CREATION OF NEW HETEROGENEOUS CATALYTIC SYSTEMS FOR ACETYLENE AND ACETYLENE AMMONOLYSIS

Komiljon Soatboev
Tashkent State Technical University named after Islam Karimov

Abdulla Daddahodjaev
Tashkent State Technical University named after Islam Karimov

Elmurod Egamberdiev
Tashkent State Technical University named after Islam Karimov

ABSTRACT

Important scientific basis for the selection of catalysts for the hydration of acetylene in the vapor phase. Today, despite the existence of a number of theories on catalyst selection, catalysts for complex parallel and sequential processes are mainly selected empirically. The important scientific basis of the choice of catalysts for the hydration of acetylene in the vapor phase is shown, and the results of the hydration of acetylene in the presence of mono- and bifunctional catalysts in the vapor phase are analyzed.

Keywords: iron, zinc and nickel oxides, mercury, cobalt, palladium, rhodium, chromium, titanium.

INTRODUCTION

The process of hydration of acetylene is a complex sequential process, which includes steps such as addition of water to three bonds, isomerization, and dehydrogenation. Such a process can be carried out only in the presence of catalysts with polyfunctional properties in the vapor phase.

Studies have been conducted on the selection of polyfunctional catalysts for the catalytic hydration reactions of acetylene to acetaldehyde and acetone. The composition and properties of the synthesized catalysts are given in Table 1. As a result of the acetylene hydration reaction, the formation of acetaldehyde or acetone has been shown, depending on the composition and nature of the catalyst used under the same conditions. The effect of temperature, catalyst size, reactor parameters, and catalyst layer heights on the technological parameters of the process was studied. Acetone production efficiency and selectivity increases up to 430oC. When the temperature exceeds 430°C, the yield and selectivity of the resulting acetone decreases due to its

conversion to other substances. Table 1 shows the effect of catalyst active components on the yield of reaction products. As can be seen from the table, in the presence of catalyst No. 14 containing iron, zinc and nickel oxides, the yield of acetone formation is 86.4%, and the conversion of acetylene is 94.8%.

The catalytic properties of various substances in the transformation of acetylene depend on the mechanism of activation of reagents and the reactivity of intermediate substances. Acetylene chemistry uses metal complexes, acid-base catalysts, salts, and metal catalysts. A complex of mercury, cobalt, palladium, rhodium, chromium, titanium and other metals acts as a catalyst in the reactions of acetylene in the liquid phase.

The hydration reaction of acetylene is a complex sequential and parallel reaction, which includes the addition of a nucleophilic agent (water) to acetylene, isomerization, condensation (formation of aldol and croton aldehyde), ring formation (paraldehyde), decarboxylation and dehydrogenation. Such processes can be carried out in the vapor phase with the presence of polyfunctional catalysts. Based on the above, the role of each component in the activation of elementary steps in the formation of acetaldehyde and acetone is taken into account when choosing a catalyst. In this process, newly developed cadmium catalysts for the hydration of acetylene in the vapor phase direct the process towards the formation of acetaldehyde and zinc catalysts.

Hydration of acetylene in the presence of a multicomponent catalyst has not been sufficiently studied. A mixture of acetaldehyde and acetone is obtained as follows. Acetylene is mixed with water vapor at 75-90 ºC in the ratio of 1:5÷1:10 and passed over the catalyst at 360 ºC at a volume rate of 160-200 h-1. The vapor-liquid mixture leaving the reactor is cooled in a cooler. It contains a 10-18% mixture of acetaldehyde and acetone in water. By-products are croton aldehyde, paraldehyde, etc. Acetaldehyde and acetone are separated from the reaction products by means of rectification. To keep the acetylene conversion around 80%, the process temperature is increased by 10 ºC every 30 hours. After 150-180 ºC, the conversion of acetylene decreases to 70%. This will stop the process. Nitrogen is passed through the system and the catalyst is regenerated for 8-12 hours. The effects of temperature, acetylene:water ratio, volume velocity, height of the catalyst layer, etc., on the yield of target products were studied.

