The importance of oil products use in the sphere of transport in the period from 2009 to 2050 is indicated in Figure 2 and Figure 3. In 2013 consumption of petrol in Transport will rise within 4%, in 2025 compared to 2009, but in 2025 is expected 2% decrease, in 2050 – 37% less than in 2009. Figure 3 shows resources used in Transport. Economic trends and prospects for the next years are for downturn in consumption of crude oil in all the industries but in Transport sector it is more considerable. In 2050 consumption of petrol is expected to be about twice less than in 2013. Respectively, the scale of usage bio and electric energy is rapidly going up.

Statistic information of the International Energy Agency and world population prospects of the United Nations gives a very reliable economic forecast for the consumption of crude oil for a long term period. It will decrease because of expected population downturn, innovations in oil refining and technology development in using green energy.

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LOW-TEMPERATURE PROPERTIES ESTIMATION OF DIESEL FUELS WITH THE APPLICATION OF COMPUTER MODELING SYSTEM OF CATALYTIC DEWAXING PROCESS

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Modern petroleum refinery industry has a tendency to the increase in oil convertion ratio and enhancement of resource efficiency. One of the most obligatory processes used widely to improve the properties of diesel fuels is the catalytic dewaxing technology. The quality of produced fuels must correspond to the technical standards and requirements for consumers' ability to use them in severe climatic conditions. Such low-temperature properties as freezing point (T_f), cold filtering plugging point and cloud point (T_c) are key characteristics of the ability of using diesel fuels in winter period [4].

Along with decreasing temperature a paraffin row of fuel composition primarily starts to transform into the solid condition. Among the main reactions the reactions, isomerization of n-paraffins C_5-C_{16} and hydrocracking of n-paraffins C_{17}-C_{27} have the crucial significance [2]. This work is devoted to the mathematical model development with the aim to optimize the catalytic dewaxing process and estimation of diesel fuel low-temperature properties. The work objective presumes the investigation of influence of the feed composition over the product (hydrodewaxed diesel fraction) composition, low-temperature properties and product yield. The study was carried out with implementation of the computer modeling system developed at the Department of Fuel Engineering and Chemical Cybernetics of Tomsk polytechnic university. In the mentioned system method of mathematical modeling is applied, which allows successfully conducting analytical description of processes taking place in the reactor.

Freezing point and cloud point strongly depend upon the number of n-paraffins C_{10}-C_{27} in the feed. The properties were determined for the feed entering the dewaxing reactor and for the product (unstable hydrogenate) leaving the reactor. To estimate the impact of feed composition on the above mentioned properties, five different feed stocks with various compositions were used. In addition, the feed flow rate, pressure in the reactor and the flow rate of hydrogen bearing gas were assumed constant while changing the temperature in the reactor.

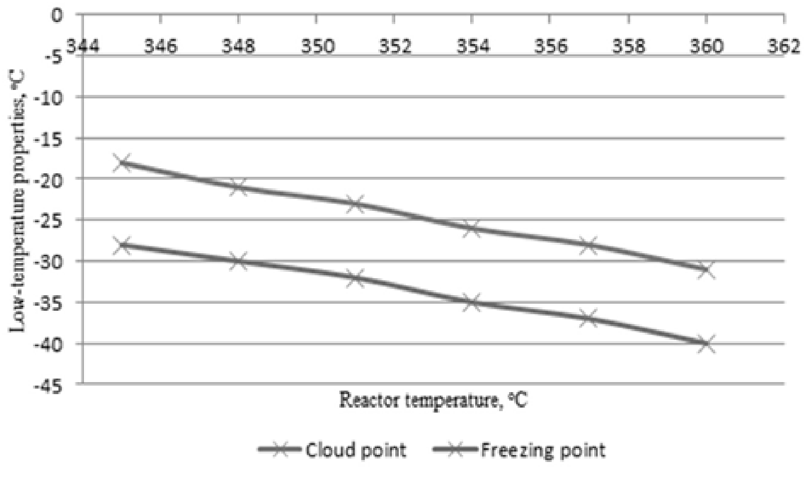

Fig. 1. Cloud and freezing points of diesel fraction leaving the reactor depending on the temperature in the reactor

