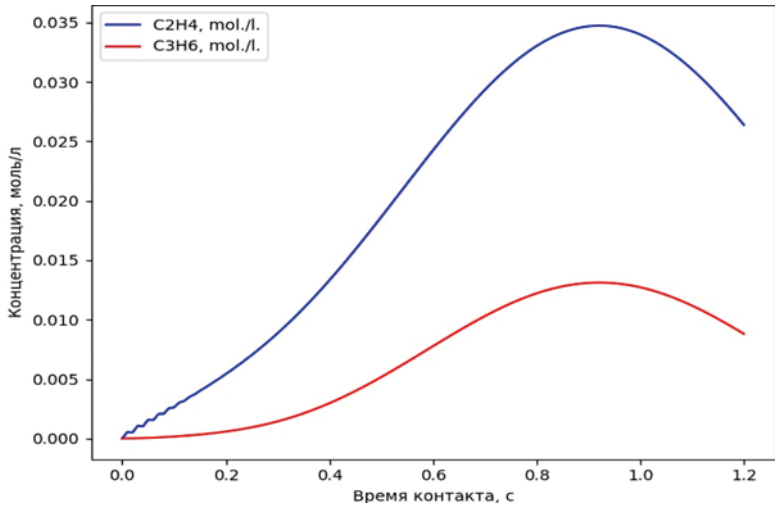

Fig. 2. *Ethylene and propylene concentrations dynamics*

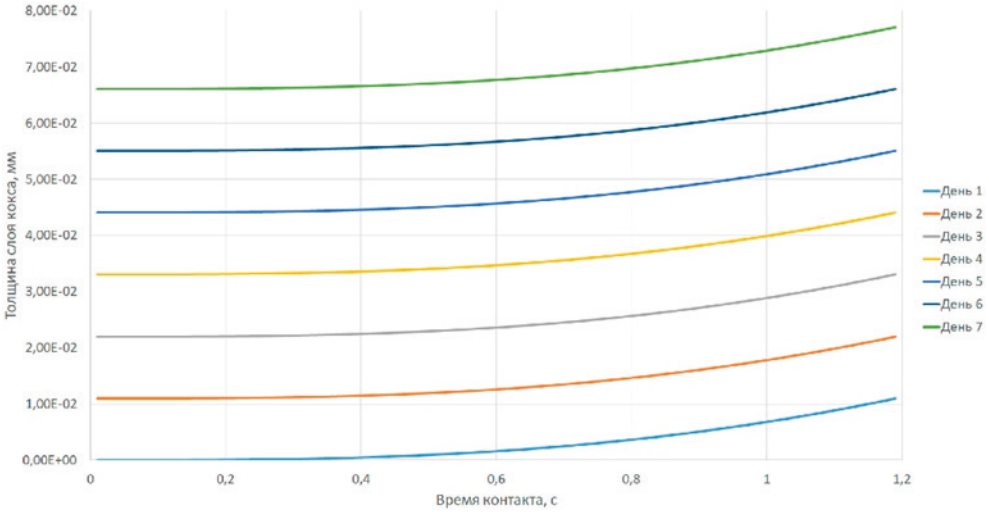

Fig. 3. *Накопление кокса в змеевике пиролиза в течение нескольких дней*

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MATHEMATICAL MODELING OF THE STABLE GAS CONDENSATE PROCESSING ON A ZEOLITE CATALYST

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One of the promising processes for producing high-octane components of gasoline is the process of processing stable gas condensate on zeolite catalysts, this process is called zeoforming. The main positive aspects of this process include high selectivity, stability of the process and high activity of the catalyst [1]. In addition to a number of positive qualities, zeolite catalysts also have negative ones,

such as a sufficiently high cracking capacity and rapid decontamination. The correct choice of optimal technological parameters will allow you to use only positive qualities while avoiding negative ones. The mathematical model will simplify the transition to industrial scale and facilitate the introduction of existing and operating production facilities [2].

The purpose of this work is to develop a mathematical model for the transformation of stable gas condensate, using the experience of industrial zeoforming plants and the technological parameters at which this process is implemented.

To achieve this goal, chromatograms of stable gas condensate and products of its processing on zeolite were analyzed at temperatures of 375 °C, 400 °C and 425 °C, a pressure of 0.25 MPa, and a volumetric feed rate of 2 h^{-1}.

To create a mathematical model, at the beginning, a thermodynamic analysis of the reactions occurring in the process under study was carried out. The thermodynamic calculation of the reaction parameters was performed using quantum chemical calculation methods. The results of the calculations are shown in Table 1.

Further, based on the literature sources and the thermodynamic parameters of the reactions, a formalized scheme of transformations of stable gas condensate on zeolite was compiled, presented in Figure 1.

