Journal of Fundamental and Applied Research **Vol. 3**, Issue 3 (2023) **20230017**

Received: 14 August 2023 / Accepted: 22 September 2023
Published online: 25 September 2023
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RESULTS OF DETERMINING THE COMPOSITION OF OIL-CONTAINING WASTE

Abdugoffor M. Khurmamatov,[1,*] Nadira K. Yusupova,[1] Nuritdin P. Alimov,[2] and Javohir K. Mirzayev[1,†]

[1]*Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, 100170 Tashkent, Uzbekistan*
[2]*Namangan Engineering and technology Institute, Namangan*

Abstract. The article presents the results of the study of the composition of oil sludges of different origins and the amount of mechanical additives in them, the results of experiments with various solvents on the separation of unnecessary additives in reservoir oil sludges, oil sludges left over from technical water treatment, and oil sludges collected in the sludge storage tank. The composition of oil sludge is very important for all types of sludge, and this indicator plays an important role in experiments carried out for the purpose of processing, disposal of oil sludge, obtaining secondary products from them or increasing the base of oil raw materials. Therefore, the amount of mechanical additives in the three types of oil sludge brought from Fergana oil refinery plant was determined in laboratory conditions.

Keywords: oil, mechanical additives, reservoir, solvent, mixer, density, viscosity, oil sludge, hydrocarbons.

I. INTRODUCTION

The main reason for the formation of oil sludge is the physico-chemical interaction of oil products with moisture, atmospheric oxygen and mechanical impurities. As a result of such processes, partial oxidation of original oil products occurs with the formation of tarry compounds. There are no homogenous oil sludges in terms of composition and physico-chemical properties [1]. Certain theoretical and practical results were achieved in the field of oil refining and preparation of oil sludge for primary processing in the republic [2]. In the Action Strategy for the further development of the Republic of Uzbekistan, the tasks of "Raising the industry to a new level in terms of quality, accelerating the production of finished products on the basis of deep processing of local raw materials, raising the activity of new industrial enterprises by mastering the production of product types and technologies" are defined. In this regard, among other things, the scientific research conducted on the creation of an energy-saving technological line for cleaning hydrocarbon waste from water and various mechanical impurities, preparing oil sludge for primary processing is important [3]. The proportion of oil products, water and mechanical impurities (particles of sand, clay, rust, etc.) varies within wide limits: hydrocarbons 5-90%, water 1-52%, solid impurities 0.8-65%. Such significant changes in the composition of oil muds are explained by a wide range of changes in their physical and chemical properties. Density of oil sludge is 830-1700 kg/m^3, solidification temperature is from -3 ℃ to +50 ℃ [4]. As a result of reprocessing oil sludge and extracting its organic part, it is necessary to separate the water and mechanical additives contained in oil sludge in order to add it to the main feedstock in order to increase the feedstock base. This is because they cause negative effects in the later use of the food. Therefore, we have developed an effective method for cleaning oil sludge from mechanical additives and conducted a number of studies [5].

II. METHODS AND MATERIALS

We determined the amount of mechanical additives according to GOST 6370-2018 [6]. This standard is intended for petroleum, liquid petroleum products and additives and is used to identify mechanical additives. The essence of the method is to pre-dissolve and filter the tested products in gasoline or toluene, wash the precipitate on the filter with a solvent and weigh it [7]. Since solidification temperatures, density, and viscosity of oil sludge are very important in their disposal or in the production of some

* Corresponding Author: gafuri_1980@mail.ru
† javakingjava15@gmail.com

products from them, experiments were conducted to determine their physico-chemical properties. The waste oil sludge from the technical water treatment of the Fergana oil refinery, the oil sludge that sank to the bottom of the tank, and the sludge accumulated in the sludge storage tanks were selected as the research object. As a result of research, the physico-chemical properties of various slurries were studied. The results are presented in the table 1 below.

