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Treatment of Industrial Wastewater with Activated Samples Based on Defecate and Bentonite

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ABSTRACT: This article presents the results of the quantitative and qualitative indicators of waste water of the industrial enterprise "Navoielektrokimyo" JS. The studied wastewater has a high concentration of dissolved salts and solids. Laboratory tests were conducted for wastewater treatment using samples activated by heat treatment based on defect and bentonite.

KEYWORDS: defect, bentonite, waste water, purification, pH, turbidity, degree of frequency, modification, roasting.

I. INTRODUCTION

The problem of deep purification of industrial wastewater contaminated with various substances is one of the most important from the point of view of environmental protection. Adsorption is a multi-purpose purification method that allows for almost complete removal of impurities from a liquid medium. Adsorption purification is effective in all concentration ranges of dissolved pollutants, especially at low pollutant contents. It is known that in order to extract pollutants of various natures from wastewater, bentonite sorbents must have a developed specific surface area with a micro and mesoporous structure. Scientific principles for selecting organophilic bentonites for adsorption purification have not yet been created. Therefore, before developing new adsorbents, it is necessary to study in more detail the structure and properties of the starting materials [1-3].

Bentonite is a natural clay mineral, hydroaluminosilicate, which has the property of swelling when hydrated (14-16 times). In a confined space, when it swells freely in the presence of water, a dense gel is formed, preventing further penetration of moisture. This property, as well as non-toxicity and chemical resistance, makes it indispensable in industrial production, construction and many other areas of application [4-6].

II. SIGNIFICANCE OF THE SYSTEM

This article presents the results of the quantitative and qualitative indicators of waste water of the industrial enterprise "Navoielektrokimyo" JS. The study of methodology is explained in section III, section IV covers the experimental results of the study, and section V discusses the future study and conclusion.

III. METHODOLOGY

Naturally occurring bentonites usually have a pH of 6-9.5 (for a 5% aqueous suspension after settling for 1 hour) and contain less than 2% sodium carbonate; the total content of interchangeable sodium and calcium does not exceed 80 me/100 g. There are two types of bentonites:

- calcium, with a low degree of swelling;
- sodium, with a high degree of swelling (swelling rate less than 7 ml/g or more than 12 ml/g).

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Some naturally occurring bentonites may have characteristics different from these values; where this is the case, the bentonite is generally considered to be activated.

For the purpose of a detailed study of the mineralogical composition of the samples and the effect of modification on their properties, methods of X-ray diffraction, thermogravimetric and electron microscopic analyzes were chosen (Fig. 1-3).

