PROTECTION OF LABOR AND ENVIRONMENT

Upgrading of technology of absorptive cleaning of oily wastewaters

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Oily wastewater treatment technology is improved through the improvement of the absorptive properties of sorbents based on plant waste. The cost of flowsheets for treatment of wastewaters contaminated with oil products is presented.

Almost all enterprises of oil and gas complex face the problems connected with the cleaning of oily wastewaters. The State International airport (SIA) “Kyiv” (Zhulyany)of oil products is not an exception. Old and nonefficient cleaning equipment does not provide the cleaning of wastewaters to the alarm concentration 0,05 mg/l [1] (Table 1).

Efficience of wastewaters cleaning by the treatment facilities of the airport

Table 1

Before cleaning mg/l	After cleaning mg/l	Level of cleaning, Y, %	Alarm concentration, mg/l
1,880	0,592	68,5	0,05

In general case during the selection of cleaning technology of particular wastewater the determinatinfactors are the consumption of wastewater, outlet concentration of oil products and concomitant contaminations, demands for the quality of cleaned water on all contaminations which are regulated. It is worth to note the oily wastewaters undergo changes from the place of formation to the place of treatment facilities which significantly worthens and complicates the treatment process. Thus, depending the demands of qualy of treated water as well as the whole row of technical and economic indicators the technologic system of treatment can be chosen, which base is the mechanic treatment. During the development of flowsheet except the polycomponent composition wastewaters it is worth to consider phase disperse state and level of aggregare resistance of oil products. During the selection of technical system it is worth to avoid the using of intermediate transferring of oily wastewaters to prevent additional emulsification of oil products. Therefore the using of free-flow treatment systems is more rational.

The aim of our scientific researches is the upgrading of treatment technology of oily wastewaters with use of sorbents on the base of plant raw material at the example SIA “Kyiv” Zhulyany.

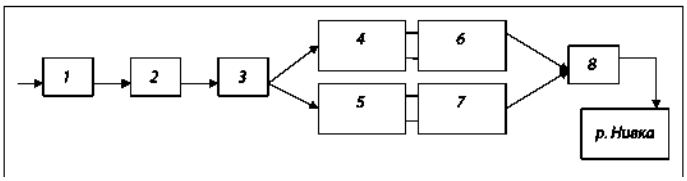


Fig.1. Upgraded flowsheet of treatment facilities SIA “Kyiv”:

1 – sand-catchers; *2* – clarifiers of hung substances (silt);

3 – oil-catchers; *4*, *5*, *6*, *7* – pools for additional cleaning of oil products by sorbent on the base of sawdust; *8* – collector

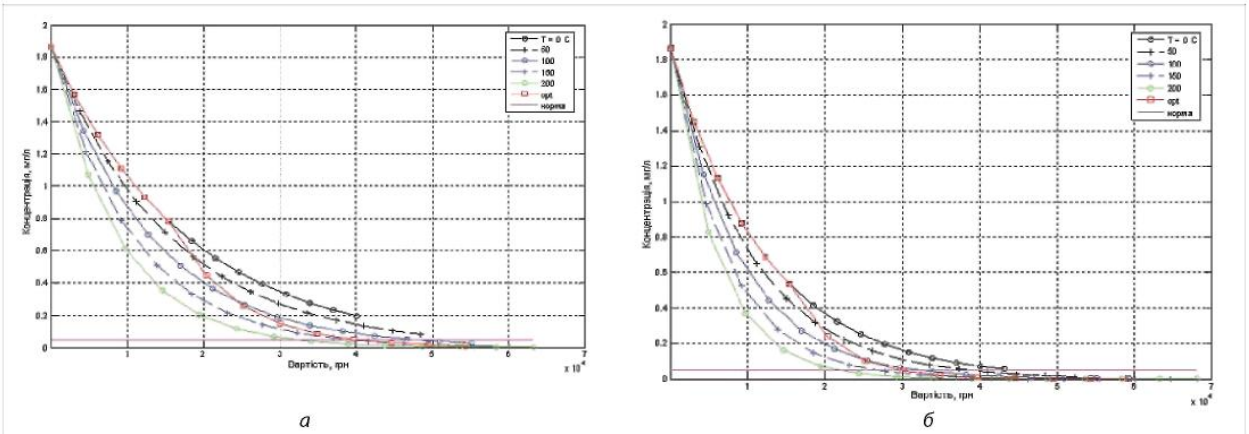
Reliable and qualitative treatment of oily wastewaters is possible only while the realization of multistage flowsheets of removing of oil products.