Types of sludge	Aggregate status	Solidification temperature, °C	Density, kg/m^3	Viscosity, mm^2/s
Waste sludge from technical water treatment	Liquid pasty	+10	1.06	960
Oil sludge that has sunk to the bottom of the reservoirs	Dense pasty	+7	0.94	950
Sludge storage sludges	Dense pasty	+3	1.2	980

TABLE I. Physico-chemical properties of various sludges

As can be seen from Table 1, the aggregate state of waste oil sludge from technical water treatment was liquid paste, and the solidification temperature was +10ºC. The densities of these oil sludges were measured using a pycnometer and found to have a density of 1.06 kg/m^3. Viscosity was measured on a VPJ-4 viscometer and was found to be 960 mm^2/s. During the experiments, the properties and composition of the samples of oil sludge that sank at the bottom of the reservoirs were studied, and the solidification temperature of this type of sludge was +7ºC, its density was 0.94 kg/m^3, and its viscosity was 950 mm^2/s. During the study of the samples taken from the sludge storage tanks in production, it was found that their solidification temperature was +3ºC, and when their density was determined using a pycnometer, the density was 1.2 kg/m^3, and according to experiments to determine the viscosity of this type of oil sludge, it was 980 mm^2/s. 50.42 g. three types of oil slurry were mixed by hand shaking for 5 minutes in a container, heated to a temperature of 40-60 ºC. A 250 ml volume of heated solvent was washed on the filter paper. We dried the filter at a temperature of 105 ºC for 45 minutes. It was cooled in a desiccator for 30 minutes and weighed. The next drying process was carried out within 30 minutes. The amount of mechanical additives was calculated using the following formula [8].

$$M = \left(\frac{m_1 - m_2}{m_3}\right) \times 100$$

where m_1 is the mass of a paper filter cup with mechanical attachments, g; m_2 – mass of a glass with a clean paper filter, g; m_3 – sample mass, g. The composition of mechanical mixtures was calculated as the arithmetic mean value of the results of two parallel determinations. If mechanical impurities are not more than 0.05%, then this condition is considered as the absence of mechanical impurities. First of all, the initial amount of mechanical impurities in oil sludge was determined. The filter paper was dried to constant weight at 105 ºC. The oil sludge sample was heated to 40 ºC in a water bath, because the analyzed oil sludges had a high viscosity. Then the weight is 2 gr. a sample of oil slurry containing 25 gr. diluted with gasoline by weight. The hot solution of the sample is filtered through a dried paper filter placed in a glass funnel. After filtration, the filter was transferred to a bottle and dried in a thermostat for 1 hour. After drying, the beaker was cooled in a desiccator for 30 minutes, and the mass of the clean filter beaker weighed on an analytical balance was 19.5498 g. The amount of mechanical additives in three types of oil slurries was determined using a Soxhlet apparatus. A round-bottomed flask was placed in a Soxhlet apparatus and the extraction solvent was poured into it and a condenser was attached. A sleeve containing the sample to be extracted was placed in the center of the apparatus, and the solvent was heated to its boiling temperature and vaporized, which rose through the apparatus, condensed in the cooler, and dripped into the sleeve as a drop. The organic part of the oil sludge located inside the sleeve on the filter paper was dissolved using a solvent and added to its main mass GOST 6370-2018 [9].

A. Results and discussions

As a result of the conducted research, it was determined how many mechanical additives are in the composition of oil sludges of three types by origin.

As can be seen from Figure 1, according to the results of the conducted research, it was proved that the composition of waste sludge from technical water treatment consists of 18% mechanical additives, 42% water and 40% organic part.

As can be seen from Figure 2, according to the results of the conducted research, it was proved that the composition of the oil sludge settled at the bottom of the reservoir consists of 5% mechanical additives, 12% water and 83% organic part.

As can be seen from Figure 3, according to the results of the conducted research, it was proved that the composition of oil sludge collected in sludge storage tanks consists of 30% mechanical additives, 21% water and 49% organic part. During the research, three types of oil slurries were studied, and in order to easily separate the mechanical additives in the oil slurries, they were mixed with solvents (light naphtha, heavy naphtha, kerosene) in a ratio of 70:30 (70% oil slurry and 30% solvent) at 60°C for 30d÷60 minutes. stirred at temp. Then, it was sent to a hydrocyclone device in order to separate the solid particles under the influence of centrifugal force. The results of the conducted experiments are included in the following table 2.

