JOURNAL OF ADVANCED SCIENTIFIC RESEARCH

ISSN: 0976-9595

Journal of Advanced Scientific Research (ISSN: 0976-9595)
Vol.2. Issue 1
page 11

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Isothermic substance bentonite-sorbents sorbtion isoterm applied mesogovac kremnezem in obtaining a nanocatalizer

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https://doi.org/10.5281/zenodo.5878511

Abstract. In this article, the chemical composition of Navahor deposit bentonite was determined in accordance with the standards of the International Union of theoretical and Applied Chemistry by the analysis of the sorbtsiya isoterm of bentonite - sorbents and the results obtained were obtained. The study also included the types of sorbtsia isoterms derived from adsorption of various gases to sorbents, descriptions of sorbtsia isoterms in mesogamous sorbents, textur and physico-chemical characteristics of the catalyst. In this study, the conducting substance bentonite - sorbents used in obtaining mesogamous kremnezem nanocatalizer is to conduct an analysis of the study of sorbtsiya isoterm.

Keywords: silica nanocatalyst, bentonite, catalyst, texture, sorbent, sorption, adsorption.

1. INTRODUCTION

In the world, kremnezem materials and composite sorbents obtained on their basis are widely used in various fields of industry with their unique properties, including high chemical, thermal, mechanical stability, low toxicity, sorbitional properties and manifestation of catalytic inertia. Mesogovak kremnezem material has a special practical significance, it is distinguished by the structure of the Uzi and the characteristics of surface morphology: a high comparative surface, porous with a size in the nanometer range and its specific physico-chemical properties. [1,2.]. Kremnezem nanomaterials, whose typical size has a porosity of 0.4 to 50 nm and has a large number of hydroxyl groups in its composition, are of great importance for media and pharmacology [3]. This type of porous nanomaterials is widely used in the transport of drugs of different functional groups (continants), as well as in their chromatographic analysis, in the immobilization of enzymes, as a binder for some viruses. Modified orgono/inorganic hybrid nanosorbents with micro - and mesogamous, various functional group substances in their composition have practical significance for the separation and analysis of samples used in the chromatography of fluid and ion Exchange. It is known that the synthesis of kremnezem materials is important not only for practical, but also for the development of important theoretical studies [4].

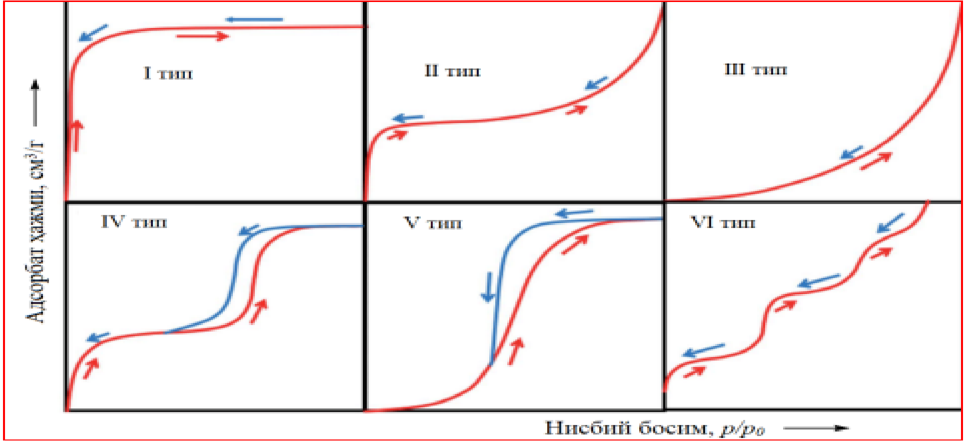
The geometrical shape and dimensions of the porous determine the slope of the adsorption process as well as The Shape of the isotherms of sorption. Usually cylinder-shaped porridges are made of aluminum and magnesium oxides, prism-shaped porridges are made of fiber cellulites, ellipticular porridges are made of soil and fagangan coal, porridges between sequential spherical granules are made of silica threeraydi. [5**].**

According to the dimensions of the porous in adsorbents, according to the IUPAC classification, the porous size is divided into the following classes: macrogovaks $d > 50$ nm, mesogovaks $d=2\div50$ nm microgovaks d $200\div400$ nm, mesogovaks $200 \div 400 > d > 3\div3{,}2$ nm, microgovaks $d < 1{,}2\div1{,}4$ nm, supermicrogovaks $3 \div 3{,}2 > d > 1{,}2 \div 1{,}4$ [6].

