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## DEVELOPMENT A FORMALIZED SCHEME OF SUBSTANCES CONVERSION IN THE ZEOFORMING PROCESS OF STABLE GAS CONDENSATE

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The growing demand of automobile fuels leads to the development and search of new technologies for their production. The problem of rational use of associated petroleum gas and stable gas condensate is also growing every year. The combined solution to these problems is the use of stable gas condensate as a feedstock for the production of high-octane motor fuels components.

Stable gas condensates (SGC) are liquid products consisting mainly of  $C_{5+}$  hydrocarbons, which produced at oil, gas and gas condensate fields as by-products of natural gas preparation [1].

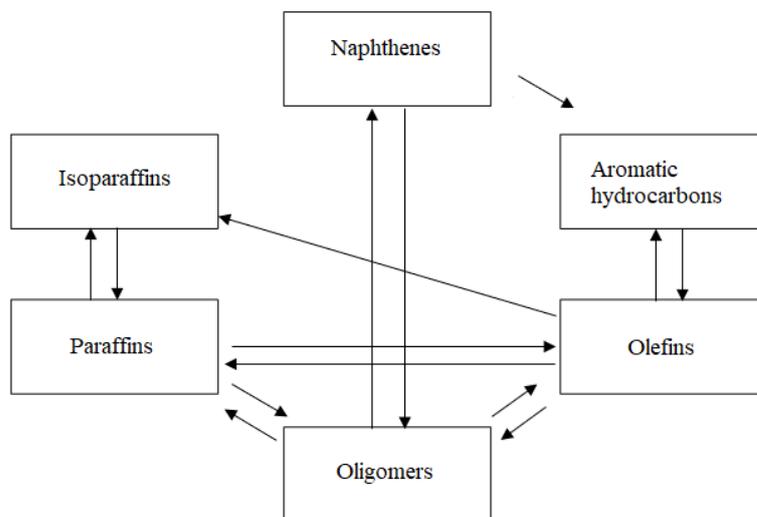
One of the most promising directions in terms of production the high-octane components of automobile gasoline is the processing SGC on zeolite catalysts – zeoforming process. The catalysts used in this process – zeolites, have acidic properties that provide a deep conversion of paraffins and olefins, as well as incomplete conversion of mono-methylparaffins and naphthenes [2].

The high-octane component of automobile gasoline obtained in the zeoforming process is characterized by a certain group composition and an octane number. These characteristics depend on the feedstock composition and may differ significantly at the processing of SGC obtained from different fields.

The aim of this work is to develop formalized scheme of substances conversion in the zeoforming process of SGC.

To achieve this goal, chromatograms of SGC and products of its processing on zeolite at a temperature of 375, 400, 425 °C, a pressure of 0.25 MPa, and a volume feed rate of 2 h<sup>-1</sup>, were analyzed [2].

As a result of the analysis of chromatograms, lists of substances whose content in feedstock and products exceeds 1 % by weight were compiled. The resulting list for feedstock includes 19 substances, including 11 paraffins, 1 olefin, 7 naphthenes; for products, it includes 34 substances, including 18 paraffins, 4 olefins, 6 naphthenes, 6 aromatic hydrocarbons.



**Fig. 1.** Scheme of SGC hydrocarbons conversion on the zeolite catalysts

At the next stage of the work, a list of theoretically possible reactions for converting feedstock into products was compiled for the selected hydrocarbons [3, 4].

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

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To begin with, a significant portion of associated petroleum gas was flared or used as the process fuel. Currently, due to the shortage of oil raw materials and toughening the requirements for environmental safety of enterprises and field production sites, the problem arises of developing processes for sustainable use of associated petroleum gas, such as conversion into various valuable products [1].

The aim of the work is to develop a formalized scheme of associated petroleum gas chemical conversion on a zeolite catalyst. To achieve this goal, the following tasks were set: the collection and processing of available information, as well as the formation of a table with data for the development of a mathematical model; compiling a list of possible reactions taking into account the characteristics of the catalyst. The object of research is the process of conversion of gaseous methane-ethane and liquid propane-butane fractions on a zeolite catalyst.

Zeolites are composed of cations of silicon and aluminum surrounded by four oxygen anions. During the catalytic process, the appearance of Brønsted Acids sites that are highly active in isomerization and cracking reactions occurs [2]. The presence of acid sites suggests that hydrocarbon

Thus, based on the literature review and thermodynamic analysis of the ongoing reactions, a group formalized scheme for the conversion of SGC hydrocarbons on a zeolite catalyst was compiled. The formalized scheme is shown in the Figure.

conversions on zeolite catalysts occur via an acid-base mechanism.

It should be borne in mind that the presence of ethylene in the initial mixture leads to a significant increase in the yield of aromatic hydrocarbons since ethylene has a high reactivity [3]. To this, we can add that the presence of ethylene in the initial mixture also allows immediately, when the mixture is loaded into the reactor, parallel to the first stage, the second stage is carried out, at which hydrogen redistribution reactions in unsaturated hydrocarbons occur with the formation of aromatic hydrocarbons.

In addition to the above transformations, acid dehydrogenation, dehydrocyclization, oligomerization, isomerization and alkylation reactions can also occur on acid sites.

Moreover, attention should be paid to the issue of catalyst deactivation Brønsted Acids because of coke formation. The process of coke formation is quite intense during cracking reactions, but it practically does not occur in hydroisomerization reactions. Since in the case of conversion of associated petroleum gas, most of the reactions are related to hydroisomerization. It can be said that catalyst deactivation will not occur intensively; however, in order for the model to be applicable for calculating