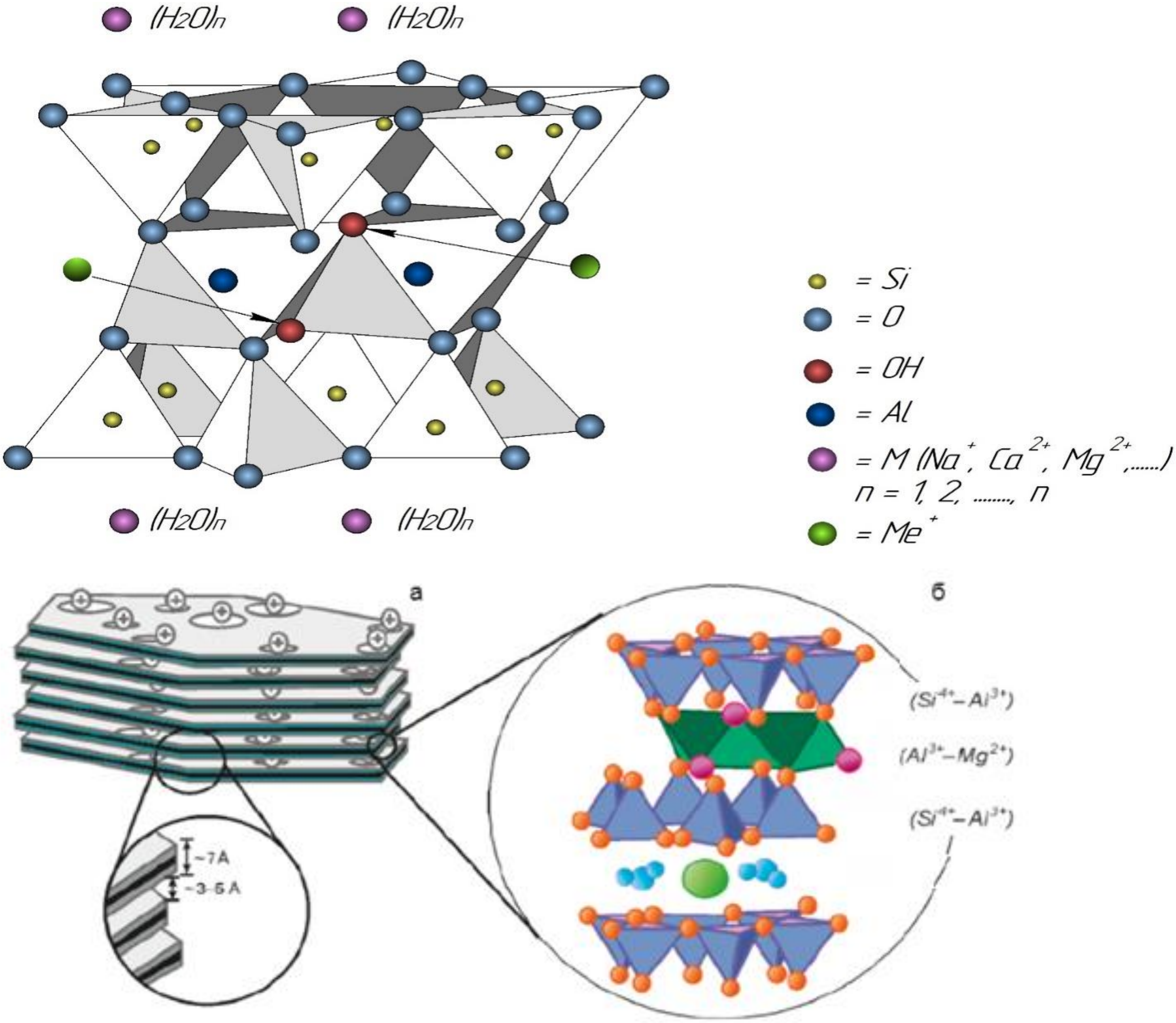

Fig. 1 Schematic structure of a bentonite particle with localization of negative charges on the surface of the layer (a) and the structure of the smectite layer (b). with demonstration of sorption centers.

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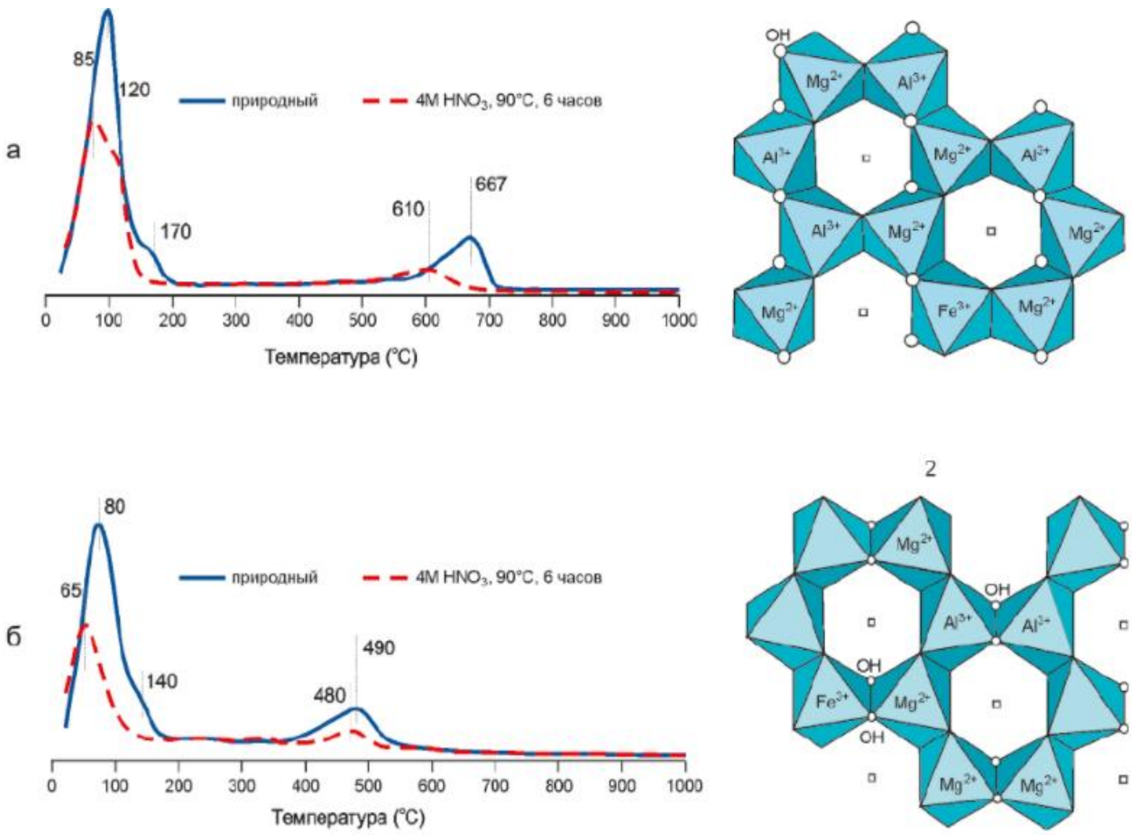

