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INVESTIGATION OF PURIFICATION OF MIXTURE OF OIL SLUDGES FORMED IN OIL REFINING INDUSTRY WITH BENTONITE CLAY

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Abstract

As a result of the research, it was established that in the oil refining industry (ORI) it is possible to clean up to 74.65% the oil sludges waste mixture (OSWM) from the oil products waste mixture (OPWM) contained in it. As it is known, it can be considered effective to carry out in the specified amount the purification of the OSWM formed in the ORI, which has a very complex composition. Thus, it was established that it is possible to purify OSWM which doesn't contain acidic gudron and non-fuel oil with bentonite clay for 85.66%. During the research, primary gasoline fraction was used instead of petroleum ether as an extractant and bentonite clay was used as an adsorbent for the purification of OSWM.

Keywords: oil refining industry, oil sludges mixture, bentonite clay, petroleum ether, chemical method, extraction, adsorbent.

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According to the information given in the technical literature, during the process of extracting oil from various sources from under the ground, along with oil, there is a significant amount of oil sludge waste contained in it. This oil sludge waste contains about 50-70 percent of oil, 25 percent of mechanical mixture and 5 percent of water. As it is known, the oil sludge formed in the oil extraction industry is a solid waste consisting only of oil, mechanical mixture and water. These wastes, which are different from each other, are obtained mainly in the oil extraction industry, during various technological processes in the ORI and also there is a certain amount of these wastes at the bottom of the storage tanks of raw oil of the ORI.

Oil sludge waste formed in the oil extraction industry differs significantly in composition and properties from oil sludge waste formed in the ORI. As noted in the literature [1-8], the process of deep, up to 100 percent, environmentally effective purification of OSWM, which is formed in the ORI and which has more complex properties, has not been fully solved until this time.

For this purpose, the samples of OSWM were taken from The Heydar Aliyev Oil Refinery and ecological scientific researches on purification of these samples from the OPWM were carried out in laboratory conditions in several directions. Mainly research methods on purification of the samples of the OSWM formed in the ORI have been developed using various coagulants, their various solutions, as well

as petroleum ether (or technical gasoline fractions) as an extractant. One of these research works was the development of the method of purification of OSWM using bentonite clay.

The following information can be given about the reason of using of bentonite clay for the purification of the OSWM samples.

As it is known, as bentonite clays have adsorbing properties, as well as due to some alkaline properties, in most cases, the purification process is carried out using bentonite clays in order to obtain high-quality oils. In the research work bentonite clay was used for the complete adsorption of OPWM contained in the OSWM. Therefore, we have developed a method for deep purification of OPWM contained in the the OSWM using different percentage solutions of bentonite clay. It should be noted that in this research work it is intended to use the residue obtained after the purification of OSWM and bentonite clay used in the purification of oil sludge as a raw material in road construction and brick production.

Experimental part: Mainly, during of our work, in practice first of all it was planned to use bentonite clay for the purification of 50 grams of OSWM, that is, for the separation of OPWM contained in it, and subsequently to use bentonite clay left in mechanical mixtures in building materials in some directions in the future, and the following results were obtained. Thus, the research work on the purification of 50 g of taken for the sample OSWM with 5, 10, 15 percent solutions of bentonite clay in several parallel directions was carried out.

As can be seen from the Table 1, using a 5% solution of bentonite clay in a volume of 10 ml, it is possible to purify the OPWM from the OSWM to 74.65%. Because at this time contacting of bentonite clay with low concentration and OSWM is better. In this case using petroleum ether (or the initial gasoline fraction instead of it) for complete purification of the OSWM with bentonite clay mainly by mixing it several times at room temperature was achieved the purification of the OPWM contained in the oil sludge to 74.65%.

