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Influence of Technological Parameters on the Process of Obtaining Bitumen

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ABSTRACT: The article presents results of experiments to determine the physicochemical properties(density and viscosity) of oil sludge mixture. Also, the results of the influence of operational parameters on the process of obtaining bitumen and the results of comparing with various State standards are presented.

KEY WORDS: oil, bitumen, oxidation, oil sludge, diluent, mixture, mixer, distillation column, constructive parameters.

I. INTRODUCTION

Oil sludge is extremely diverse in composition. The main attention in the study of composition is given to the sludge generated at oil refineries (ORF). They are complex systems consisting of oil products, water and mineral parts (sand, clay, silt, corrosion products of storage tanks).The ratio of these components varies in a very wide range depending on the type of raw material, its processing schemes, equipment and reagents used for purification of wastewater [1, 2, 3].

Basically, sludges are heavy oil residues containing on average: oil products 10-56%, water 30-85%, solid impurities 13-46%.The organic part is a mixture of unoxidized hydrocarbons (benzines, naphthenes, alkylbenzenes, naphthalenes) and heterocyclic compounds [4-7].

As known, about 3000 tons of oil sludge is accumulated at the Bukhara Oil Processing Plant annually and these oil sludges are not used anywhere. This negatively affects the environment. Therefore, the processing of oil sludge is an important environmental and economic task.

II. SIGNIFICANCE OF THE SYSTEM

The article presents results of experiments to determine the physicochemical properties(density and viscosity) of oil sludge mixture.The study of literature survey is presented in section III, methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and conclusion.

III. METHODOLOGY

Experiments on obtaining bitumen from oil sludge were carried out. Also, it has been studied an effect of the duration of diluted oil sludge distillation at the temperature of distillation column bottom.

The results are shown in Fig. 1.

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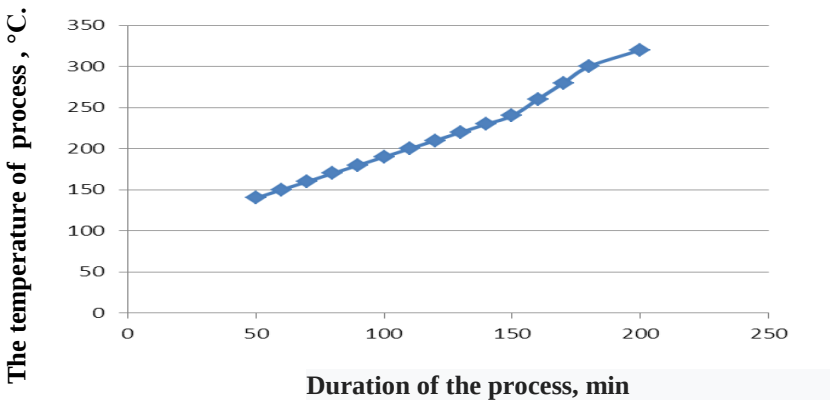

Fig.1. Influence of distillation process duration at the temperature of distillation column bottom part

The distillation process continued/lasted for 200 min, while the maximum temperature of the distillation process was reached up to 320 ° C.

Fig. 1 shows that with an increase in the duration of the process up to 200 min, the temperature in the bottom part of column increases from 140° C to 320° C. The higher oxidation temperature, the faster process proceeds. However, at a very high temperature, the reactions of carbenes and carbides formation are accelerated, which is unacceptable. Therefore, the optimum temperature of the rectification process in the bottom part of column is 320 ° C. The main factors influencing the oxidation process and the quality of oxidized bitumen are the nature of raw material, an oxidation temperature, and air consumption.

In order to separate mechanical impurities from the composition of oil sludge, several experiments were carried out, dilutions of oil sludge were made with various diluents: light naphtha, heavy naphtha, reformate and gasoline. The results are shown in the following diagrams.

