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Synthesis of Highly Effective Sorbent Based on Navbahore Bentonite

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ABSTRACT:Synthetic zeolites CaA, NaA, HSZ obtained from Navbahore bentonite and NaY were investigated to select the optimal adsorbent for fine purification of natural gas from undesirable components. And it was concluded that among the zeolites studied, the most stable zeolite in acidic media is NaY zeolite, and the HSZ zeolite obtained by Navbahor bentonite is more effective in breakability. The total adsorption capacity of the synthetic zeolite HSZ obtained by Navbahor bentonite at 25 °C is H_2S-182 g/l. A mathematical model of adsorption cleaning of natural gases has been developed. Process design parameters have been defined. It has been found out and determined that a significant disadvantage of adsorbents is the reduction of their activity in the sorption process, especially in the purification of multicomponent mixtures. The adsorption process is significantly influenced by the rate of natural gas through the adsorbent bed, which is determined by the pressure drop of the bed and other conditions necessary for intensive mass exchange. Diffusion coefficients at different values of adsorbent layer height were investigated. As the height of the adsorbent layer increases, the diffusion coefficient increases substantially. The height of the adsorber also changes the process parameters of adsorption fine cleaning of natural gases, which determine the optimal process mode. Therefore, it is necessary to take into account the diffusion coefficient in computer modelling of industrial adsorbers for fine cleaning of natural gases. The purpose of this work is the synthesis of highly efficient sorbents based on Navbahor bentonite and the optimization of oil and natural gas purification processes from acidic impurities.

KEYWORDS: bentonite, sorbent, natural gas, drying, purification. adsorption, natural gas, acid gases.

I.INTRODUCTION

Natural gas is a mixture of gaseous combustible compounds, the main components of which are low molecular weight hydrocarbons (C_1 – C_4alkanes). In small amounts, they include hydrogen, carbon monoxide and hydrogen sulfide [1-4]. In the process of extraction, natural gas carries out moisture in its composition, which forms crystalline hydrates with gas molecules at low temperatures. In the presence of water, corrosion processes of equipment intensify, and emergency situations may arise due to blockage of gas pipelines and equipment of gas processing plants with hydrates. In this regard, the removal of moisture from natural gas is one of the necessary processes for preparing gas for transportation and further processing. The moisture content of a gas is determined by the dew point temperature and is regulated by permissible norms (industry standards). The process of drying natural gases is an important and indispensable link in the process of their preparation for transport through main gas pipelines. All gases transported through main gas pipelines are subject to mandatory drying from moisture, the depth of which is regulated by the requirements of industry standards and technological indicators of the processes of further gas processing [4-5].
The main processes for dehydrating natural gases are processes carried out by the four most widely used methods in the industry: cooling, absorption, adsorption and a combination of the previous three methods. In addition, it is well known

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that methods of drying gases according to the classification criterion are divided into three main groups: physical, chemical, physicochemical [6-8].

The method based on the use of bifunctional absorbents has found the greatest industrial application, which is defined as three main groups of absorbents:

- a mixture of diethylene glycol and triethylene glycol monoethyl ether;
- N methylpyrrolidone (N-MP);
- a mixture of diethylene glycol with diesel oil.

Improvement of the indicators of the gas cleaning process on zeolites (lowering the moisture dew point, improving the quality of desulfurization) was achieved by the development of new grades of zeolites such as 4A, 4A and 5A, moulded in the form of a trilist. To improve the process of drying and purification of gases with the achievement of maximum performance, some researchers recommend using a combined adsorption system of adsorbents of two layers. One layer of the system consists of zeolite granules of various shapes and diameters, and the second - of the frontal layer in the form of aluminium oxide [2-6].

At present, based on the unique properties of bentonite clays, their studies, especially the adsorption characteristics, have received considerable attention. Bentonites are widely used in various fields, more than two hundred areas of various industries are known, where the unique properties of bentonites are used, including in the processes of purification and preparation of hydrocarbon processing for processing, although the literature data on their use in the processes of drying and purifying natural gases is very small. The value and significance of bentonite clays are evidenced by the data on their value: a kilogram of bentonite powder on the world market is estimated at a higher price even than the main energy carrier oil, while the costs of extracting, refining and processing bentonite clays for sale, according to literature data, are lower than oil [8-9].

