European Scholar Journal (ESJ)
Available Online at: https://www.scholarzest.com
Vol. 2 No. 3, March 2021,
ISSN: 2660-5562

STUDYING THE PROCESS OF LIGHT FRACTIONS OF DILUTED OIL SLUDGE

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Article history:

Received: 28th February 2021
Accepted: 7th March 2021
Published: 28th March 2021

Abstract:

The article presents the results on the influence of various factors on the distillation process of diluted oil sludge, as well as changes in the physicochemical properties and isolated amounts of light hydrocarbon fractions of diluted oil sludge. In addition, the main factors affecting the oxidation process and the quality of oxidized bitumen.

Keywords: Distillation, oil sludge, dilution, separation, fraction, gasoline, kerosene, oxidation, deasphalting

The best bitumen are obtained with a low content of paraffins (paraffins prevent adhesion to minerals) and with a high content of resinous-asphaltene components. Oxidation is more active with increasing pressure in the oxidation zone. At the same time, raw materials with a low amount of oils give bitumen with high elongation, and plasticity intervals, as well as penetration. With an increase in air consumption, the intensity of the process also increases and the heat resistance of the final bitumen product increases. Residual fractions are usually oxidized in the cube - this method is used abroad, in old plants and in the production of low-tonnage types of bitumen [1,2].

Oxidation with air oxygen of various oil residues and their compositions at a temperature of 180 - 3000C (oxidized bitumen). Air oxidation can significantly increase the content of asphalt-resinous substances, the most desirable component in the composition of bitumen. Oxidized bitumens are obtained in batch and continuous apparatuses, the latter are more economical and easy to maintain. The principle of obtaining oxidized bitumen is based on compaction reactions at elevated temperatures in the presence of air, leading to an increase in the concentration of asphaltenes, which contribute to an increase in the softening temperature of bitumen, and resins, which improve the adhesion and elastic properties of the commercial product [3,4].

Experiments were carried out to study the content of asphaltenes in bitumen with deepening of the process, which increase the softening temperature, the results are shown in Fig. 1 [5].

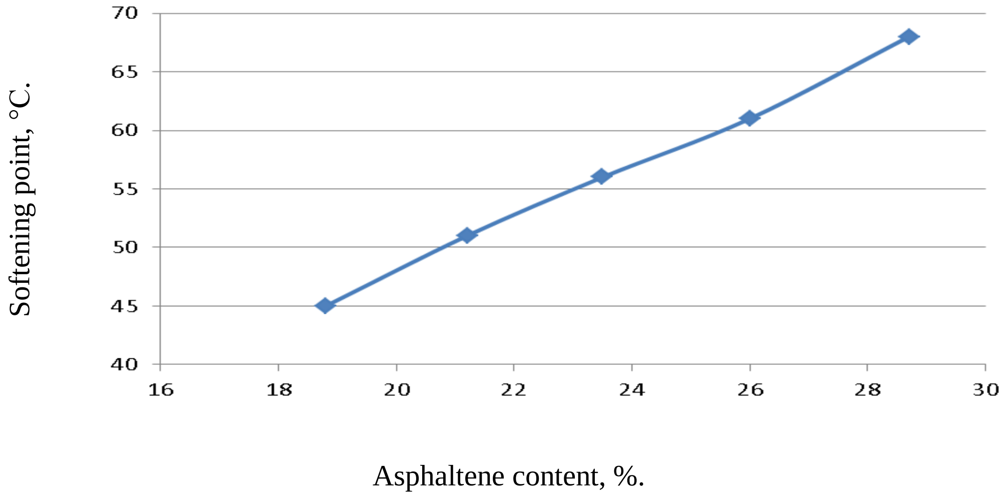

Fig. 1. Change in the softening point of the resulting bitumen depending on the content of asphaltenes

Figure 1 shows that, with a change in the amount of asphaltenes in bitumen from 18.8 to 28.7, the softening temperature of bitumen increases from 45 ° C to 68 ° C. According to the data in Fig. 1, asphaltenes are formed from polycyclic aromatic hydrocarbons, from resins, the formation of asphaltenes is much less important, and paraffinonaphthenic hydrocarbons do not change.