Adsorbents are classified into six types according to the Brunauer classification (brunauer-Deming and Deming-tellur classification) [7] of sorption isoterms derived from adsorbent adsorption of various gases. Classification of isoterms of sorbtsia is presented in Figure 1:

- Type I sorption isotherm -the highest amount of adsorption occurs at low relative pressures (p/p0=1) (Lengmyur isotherms are called).
- Type II-this sorption isoterm represents free mono - or polymolecular adsorption, characteristic of macular adsorbents.

Type III-this type of isotherma is usually less than threeraydi and represents the connection of the isotherma with the absence of turning points by the interaction between the adsorbate.



1-picture. Types of isotherms of sorbts from adsorption of various gases into sorbents.

IV-this isomer is formed from adsorption, which occurs on the account of capillary condensation in the mesogastia, representing a single layer of adsorption, and on the account of residual pressure (p/p0=0,4) adsorption and desorption isotherms form a ring of hysteresis, intertwined.

V - also there are not two characteristic turning points, such as Type III ISO-national. On account of capillary condensation in mesogovaks, such as Type IV isoterma, the formation of hysteresis rings occurs.

VI - as for the sorbtion isoterm, it is formed on the account of step-by-step polymolecular adsorption on the account of weak interaction between adsorbent-adsorbent molecules. [8].

Therefore, it is urgent to conduct an analysis of the study of sorbtsia isoterm of the Constituent bentonite - sorbents used in obtaining mesogovagal kremnezem nanocatalysts and to determine its basic description.

II.THE MAIN PART

Research Methods

The elemental composition of the materials obtained was determined using the X - ray spectrum microanalysis (RSMA) with the addition of JEOL-JED - 6390 EDS in the JEOL-2200 scanning electron microscope. The acidic properties of ammonia in the USga-101 universal sorbtsion gas analyzer were studied by thermodestrated desorption method. The quality and quantity composition of reaction products were analyzed in chromatography "Crystal 5000" with Capillary colonic and flame-ionization detektorli. The amount of hydrogen and uglerod oxides was carried out in the "Crystal-5000" gas chromatography, which was provided with a detektorli and PropakQ phase-retaining column on thermal conductivity. Determination of the porous structure and comparable Surface Surface of catalysts was carried out in the automatic gasliadsorbtion analyzer TriStar II by the method of Brunauer, Emmet, wires (bet). The comparative surface surface was calculated at 77 K by the adsorption isoterm of nitrogen. The size and size of the pores of the catalysts were determined from the data on the isotherms of desorption and adsorption respectively at R/ro=0,99 relative pressure according to the model BJH (Barett-Joyner-Halend). Bentonite in Navoi region Navahor district is a light gray powder, odorless, almost insoluble in water and organic solvents, pH value of the suspension is 7,1-8,7. The weak alkalinity of the suspension is explained by the presence in the clay of hydroxide soil and hydroxide metals. According to adsorption properties, this is a combined meso-macro-microbial adsorbent, its specific surface is 54,5 m2 / g, the porous volume is 0,065 cm3 / g, the average porous magnifier is 4,8 nm, adsorption activity for methylene is blue - 62,0 bentonite / g.

Benzene to sorbent samples taken at different temperatures (saturated vapor at 298 K p o = 74,7 mm.top of the mercury.), n-hexane (saturated steam p o = 150 mm. top of the mercury.) toluol (saturated vapor p o = 25,5 mm. Mercury ust) and water vapor (saturated vapor p $o$imi p o = 23,75 mm.top of the mercury.) adsorption was studied using a sensitive Quartz spiral device of Mak-Ben-Bakra.

III. RESULT AND DISCUSSION

Some physical sizes of substances obtained as adsorbates are carried out in different techniques. [9] in the formulation of adsorption data of adsorbate: benzene was initially cleaned under vacuum conditions, its Vapor was frozen until it was the same as the vapor data for pure benzene. Then the benzene was dissolved and the gases dissolved in it were released. Before measuring benzene vapor adsorption in adsorbents in the sensitive Quartz spiral device of Mak-Ben-Bakra in static conditions, residual pressure in each adsorption system was vacuumed until 1,33·10-3 Pa and adsorption isotherms were obtained at 298 K. In this, the measurement error did not exceed 0,05 mmol/g. Toluol and n-hexane adsorption on Sorbent samples was also performed in the above order.

