ХИМИЧЕСКИЕ НАУКИ

SYNTHESIS OF ALIPHATIC ALCOHOLS ON THE BASE ON ETHYLENE

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DOI: 10.31618/nas.2413-5291.2020.2.60.302

ANNOTATION

Synthesis of 2-methylpropanol-1 from ethylene and ethanol at high pressure was investigated. The process parameters were determined and the effect of temperature and reaction time on the product yield was studied.

Key word: ethylene, ethanol, synthesis on the base of ethylene, telomerization, high - pressure and catalytic reactions.

Saturated monatomic alcohols are a great practical importance on an industrial scale. For example: isopropyl alcohol is used as a raw material in medicine, the chemical industry and at production of acetone; isoamyl alcohol - in the production of validol, solvents, carbon dioxide and in the perfume industry; isomers of octyl alcohol are plasticizers, surfactants, perfume compositions, etc. [1-4].

It should be noted that from aliphatic alcohols only methyl and ethyl alcohols are produced in the Republic, but other aliphatic alcohols necessary for various industries are not produced. It is necessary to note that the highest aliphatic alcohols and compositions on their base, including isopropyl, octyl, lauryl alcohols are used as surfactants, plasticizers, flotation agents and they are imported. In the Republic there are possibilities for the production of these alcohols on the base of local raw materials [5,6].

Saturated alcohols were synthesized from ethanol and at this acetone, compounds of titanium and aluminum were used as catalysts [1].

One of the unconventional ways of produce alcohols necessary for industry is telomerization reactions. In this case more high-molecular alcohols are synthesized. Ethylene is used as telogen and raw - materials at production of propanol and butanol. Organic peroxide is used as a catalyst. The process was carried out mainly at temperature 100° C, pressure of 6.0 MPa and reaction time of 1-6 hours, and various telomeres corresponding to the initial alcohol are formed [2]. The type of product has depended on the process temperature, ethylene pressure and especially the reaction time. By selecting technological parameters it is possible to control the type and volume of products.

The process can be presented in general by the following reaction equations:

$$CH_3{-}CH_2OH + H_2C{=}CH_2 \xrightarrow{P,T,K} C_3H_7OH$$

$$CH_3{-}CH_2OH + 2H_2C{=}CH_2 \xrightarrow{P,T,K} C_4H_9OH$$

$$CH_3{-}CH_2OH + 3H_2C{=}CH_2 \xrightarrow{P,T,K} C_8H_{17}OH$$

$$CH_3{-}CH_2OH + 4H_2C{=}CH_2 \xrightarrow{P,T,K} C_{10}H_{21}OH$$

The telomerization reaction has included following stages with the participation of ethanol and ethylene:

$$C_2H_5OH + C_2H_4 \xrightarrow{P,T,K} C_4H_9OH \xrightarrow[P,T,K]{H_2C{=}CH_2} C_6H_{13}OH \xrightarrow[P,T,K]{H_2C{=}CH_2}$$

$$\longrightarrow C_8H_{17}OH \xrightarrow[P,T,K]{H_2C{=}CH_2} C_{10}H_{21}OH \xrightarrow[P,T,K]{H_2C{=}CH_2} C_{12}H_{25}OH$$

Synthesis of 2-methylpropanol-1 using this method is important, isobutyl alcohol is used in various industries, it can also replace butanol-1, due to its low cost. In addition to nitrocellulose, rubber, and printing inks [3], it is used as a component of varnish, a gel-like liquid, as a paint remover, and in perfumes [7].

The process was carried out in a sealed reactor at high pressure. Ethyl alcohol and gaseous ethylene were used as the initial materials [8,9]. Synthesis of 2-methylpropanol-1 was performed under various conditions: temperature of 30-100° C and pressure of 10-40 ATM., the reaction duration was 2-6 h. The influence of the reaction time on yield of 2-methylpropanol-1 was studied (Fig. 1).

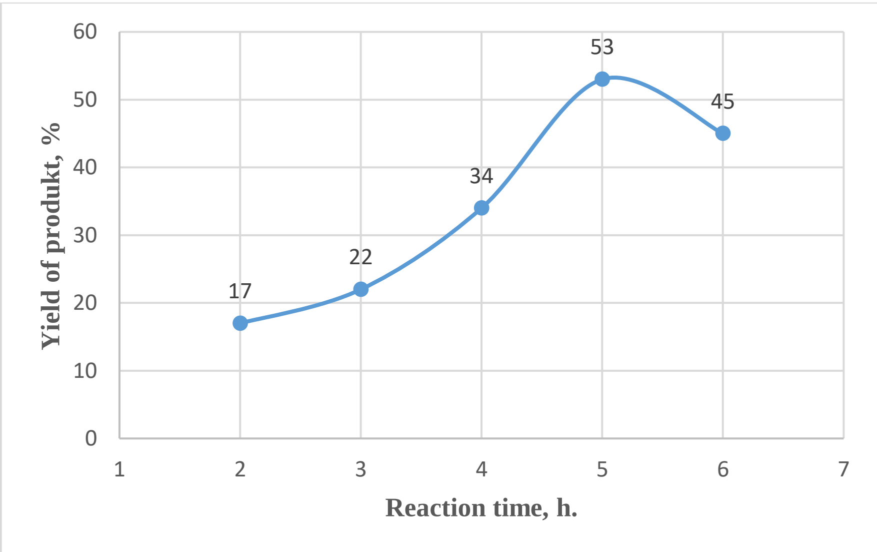

Fig. 1. Influence of reaction time on yield of 2-methylpropanol-1

With increasing reaction time from 2 to 6 h. the yield of 2-Methylpropanol-1 has increased from 17 to 53%. A further increasing reaction time caused decreasing of yield of the product: for example, during 6 h. the yield was equaled 45%.

