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P.A. Nadirov
Azerbaijan State University of Oil and Industry
Baku, Azerbaijan

N.M. Miriyeva
Azerbaijan State University of Oil and Industry
Baku, Azerbaijan
Kerem_shixaliyev@mail.ru

STUDY OF THE PROCESS OF ETHYLENE CONVERSION ON NAY SEOLITE AND ITS MODIFIED SAMPLES

Abstract: *NaH zeolite was modified using the ion exchange method and NaHY and NaLaY catalyst samples were synthesized. The activity of primary NaY zeolite and its synthesized samples has been extensively studied in the process of ethylene conversion. It was found that the modified samples had a higher activity than the original NaY sample. The highest selectivity for aromatic hydrocarbons belongs to the NaLaY (2% La) sample. In the presence of the above sample, the yield of benzene and toluene from the process was 25.3 and 34.5% (3500C, 1 atm. Pressure), respectively.*

Key words: *catalysis, zeolite, ethylene. oligomerization, aromatization.*
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Introduction

As is known, zeolite-containing catalysts are widely used in various fields of the petrochemical industry. One of the urgent issues in this direction is the process of oligomerization of small molecular weight olefins on zeolite catalysts and their transformation into more valuable substances.

In the presented work, H-form (NaHY) and La-form (NaLaY) of NaY zeolite catalyst were synthesized using ion-exchange method. The synthesized samples and the initial NaY sample were studied in detail in the process of ethylene conversion [1-3].

The experimental part

To synthesize a NaHY sample, the powdered primary NaY zeolite was treated with NH4Cl solution (1N). The ion exchange process was carried out at a temperature of 800 C with continuous stirring. The process was carried out within 10 hours by replacing the solution with a new one. After the ion-exchange process was completed, the solution was filtered and the obtained solid mass was dried in an oven at 1300C. The synthesized catalyst sample was then prepared for the process. NaLaY (2% La) catalyst samples were synthesized by the same method. Here, the initial NaY sample was treated with a solution of LaCl2 (0.1N) salt. The solid obtained at the end of the process was dried and then incinerated at 5500C. Finally, the synthesized sample was prepared for the process by forming granules of about 2 mm in size.

The activity of the synthesized catalyst samples has been extensively studied in the process of ethylene conversion. The process was carried out in a flowing laboratory facility at atmospheric pressure and in the temperature range of 150-5500 C. At this time, the volume of gas supplied to the reactor was taken as 1800 h. Analysis of gas and liquid products from the process was carried out using the chromatographic method.

Results obtained and their discussion

Studies have shown that all three catalyst samples are active in this process. Figure 1 shows the temperature dependence of the conversion rate of ethylene on the studied catalyst samples