Depending on the nature of the raw material and the required properties of the bitumen, an appropriate oxidation temperature should be selected. For most types of raw materials, taking into account economic feasibility, it is close to 250 ° C. The temperature range for the production of bitumen in industrial conditions is 230 ÷ 270^{0}C, the air consumption is 2.8 ÷ 5.5 m3 / (m^2 · min) with a column diameter of 3.2 ÷ 3.4 m and a height of 14 ÷ 15 m [5] ...

To extract the resinous-asphaltene substances, after the rectification process, a deasphalting process was carried out. Liquefied propane at 190 ° C was used for deasphalting. Liquefied propane in a ratio of 1: 5 to the mixture was fed to the bottom of the column. The mixture was intensively treated with an upward flow of propane, freed from oils, which dissolve in propane. Resinous-asphaltene substances insoluble in propane were settled at the bottom of the column. After the deasphalting process, the mixture was oxidized with air using a compressor. Oxidation was carried out at a temperature of 220 ° C, 2 atm. and the duration of the process is 180 minutes. In order to obtain bitumen, a mixture of 3400 ml was prepared, i.e. Gf = 3400 ml (diluted oil sludge with various diluents). In order to determine the optimal duration of the oxidation process, a series of experiments were carried out for 2 to 6 hours. During the oxidation process, carbon and hydrogen atoms are detached, resulting in the formation of carbon dioxide and water. The oxidation process is carried out according to the following scheme: paraffin-cycloparaffinic, monocyclo-aromatic hydrocarbons under the influence of oxygen are converted into bicyclo and polycyclo-aromatic hydrocarbons. Next comes the formation of resins, asphaltenes are formed from resins, and from them - carbenes and carboids. The duration of the oxidation process of obtaining bitumen affects the amount of the resulting product. With an increase in the oxidation time of the process, the product yield decreases. The results of the studies are shown in Fig. 2 [6].

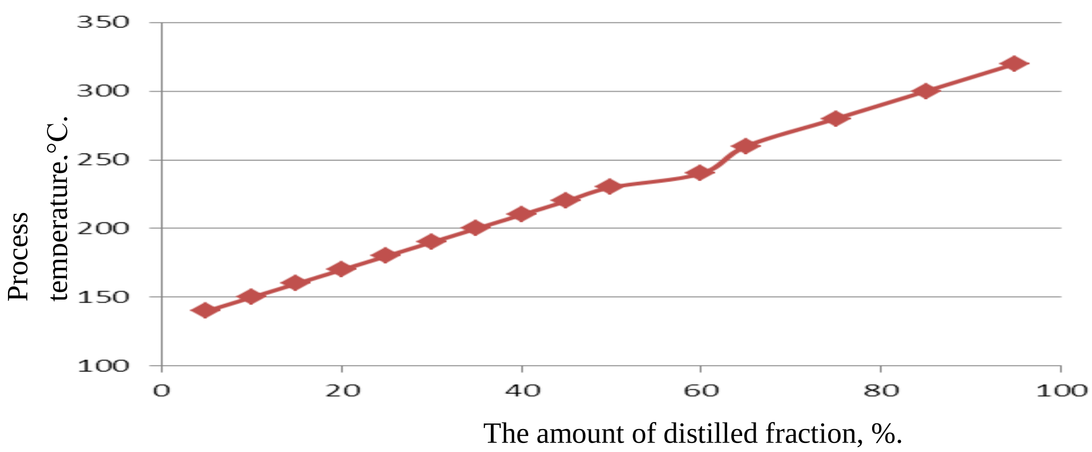

Fig. 2. Influence of the temperature of the oxidation process on the amount of distilled fraction

Figure 2 shows that with an increase in the temperature of the oxidation process from 140 ° C to 320 ° C, the amount of distilled light hydrocarbon fraction increases to Gd = 750 ml of the total mass. At the same time, in the bottom part of the distillation column, 2.5 kg of the finished mass remains for obtaining construction bitumen [6].