Fig. 2. Results of thermogravimetric analysis for (a) cis-vacant and (b) trans-vacant bentonites. The insets show models of orientation of OH groups in the octahedral network according to the cis motif (1) and trans motif (2).

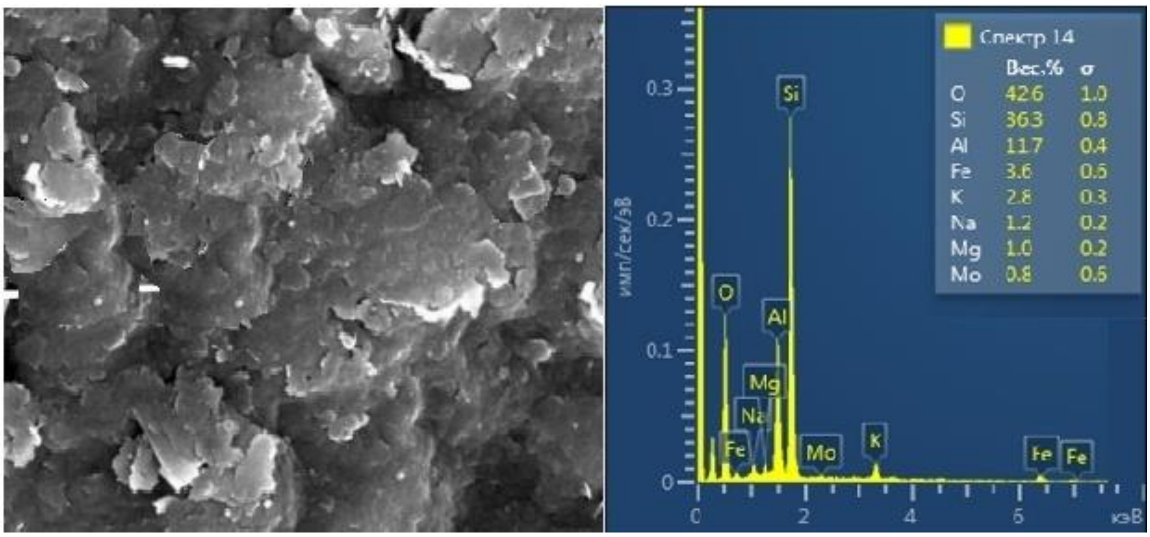

Fig. 3. Electron microscopic image of bentonite

It is clear from the figures that, due to the presence of active centers, bentonite exhibits sorption activity, and an electron microscopic image demonstrates its porosity.