During the study it was established that using gasoline fraction and 5% solution of bentonite clay in the volume of 10 ml it is possible to achieve the purification of the OPWM from the OSWM, which does not contain a mixture of fuel oil, gudron and acidic gudron to 85,66%. The results of this work are shown in the Table 1. This is explained by the fact that the OSWM containing fuel oil, gudron and acidic gudron mixtures is very poorly adsorbed by bentonite clay at room temperature. When the purification of the OSWM with the same composition is carried out at high temperature, many ecotoxicant substances are released into the atmosphere. Most likely, it is possible to carry out with a higher efficiency the purification of the OPWM from the OSWM, which has a very complex composition, as it was mentioned, in closed apparatuses using the gasoline fraction and depending on the specified volume and the concentration of bentonite clay.

Therefore, in subsequent directions it is more expedient to add the extractant to the mixture at the first stage and to mix it, for more effective purification of the OSWM, contained in it, as noted in the literature [1-8]. Then the mixture is mixed with the extractant for the purification of the OPWM, which is absorbed by the bentonite clay.

Thus, it is impossible to achieve the purification of the OPWM contained in the OSWM when only bentonite clay solutions with different percentages are used. At the first stage, when only petroleum ether or technical gasoline fraction was used as an extractant, it was established that the OPWM contained in the oil sludge is more separated.

At the same time, it should be noted that first of all for the purification of the OSWM with some chemical reagents the taken sample was brought to a completely dissolved form by adding the industrial waste water taken from the ORI, in the ratio of 1:10 (5-10 times more than the oil sludge sample), because in this form the purification of the oil sludge is higher.

During the experiment, we found that depending on the amount of used chemicals or adsorbent substances, coagulant reagents, the environmental effectiveness of the purification of the OSWM differs significantly.

Thus, during the experiments, repeated several times at different temperatures, mainly at temperatures above 60°C, the inexpediency of purification of the OSWM was determined. Because the volatile organic compounds contained in the oil sludge evaporate more, and thisleads to environmental pollution.

It has been determined by us that in general it is more expedient and more effective to carry out the process of the environmentally effective purification of OPWM from oil sludges at low temperatures in order to avoid the occurrence of the mentioned environmental problems.

At the first stage, the sample of the OSWM is mixed with the industrial waste water in a ratio of 1:10 in order to bring it to a completely dissolved form. Then the purified OSWM is extracted initially. Using the same chemical method, the indicators of purification of the sample of OPWM from the OSWM specified in the Table 1 were achieved. This method was developed by us for the first time.

the OSWM sample										
№, amount, g, temp., °C	**the composition before the purification**			**used during the purification**		**the composition after the purification**			**time of the purification, h**	**effectiveness of the purification of the OPWM, %**
	amount of the OPWM, %	**amount of water, %**	**amount of mechanical mixture, %**	**volume of the**	**volume of the 5% bentonite clay solution,**	**amount of the OPWM, %**	**amount of water, %**	**amount of mechanical mixture, %**		
-1 0 g 0° °C*	7,60	2,22	0,18	,0	5 ,0 1 0,0 2 0,0 2 5,0	4,81 5,11 0,12 8,4	,14 ,06 ,17 ,25	0,18 0,18 0,18 0,18		4,87 4,65 9,53 0,17
-2 0 g 0° °C*	7,60	2,22	0,18	,0	5 ,0 1 0,0 2 0,0	7,17 2,52 5,09	,51 ,04 ,08	0,18 0,18 0,18		0,14 4,26 1,65

N-3	7,60	2,22	0,18	,0	5 ,0	3,16	,12	0,18		6,54
0 g					1 0,0	,14	,03	0,18		5,66
0°					2 0,0	8,28	,08	0,18		1,46
°C*					3 0,0	2,2	,35	0,18		6,27

Table 1. The results of purification of OSWM using bentonite clay solutions with different percentages. *t°C - while increasing of the mixing time and the temperature till 60°C, the time of the purification is maximum 1 hour, *N-3 - the OSWM, which does not contain fuel oil, gudron and acidic gudron.