Most of the oxygen in the air goes to the formation of water and carbon dioxide, a small part - to the formation of organic substances containing oxygen. Petroleum hydrocarbons are oxidized simultaneously in two directions. In the process of oxidation, many reactions occur simultaneously: oxidative dehydrogenation, dealkylation, oxidative polymerization, polycondensation, cracking, followed by densification of its products. Dehydrogenation is the elimination of hydrogen. Dealkylation is the substitution of an alkyl group in an organic compound molecule by an H atom. Depending on the atom to which the alkyl group was attached, C, O, N and S dealkylation are distinguished. Dealkylation is sometimes also referred to as the substitution of the H atom for organic radicals, for example, hydroxy and cyanoalkyls [5].

In the course of the experiments, the effect of the duration of distillation of diluted oil sludge on the temperature in the bottom of the distillation column was also carried out. The distillation process lasted for 200 minutes, while the maximum temperature of the distillation process was reached up to 320·C. The results are shown in Fig. 3 [5].

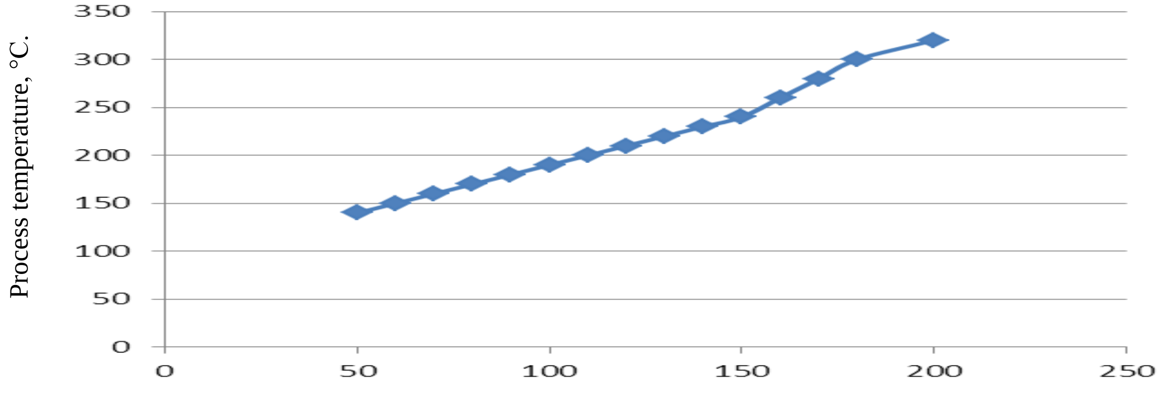

Fig. 3. Influence of the duration of the distillation process on the temperature of the bottom part of the distillation column

It can be seen from Fig. 3 that with an increase in the duration of the process to 200 min, the temperature in the bottom part of the column rises from 140^0C to 320^0C. The process proceeds rapidly with an increase in the oxidation temperature. However, at too high a temperature, the reactions of formation of carbenes and carbides are accelerated, which is unacceptable. Therefore, the optimum temperature of the rectification process in the bottom part of the column is 320 ° C. The main factors affecting the oxidation process and the quality of the oxidized bitumen are the nature of the raw material, the oxidation temperature, and air consumption. The reaction rate of the process of oxidation of raw materials into bitumen can be evaluated in different ways. The simplest and most convenient is the determination of the softening point, which is usually carried out to control the quality of the finished product [6].

In addition, a series of experiments were carried out to study the yield of light fractions from diluted oil sludge and the change in the physical parameters of the resulting fraction at different temperatures and different diluents. The total weight of the diluted oil sludge is 10,000 ml (30% diluent + 70% oil sludge), and the density of the mixture at 20 ° C is 980 kg / m3. The results of the experiments are shown in Fig. 4.