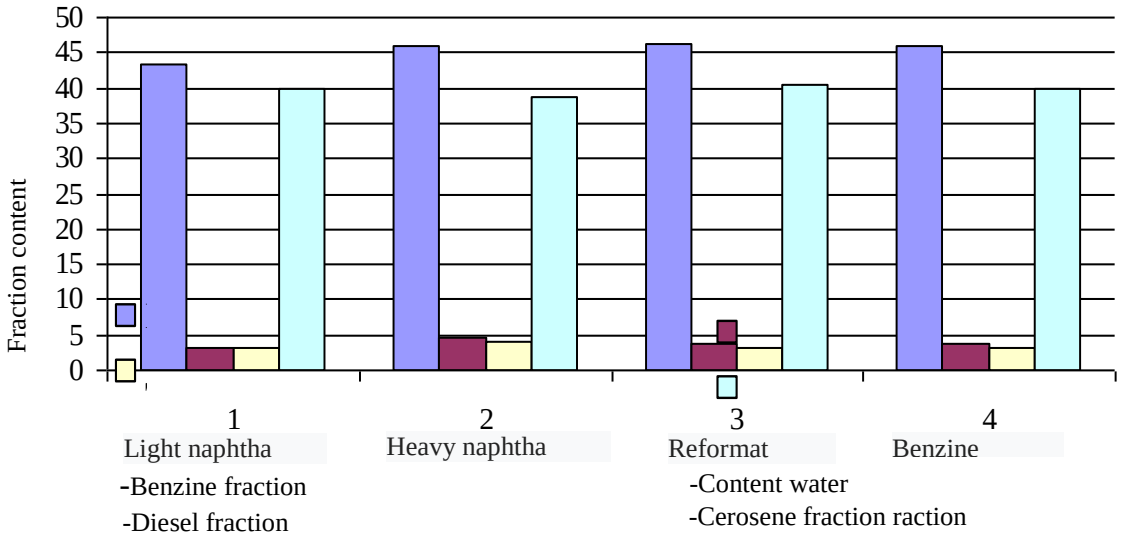

Fig. 2 Yield of light fractions when diluting oil sludge with various diluents

IV. EXPERIMENTAL RESULTS

Fig. 2 shows that the duration of stirring for each experiment is 60 minutes, a ratio of solvents is 30%. The water content in the oil sludge when diluted with light naphtha is 39.75%, in heavy naphtha it is 38.73%, and in the reformate 40.4%, in gasoline 39.88%, i.e. the water content in the oil sludge is on average 39.69%, the gasoline

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fraction is 46.2%, the kerosene fraction is 3.75%, the diesel fraction is 3.05%. It is due to the fact that the most suitable diluent is - with a ratio of 30% reformate and 70% sludge.

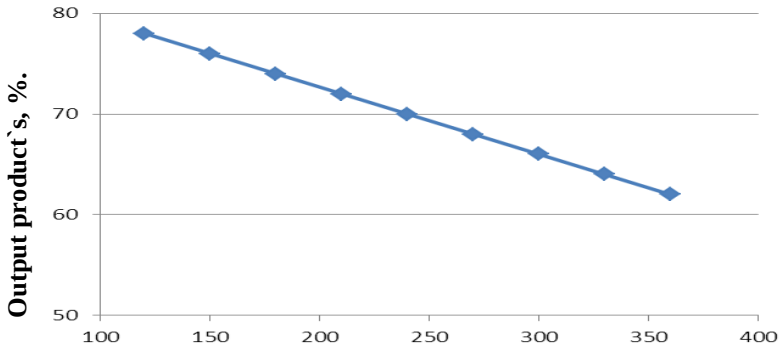

Fig. 3.The duration effect of oxidation process on the product yield

We carried out the process of oxidation of raw materials for 2 to 6 hours. The duration of oxidation process upon receipt of bitumen affects the amount of product obtained. The duration of oxidation process increases from 120 minutes to 360 minutes. With increasing time of oxidation process, the yield of product decreases. This is due to the fact that during the long-term treatment of the tar with oxygen, oil fractions are released.