The separation of the oil products wastes contained in the oil sludges was completed in the separating funnel after initial mixing the significantly thinned oil sludge sample taken from the ORI with petroleum ether. The amount of the obtained organic layer is determined, but due to the fact that a significant amount of OPWM remains in the purified OSWM, the residual mixture is extracted several times at 20-60°C. During the experiment, it was found that when the refining is carried out only with petroleum ether it is possible to separate up approximately 70 percent of the OPWM from the sludge. However, when bentonite clay is used at the second stage, as a result of the addition of the bentonite clay, which has a low concentration, it was determined that the purification of the OPWM from the OSWM containing fuel oil, gudron, acidic gudron was carried out up to 74.65 percent.

Discussing of the results: Thus, comparing with our previous research works, it is possible to achieve 74.65-85.66% purification of the OSWM with bentonite clay depending on its composition. This is explained by the fact that as bentonite clays absorb polycyclic aromatic, asphalten and other high-molecular hydrocarbons, it is impossible to achieve complete separation of the OPWM contained in the oil sludge. Nevertheless, at the last stage after removing the separated organic layer with an extractant the research on the re-purification of the remained OPWM, which contains mechanical mixture and bentonite clay and which is absorbed into bentonite clay was carried out in several stages. However, in this case, both using additional energy carriers and using additional reagents, it is possible to achieve the purification of the OPWM contained in bentonite clay. Thus, during the purification using bentonite clays, it is possible to achieve purification of the OPWM from the OSWM without extractant up to 54.87 percent and approximately 75.65-85.66 percent initially using petroleum ether (technical gasoline fraction mixture). Therefore, comparing with our previous studies, during the purification process with bentonite clays a purification above 85.66 percent was not achieved. That is why we considered appropriate to carry out the research work in a different direction. But at the same time, it can be noted that we consider advisable to use bentonite clays in order to purify the oil sludges which in most cases contain highly resinous compounds that cannot be separated, since the purification up to 70-75 percent has also great importance. Because at this time, we consider expedient to carry out the initial purification of oil sludge to about 85.66 percent in accordance with the mentioned technological regime instead of the consumption of electricity and temperature existing and used in large technological facilities.

During the experiment, it was found that instead of petroleum ether as an extractant, it is possible to use a technical gasoline fraction obtained from the primary processing of oil and containing a significant amount of pentane, hexane, toluene with high solvent power and other solvent hydrocarbon compounds, and it has almost the same results.

Thus, it can be considered scientifically based to use the mixture of solid wastes obtained during the purification of the oil sludges containing high-molecular resin compounds with bentonite clays as a raw material in brick production. Thus, the mechanical mixtures contained in oil sludge have almost no high radioactivity. Therefore, using of the bentonite clay containing a mixture of resinous oil wastes in the production of building materials can be considered expedient. In comparison with the reagents previously used by us, the purification of OSWM with bentonite clay is less effective. That is why we consider more expedient to use this mixture of bentonite clays containing heavy resin compounds in building materials.

Considering the above explanations, suggestions and the possibility of using mechanical mixtures containing bentonite obtained in solid form with 14-25% of the OPWM remaining after purification the OSWM formed in Oil Refinery and having very complex physico-chemical properties from the OPWM, it is possible to evaluate the research work positively.

At the same time, based on the results of the research work, it can be noted that it is possible to purify oil-contaminated soils using bentonite clay with adsorbent properties only in dry condition. In this case, the possibility of purification of oil wastes adsorbed into bentonite clay can be considered justified.

The results: The purification of the mixture of oil sludges formed in the ORI using 5, 10, 15 percentages solutions of bentonite clay in different directions has been studied. It has been established that when the bentonite clay with low concentration (5% solution) comes into contact with OSWM, petroleum ether or technical gasoline fraction is used as an extractant, when mixing and heating processes are carried out well, higher results of the purification of oil sludge can be achieved. Despite the fact that 100% purification has not been achieved, great economic and environmental importance of the purification of oil sludges mixture using the mentioned method can be considered justified.

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