Based on the foregoing, it can be stated that the problem of studying bentonite clays and zeolites as adsorbents in the processes of drying, purification and preparation of natural gas for preparation is currently relevant.

Ethylene glycols with a mass content of 98.5% by weight were taken as absorbents. For laboratory studies, an experimental laboratory setup was designed, on which the absorption capacity of absorbents in relation to moisture and acidic components was determined. We assessed the absorption capacity of the reagents by the attained dew point temperature of natural gas [3-8].

II. EXPERIMENTAL PART

Adsorption experiments were carried out at an experimental laboratory plant using the following procedure. The adsorbent slurry was activated in a muffle furnace at 784K for 2.5 hours and then cooled in a desiccator to a constant weight (weighing accuracy up to 0,001 g). The process of cleaning natural gas on adsorbent samples was studied at various temperatures in a model experimental plant. Natural gas from the cylinder was supplied to an adsorption column (adsorber), which is a cylindrical apparatus with a total height of 210 mm and a diameter of 45 mm (volume of 8.45 cm^4). The adsorber with the adsorbent was installed in the furnace. The adsorption temperature was recorded by a thermocouple installed in the adsorber thermocouple pocket.

The furnace is heated by connection to a common electric network ~ 220V. Gas passing through the adsorbent layer enters the gas meter filled with brine (saturated aqueous solution of table salt), while the brine is displaced into the cylinder. The pressure in the adsorber is atmospheric and manually controlled using a glass pressure gauge by taking a saturated solution of NaCl from the gasometer. Gas purified from the gasometer is fed through a sampler to a chromatograph to connect the gas analyzer first to one column, then to a second column to determine the content of water and acidic components (H_2S and CO_2) in the gas. The experiments were carried out at atmospheric pressure at specified values of temperature and suspension of the adsorbent. The feed time was 40 minutes. The adsorbent loading was 50 g. The installation investigated the adsorption process on the specified samples of adsorbents at temperatures: 20, 25, 40, 45, 40 °C.

Before the experiment, the adsorbent was activated at operating temperature by nitrogen purging for 10 minutes. Based on the results of the analysis, the dynamic activity of the HSZ adsorbent obtained by Navbahor bentonite [10-15] was calculated by the formula:

$$A_d = C_0 \bullet W \bullet \tau / h$$

where C_0 is the initial concentration of H2S, CO_2 and NO_2 in solution, g/100 g;

W - gas flow rate, m/s;

τ - time of protective action of adsorbent,

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h - the height of the adsorbent layer, m.

We studied isotherms of adsorption of CO_2, H2S and NO_2 on adsorbents-activated carbon of SCT and HSZ obtained by Navbahor bentonite. Adsorption isotherms were determined on the HSZ zeolite obtained by Navbahor bentonite. It has been found expedient to use the obtained Navbahore bentonite for adsorption separation of CO_2, H_2S and NO_2 zeolite HSZ. Adsorption isotherms are quantified by the Langmuir equations.

III. RESULTS AND DISCUSSION

Study of the adsorption activity of adsorbent samples with respect to water at different contact times. Figure 1 shows the results of a study of the moisture capacity of the adsorbents under study (zeolites - VCC obtained from Navbakhor bentonite, NaA and CaA, aluminosilicate and bentonites-activated with hydrochloric acid HCl and activated with sodium carbonate Na_2CO_4) depending on the time of adsorption at a temperature of the natural gas drying process of 20 °C and atmospheric pressure.