Fig. 1 shows the relationship between cloud point and freezing point of the diesel fraction after the processes of isomerization and hydrocracking in the Ni-containing zeolite catalyst bed. Value of the feed flow rate was taken as 300 m^3/h; pressure in the reactor equals to 6.8 MPa; and feed of hydrogen bearing gas was taken equal to 20000 m^3/h. The graph illustrates information for one date, and the initial values of T_f and T_c amounted to -11 ^oC and -1 ^oC correspondingly. As it can be seen from Fig. 1, with increasing temperature T_f ranges from -28 ^oC to -40 ^oC and T_c declines from -18 ^oC to -31 ^oC. Diesel fuels with such temperatures are appropriate to the national standard №305-82 as winter fuels for temperate climatic zones.

Figure 2 represents correlation between the value of product yield and reactor temperature regime. The graph shows that yield slightly decreases with the rising temperature. For instance, at the temperature of 345 ^oC the yield has a peak at 61 % and it gradually reaches the value of 57 % at the temperature of 360 ^oC. Therefore, rise of temperature provides obtaining of the lower yield of the product with better low-temperature properties. To the contrary, decrease of temperature results in increased product volume with undesirable values of temperature properties.

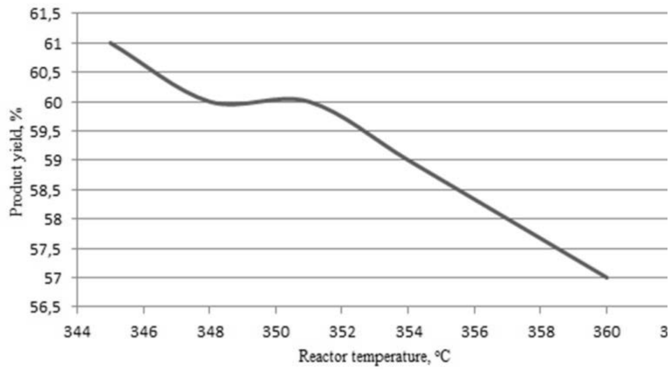

Fig. 2. Yield of diesel fraction leaving the reactor depending on the temperature of the reactor

The reasons for such relationships are explained by the mechanism of the reactions [1, 3]. Thus, temperature rise in the reactor leads to increasing of rate of high-molecular normal paraffin hydrocracking reaction. Also rate of conversion of these paraffins enhances. In its turn, this results in growing quantity of low-molecular n-paraffin, iso-paraffin and naphthene molecules, which contributes to the reduction of low-temperature properties. On the other hand, increasing temperature has a negative impact on the process selectivity, and hydrocarbon gases and hydrogen sulphide are formed. Consequently, the yield of the pure diesel fraction decreases.

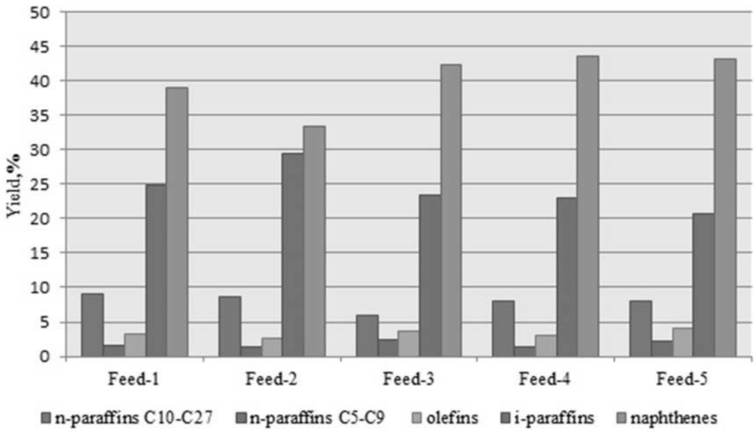

Fig. 3. Yield of hydrocarbon groups depending on feed composition during the catalytic hydrodewaxing process

The bar chart in Figure 3 shows the influence of feedstock composition on the yield (wt.%) of hydrocarbon groups in the diesel fraction. It is apparent from the chart that at constant technological conditions various feed composition has significant effect on the number of components in the product. For example, the yield of high-molecular n-paraffins ranges from 6 to 9.08 %, low-molecular paraffins yield varies from 1.3 to 2.5 %, isoparaffins yield – from 20.73 to 29.5 %, the yield of naphthenes amounts to 33.4-43.6 %. Sulphur content in the product also depends on the feed composition entering the reactor of hydrodewaxing.