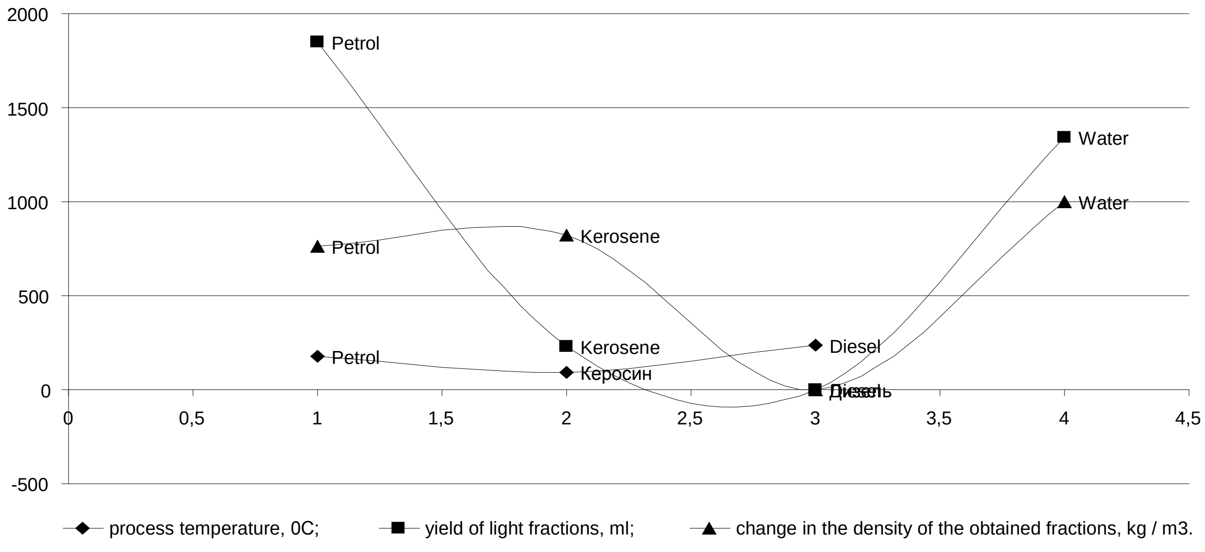

Fig. 4. The yield of light fractions from diluted oil sludge and changes in the physical parameters of the resulting fraction at different temperatures (diluting agent - reformate)

It can be seen from Fig. 4 that with an increase in the temperature of the distillation process of diluted oil sludge with reformate to 176 ° C, the release of light fractions was 1849 ml, and the density of the obtained fraction, i.e. gasoline during distillation 760 kg / m3, and the release of kerosene 232 ml at a temperature of 192 ^{0}C, the density of kerosene was 820 kg / m3, with an increase in temperature to 235 C, the release of the diesel fraction is absent, the water content is 1340 ml. Experiments with light naphtha were also carried out, the results of the experiments carried out are shown in Fig. 5