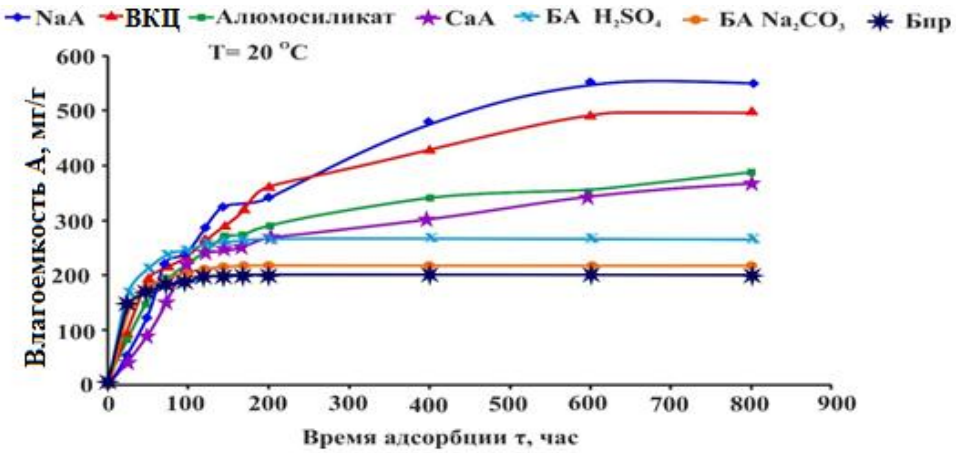

Fig. 1.Moisture adsorption isotherms for various adsorbent samples

We also carried out a study of the adsorption and desorption of moisture on differently activated (nanostructured) bentonite clay.Activation with sodium carbonate creates an alkaline environment, which affects the chemical composition of bentonite due to the dissolution of free silica - a decrease in the content of silicon oxide and an increase in the content of oxides of aluminium, iron, alkali and alkaline earth metals in bentonite samples.

s a result of the substitution of sodium ions by metals of the first group of the table of elements in the bench complex, their more than fourfold increase, and this, in turn, increases the ion-exchange clay capacity from 85 to 120 mg eq / 100 g of clay.The washing out of aluminium, iron and magnesium ions during acid treatment leads to the destruction of the crystal structure of clay minerals and contributes to the development of the surface.

The specific surface area of bentonite increases more than threefold, to 87 m2 / g due to the development of a structure characterized by a smaller pore size - a decrease in their diameter from 118 to 77 nm is observed.

We can also notice that the highest adsorption is possessed by bentonite activated with HCl — 178 mg / g, and the lowest is possessed by natural - 150 mg/g.

This phenomenon can be explained by the fact that bentonite activated with hydrochloric acid has the highest specific surface area, 87 m2 / g versus 24 m^2/g.Determination of moisture absorption of these adsorbents was carried out using a desiccator method.The duration of adsorption was up to 800 hours.Removal of indicators of moisture capacity of adsorbents was carried out for the first 8 days every day, and then once with an adsorption duration of 200 hours.

A comparative analysis of the adsorption isotherms shown in Figure 2 shows that the moisture capacity of the adsorbents, depending on the duration of the experiment on the adsorption of water vapour, is different and changes over the course of the experiment.

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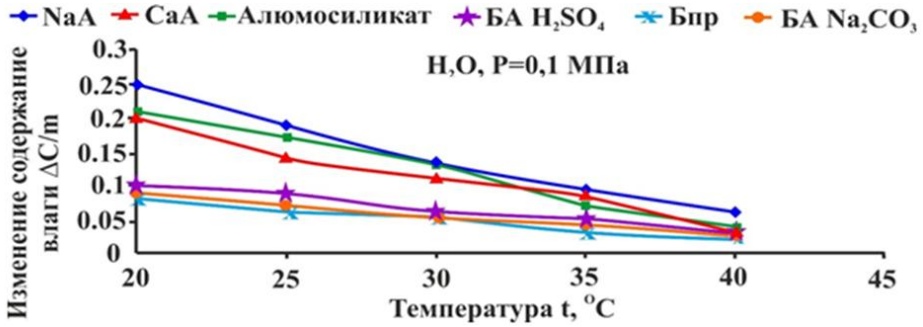

Fig. 2.Dependence of the change in moisture content on temperature.

