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INVESTIGATION OF THE INFLUENCE OF STABLE GAS CONDENSATE ZEOFORMING PROCESS TECHNOLOGICAL PARAMETERS ON THE OBTAINED PRODUCTS CHARACTERISTICS

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Introduction

- Stable gas condensates (SGC) are the liquids, which mainly consist of hydrocarbons C_{5+}. SGC are derived at the fields from natural gas as the by-products.
- The problem of stable gas condensate sustainable utilization is urgent and requires comprehensive solution.
- The existing ways of stable gas condensate use, such addition to the marketable oil in order to increase light products yield, addition to heavy oils in order to decrease the viscosity and improve the pumpability and processability, injection into oil-bearing formation for maintaining the reservoir pressure, do not ensure its sustainable utilization.
- Studying the properties of stable gas condensate and development of the technologies for its conversion into valuable products, such as the components of high-octane gasoline, are topical issues.
- In terms of high-octane gasoline components production, the most promising direction is conversion of stable gas condensate via the process of zeoforming on zeolite catalysts, which are characterized by high catalytic activity and are resistant to catalytic poisons.

Methods for determining the composition and properties of feedstock and products

To determine individual and group composition of the SGC sample and the zeoforming products the method of gas-liquid chromatography was applied (Chromatec-Crystal 5000 chromatograph with a quartz capillary column 25 m × 0.22 mm, stationary phase – SE-54, carrier gas – helium). Research octane number (RON), motor octane number (MON), Reid vapor pressure (RVP), density at 15 °C of the stable gas condensate and the zeoforming product were calculated throughout the composition using the software "Compounding" (Kirgina M.V., et al. *Chem. Technol. Fuels Oils*, **50(1)**, 2014, pp. 17-27.).

Composition and properties of studied SGC sample

Sample of stable gas condensate, using in the work, is being obtained as a by-product in the processing of commercial gas at one of the oil and gas fields in Siberia. Properties of SGC sample are shown in Table 1, group hydrocarbon composition are shown in Figure 1.

Table 1 – Properties of studied SGC sample

Properties	Value	Properties	Value
RON/MON	67.2/64.0	Density at 15 °C, kg/m^3	691.5
RVP, kPa	65.5	Benzene content, % vol.	0.17