The influence of temperature on the product yield was also investigated. Experiments were performed in the range of 30-80° C (Fig.2).

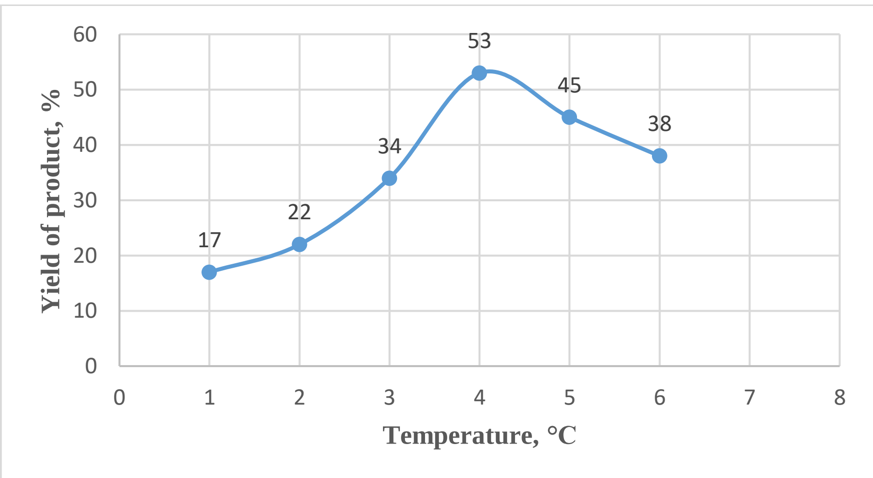

Fig.2. Influence of temperature on the yield of methylpropanol-1

During of experiments optimal conditions namely temperature 60° C, pressure of 10 ATM. and a reaction time of 5 have been determined.

The structure of synthesized 2-methylpropanol-1 was proved by IR spectroscopically (Fig. 3).

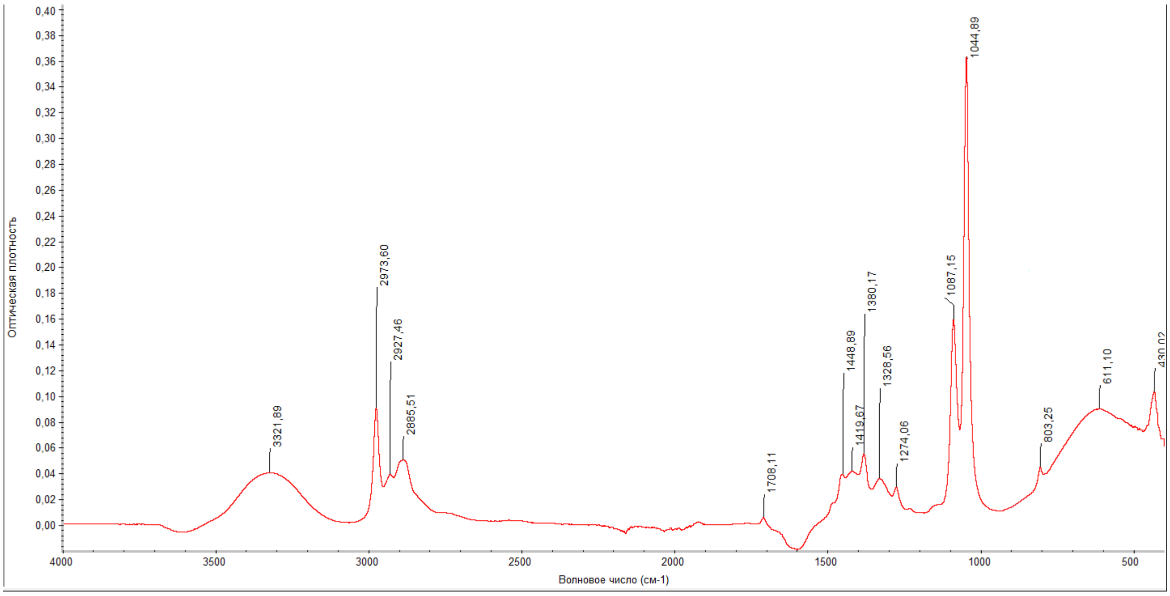

Fig.3. The IR spectrum of 2-methylpropanol-1

Spectrum analysis showed that the intense signal of the hydroxyl group of 2-Methylpropanol-1 in the IR spectrum was observed in the region of 3321 cm^{-1}, the intense valence vibration signal of the hydroxyl group (C-OH) bound of to carbon was observed in the region of 1044 cm^{-1}. The signal of asymmetric stretching vibrations of methylene group (CH_2) was observed in the region of 2927 cm^{-1} with high intensity, the signal of spindle oscillations was observed in 1328 cm^{-1}, stretching vibrations of methine group (CH) under 2885 cm^{-1}; asymmetric stretching vibrations of methyl group (CH_3) were observed in the range of 2973 cm^{-1} with high intensity, the signal of asymmetric and deformation vibrations were observed in the range 1448 cm^{-1}.

Thus, the synthesis of 2-methylpropanol-1 on the base of ethylene and ethanol was investigated. The influence of reaction time and temperature on the product yield was determined, the process was optimized and the structure of obtained products was proved using IR spectroscopy.

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