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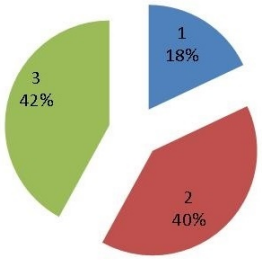


FIG. 1. 1-mechanical additives, %; 2- amount of water in fractions separated as a result of processing; 3rd organic part, %. Composition of waste sludge from technical water treatment

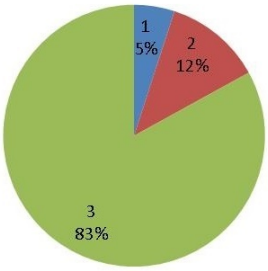


FIG. 2. 1- mechanical additives, %; 2- amount of water in fractions separated as a result of processing; 3rd organic part, %. The composition of the oil sludge that has sunk to the bottom of the reservoir

As can be seen from Table 2, the concentration of mechanical additives was 0.04% as a result of separation of mechanical additives by mixing waste sludge from technical water treatment with 30% light naphtha for 60 minutes, and mixing oil sludge with 30% heavy naphtha for 60 minutes we can see that the amount of mechanical additives was 0.07% as a result of melt cleaning, and the concentration of mechanical additives was 0.1% as a result of separating the mechanical additives from its content by mixing with 30% kerosene for 60 minutes.

As can be seen from Table 3, the concentration of mechanical additives was 0.02% as a result of separation of mechanical additives by mixing the oil sludge settled at the bottom of the tank with 30% light naphtha for 60 minutes, and dissolving the oil sludge with 30% heavy naphtha for 60 minutes we can see that the amount of mechanical additives was 0.04% as a result of cleaning, and the concentration of mechanical additives was 0.13% as a result of separation of mechanical additives in its content by mixing with kerosene at a ratio of 30% for 60 minutes.

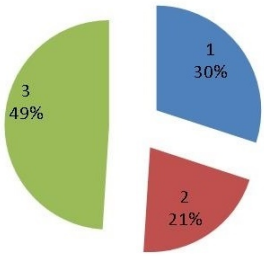


FIG. 3. 1-mechanical additives, %; Amount of water in fractions separated as a result of 2nd processing, %; 3rd organic part, %. Composition of oil sludge collected in sludge storage tanks

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Solvents	Duration of mixing, min	Amount of mechanical additives, %
Light naphtha	60	0.04
Heavy naphtha	60	0.07
Kerosene	60	0.1

TABLE II. Results of purification of waste sludge from technical water treatment from mechanical additives

Solvents	Duration of mixing, min	Amount of mechanical additives, %
Light naphtha	60	0.02
Heavy naphtha	60	0.04
Kerosene	60	0.13

TABLE III. Results of cleaning the oil sludge from mechanical additives

Solvents	Duration of mixing, min	Amount of mechanical additives, %
Light naphtha	60	0.05
Heavy naphtha	60	0.11
Kerosene	60	0.17

TABLE IV. Results of cleaning of oil sludge collected in sludge storage tanks from mechanical additives

As can be seen from Table 4, the concentration of mechanical additives was 0.05% as a result of separation of mechanical additives by mixing the oil sludge settled at the bottom of the tank with 30% light naphtha for 60 minutes, and dissolving the oil sludge with 30% heavy naphtha for 60 minutes we can see that the amount of mechanical additives was 0.11% as a result of cleaning, and the concentration of mechanical additives was 0.17% as a result of separation of mechanical additives in its content by mixing with kerosene at a ratio of 30% for 60 minutes.

III. CONCLUSIONS

As a result of the conducted experiments, solidification temperatures, densities and viscosities of three types of oil sludges were determined, and light naphtha was proved to be the most suitable solvent for oil slurries. As a result, the results of cleaning from mechanical additives showed that the amount of mechanical additives was the least, 0.05%.

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