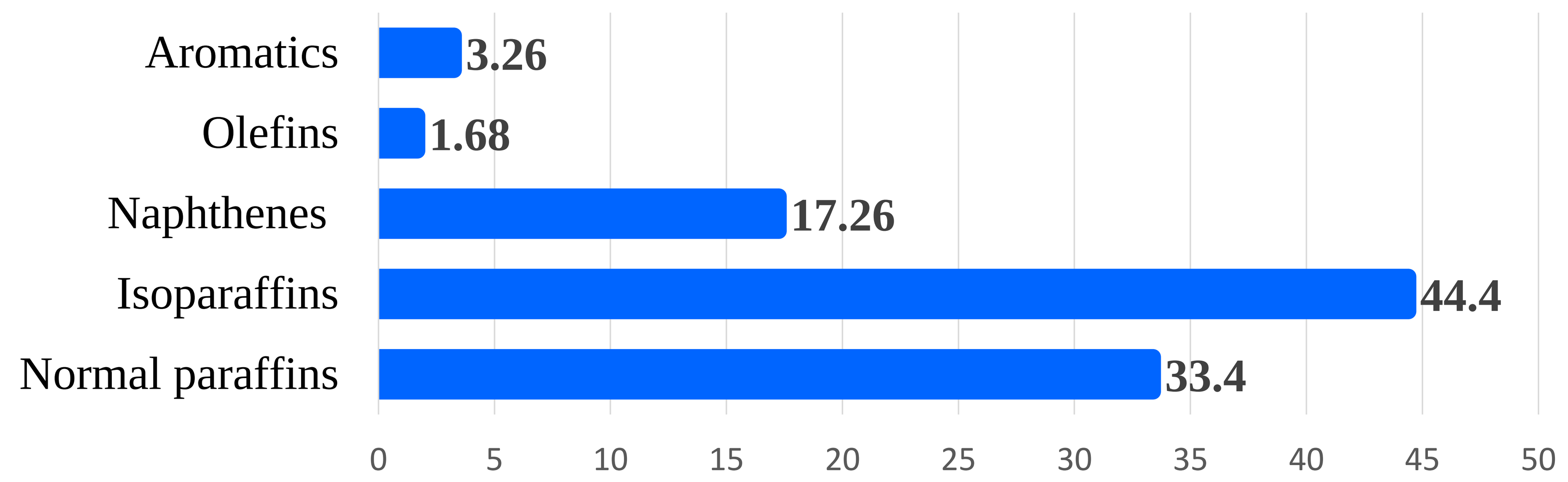

Figure 1 – Group hydrocarbon composition of studied SGC sample, % vol.

Experimental

Zeoforming of stable gas condensate was implemented at the continuous laboratory catalytic unit. To carry out the process a ZSM-5 type zeolite catalyst, produced by PJSC "Novosibirsk Chemical Concentrates Plant" (KN-30 brand) was used. For the investigation of the influence of stable gas condensate zeoforming process technological parameters on the obtained products characteristics some tests were carried out under conditions of process technological parameters variation. Table 2 shows the full technological parameters of the all tests.

Table 2 – Technological parameters of SGC zeoforming process

Test number	Temperature, °C	Pressure, MPa	Feedstock space velocity, h^{-1}
1	325	0.25	2
2	350	0.25	2
3	375	0.25	2
4	375	0.35	2
5	375	0.45	2
6	375	0.25	3
7	375	0.25	4

The authors thank PJSC "Novosibirsk Chemical Concentrates Plant" for providing samples of catalyst.

Results and discussion

Table 3 shows the properties of product obtained by zeoforming of SGC sample.

Table 3 – Properties of obtained products

Properties	Test number						
	1	2	3	4	5	6	7
RON	73.7	81.7	85.1	87.4	76.5	84.2	83.1
MON	70.4	77.2	79.9	82.6	71.8	79.7	78.8
RVP, kPa	85.8	119.6	117.2	151.1	62.7	139.8	134.7
Density at 15 °C, kg/m^3	684.2	696.8	713.5	706.9	724.9	694.8	692.9
Benzene content, % vol.	0.25	0.63	1.42	0.06	0.6	0.06	0.07

Figure 2 shows the group hydrocarbon composition of products obtained by zeoforming of SGC sample at variation of technological parameters.