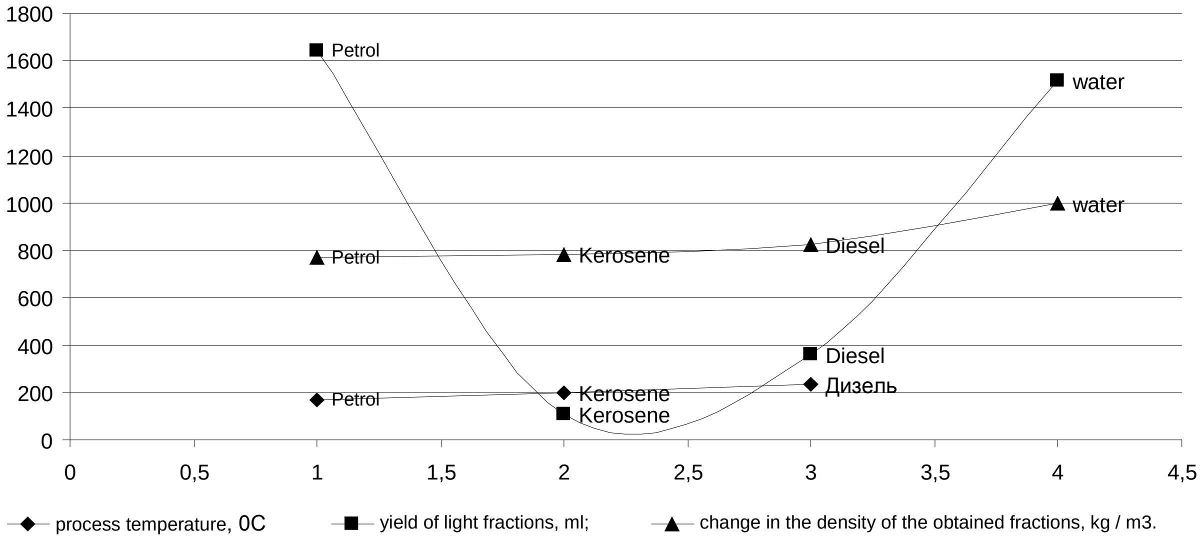

Fig. 5. The yield of light fractions from diluted oil sludge and changes in the physical parameters of the resulting fraction at different temperatures (diluting agent - light naphtha)

The separation of light fractions was 1645 ml, at the temperature of the distillation process with light naphtha up to 166 ^{0}C, and the density of the obtained fraction, i.e. gasoline during the distillation of 770 kg / m3 (Fig. 5), the amount of kerosene was 110 ml at a temperature of 196 ^{0}C, its density was 780 kg / m3, with an increase in temperature to 237 ^{0}C, the release of the diesel fraction is 360 ml, the water content is 1515 ml ...

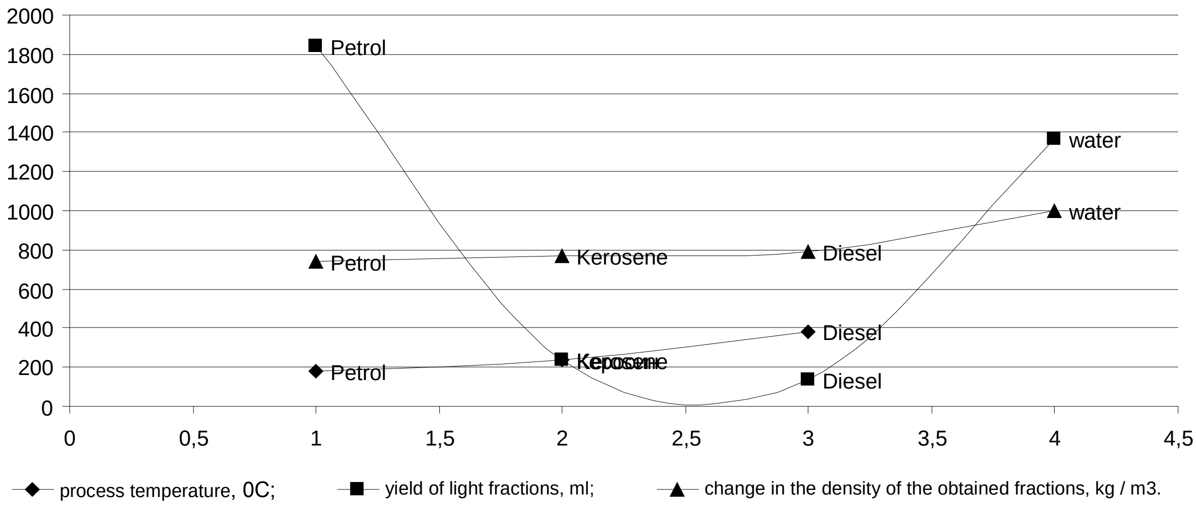

Fig. 6. The yield of light fractions from diluted oil sludge and changes in the physical parameters of the resulting fraction at different temperatures (diluting agent - heavy naphtha)