The developed scheme of transformations became the basis for the kinetic model of the process under study.

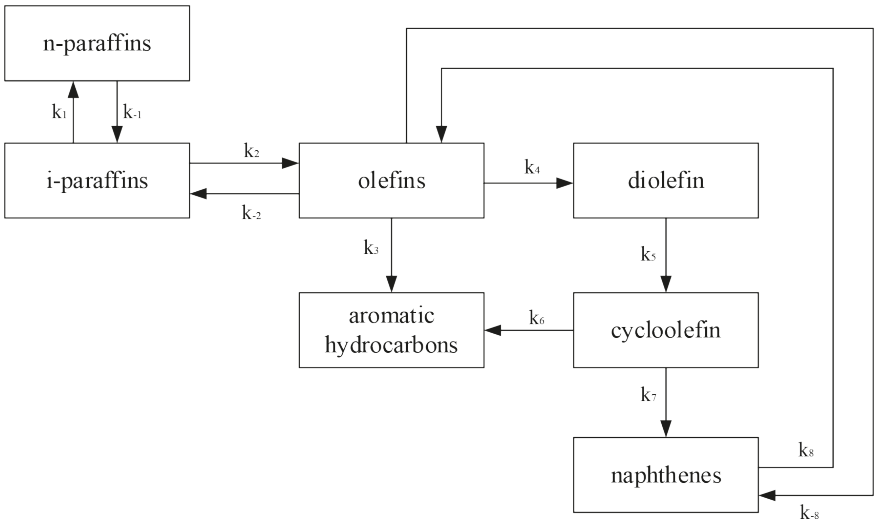

Fig. 1. *Formalized scheme of transformations of stable gas condensate on a zeolite catalyst: k_1–k_8 – rate constants of direct reactions; k_{-1}, k_{-2}, k_{-8} – rate constants of reverse reactions*

Table 1. Thermodynamic parameters of the reactions at 698 K

Reactions	Δ*H*, kJ/mol	Δ*G*, kJ/mol
N-paraffins = I-paraffins	11.162	–8.007
I-paraffins = Olefins	90.070	–17.027
Olefins = Aromatic hydrocarbons	–423.713	–327.707
Olefins = Diolefins	–24.042	–17.711
Diolefins = Cycloolefins	–154.795	–31.741
Cycloolefins = Aromatic hydrocarbons	–168.128	–153.029
Cycloolefins = Naphthenes	–168.128	–153.029
Olefins = Naphthenes	–211.364	–30.646

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RESEARCH OF THE ASSOCIATED PETROLEUM GAS CONVERSION INTO AROMATIC HYDROCARBONS ON A ZEOLITE CATALYST

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Oil production and refining processes have a strong impact on the environment due to the significant amount of associated petroleum gas that is flared [1].

The object of the study is the process of associated petroleum gas conversion into liquid hydrocarbons. This process makes it possible to efficiently utilize associated petroleum gas and obtain aromatic hydrocarbons – a valuable petrochemical feedstock. In addition, in the reactions of the process, a hydrogen-containing gas is formed, which is a high-energy fuel, which is increasingly being introduced into the structure of the world energy consumption. High activity and selectivity, as well as resistance to catalytic poisons characterize zeolite catalysts used in this process [2].

The aim of this work is to develop mathematical of associated petroleum gas conversion based on the approach presented in [3].

At the first stage of the work thermodynamic parameters of the reactions were calculated (Table 1) at the temperature of 520 °C and the pressure of 1.2 MPa.

Further, based on the literature and the thermodynamic parameters of the reactions, a formalized scheme was drawn up for the conversion of associated petroleum gas on zeolite.

The developed transformation scheme became the basis for a kinetic model of the process under study.

The system of equations of the kinetic model:

$$\begin{cases} \frac{dC_{paraffins\ C1–C2}}{dt} = -2W_1 + 2W_{-1} + W_3 + W_2 \\ \frac{dC_{paraffins\ C3–C5}}{dt} = -W_2 + W_{-2} - W_3 + W_{-3} \\ \frac{dC_{olefins}}{dt} = 4W_1 - 4W_{-1} - 4W_4 + 4W_{-4} + 4W_2 - 4W_{-2} \\ \frac{dC_{aromatic\ HC}}{dt} = -W_5 + W_4 + W_3 - W_{-3} - W_{-4} \\ \frac{dC_{H_2}}{dt} = W_1 + W_3 + W_4 \\ \frac{dC_{polyaromatic\ HC}}{dt} = -W_6 + W_5 - W_{-5} \\ \frac{dC_{coke}}{dt} = W_6 \end{cases}$$

The reaction rate equations are given in the table 2.