With an adsorption duration of 20,100 hours, bentonite activated with hydrochloric acid showed the highest moisture capacity. Its moisture intensity under these conditions is in the range of 180-240 mg/g. It is followed by natural bentonite, the moisture absorption of which at 20-ton adsorption is 145 150 mg/g, increasing to 200 mg/g for 5 days.
During the first day of the experiment, the adsorption efficiency is increased in the following series:

- CaA (40 mg/g);
- NaA (40 mg/g);
- aluminosilicate (85 80 mg/g);
- HSZ obtained from Navbahor bentonite (95 mg/g);
- natural bentonite (145 mg/g); HCl activated bentonite (175 mg/g).

On the fourth day of the experiment (duration 100 hours), the moisture content of the adsorbents changed as follows:

- natural bentonite (190 mg/g);
- bentonite activated with Na_2CO_4 (210 mg/g);
- CaA (220 mg/g);
- HSZ obtained from Navbahor bentonite (245 mg/g);
- NaA (245 mg/g);
- HCl activated bentonite (245 mg/g).

The next 4 days, the moisture capacity was:

- natural bentonite (200 mg/g);
- bentonite activated with Na_2CO_4 (220 mg/g);
- HCl activated bentonite (280 mg/g);
- CaA (280 mg/g);
- alumina silicate (290 mg/g);
- NaA (450 mg/g);
- HSZ obtained from Navbahor bentonite (275 mg/g).

At the subsequent time of the experiment to investigate the effect of adsorption duration (800 hours) on the moisture content of the adsorbent, it can be seen that for all bentonites, the moisture content stabilized at the level reached during the 200-hour treatment:

- natural bentonite (200 mg/g);
- bentonite activated with Na_2CO_4 (220 mg/g);
- HCl activated bentonite (280 mg/g).

The moisture consumption of zeolites and aluminosilicate increased as the adsorption time increased. In zeolites NaA and HSZ, the water capacity of Navbahor bentonite obtained increased and became maximum for 25 days, then stabilized at the level: NaA - 550 mg/g, HSZ obtained Navbahor bentonite - 500 mg/g.
On day 44 of the experiment, the water capacity of zeolite NaA tended to decrease slightly. In adsorbents: aluminium silicate and CaA zeolite, the moisture intensity increased with increasing adsorption duration up to 800 hours: in aluminosilicate up to 490 mg/g, in CaA zeolite up to 485 mg/g.
Thus, from the comparison of the adsorption isotherms shown in Figure 2, the largest amounts of water were adsorbed by zeolite NaA: with an increase in the treatment time from 280 hours to 800 hours, the moisture capacity increased from 400 mg/g to 550 mg/g, in HSZ, the obtained Navbahor bentonite in this interval of duration, the water capacity increased from 400 to 500 mg/g.

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The most effective natural gas dryers were NaA and HSZ zeolite obtained from Navbahor bentonite, the efficiency of which in terms of moisture absorption increased with an increase in the duration of adsorption, starting from 100 hours. With an adsorption duration of up to 100 hours, the most effective adsorbent was CaA zeolite. In the samples of bentonite clays, water absorption proceeded efficiently in the first hours of adsorption (20-100 hours) up to maximum saturation; upon further contact of the gas with the adsorbent, the moisture capacity did not change and was at a stable level of maximum adsorption.Figure 2 shows the results of a study of the adsorption activity of adsorbents (zeolites, aluminosilicate and bentonites) in water at different temperatures. The influence of temperature was investigated in the range of 20 - 40 °C and atmospheric pressure. The value of the change in the moisture content in natural gas samples per unit mass of the adsorbent (ΔC/m) is taken as the value of adsorption of adsorbent samples.