Fig. 3 shows that with an increase in the oxidation time from 120 min to 360 min, the amount of product decreases from 78% to 62% due to the distillation of hydrocarbon fraction.

In the bottom part of distillation column, raw materials were distilled, as a result of which pairs of light distillates leaving the upper part of the distillation column were condensed and cooled with water in a vertical tube cooler. Then, the cooled condensate entered the measuring capacity.

In the course of experiments, the hydraulic resistance of the model hydrocyclone was also determined:

$$\Delta P = \frac{\xi \rho \omega^2}{2}, \qquad (1)$$

where ξ - coefficient of hydraulic resistance of a hydrocyclone; ω - input flow rate, m/s; ρ - medium density, kg/m^3.

The hydraulic resistance coefficient of a model hydrocyclonewas determined by the formula:

$$\xi = \frac{\Delta P}{\frac{\rho \omega^2}{2}}, \qquad (2)$$

where, ΔP - pressure loss in a hydrocyclone, Pa

Table 1

The influence of diluent when cleaning oil sludge from mechanical impurities(fluid flow rate 20 m/s)

№	Amount of solvent, %	The degree of purification of hydrocyclone,%	Hydraulic resistance of a hydrocyclone, Pa	Coefficient of hydraulic resistance
1	5	79,61	1701	8,67
2	10	84,98	1651	8,42
3	15	88,19	1599	8,16
4	20	92,85	1546	7,89
5	25	95,97	1498	7,64
6	**30**	**99,91**	**1450**	**7,40**
7	35	99,91	1410	7,19

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8	40	99,91	1390	7,09
9	45	99,91	1315	6,70
10	50	99,91	1278	6,52

From tab.1 it is seen that when adding 5% diluent to the mixture, the degree of purification of hydrocyclone is reached 79.61%, at the same time, the hydraulic resistance of the hydrocyclone is 1701 Pa.

Based on our studies, we determined the optimal amount of solvent for diluting oil sludge, with the addition of light naphtha up to 30%, the efficiency of cleaning a hydrocycloneis reached to its maximum, this index is 99.91%, while the hydraulic resistance of hydrocyclone was 1450 Pa, and the hydraulic resistance coefficient is 7.4. By increasing the amount of solvent in the mixture, the proportion of mechanical impurities in the composition of oil sludge is reduced.

Below are the physicochemical properties of the bitumen we have obtained under laboratory conditions. Samples are analyzed according to GOST 22245-90, with instruments and measuring instruments that have passed the State test.

Table 2
The results of comparing the obtained bitumen with various STSTs

The name of indicators	STST22245-90 OB 60/90	Norm TS05767930-263:2017	Marks of obtained bitumen from oil sludge
Softening point by RaB, °C.	Not less 45	Within 38-50	57
Needle penetration depth, 0,1 mm, at 25°C	60-90	140-220	200
Needle penetration depth, 0,1 mm, at 0°C	Not less 10	-	140
Elongation, cm, at 25°C	Not less70	-	72
Fragility temperature, 0°C	Not higher -6	-	-5
Flashpoint, in an open crucible °C.	240	250	245

From the tab.2 it can be seen that the bitumen obtained by us has a softening temperature according to RaB 57°C, needle penetration depth 0.1 mm, at 25° C 200° C, needle penetration depth 0.1, at 0° C 140, brittle temperature -15, flash point 170° C.

V. CONCLUSION AND FUTURE WORK

Thus, the optimal operating parameters of the process of obtaining bitumen are determined: softening temperature according to RaB57°C; needle penetration depth 0.1 mm, at 25°C 200;a change in the content of asphaltenes in bitumen from 23.2 to 33.5 increases the softening temperature of bitumen from 71°C to 91°C. The liquid flow velocity in the hydrocyclone is 20 m/s, the hydraulic resistance of the hydrocyclone is 1450Pa. The bitumen obtained by us complies with the requirements of STST 22245-90 BO 60/90.

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