Chemical analysis of fine clay fractions was carried out according to GOST 21216-2014, according to which the weight percentages of SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MgO, MnO, CaO, Na_2O, K_2O and P_2O_5 are determined. From the chemical analysis data, it follows that the bentonite clay under study is rich in alkali metal ions. The table also provides data on the chemical composition of Krantaus (KR) and Navbakhor alkali bentonite (NAB).

Based on the results of chemical analysis of bentonite clays, it became known that the studied samples differ in the content of main oxides.

The structural structure and chemical composition of bentonite has shown that, due to its composition, it can enter into the following reactions with ions of alkali and heavy and rare metals:

$$Al_2[Si_4O_{10}](OH)_3 + Ca^{+2} \rightarrow Ca_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Fe^{2+} \rightarrow Fe_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Ni^{2+} \rightarrow Ni_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Co^{+2} \rightarrow Co_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Mg^{+2} \rightarrow Mg_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Ba^{+2} \rightarrow Ba_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Cu^{+2} \rightarrow Cu_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Mo^{+2} \rightarrow Mo_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$
$$Al_2[Si_4O_{10}](OH)_3 + Mn^{+2} \rightarrow Mn_2[Si_4O_{10}]\downarrow + Al(OH)_3\downarrow$$

The results obtained regarding the structure of bentonites confirm the existing idea of a continuous arrangement of structural units with intermediate space containing exchangeable cations and water molecules associated with functional groups of the monotmorillonite lattice inside - the presence of functional groups with hydrogen bonds of varying intensity [7-12].

Thus, methods for treating industrial wastewater are very diverse. However, the use of any one treatment method, due to the complex multicomponent composition of wastewater, will not be enough. Therefore, it seems advisable to carry out multi-stage wastewater treatment, where the final stage is adsorption treatment, characterized by high efficiency, simple technological design, and the use of available and fairly cheap reagents.

From the literature it is clear that defecate can be used as an adsorbent for the treatment of wastewater contaminated with industrial waste. Based on the above, this work studied the influence of thermally processed defecate and bentonite on the degree of wastewater purification from polluting ions.

Determinations of color index, suspended solids content, anions, cations and other indicators of water were carried out in accordance with approved methods. The chemical composition of wastewater was determined: Na^+ and K^+ cations - by flame photometry, NH^{4+}, NO^{2-}, Fe^{2+} - by spectrophotometer (SF-26), Ca^{2+} and Mg^{2+} - by complexometric titration, CO_3^{2-}, HCO_3^- - by titrimetric titration with Trilon B, SO_4^{2-}- ions and dry residue - by the gravimetric method, pH - by measurement on an EV-74 pH meter, NO3- - by a potentiometric method, on an EV-74 ion meter [13-16].

IV. EXPERIMENTAL RESULTS

In the first stage of the work, the quantitative and qualitative characteristics of wastewater from the Navoi electrochemical enterprise were determined. The initial parameters of wastewater (selected from the combined sewer of enterprises) are given in Tables 1 – 2. In table Table 1 shows the results of mass spectrometric analysis (ICP–MS) of wastewater, as well as the maximum permissible concentration of industrial waters for comparison. As can be seen from the tables, in wastewater the content of Ca^{+2} – 220 mg/l, Mg^{+2} – 152 mg/l, NH^{4+} ions is 60 mg/l; Cu – 26 mg/l, Fe – 116 mg/l, Ni – 58 mg/l, As – 0.84 mg/l; Se – 1.1 mg/l; Sr – 3.95 mg/l; SO_4^{2-} -1017 mg/l; Cl^-- 452 mg/l; NO^{3-} - 230 mg/l. And the dry residue is 3700 mg/l. This suggests that this wastewater has a complex chemical composition, for the purification of which it is necessary to use a multifunctional adsorbent.

To do this, we activated samples based on defecate and bentonite in different mass ratios at 400 – 650 ºC. The obtained samples were used for wastewater treatment, the results of which are shown in Tables 3 and 4. Since samples based on defecate and bentonite contain organic impurities, heat treatment leads to the combustion of organic substances not to the final products - NO_2, H_2O, CO_2, but only to the stage of charring and the formation of carbon particles deposited on the surface of $CaCO_3$, at which it is obtained modified sample with high adsorption properties.

Table 1
Results of mass spectrometric analysis of wastewater (mg/l).