Moisture content in natural gas samples was determined by the chromatographic method. With an increase in temperature, there is a tendency to a decrease in the adsorption activity of adsorbents with respect to water. Zeolite NaA has the highest activity in the adsorption of water vapour. The change in the content of absorbed moisture at 20 °C is (ΔC/m) 0.25 versus 0.2 for aluminosilicate; 0.19 - CaA zeolite; 0.1 - bentonite activated by HCL; 0.09 - bentonite activated with Na_2CO_4; 0.085 - natural bentonite.When the temperature rises to 40 ° C, the change in moisture content on NaA zeolite is 0.08, on aluminosilicate - 0.04, on CaA - 0.04, on zeolites (natural, activated with hydrochloric acid and sodium carbonate) is 0.025. The absorption capacity of an adsorbent under operating conditions is considered to be its working or dynamic activity. The dynamic activity is always lower than the static one and depends on the working conditions of the adsorbent. The dynamic activity of adsorbents is the main indicator that determines the size of adsorbers and the sorption cycle time. Zeolites are mainly used to remove H2S, CO2 and NO2 from gases. The characteristics of the adsorbent (samples of zeolite HSZ obtained from Navbahor bentonite) are shown in Table 1.

Table 1. Adsorption properties of Navbakhor bentonite

Indicators	***Samples***		
Density, g/cm^4	1	2	4
	0,885	0,880	0,848
Grainsize (inmm),%			
2,8-2,0	44,2	44,0	41,7
2,0-1,5	74,8	72,8	74,8
1,5-1,0	4,1	4,2	4,7
Content,%			
Ashes	8,4	8,1	8,9
potassium	0,20	0,27	0,28
sulfurs	0,47	0,48	0,78
Porevolume, cm^4/g			
V_{mi}	0,28	0,42	0,44
V_{mi}	0,11	0,14	0,12
V_{mi}	0,28	0,41	0,45
V_{Σ}	0,78	0,87	0,80
Structuralconstants W_0 cm^4/g	0,29	0,44	0,45
B 10^7 (forbenzene)	0,44	0,54	0,54

Adsorption allows almost complete removal of contaminants from the gas mixture and allows for deep cleaning of gases.This explains the increasing use in environmental protection of adsorption methods for gas separation and purification where other methods are not effective enough.Adsorbents used in exhaust gas treatment systems must meet the following requirements: have a high adsorption capacity during absorption of components having a small concentration in gas mixtures, have high selectivity, have high mechanical strength, have the ability to regenerate and have low cost.

The analysis of various adsorbents for the adsorption of CO_2, H_2S and NO_2 from natural gas showed that it is advisable to use the HSZ obtained from Navbahor bentonite. In computer simulations, adsorption isotherms are of particular importance, as well as the exact numerical value of the dynamic activity. The dynamic activity of adsorbents is the main indicator that determines the size of adsorbers and the sorption cycle time. A gas mixture of H_2S, CO_2 and NO_2 was passed through a fixed bed of HSZ zeolite obtained from Navbakhor bentonite at a pressure of 1-7 MPa, at 20–40 °C by feeding it into the upper part of the adsorber. The adsorption of H_2S, CO_2 and NO_2 occurs on a fixed bed of HSZ zeolite obtained from Navbahor bentonite. The process is carried out in 4 adsorption devices.

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Table 2. Values of the static and dynamic activity of adsorbents-activated carbon of SCT and SCC obtained by Navbahor bentonite

Adsorbents	***Activated SKT angle***			***HSZ obtained from Navbahor bentonite***		
components	**H_2S**	**CO_2**	**NO_2**	**H_2S**	**CO_2**	**NO_2**
Staticactivity, g/100 g	9,88	8,74	7,97	12,28	10,51	9,85
Dynamicactivity, g/100 g	8,02	5,24	4,84	9,89	8,44	8,81

The first adsorber operates in the adsorption mode, the second desorption, the third regeneration and the fourth cooling. The natural gas velocity is determined by the hydraulic resistance of the adsorbent bed. The layer of HSZ zeolite obtained from Navbahor bentonite is gradually saturated with undesirable components H_2S, CO_2 and NO_2. After complete saturation of the zeolite, the adsorber is switched to the regeneration mode directly in the adsorber and further, respectively. Natural gas consumption was monitored with a flow meter.

The moisture of the gas mixtures at the outlet of the adsorber was measured with a "Parametric-280" device. The concentration of the components of the gas mixtures was determined with a "Rubotherm" device. At various values of the pressure drop of the adsorbent layer, the concentration of gas mixtures was determined. The value of the concentration of gases, depending on the conditions of the adsorption process, contained in the purified stream at the outlet of the adsorber, are shown in Table 3.