On the base of results of the performed complex researches [2–4] we proposed the upgrading of treatment technology of wastewaters contaminated with oil products. The proposed technologic system must be composed of three stages (Fig.1). At the first stage the mechanical treatment is provided in the case of high concentration of oil products (classic sand-catchers (1), clarifiers (2) and oil-catchers (3)), at medium concentration – depth treatment by non-treated apsorptive materials of vegetable matter (which are wastes nowadays) – sawdust or sunflower peeling (pools 4 and 5) (tab. 2) and at third – with treated at the temperature 200 °(pools 6 and 7) (tab. 3). For the thermal treatment of sorbents on the base of vegetable raw in the laboratory conditions the chamber laboratory electric oven was used CHOJI 7,2/1100; in the industrial conditions system SNOL 2250/500.

Table 2

Efficiency of treatment of oily wastewaters by untreated sawdust and sunflower peeling

Sorbent	Before tretment, mg/l	After treatment, mg/l	Level of treatment
Sawdust	1,880	1,720	8,5
Sunflower peeling		1,516	19,4



а *б*

Fig. 2.Expenses for treatment of contaminated wastewaters to the alarm concentration by the treated under different temperature modes under the technologic scheme 4: a - sawdust *б* – sunflower feeling

Table 3 Efficiency of oily wastewaters by sorbents on the base of sawdust and sunflower peeling

Fraction size, mm	Treatment parameters		Outlet of sorbent B, %	After treatment mg/l	Degree of treatment *Y*, %
	Time offfect, min	temperature *T*, ºC			
1–3	20	200	89,5	0,932	50,4
Sunflower peeling					
10	20	200	87,6	0,812	56,8

Applying of sandcatchers provide the initial detachment of suspended substances of mineral origin as a result of gravitation power. Then wastewaters go to clarifiers where the main part of

organic hung substances are settled to the bottom. At the last stage of the mechanical treatment the deparation of water and oil occurs in oil catchers because if the difference of their density.

Deep cleaning (to the value HF) of wastewater is provided with the applying of sorptive materials of vegetable matter, in particular the pools with the sawdust for example.

The technical and economic calculation of the cost of treatment process of oily wastewaters gave us an opportunity to find out that it is advantageous to use 5 layers (65 cm) of untreated sorptive materials of vegentable matter and 5 layers (65 cm) – treated ones at the temperature 200˚C. Consequently 5 layers of untreated sawdust are filled up to 4 and 5 pools and 5 layers of treated one – to 6 and 7 pools (see fig.1)

After the passing of oily water with the volume 165,5 м^3 per year through the untreated sawdust (4 and 5) the concentration of oil products in it decreases twice (fig. 2,a). The ability to soak up the sorbent fully is not lost (tab.4) therefore the replacement of sorbent in the pools can be done once per a year that decreases the necessary volumes of sorbent. The frequency of change of sorbent is defined at the base of control of concentration of oil products in wastewaters after the passinf through the pools 4 and 5; 6 and 7. To ensure the uninterrupted process of treatment of polluted wastes we proposed to place the pools 4,6 and 5,7 in the parallel way (see fig. 1.)

If it is necessary to change the waste sorbent, for example, in pools 4 and 6, consequently the pools 5 and 7 will be able to work and ensure the necessary treatment.

Table 4 Efficiency of treatment by untreated and thermally treated sawdust after the repeat using

Before treatment mg/l	After treatment, mg/l		Degree of treatment *Y*, %	
	untreated (20 °C)	treated (200 °C)	untreated (20 °C)	treated (200 °C)
1,880	1,683	0,932	10,5	50,4
	1,743	1,100	7,3	41,5
	1,872	1,312	0,4	30,2

Below in tab.5 there is the comparison analysis (according the cost) of five proposed flowsheets.

The flowsheet 4 is the optimum because the cost of treatment process is the smallest and amounts to 39 600 and 29 800 hryvnas for sawdust and sunflower peeling respectively. The quantity of sorbent layers used at this is 10 id est as it was said above is composed of 5 layers of untreated raw and 5 – treated at the temperature 200 ºC.