With the help of data from adsorption of various adsorbents to sorbents, their textural characteristics were determined: the Surface Surface (SBET, m2/g), the average diameter of the porous (D, nm), the size of the porous (Vs), the monocompatibility (a ∞) and saturation adsorption (as) were calculated using the following methods [10].

Calculation of the comparative surface surface of Sorbent samples. Adsorption isoterma models are mainly used to quantify the adsorption of gases in solid adsorbents. In most cases, when determining the comparative surface surface of sorbents from adsorption results, the value of the monocowate capacity is used [11].

$$S = a_{\infty} \cdot N_A \cdot \omega$$

S - the comparative surface surface surface of adsorbents (m2 / g), $N\ A$ - Avogadro constantsi, $a\ \infty$ - the monohydrate capacity of the adsorbent, ω-the area occupied by a single molecule of adsorbate in monohydrate (NM2).

For a nitrogen molecule, this number is equal to 0,162 nm2, and for benzene to 0,49 nm2. Bet isoterma model. The Bet (Brunauer, Emmet and wires) method is the standard method of measuring the comparative Surface Surface finish of porous materials. A linear form of the bet equation was used to determine the comparative surface surface of the Sorbent samples on the basis of the adsorption isomer. [12].

$$p/p_s\ a(1 - p/ps) = 1\ a_\infty C + C - 1\ a_\infty C \cdot p/p_s$$

$$1\ a(1 - p/p_s) = 1\ a_\infty C + C - 1\ a_\infty C \cdot p/p_s$$

p/ps – the relative pressure of the adsorbate vapor, $a\ \infty$ – the capacity of the monohydrate, a-the amount of adsorbable substance at the same pressure (mmol / g) c – the constant size associated with adsorption and condensation heat as well as temperature. Based on the obtained exponential datap/ps (1$-p/ps$) and the graph of the linear link coordinate of the values of $p\ /\ p\ s$ is drawn. $y = p/ps\ a\infty(1 - p/ps)$ $x = p/ps$ from the graph obtained using a linear link, the value of 1 $a\ \infty$ s from the ordinate axis of the cross-sectional magnitude is obtained, while the tangent is in the straight line of the angle C-1/ $a\ \infty\ C$ (figure 8). On the basis of these data, a comparative surface size (sbet) is determined at $a\ \infty$ and S values. Usually linear dependence in the bet equation gives a good result in the equation, while the relative pressure is 0,5÷1. Therefore, the exact results of the bet equation are observed in isotherms of Type II and Type IV, while in isotherms of Type III and V there are deviations from the exact values. [13**].**

Bentonite in Navoi region Navahor district is a light gray powder, odorless, almost insoluble in water and organic solvents, pH value of the suspension is 7,1-8,7. The weak alkalinity of the suspension is explained by the presence in the clay of hydroxide soil and hydroxide metals. According to adsorption properties, this is a combined meso-macro-microbial adsorbent, its specific surface is 54,5 m2 / g, the porous volume is 0,065 cm3 / g, the average porous magnifier is 4,8 nm, adsorption activity for methylene is blue - 62,0 bentonite / g., this is confirmed by a number of literature data. According to its technological properties, it is a fine dispersion medium-weight powder with an average fluidity index. For use in the chemical industry, the standardization of bentonite clay is carried out.

Standardization of bentonite was carried out according to the following indicators: description, pH of aqueous suspension, adsorption activity at drying time, cation exchange capacity, heavy metals (mishyak), comparative surface area, volume and average size of the swabs.

Technological and adsorption standardized descriptions of bentonite clay" navahor " are presented in Table 1.

Table 1

Technological and adsorption characteristics of bentonite clay" Navbahor"

№ п/п	Quality indicators of bentonite clay.	Features of bentonite clay.
1	Description.	light gray powder, odorless, almost insoluble in water and

		organic solvents
2	in the water pH suspension (5 в 100)	7,1-8,7
3	Loss of mass in drying.,%	Not more than 8%
4	Adsorbtion activity, bentonite/g	62,0±0,2
5	Cation exchange capacity, bentonitekv.	19,4
6	Meringue	no
7	Si^{4+} and Al^{3+} elements ratio	3:1
8	Specific surface area by five-point vet method, m^2/g	54,5±2,0
9	$P/P_0 = 0{,}98$, sm^3/g volume of pressure porous	0,065±0,005
10	The average size of the pores, in nm	4,8
11	Moisture of bentonite clay, %	26 -28
12	Humidity of dry bentonite clay, %	2-3