Table 3. Values of the concentration of gases contained in the purified stream at the outlet of the adsorber depending on the conditions of the adsorption process

Thevalueofthepressuredropintheadsorptionlayer, kg/cm^2	***Contentofcomponentsofgasmixturesaftercleaning,%vol.***		
	H_2S	**CO_2**	**NO_2**
0,154	0,059	0,041	0,088
0,174	0,054	0,044	0,08
0,184	0,048	0,018	0,08
0,184	0,042	0,012	0,072
0,194	**0,038**	**0,009**	**0,058**
0,204	0,041	0,010	0,078
0,214	0,042	0,014	0,084
0,224	0,044	0,020	0,087
0,244	0,048	0,027	0,092

Thus, the proposed method for the separation of gas mixtures allows adsorption in relation to a three-component gas mixture H_2S: NO_2: CO_2, the initial composition of which in % vol. corresponds to - H_2S-80%, CO_2-15%, NO_2-5%, using in as a zeolite HSZ obtained by Navbahor bentonite while maintaining a pressure drop in the adsorption layer of 0.184 ÷ 0.204 kg/cm^2. The optimal conditions for the adsorption of the contained gas components in the mixture are to carry out the process at a pressure drop in the adsorption layer of 0.194 kg / cm^2, which provides after cleaning the content of% by volume: H_2S-0.038, CO_2-0.009, NO_2-0.058. Previously, the degree not to use the adsorption capacity was on various HSZ zeolites obtained from Navbahor bentonite - 49%, NaA - 42% and CaA -24%. Our experimental data show that at a gas velocity of 1.5 m / s and while maintaining a pressure drop in the adsorption layer of 0.184 - 0.204 kg / cm4, the degree not before using the adsorption capacity approaches zero. A method for purifying a gas mixture containing carbon dioxide, nitrogen dioxide and hydrogen sulfide, comprising contacting the gas stream with synthetic zeolite HSZ obtained from Navbakhor bentonite, characterized in that the process is carried out at a pressure drop in the adsorption layer of 0.184-0.204 kg/cm^4. The objective of the development method is the separation of gas mixtures, which allows cleaning from the simultaneous presence of hydrogen sulphide, sulphur dioxide and NO_2.

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The problem is solved by the proposed cleaning method: by contacting a gas stream containing CO_2, H_2S and NO_2 with an HSZ adsorbent obtained from Navbakhor bentonite at a pressure drop in the adsorption layer of 0.184 ÷ 0.204 kg/cm^2.

The proposed method for the separation of gas mixtures allows for adsorption in relation to a three-component gas mixture H_2S: NO_2: CO_2, the initial composition of which is in% vol. corresponds to - H_2S -80%, CO_2-15%, NO_2-5%, using as a zeolite HSZ obtained from Navbahor bentonite while maintaining a pressure drop in the adsorption layer.

When solving the problems of fine purification of natural gases from CO_2, H_2S and NO_2, along with absorption and catalytic methods, adsorption processes have become widespread. The adsorption of CO_2, H_2S and NO_2 from gas mixtures can occur on zeolites, silica gels and activated carbons. In an experimental study, the curves of the adsorption of CO_2, H_2S and NO_2 from gas mixtures were studied.

Adsorption isotherms were determined in various adsorbents: HSZ zeolites obtained from Navbahor bentonite, TA 95 and TA 120 activated carbons, and in KSM silica gels. The results of studies of the adsorption capacity of various adsorbents for CO_2, H_2S and NO_2 from gas mixtures under identical conditions have been obtained. The predominant use for the sorption separation of CO_2, H_2S and NO_2 on HSZ zeolite obtained from Navbahor bentonite was revealed. The limiting static activity of the HSZ adsorbent obtained from Navbahor bentonite in terms of CO_2–11.0 was determined; H_2S – 12.7 and NO_2–9.8 g/100 g. The process of purification of gas mixtures on zeolites is cyclic.

The organization of continuous processes of fine purification of natural gases on zeolites is also associated with structural and technological difficulties.