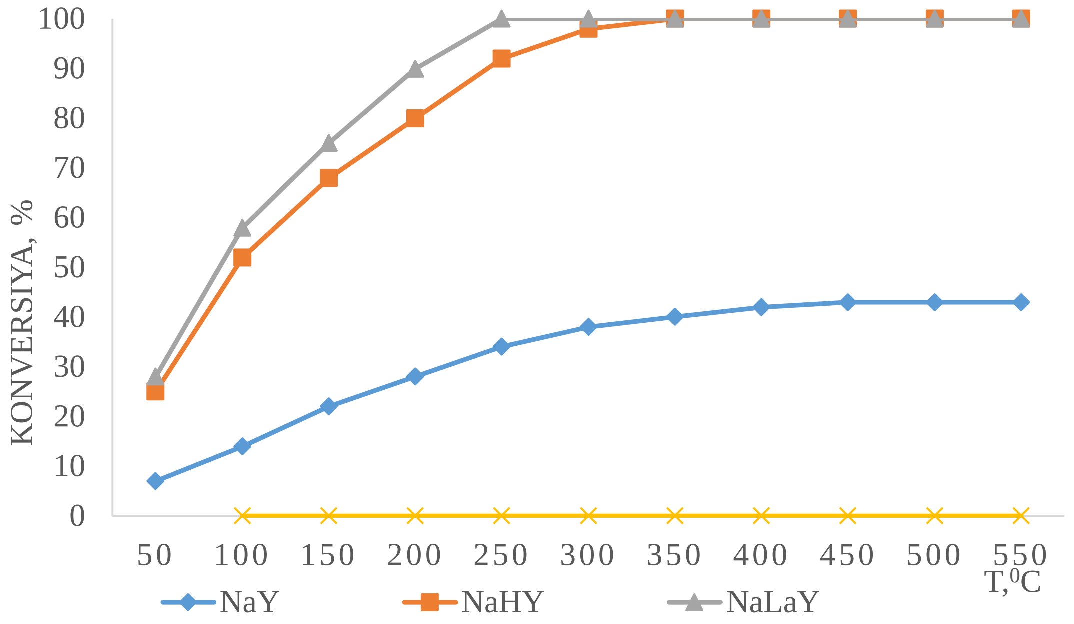

Figure 1: Temperature dependence of the rate of conversion of ethylene on NaY, NaHY and NaLaY catalyst samples

As can be seen from the figure, the maximum conversion rate of ethylene on the original NaY sample was about 43%, while on other samples it was 100%.

Studies have shown that oligomerization of ethylene occurs on primary NaY, NaHY and NaLaY samples up to 2500C. The reaction products obtained in this case and their output are given in Table 1.

Table 1. Results of conversion of ethylene on catalyst samples of different composition (t = 250oC, volume speed = 1800 hours-1)

Catalyst sample	Exit , %					
	$\sum C_2$-C_4	$\sum C_4H_8$	$\sum C_4H_{10}$	i-C_5H_{12}	$\sum C_6$-C_8	$\sum C_{8+}$
NaY	2,2	86,2	8,0	2,6	1,0	0,0
NaHY	7,6	22,4	8,5	20,6	26,4	14,5
NaLaY	5,3	14,5	6,3	12,7	28,6	32,6

As can be seen from the results given in Table 1, ethylene is mainly dimerized on the initial NaY sample at this temperature. In this case, the high yield of high molecular weight hydrocarbons from the conversion of ethylene on decanted catalyst samples (NaHY, NaLaY) suggests that the process is characterized by a more complex mechanism in the presence of these samples. Thus, in this case, along with the oligomerization reaction, we can say that isomerization, disproportionation and cracking reactions occur in parallel [3-5]. As can be seen from the results given in Table 1, at the indicated temperature

It was found that at temperatures above 3200C, the yield of the liquid product begins to increase, and this is observed up to 4500C. The decrease in the yield of liquid products at relatively high temperatures (450-5500C) can be explained by the production of small molecular weight hydrocarbons as a result of the acceleration of the cracking reaction.

It was determined that the liquid product obtained from the process at a temperature of 3500C consists of benzene, toluene, ethyl-benzene, methyl-ethyl-benzene and aliphatic hydrocarbons. Table 2 shows the yield of liquid products obtained from the conversion of ethylene to catalyst samples at a temperature of 3500C.

Table 2. Yield of liquid products obtained from the conversion of ethylene on catalyst samples of different composition (t = 350oC, volume rate = 1800 hours-1)

Catalyst sample	Exit , %					
	benzol	toluol	etil-benzol	metil-etil-benzol	alifatik karbohidro genlər	ksilollar
NaY	4,4	6,2	2,4	1,2	85.6	0,2
NaHY	23,6	28,4	6,5	4,6	30,4	6,5
NaLaY	25,3	34,5	8,3	12,6	11,7	7,6

As can be seen from the results in Table 2, the highest yield of aromatic hydrocarbons corresponds to the NaLaY catalyst sample.

The end result

Thus, based on the results of the conversion of ethylene on a given catalyst sample, we can say that at relatively low temperatures (50-1500C) olefin dimerization occurs mainly. However, at relatively high temperatures (200-3500C), isomerization, disproportion and cracking reactions are accelerated in parallel. It was found that the initial NaY sample had low activity in this process. In its presence, the maximum value of the conversion rate of ethylene was only 43%, and the reaction product consisted mainly of aliphatic hydrocarbons. The conversion rate of ethylene on NaHY and NaLaY samples was 100%. The formation of aromatic hydrocarbons on these samples is observed starting from 3200C, and the highest selectivity corresponds to the NaLaY sample. The yield of benzene and toluene obtained from the conversion of ethylene in the presence of the above sample was 25.3 and 34.5%, respectively.

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