With an increase in the temperature of the process (Fig. 6), the distillation of diluted oil sludge with heavy naphtha to 183 ° C, the release of light fractions was 1845 ml, and the density of the resulting fraction, i.e. gasoline during distillation 740 kg / m^3, and the release of kerosene 240 ml at a temperature of 239 ^{0}C, the density of kerosene was 770 kg / m^3, with an increase in temperature to 381 ^{0}C, the release of the diesel fraction was 140 ml, and its density was 790 kg / m^3, the water content is 1370 ml, the density of the released water is 1000 kg / m^3.

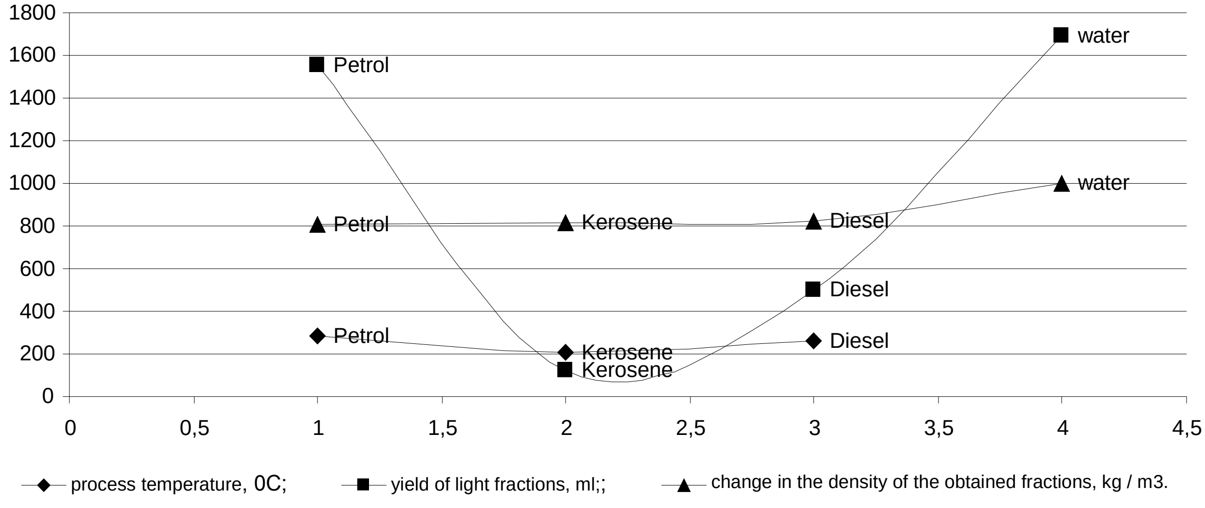

Fig. 7. The yield of light fractions from diluted oil sludge and changes in the physical parameters of the resulting fraction at different temperatures (diluting agent - gasoline)

It can be seen from Fig. 7 that with an increase in the temperature of the distillation process of diluted oil sludge with gasoline up to 288 ° C, the release of light fractions was 1553 ml, and the density of the obtained fraction, i.e. gasoline during distillation 810 kg / m^3, and the release of kerosene 121 ml at a temperature of 210 C, the density of kerosene was 815 kg / m^3, with an increase in temperature to 263 C, the release of the diesel fraction was 499 ml, and its density was 823 kg / m^3, the amount of water is 1689 ml, the density of the allocated water is 1000 kg / m^3.

Thus, changes in the physicochemical properties and isolated amounts of light hydrocarbon fractions from the composition of diluted oil sludge also depend on their diluent. In addition, the main factors affecting the oxidation process and the quality of the oxidized bitumen are the nature of the raw materials, the oxidation temperature, and air consumption. The reaction rate of the process of oxidation of raw materials into bitumens can be evaluated in different ways, the simplest and most convenient is the determination of the softening temperature, which is usually carried out to control the quality of the finished product.

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