Elements	Wastewater	MPC
Be	0,00028	0,0002
Al	0,058	0,5

Mn	0,83	0,1
Ni	58,00	0,1
Cu	26,00	1,0
Zn	0,048	1,0
As	0,84	0,05
Se	1,1	0,01
Sr	3,95	7,0
Mo	2,8	0,25
Cd	0,00085	0,001
Hg	0,000072	0,0005
Pb	0,00013	0,03

Table 2
Results of analyzes and tests of tailings pond water

Cations	**Content per liter**			**Other indicators**	
	mg/l	**mg-ekv/l**	**%-ekv/l**		
Na^+	520	22,62	46	Hardness mkv/l: total	23,50
K^+				Carbonate	11,80
NH_4^+	60	3,33	7	Non-carbonate	11,70
Ca^{2+}	220	11,00	22	pH	7,80
Mg^{2+}	152	12,50	25	CO_2 free mg/l	110
Fe^{3+}	<0,3			CO_2 agr mg/l	нет
Fe^{2+}	<0,3			SiO_2 mg/l	24
total	952	49,45	100	oxidation O_2 mg/l	7,50
				H_2S mg/l	102,0
Anions				Dry residue: mg/l	
				Experimental.	3700
				Calculated	3035
Cl^-	452	12,75	26	**Physical properties**	
SO_4^{2-}	1017	21,19	43	Transparency	dim
NO_2^-	<0,01	-	-	Taste	Very salty
NO_3^-	230	3,71	7	Color	green
CO_3^-	Нет	-	-	Smell	smell of sulfur
HCO_2^-	720	11,80	24	Sediment	650 mg/l
total	2419	49,45	100		

Table 1
Results of mass spectrometric analysis of wastewater treated with samples based on activated defecate and bentonite (mg/l)

Elements	**Treated wastewater**	**MPC**
Be	0,00005	0,0002
Al	0,0053	0,5
Mn	0,053	0,1
Ni	1,41	0,1
Cu	1,38	1,0
Zn	0,006	1,0
As	0,12	0,05
Se	0,18	0,01

Sr	0,95	7,0
Mo	0,19	0,25
Cd	0,00025	0,001
Hg	0,000031	0,0005
Pb	0,00001	0,03

Table 3

Results of analyzes and tests of wastewater treated with samples based on activated defecate and bentonite

Cations	**Content per liter**			**Other indicators**	
	mg/l	**mg-ekv/l**	**%-ekv/l**		
Na^{+}	192,4	8,3694	11	Hardness mg-ekv/l: total	8,620
K^{+}	18,5	0,4736	2	Carbonate	3,90
NH_4^{+}	22,2	1,2321	6	Non-carbonate	3,10
Ca^{2+}	81,4	4,07	23	pH	7,40
Mg^{2+}	56,24	4,625	58	CO_2 free mg/l	29
Fe^{3+}	0,3			CO_2 agr mg/l	no
Fe^{2+}	0,3			SiO_2 mg/l	9
total		18,77	100	**Dry residue: mg/l**	
anions				Experimental.	1213
				Calculated	1158
Cl^{-}	167,24	4,0675	22	**Physical properties**	
SO_4^{2-}	447,31	10,5668	56	Transparency	Transparent after filtering
NO_2^{-}	0,0037	0	0	Taste	Very salty
NO_3^{-}	52,54	0,8473	5	Color	No color
CO_3^{-}	0	0	0	Smell	Without smell
HCO_2^{-}	200,91	3,293	17	Sediment	Sediment forms when standing
total		18,77	100	Weigh it. substances, mg/l	300

Bathing time in the republic in production conditions, water is a vital resource, saving it and returning it to the cycle is an urgent problem.

From Table 3 it can be seen that it is possible to purify industrial wastewater to MPC standards.