Effect of temperature on yield of target products and acetylene conversion. 14 – catalyst. C_2H_2:H_2O = 1:5, $V_{C_2H_2}$ = 180 hour^{-1}.

Table-1

№	Temperature, ^{0}C	Selectivity, %		Acetylene conversion, %
		On acetone	According to acetaldehyde	
1	320	2,0	30,0	35,0
2	340	8,0	37,0	50,0
3	360	23,0	67,0	80,0
4	380	42,0	49,0	92,0
5	400	56,0	27,0	94,0
6	420	72,0	8,0	95,0
7	440	83,0	2,0	94,0
8	480	75,0	-	95,0

As can be seen from the table, increasing the temperature from 320 to 440ºC causes an increase in the yield of acetone. The selectivity of acetaldehyde formation increases steadily up to 360ºC, and then decreases significantly, which indicates the presence of sequential and parallel processes.

Systematic studies are conducted to create mono- and bifunctional homogeneous and heterogeneous catalysts for the synthesis of acetaldehyde, acetone, and pyridine bases. Methods of analysis and verification of the obtained products and synthesized catalysts have been developed.

Physico-chemical (composition, surface area, mechanical strength, surface acidity, x-rays, derivatograms, etc.) and usage characteristics (catalyst composition, antigen conversion) of the created catalysts were studied. Studies on the thermal synthesis of catalysts were carried out in the Paulik-Paulik and Erdey (VXR) derivatograph, and 3 endo and 2 exothermic effects were noted. As the time of using cadmium-zinc-aluminum catalysts increases, their mechanical strength increases (12 kg/cm2 for 200 hours) and at the same time its specific surface (from 151.6 to 97.2 m2/g) decreases.

REFERENCES:

1.E.Egamberdiev, S. Turabdjanov, D. Mirzaeva, Kh. Khaydullaev, U. Sharipova, A. Shokhakimova, and O. Bakhtiyorov.: Effect of chitosan substance on the mechanical properties of paper obtained on the basis of flax cellulose. E3S Web of Conferences 371, 01045 (2023) https://doi.org/10.1051/e3sconf/202337101045

2. Egamberdiev E.; Ergashev Y.; Turabdjanov S.; Abdumavlyanova M.; Makhkamov A.; Rashidov, Sh.; Karimov, Sh.: Effect of chitosan on the surface properties of

cellulose-based paper obtained from the flax plant. E3S Web of Conferences 371, 01010 (2023) https://doi.org/10.1051/e3sconf/202337101010
3. Ergashev Y.; Egamberdiev E.; Mirkhodjaeva D.; Akmalova G.; Umarova M.; Kholdarov R.: Obtaining a filter material used in gas and air purification. E3S Web of Conferences 371, 01012 (2023) https://doi.org/10.1051/e3sconf/202337101012
4. Igamqulova N.; Mengliev, Sh.; Egamberdiev E.: Reduction of waste disposed to the environment through recycling of unused methyldiethanolamine. E3S Web of Conferences 371, 01049 (2023) https://doi.org/10.1051/e3sconf/202337101049
5. Arslanov, Sh.; Turabdjanov S.; Azimova, Sh.; Azimov D.; Sultankhojaeva N.; Egamberdiev E.: Physico-chemical properties and research of acids contained in oils of Uzbekistan. E3S Web E3S Web of Conferences, 2023, 371, 01021, DOI 10.1051/e3sconf/202337101021
6. Egamberdiev E.; Turabdjanov S.; Akmalova G.; Mukhtarova N.; Ayubova I.; Mirzakhmedova M.; Rakhmonberdiev G.: Obtaining paper from composition of different fibers and its analysis. E3S Web of Conferences, 2023, 371, 01004, DOI 10.1051/e3sconf/202337101004
7. Ergashev Y.; Egamberdiev E.; Turabdzhanov S.; Akmalova G.; Isanova R.; Rashidov R.; Sobitov O.: Obtaining filter material from natural fiber composition and areas of its use. E3S Web of Conferences, 2023, 371, 01047, DOI 10.1051/e3sconf/202337101047