

**PROGRESSIVE DECOMPOSITION OF C-C BONDS IN PROPANE-BUTANE
MIXTURES IN THE PRESENCE OF NON-METALLIC MODIFIED MESOPORUS
ZEOLITE CATALYSTS**

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Light olefins, including ethylene, propylene, butenes, and butadienes, are the main building blocks used in the chemical industry to produce polymers, solvents, construction, synthetic fibers, etc. [1-6]. Ethylene can be used to produce polyethylene, polyvinyl chloride, etc. Due to the increasing demand for polyethylene, ethylene production is expected to increase from 169 million tons in 2017 to 230 million tons in 2023. Propylene is used to produce polypropylene, acrylonitrile, etc. [7-11]. Annual butene production is around 132 million tons, among which isobutene is mainly used as a raw material for the production of alkylates [12-17].

The reaction was carried out in a quartz reactor (reactor diameter 12 mm) with a catalyst volume of 1 cm³. The size of the catalyst particles was 0.5-1.0 mm. Before starting the experiment, the catalyst was heated in a helium stream at 750 °C for 20 minutes. The reaction products were analyzed by gas chromatography every 10 minutes. The position, dispersion and structure of the active centers of the catalyst were examined using electron microscopy and electron diffraction. The composition of the starting and resulting compounds was analyzed by chromatography.

In order to reduce the formation of soot as a result of the catalytic high-temperature C-C bond cleavage of the propane-butane mixture, catalysts designed for the high-temperature cleavage of the transformed B propane-butane mixture were prepared and their effect on the formation of lower olefins was studied.

The effect of boron. The catalyst created for the decomposition of a propane-butane mixture at high temperatures is 5B-5%CoO*5%NiO*2%ZrO₂*8%Na₂SO₄ and 5B-5%CrF₃*CoF₂*5%NiF₂. The results of the high-temperature decomposition of a propane-butane

mixture with the cleavage of the C-C bond in the presence of 2%ZrO₂*8%Na₂SO₄ are presented in Tables 1 and 2. The data presented in Table 1 show that the introduction of 5% boron allows the decomposition of a propane-butane mixture at high temperatures with a decrease in the yield of the combustible substances. However, at the same time, the yield of the target products decreases significantly, especially in the relatively low temperature range of the process. At the same time, a decrease in the degree of conversion was noted.

Table 1

2*8%Na₂SO₄ on the yield of the main products as a result of the progressive decomposition of a propane-butane mixture with high- temperature C-C bond cleavage

Process conditions:					
Temperature, °C	600	650	700	750	800
Exposure time, s	0.24	0.24	0.24	0.24	0.24
Water vapor: reagent (initial substance)	0.4:1	0.4:1	0.4:1	0.4:1	0.4:1
Experiment results:					
1. Yield, %(mass) Gas, including					
H ₂	0.00	0.08	0.24	0.64	1.25
C H ₄	2.32	3.96	7.32	16.31	24.04
C ₂ H ₄	1.73	4.82	12.92	25.07	35.18
C ₃ H ₆	0.122	1.60	7.43	15.78	14.24
Σ C ₄ H ₈	0.05	0.26	0.29	0.36	0.77
resin	0.24	0.34	0.41	0.84	2.67
Ingredients	0.09	0.122	0.124	0.129	0.24
Σ	1.90	6.78	20.83	41.55	50.71
2. Unum Σ unsaturated hydrocarbons	3.53	10.33	28.20	59.16	78.77
S ₂ -S ₄ % (mass)					
3. Conversion rate, % (mass)					

Appendix 2

3*CoF₂*5%NiF₂*2%ZrO₂*8%Na₂SO₄ on the yield of the main products as a result of the progressive decomposition of the propane-butane mixture with high-temperature C-C bond cleavage

Process conditions:

Temperature, °C	600	650	700	750	800
Exposure time, s	0.24	0.24	0.24	0.24	0.24
Water vapor: reagent (initial substance)	0.4:1	0.4:1	0.4:1	0.4:1	0.4:1
Experiment results:					
1. Yield, %(mass) Gas, including					
H ₂	99.69	99.67	99.58	99.46	98.52
C ₂ H ₄	0.00	0.06	0.28	0.81	1.55
C ₃ H ₆	2.26	4.70	6.65	15.02	25.88
C ₄ H ₈	1.68	4.30	11.32	23.42	37.26
Σ C ₄ H ₈	0.09	1.48	6.10	15.67	14.45
resin	traces	0.05	0.128	0.24	0.94
Ingredients	0.24	0.24	0.32	0.42	1.26
2. Unum Σ unsaturated hydrocarbons	0.07	0.08	0.120	0.122	0.22
S ₂ -S ₄ % (mass)	1.78	5.87	17.74	39.61	53.33
3. Conversion rate, % (mass)	3.30	10.00	24.29	55.56	82.11

The results presented in Table 2, similar to the experimentally calculated data presented in Table 1, show a decrease in the formation of the complex. The catalyst 5%CrF₃*CoF₂*5%NiF₂*2%ZrO₂*8%Na₂SO₄, developed for the decomposition of a boron-modified propane-butane mixture at high temperatures, also allows for a decrease in the total yield of ethylene, propylene and unsaturated hydrocarbons. At the same time, a decrease in the degree of conversion was noted. An increase in temperature contributed to an increase in the yield and degree of conversion of lower olefins, i.e. low molecular weight unsaturated hydrocarbons, i.e. ethylene, propylene and butylenes, but their values were lower than those in the presence of catalysts developed for the decomposition of an untransformed propane-butane mixture at high temperatures.

Thus, catalysts designed for the decomposition of propane-butane mixtures at high temperatures, such as boron-transformed 5%CrF₃*CoF₂*5%NiF₂*2%ZrO₂*8%Na₂SO₄, are not used in the production of lower olefins due to their sufficiently low catalytic activity.

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