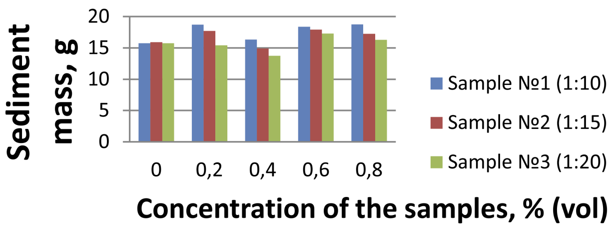

Fig. 1. *The amount of oil residue depending on the concentration*

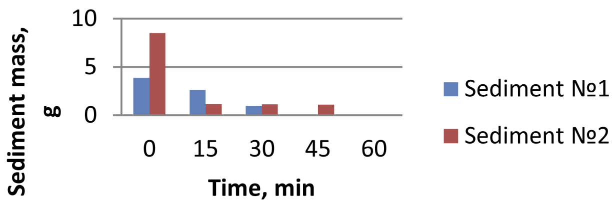

Fig. 2. *The amount of oil residue depending on the exposure time*

nus 10 °C. The experiment time is 40 minutes, the rods were removed from the metal cups and allowed to drain the residual oil for 10 minutes. Next, set the temperature of the "cold" rod plus 50 °C, collecting paraffins. The amount of sediment was determined by the gravimetric method. The inhibitory ability of HA was calculated by the formula:

$$I=(W_0-W_1)\cdot 100/W_0,$$

where I – is the inhibitory ability, %; W_0 – sediment yield for the original oil, g; W_1 – sediment yield for oil with an additive, g.

Figure 1 shows, that the greatest decrease in the amount of sediment caused by addition of sample №2 (0.4 % (vol.)). The inhibitory ability was 13 %. Evaluation of the dissolving ability was carried out according to a technique that allows to determine the ability of HA to keep in suspension the HMW compounds that are part of the ARPD. Oil residues of similar mass were collected in sieves and were lowered into a glass of HA with a volume of 50 ml for 15 minutes. Next, we established destruction, swelling and volume reduction in percent of samples. Then we repeated procedure for 15 minutes until the deposits were completely dissolved (figure 2).

The saturation of the solvent with HMW compounds was determined by the formula:

$$C_n=m/V\cdot 1000,$$

where m – is the mass of the sample, g; V – is the volume of solvent (V1+V2+...+Vn), sm^3.

According to the results of the experiment, it is also seen that the saturation of HA increased from 26, 34 to 148.60 g/sm^3, in proportion to the increase in the initial sediment volume. The dissolution time of the precipitate increased by 2 times. It was found that HA have an inhibitory effect. The most effective way is to add them in the ratio with NaOH (1 : 20), in an amount of 0.4 % (vol.). A further increase in concentration is impractical. Established humic acids dissolving ability, the time of which increases in proportion to the increase in the initial amount of sediment.

References

1. *Alimohammadi S., Zendehboudi S., James L. A comprehensive review of asphaltene deposition in petroleum reservoirs: Theory, challenges, and tips // Fuel, 2019.– V.2.– P.753–791.*

INVESTIGATION OF THE TEMPERATURE EFFECT ON CHARACTERISTICS OF THE PRODUCTS, OBTAINED BY UPGRADING STRAIGHT-RUN DIESEL FUEL ON ZEOLITE

I.A. Bogdanov, A.A. Altynov
Scientific supervisor – PhD, associate professor M.V. Kirgina
Linguistic advisor – PhD-student I.A. Bogdanov

National Research Tomsk Polytechnic University
634050, Russia, Tomsk, 30 Lenin Avenue, bogdanov_ilya@mail.ru

Providing remote regions with high-quality diesel fuel is very important task for the domestic oil industry, since at the moment, the cost of its transportation is a significant part of the cost of fuel sold in such areas.

The solution to this problem is also complicated by the need to supply low cold-test fuels, since

Table 1. Characteristics of feedstock diesel fraction and the obtained products

Characteristics		Diesel fraction	Product 1	Product 2
Cloud point	°C	–4	<–70	<–70
Cold filter plugging point		–5	–51	–58
Pour point		–16	<–70	<–70
Density at 15 °C	kg/m^3	836.5	835.0	851.0
Kinematic viscosity at 20 °C	mm^2/s	4.148	2.167	2.828
Sulphur content	mg/kg	3911	3741	3442

most of the remote regions are characterized by a rather harsh climate.

Existing processes for improve the low-temperature properties of diesel fuels, in particular, catalytic dewaxing, require the use of an expensive catalyst containing noble metals and hydrogen-containing gas, which makes the use of this process advisable only at major refineries, also it does not solve the issue of fuel transportation costs.

A promising direction in solving this problem is the use of small-tonnage units for the production of low cold-test diesel fuels operating without hydrogen-containing gas and using zeolites as catalysts.

The aim of this work was to study the temperature effect on characteristics of the products, obtained by upgrading straight-run diesel fuel on zeolite.

To assess the effect of temperature on the obtained products characteristics, the authors was implemented the process of upgrading diesel fuel, on a laboratory catalytic unit, under the following technological parameters:

1. Process temperature – 375 °C, pressure – 0.35 MPa, feedstock space velocity – 0,5 ml/min.
2. Process temperature – 425 °C, pressure – 0.35 MPa, feedstock space velocity – 0,5 ml/min.

A straight-run diesel fraction was used as the feedstock of the process, and a KN-30 brand zeolite catalyst was used as a catalyst.

The results of determining the characteristics of the feedstock and the obtained products are shown in the Table.

All presented characteristics were determined according to the procedures regulated [1].

From the results presented in Table it follows that in terms of low-temperature properties and viscosity, both obtained products meet the requirements for diesel fuel brand A (arctic), and for density values meet the requirements for brand W (winter) [1].

With increasing process temperature, an improvement in low-temperature properties is observed (CFPP decreases by 7 °C), but such indicators as density (increase by 16 kg/m^3) and viscosity (increase by 0.661 mm^2/s) deteriorate. It is also important to note that in the process of upgrading, the sulfur content decreases, and with increasing temperature this effect intensifies (decrease in sulfur content by 170 mg/kg and 469 mg/kg, respectively).

Thus, from the obtained results it can be concluded that the use of a KN-30 brand catalyst is promising for the upgrading of diesel fuel. From the presented process technological parameters, the most optimal are technological parameters №1.

References

1. *USS 305-2013 "Diesel fuel. Specifications".– M.: Standartinform, 2014.– 10 p.*