It should be noticed that iso/normal paraffin ratio increases with the rising temperature in the reactor, while for the lighter commercial fractions (light naphtha, kerosene, etc.) this ratio decreases along the reactor. This phenomenon can be attributed to a higher rate of isomerization of long chain n-paraffins into isoparaffins [3].

To summarize, the composition of feedstock constantly changes. Therefore, the process of catalytic hydrodewaxing should be carried out at the optimal conditions, taking into consideration the difference in feed compositions. By doing this the main problems of process optimization are solved. Firstly, the maximum yield of the product with specified qualities is obtained. Secondly, effective resource utilization at production site is conducted.

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EFFICIENCY ANALYSIS OF NON-STATIONARY WATER FLOODING AS A HYDRODYNAMIC ENHANCED OIL RECOVERY METHOD IN WESTERN SIBERIA

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In this paper the applying non-stationary water flooding method effectiveness is described. At the first stage of research it was concluded that this method is characterized by low increasing of oil production in Western Siberia fields. In majority of cases non-stationary water flooding is applied in combination with injection of gel forming composition and acid treatment. For this reasons the net effect of the non-stationary water flooding is hard to be estimated [3]. Then the sector of multi-operated hydrodynamic model for Upper Jurassic reservoirs was created in simulation software "Tempest More ". The model parameters have been set on the basis of twenty five field static analysis. The objective of simulation is to perform the evaluation of non-stationary water flooding for specific geological and physical conditions. The reservoirs with various distribution of permeability (homogeneous, non-homogeneous, stochastic non-homogeneous) were examined [2].

The non-stationary water flooding is associated with the change of the filtration flow direction. In sector model both classic and our new non-stationary flooding technology schemes were used. These schemes consider geological and physical reservoir properties and also conditions of this method. [1].

For these environments a real development system with the five-point placement of wells has been selected. The hydrodynamic simulation was carried out for one year during the summer, after seven years of field development and watercut of 90%. As a result, after fifteen years of oil production the calculations indicate that non-stationary water flooding for these geological and physical conditions do not result in oil production increase (Fig.).

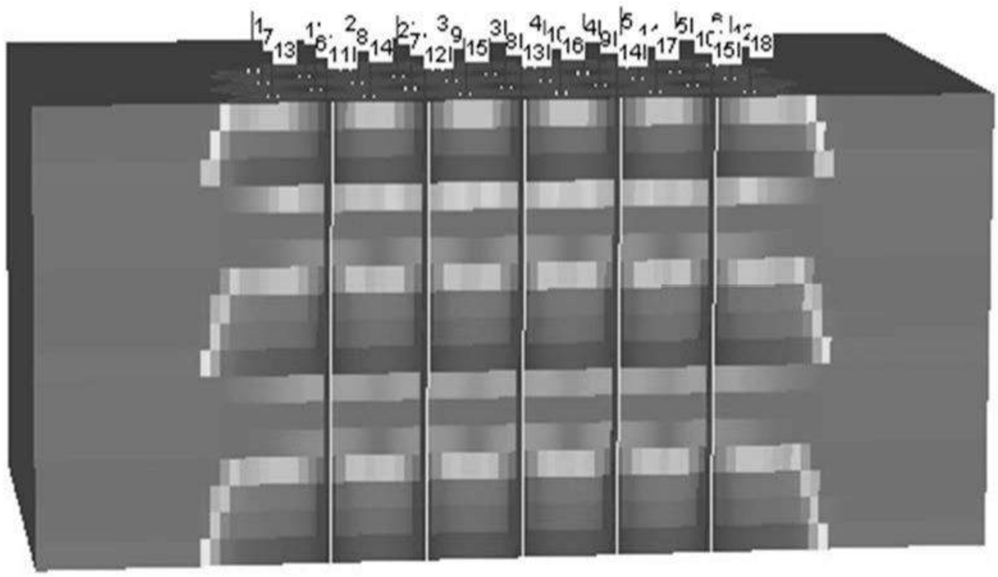

Fig. The basic variant of the model