The nomogram diagrams were built for comparison of five proposed flowsheets of treatment as for the cost of the process (see fig. 2) which reflect the changes of oil products concentrations in wastewaters of the volume 165,5 м^3 (annual consumption of the airport) depending the put means (in coordinates: concentration-cost) at different temperature of processing of sorbent for all abovenamed technological treatment systems. The points on the graphics show the corresponding achieved meaning of concentration and expenses during passing of oily wastes through each layer of the sorbent with the height 13 m to the reaching of meaning HF of oil products in wastewaters 0,05 mg/l, which is indicated on the figures with the line of crimson color. The points of crossing of curves of concentration of oil products with this line on the scale of abscisses correspond the cost of indicated technologies.

The search of optimum technology of cleaning of wastewaters on the given nomogram diagrams of reducing of concentration of oil products with corresponding expenses for different conditions of temperature processing of sorbent is the typical task of the dynamic programming which consider the process of consequent Choice of sorbent layers with different thermic treatment to minimize the general value and cost spent for the technological process. As the

calculations show the best variant for all presented flowsheets is when the sawdust processed thermally is filled up into all pools. But the process of thermal treatment is rather labor intensive and there is the flowsheet when the general expenses are somewhat bigger but the volume of thermally treated sawdust is half less. At this flowsheet the first pools are filled with the untreated sawdust and the other – with the treated one. This variant is shown with red color on Fig.2. It is also worth to note that increasing the expenses for thermal treatment relative to the expenses for untreated sawdust this variant of the technology will be the optimum.

Table 5 Cost of flowsheets of wastewaters contaminated with oil products

№ of technologicaL VARIANT	Flowsheet	Expenses, hr. 5(20 °C)+ 5(200 °C) layers: sawdust	Expenses, hr. 5(20 °C)+ 5(200 °C) layers: Sunflower peeling	Including the expenses for thermal treatment of sawdust , sunflower peeling %	Expenses for treatment bu non thermally treated sawdust, hr.	Including expenses for thermal treatment of sawdust, %	Expenses for treatment bu thermally treated sawdust, hr.	Including expenses for thermal treatment %
1	Without cost of sorbent utilization	43 100	30 800	54/52	52 200	0	40 300	58
2	Without cost of sorbent *	58 700	43 200	40/37	84 150	0	50 500	46
3	All expanses	84 100	63 500	28/25	136 400	0	67 300	35
4	Without cost of sorbent, with change of thermally treated sorbent, once/year	39 600	29 800	29/27	63 100	0	32 000	37
5	All expanses and change of thermally treated sorbent, once/year	58 600	45 000	20/18	102 300	0	44 600	26

* At the most enterprises of woodworking industry the sawdust is the free material, only its transportation demands the expanses.

Therefore to reach the meanings HF for oil products (0,05 mg/l) the using of 10 layers of sorbent is the optimal: 5 layers of untreated raw and 5 layers of raw treated at the temperature 200 ºC (point of crossing of the optimum curve indicated by red color and the line of alarm norm which is depicted with crimson color and placed parallelly of the axis of abcsisses).

The alternative to the using of 10 layaers of the sorbent at the base of sawdust and sunflower peeling is the using of 21 layers of untreated vegetable wastes or 7 layers treated at the temperature 200 °C, to reach the meaning of GDK of oil products in wastewaters.

Today the question of the utilization and regeneration of waste sorptive materials is not fully studied. Such materials after the dehydration as a rule are gone out to the polygons of industrial wastes which is not grounded economically.

Regeneration of sorbents at the base of vegetable raw by chemical methods is not advantageous because demands the consumption of large quantity of reagents and also becomes the problem of the further wastes which appeared. Concerning this the thermal treatment of sorbents with residual content of oil products is interesting. The utilization of wasted sorbents was made by means of burning in the stationary boiler-room on the territory of the factory 410-ЦА,. located at the distance not more than 2 km from the ttreatment facilities of the airport. Gas analyzer used for the control of the products of the burning did not fix the values over the norms. To prevent the pollution the atmosphere the using of thermic and catalytic processes and polymer components. But this aspect of the problem demands the further additional researches.

The proposed flowsheet can be taken as the basis for the development of the schemes of treatment of oily wastewaters of many enterprises of oil branch.

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