It has been established that the modified defect obtained at 650 ºC purifies industrial wastewater until it is environmentally friendly and this water can be used for the technical needs of the plant

V. CONCLUSION AND FUTURE WORK

The results of the studies showed that for a number of indicators it was possible to achieve an effective reduction in the content of pollutants, the residual concentrations of which will satisfy the requirements of industrial waters. For example: if the initial wastewater of a tailings pond contains Mn elements of – 0.83 mg/l; Cu – 26 mg/l, Fe – 116 mg/l, Ni – 58 mg/l, As – 0.84 mg/l; Se – 1.1 mg/l; Sr – 3.95 mg/l then after treatment with thermally processed defecate, their content in water decreased to Mn – 0.53 mg/l; Ni – 1.41 mg/l; Cu – 1.38 mg/l; As – 0.12 mg/l; Se – 0.18 mg/l; Sr – 0.95 mg/l, i.e. the degree of purification for these elements lies in the range of 75 – 85%.

Thus, the study showed that the use of modified defecate significantly reduces the content of heavy metals in wastewater.

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REFERENCES

1. Daifa M., Shmoeli E., Domb A. J. Enhanced flocculation activity of polyacrylamide-based flocculant for purification of industrial wastewater //Polymers for Advanced Technologies. – 2019. – T. 30. – №. 10. – C. 2636-2646.
2. Sturchio N. C. et al. Lead adsorption at the calcite-water interface: Synchrotron X-ray standing wave and X-ray reflectivity studies //Geochimica et Cosmochimica Acta. – 1997. – T. 61. – №. 2. – C. 251-263.
3. Garcıa-Sánchez A., Alvarez-Ayuso E. Sorption of Zn, Cd and Cr on calcite. Application to purification of industrial wastewaters //Minerals Engineering. – 2002. – T. 15. – №. 7. – C. 539-547.
4. Shamsan A. et al. Performance of a variety of treatment processes to purify wastewater in the food industry //Current Chemistry Letters. – 2023. – T. 12. – №. 2. – C. 431-438.
5. Pugacheva I.N., Karmanov A.V., Zueva S.B., De Michelis I., Ferella F., Molokanova L.V., Vegliò F. Heavy metal removal by cellulose-based textile waste product. Izv. Vyssh. Uchebn. Zaved. Khim. Khim. Tekhnol. [Russ. J. Chem. & Chem. Tech.]. 2020. V. 63. N 2. P. 105110.
6. Zubkova O.S., Alekseev A.I., Zalilova M.M. Research of combined use of carbon and aluminum compounds for wastewater treatment. Izv. Vyssh. Uchebn. Zaved. Khim. Khim. Tekhnol. [Russ. J. Chem. & Chem. Tech.]. 2020. V. 63. N 4. P. 8691.
8. Arvaniti O. S., Stasinakis A. S. Review on the occurrence, fate and removal of perfluorinated compounds during wastewater treatment //Science of the Total Environment. – 2015. – T. 524. – C. 81-92.
9. Usmonov R.M., Kuldasheva Sh.A., Salihanova D.S., Eshmetov I.D., Abdurakhimov S.A. Cleaning of waste water for fatty production by waste of sugar production - defecate//Austrian Journal of Technical and Natural Sciences. № 9–10. 2018. -p.p. 82-86.
10. Sverguzova, Zh.A. Purification of model solutions and emulsions from milk fat, whey and asparagine with modified defecate // Geosystems: development factors, rational use, management methods: materials of the International Scientific Conference; edited by Doctor of Geography, Prof. S.Ya. Sergina. Tuapse: Sterkh, 2008. pp. 218-219.
11.Produkt.by/story/perspektivy-ispolzovaniya-saharnogo-defekata-v-respublike-belarus. Sazonova A.V., Maltseva V.S. Prospects for using beet sugar production waste as sorbents // Vodoochistka. Water treatment. Water supply. 2012 No. 1 (49). P.16-18.
12. Blagadyreva, A.M. Assessing the effectiveness of using thermally modified defecate for wastewater treatment from petroleum products and explaining the mechanism of the water treatment process // Ecology, energy and resource saving, environmental protection and human health, waste disposal: abstract. report International scientific and practical conference, 2009 Kharkov, T.2. P.333 -334.
13. Dorokhova E.N., Prokhorova G.V. Analytical chemistry. Physico-chemical methods of analysis. Textbook High school, 1991. P. 255.
14. Kuzmin V.I. Gravimetry. 2011, 163 p.