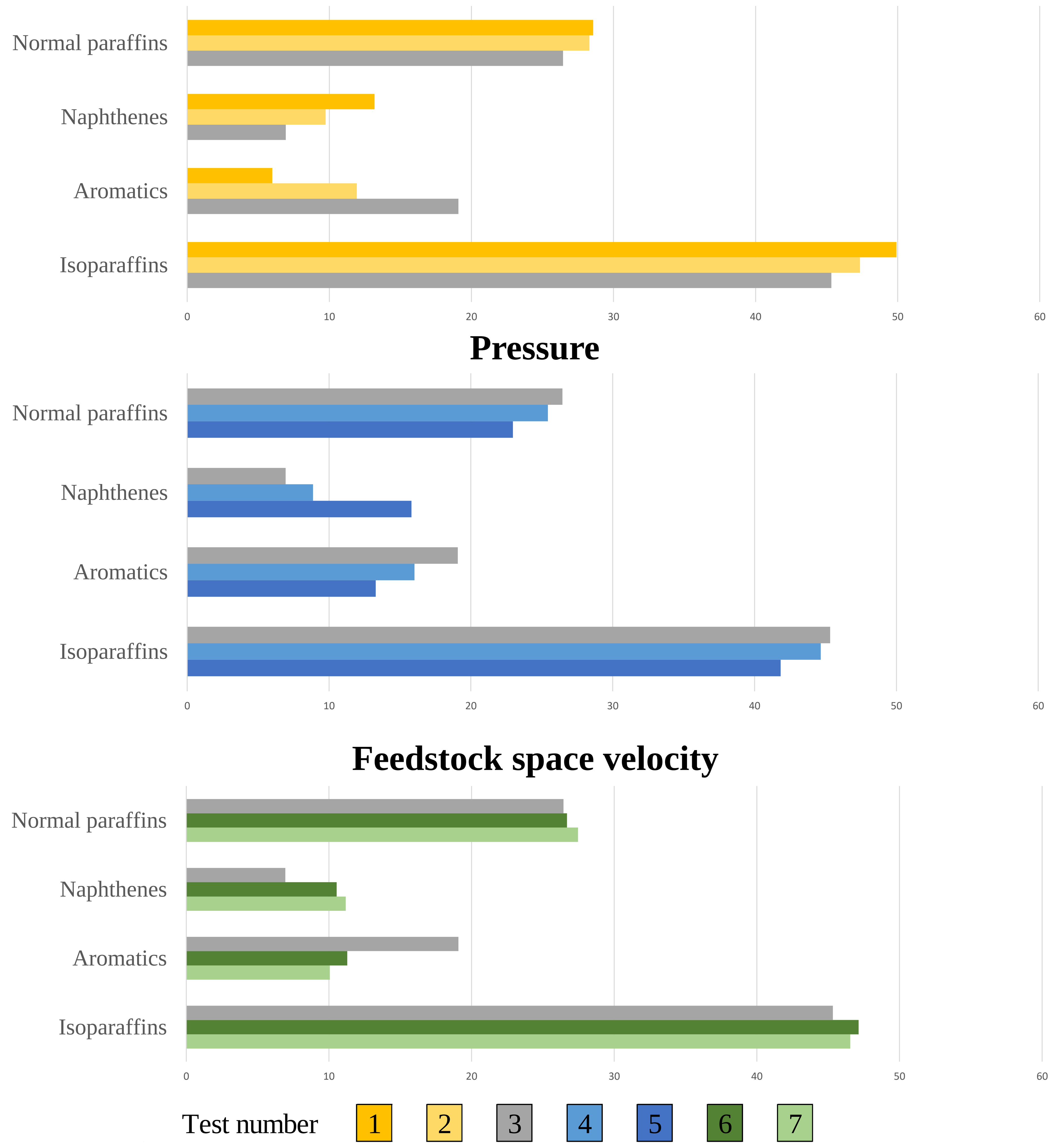

Figure 2 – Group hydrocarbon composition of products obtained at variation of technological parameters, % vol.

From the results presented in Table 2 and Figure 2 it follows that with an increase in the process temperature, the content of aromatic hydrocarbons sharp increases and the product octane number increases. With increasing process pressure, the content of aromatic and isoparaffin hydrocarbons in the product composition decreases, which entails a decrease in the octane number.

With an increase in the feedstock space velocity, the residence time of the feedstock in the reaction zone decreases and, as a result, the content of isoparaffinic increase and the content of aromatic hydrocarbons decrease. The obtained results indicate that at a feedstock space velocity of more than 2 h^{-1}, the residence time of the feedstock-catalyst is insufficient for the formation of aromatic hydrocarbons. With an increase in the feedstock space velocity to 4 h^{-1}, the content of isoparaffins in the product also decreases, which indicates that at a feedstock space velocity of more than 3 h^{-1}, the contact time is also insufficient for isomerization reactions.

From the point of view of gasoline production, it is important that the obtained product has a high octane number and at the same time low SVP and benzene content, since these indicators are strictly regulated by standards.

Thus, from the point of view of gasoline components production, the most promising of the presented products is the product obtained in the test No. 2. This product is characterized by a sufficiently high octane number and a relatively low SVP and benzene content.

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