IV. EXPERIMENTAL RESULTS

We have developed a completely new approach for the fine purification of natural gases on synthetic zeolites. It was found and determined that a significant disadvantage of adsorbents is a decrease in their activity during sorption, especially when purifying multicomponent mixtures. Consequently, for the adsorption of natural gases in our example, the main role is played by the pore size (also granules), the height of the working layer, the amount of zeolite adsorbent, and the temperature regime of the adsorption and regeneration stage. The rate of natural gas through the adsorbent bed, which is determined by the pressure drop of the bed and other conditions necessary for intensive mass transfer, has a significant effect on the adsorption process. We have determined the optimal value of the pressure drop in the adsorbent bed.

The optimal value of the pressure drop Δp, which guarantees the complete absorption of H_2S, CO_2 and NO_x, varies within the range of 18.78 kPa / 19.81 kPa.

In this regard, we have carried out several experimental studies on the adsorption of H_2S, CO_2 and NO_x from natural gas on synthetic zeolites. As a result, isotherms and kinetics of natural gas adsorption were obtained. The design and technological parameters of the process have also been determined. Adsorption isotherms correspond to the Langmuir isotherm type. When a mixture of substances moves through an adsorber filled with an adsorbent, concentration fronts of each component of the mixture are formed.

The separation of substances is carried out due to the difference in time of retention of the mixture molecules in the stationary phase. The nature of the movement and blurring of the fronts depends on the adsorption isotherm and on the factors of the non-ideality of the process, i.e., on the final rate of establishment of equilibrium between the substance in the mobile and stationary phases (kinetic deceleration).

The experimental isotherm of adsorption and kinetics on synthetic zeolite NaA showed that the height of the adsorbent bed is 5.48 m, the diameter of the adsorber is 4.79 m, and the working bed of adsorbent is 142 cm, guaranteeing the complete absorption of H_2S, CO_2 and NO_x.

It should be noted that, with an optimally selected technological mode, scheme and hardware design, undesirable components can be almost completely removed from natural gases of various fields, which simultaneously contain hydrogen sulfide H_2S, carbon dioxide CO_2 and nitrogen oxides NO_x by the adsorption method. The new approach will provide not only protection of the biosphere from undesirable components but also prevent the increase in equipment to corrosion, rapid and irreversible poisoning of catalysts used in various processes of chemical technology.

V.CONCLUSION

1. To develop a promising method for the preparation of natural gas for its further processing into a methane-hydrogen mixture, the adsorption capacity of various types of solid adsorbents - zeolites, zeolite-containing catalysts,

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aluminosilicate, silica gel and bentonites (natural, activated with sodium carbonate Na_2CO_4 and hydrochloric acid HCl from the bentonite clay deposits of Navbakhor Republic of Uzbekistan).

2. The conducted studies of the adsorption activity of adsorbent samples with respect to H_2O show that NaA zeolite is the most effective for dry natural gas.

4. It was found that the activation of bentonite clays Na_2CO_4 and HCl significantly increases their adsorption activity. The research results show that at the initial stage of adsorption, the activity of bentonite clays is higher than that of the adsorbents studied by us, especially in terms of moisture absorption.

4. Despite the fact that natural bentonite clays have a relatively low adsorption activity, they have, in our opinion, prospects for use in drying processes, since activation with aqueous solutions of Na_2CO_4 and HCl promotes an increase in the adsorption activity of bentonite adsorbents.

5. Developed a mathematical model of adsorption purification of natural gases.

The design parameters of the process have been determined.

6. The diffusion coefficients have been investigated for different values of the height of the adsorbent layer. With an increase in the height of the adsorbent layer, the value of the diffusion coefficient increases significantly. The numerical values of the diffusion coefficient increase in the following sequence for the components: NO_x, CO_2, H_2S. The highest numerical value of the diffusion coefficient has H_2S, and the lowest NO_x. Along with the height of the adsorber, the values of the technological parameters of the adsorption fine purification of natural gases, which determine the optimal model of the process, also change. Therefore, it is necessary to take into account the diffusion coefficient in computer modelling and industrial adsorbers for the fine purification of natural gases.

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