averages $300 \text{ mgO}_2/\text{dm}^3$ for BOD – $130 \text{ mgO}_2/\text{dm}^3$.

According to these data, the ratio of BOD/COD = 0.43, which indicates the possibility to characterize the pollution of this waste water category as a biochemical oxidation, however the petroleum products consumption by microorganisms is less intensive.

Regulatory quality index of oily wastewater treatment is calculated as PP concentration.

In order to adjust these parameters it is important to know which major groups of substances compose oily wastewater pollution, suggested being treated by biochemical means.

For this purpose, due to the lack of published data, we conducted an experimental calculation of oily wastewater pollution structure by means of organic matters.

The results of this investigation can be seen in Table 1.

Table 1

The results of chromatographic separation of oily waste water sample

Weigh of the sample subjected to separation, g	The hydrocarbon fractions output (in% by mass)			
	Paraffin-naphthenes	Aromatic	Resinous	Separation loss
0,2532	58,21	28,51	4,38	8,90
0,2498	58,21	28,58	4,04	9,17
0,2512	57,17	28,50	3,86	10,47
Average index	57,86	28,53	4,09	9,51

The major hydrocarbon fractions structure is as follows: paraffin-naphthenes were paraffin constitute 62%, naphthenes – 38%, 14.7% of which are monocyclic.

bicyclic constitute 14.4% and tricyclic – 8.9%; aromatic hydrocarbons consist of alkylbenzene – 23.4%, indany and terakiny – 16.4%, dinaftenbenzene – 11.7%, naphthalene – 24.1%, acenaphthene – 9.3% fluorene – 4.8% phenanthrene – 6.4% pyrene – 2.7% benzthiophene – 0.4% naphthalene-benzthiophene – 0.8%.

According to the results of mass spectrometry investigation, the petroleum products in the given waste water sample correspond the weight of petroleum paraffin or light oil fraction i. e. they can be oxidized by means of microorganisms which belong to the Rhodococcus, Pseudomonas, Micrococcus and Acinetobactergenera.

The intensification of aeration facilities for biochemical treatment is carried out by the improvement of contacting reacting phases (impurities, sludge, oxygen) in order to intensify both the mass transfer process and its speed [3].

The objects of investigation were waste water samples with the following indexes: Petroleum products concentration – 80 mg/dm³, COD – 300 mhO₂/dm³, BOD – 130 mhO₂/dm³, suspended matter – 125 mg/dm³, pH 6.9 – 7.3, nitrogen ammonium salts – 36 mg/dm³, nitrites – 0.298 mg/dm³, nitrates – 0.25 mg/dm³.

The speed of biochemical oxidation of contaminants was measured in order to estimate the opportunities of hardware design process.

Since the amount of pollutants in waste water which are oxidized by means of adapted activated sludge is proportional to the amount of oxygen used in the activated sludge process of oxidation (metabolism), the maximum speed of pollutants' biochemical oxidation process was expressed by the maximum speed of oxygen usage, which was measured by a portable measuring device the Oxi 330i that investigates the dissolved oxygen in the water.

Table 2 presents the investigation data on intensity of oxygen consumption by sludge mixture via Oxi 330i.

Table 2

The data of experimental investigation on intensity of oxygen consumption by sludge mixture via Oxi 330i.

Time, min	The decrease of oxygen concentration in samples measured in mg/dm ³ /min within discrete stretch of time (20 min) in the presence of petroleum products concentration (mg/dm ³)			
	Without adding PP	40	60	80
0	0,0435	0,064	0,244	0,151
20	0,085	0,140	0,460	0,426
40	0,125	0,225	0,730	0,675
60	0,186	0,315	0,880	0,915
80	0,205	0,360	1,070	1,102
100	0,215	0,420	1,315	1,252
120	0,250	0,515	-	-

As it can be seen from the Table 2, the more NP concentration is, the more is speed of the process, but when the concentration is 60 ... 80mg/dm³ the increase is inconsiderable.

The possibility of biochemical treatment of oily waste water and its main parameters were investigated by means of reactor-mixer.

The main parameters of waste water biochemical treatment technology were determined. The main parameters of contaminants removal process which are carried out by means of in aeration facilities are the speed of the removal process, oxygen consumption and the adapted activated sludge increase.

The speed of the removal process is measured in BOC (biochemical oxygen consumption), the unit of ash-free matter of activated sludge that is removed within the unit of time (mg/hour).

These parameters are under the influence of the ability to subside, which is measured in sludge index – capacity (cm³). The capacity takes 1 g of sludge after 30 min sedimentation in measuring cylinder.

The level of sludge activity was taken as the main biochemical characteristic that is expressed through DHO (dehydrogenase) activity.

The DHO (dehydrogenase) activity is defined by the concentration of formazan which is created as the result of chemical reaction between sludge and tritanetetrazoles chloride (TTC).

In such a way the concentration of formazan is represented as ratio of formazan to ash-free matter of activated sludge.

The methods of ether-soluble substances and hydrocarbons calculation were used for the determination of waste water quantitative structure

During the perpetual work of the cleaning facility within the 12 hours of aeration length in running mode, the contaminants' concentration according to BOC₅ during three dubbed working cycles reduced from 130 to 22,86 mgO₂/dm³ i.e. by 82,42% which shows the incomplete biochemical treatment.

The approximation of hyperbolic functions data by means of the smallest quadrates testifies the limiting quality of purified water according to COD (chemical oxygen consumption) – 32,86mhO₂/dm³ and the highest possible efficiency according to COD – 89,05% (with COC average index 300 mgO₂/dm³); according to petroleum products – 88,5 %, with the highest possible contents of petroleum products in purified water – 1,4mg/dm³.

Although the cleaning efficiency according to BOC₅ and COD does not comply with the complete biochemical purification process, the efficiency of petroleum products removal appeared to be high enough [4].

As it can be seen from the investigation, the highly oxidized substances of contaminants are removed relatively quickly within a single-stage treatment in a simple reactor-mixer, but their small number makes it impossible to get a high cleaning efficiency through the hardly oxidized substances existent in oily wastewater.

The increase of contaminant removal efficiency for COD during biomass growth probably indicates the presence of sorption processes by which activated sludge removes the hardly oxidized, emulsified and coarse impurities.

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