Journal of Engineering and Applied Sciences 11 (Special Issue 1): 2876-2877, 2016
ISSN: 1816-949X

KA_{co} Zeolite Adsorption of Ethyl Alcohol

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Abstract: The present research considers influence of water concentration on adsorption process. It is proved that adsorption takes place due to molecular gate properties of KA_{CO} zeolite and KA_{CO} zeolite adsorption efficiency depends on water concentration. The concentration degree is statistically discovered. If water concentration in ethyl alcohol exceeds 10%, the phenomenon of alkaline formation is observed. Zeolite is regenerated at 300-350°C. The obtained data were verified by series of tests with the varying water concentration. On the basis of the conducted research alcohol liquid desiccation units for wells and main compressor stations are offered.

Key words: Zeolite, ethanol, adsorption, molecular gate properties, KA_{CO}

INTRODUCTION

It is known that use of adsorbents for natural gas dehydration from moisture and liquid hydrocarbons has great industrial value. But, except natural gas dehydration the oil and gas entities face a number of problems with the organic substances (alcohols) connected with dehydration which are one of the main links of engineering procedures on production and gas transportation. And, as organic liquids moisture content substantially changes properties of alcohols, need of their dehydration is extremely urgent task for oil and gas entities which use rather large volumes of alcohols, spirit solutions being inhibitors of hydrate formation (Paranuk and Saavedra, 2015).

In this regard, it is possible to note that the dehydration of natural gas solid adsorbents has great theoretical and practical base which allows to build adsorptive units and adsorptive filters for dehydration of various environments (Paranuk *et al.*, 2015). And these units very often are used on objects of transport and natural gas production. And here the azeotropic solutions or units for dehydration of alcohols and solutions are scarce. It is connected with rather difficult mathematical adsorption process description of solutions on solid adsorbents and with theoretical and practical base which, in our opinion? Is incomplete, therefore it is necessary to engage extremely urgent in development and search of perspective adsorbents for implementation of this task.

MATERIALS AND METHODS

Experimental procedure: This research was carried out *in vitro*. The mass of the researched zeolite of the KA_{CO} brand made 50 g, 96% C_2H_5OH alcohol H_2O water distilled. For dehydration of ethanol we used KA_{CO} brand zeolite with diameter of granules 1.6 mm bulk density of 0.85 g/cm^3, the size of zeolite declared by the producer 3Å (0.3 nm) amount of solution made 200 mL in case of different concentration of water. Range of H_2O concentration (from 10-70%). Temperature at which this laboratory research was conducted made t = 24 degrees Celsius and pressure made 0.1 MPas. Density of mix was determined by areometers of the Areometer AOH-1 brand (the range of measurements 700-1840 kg/m^3). Weight was determined by means of laboratory scales Leki 5002. The extreme size of adsorption is calculated by Eq. 1:

$$a = \frac{\upsilon}{m_1} = \frac{m_2}{m_1 \cdot \mu} \quad (1)$$

Where:

- υ = Amount of the adsorbed substance (mol)
- m_1 = mass of adsorbent (g)
- μ = The molar mass of adsorbed substance (g/mol^{-1})
- m_2 = Weight of adsorbent hinge plate with the adsorbed substance

For graphic display it is possible to use the dependence (Eq. 2):

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$$\lg a = \lg \frac{m_2}{m_1 \cdot \mu} \quad (2)$$

RESULTS AND DISCUSSION

In Fig. 1, the adsorption isotherms received by us from water ethanol solution at different concentration of H_2O and pressure of 0.1 MPas are presented. It is established that at increase in concentration of water higher than 10% alkali are formed, it is confirmed by the data obtained on IK-spectroscope Verner 700. On the basis of the submitted spectrogram (Fig. 2) conclusions are drawn that in the studied mixes after adsorption on zeolites presumably potassium hydroxide is formed. It is possible to assume that there is an exchange the equal charged ions of H+ and K+ and Eq. 1 can be written down as follows (Borisov *et al.*, 1991):

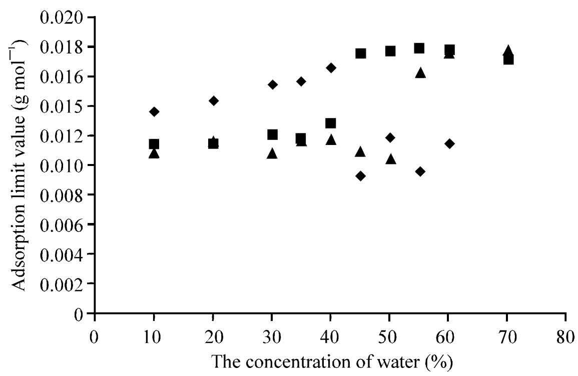

Fig. 1: Isotherms of solution adsorption at changes of water concentration in range (from 0-70%), temperature of t = 24 degrees Celsius and pressure of 0.1 MPas (Karnaukhov, 1999)

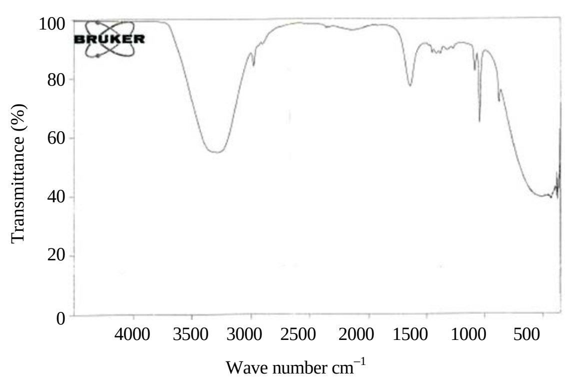

Fig. 2: The IK-spectrogram of the studied solution after adsorption on zeolite

$$a = \frac{k \cdot a_0 \cdot c / c_{н}}{1 + (k-1) \cdot c / c_{н}} \quad (3)$$

Where:

k = Balance constant

$c_{н}$ = Initial concentration of solution (mol, eq./m^3)

c = Final concentration (mol, eq./m^3)

a_0 = Complete reservoir volume of adsorbent (mmol, eq./m^3)

This equation gives very exact analytical description of isotherms adsorption in which for binary solutions there is a cationic exchange. It should be noted that it can be used in creating technological calculation when designing the adsorptive units (Paranuk and Saavedra, 2015). From the Fig. 1, it is also possible to note that uses of KA_{CO} for dehydration of alcohols is urgent only in the narrow range of water concentration (from 5-40%); in case of higher concentration adsorbent behaves unsteady that is confirmed by the experimental data obtained by researchesr.

Thus, we see typical isotherms common to the adsorptive systems with adsorbents possessing certain structure of synthetic KA_{CO} zeolite. Therefore it is possible to claim that KA_{CO} belongs to the class of adsorbents with rigid structure and works at small concentration of water. And it can be used in deep dehydration of solution.

CONCLUSION

It is possible to note that the received results can be applied to realization of various technological units on dehydration solutions, from the received schedule of Fig. 1 it is visible that the studied adsorbent works in the narrow range of water concentration (from 0-40%) and use of adsorbent at higher concentration is unexpedient.

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