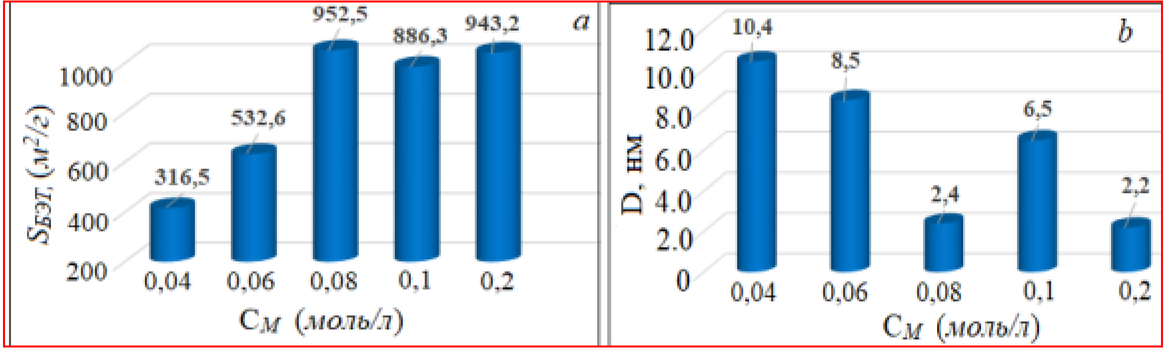
It is known that the adsorption isotope model of Lengmyur is used mainly for quantitative evaluation of adsorption of gases in solid adsorbents. Monomolecular adsorption on microcapsules is used in the evaluation of monocaval capacity (∞) and specific surface size of sorbents as a result of polymolecular adsorption on meso and macrocapsules. On the basis of experimental data, the inverse sign value of the Lengmyur equation was used to determine the dependence of the adsorbents on the pressure of the monocouple (am).

Table 2

Silica sorbentlar texture characterizationalaring TEOS concentration of boglikligi (50°C)

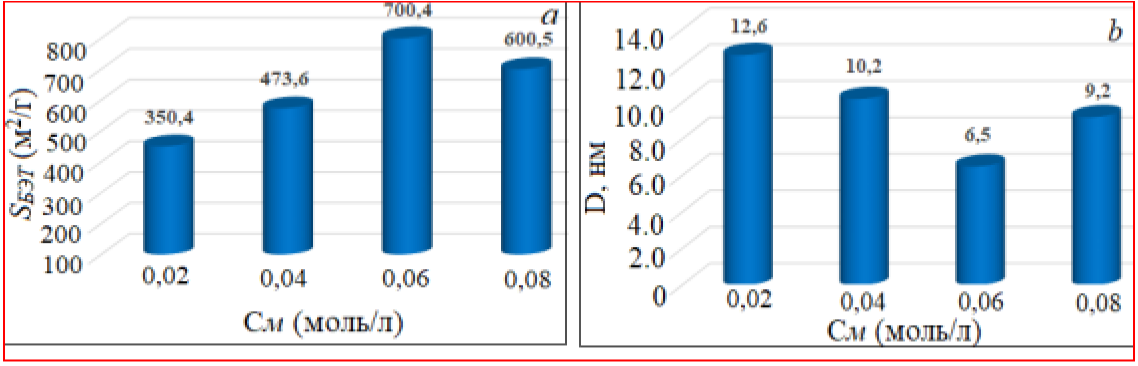
TEOS,mol/l	**S_{BET} ,m^2/g**	**V,cm^3/g**	**D,hm**	**a_s, mol/l**	***P,g/sm^3***
0,04	316,5+-45,3	0,44+-0,05	10,4+-0,8	3,52+-0,6	0,45+-0,02
0,06	532,6+-51,6	0,40+-0,11	8,5+-0,4	3,98+-0,7	0,31+-0,03
0,08	952,5+-32,6	0,32+-0,11	2,4+-0,3	4,85+-0,3	0,12+-0,06
0,1	886,3+-20,6	0,36+-0,09	6,5+-0,5	4,76+-0,2	0,19+-0,06
0,2	943,2+-52,0	0,34+-0,02	2.2+-0,6	5,12+-0,8	0,15+-0,02

From the data presented in Table 2, it is possible to build that in the texturing of kremnezem sorbents: when the concentration of Theos (at a temperature of 50°C) is increased from 0,04 to 0,2, the surface of the porous is reduced by 3 times, and the size of the average diameter by 5 times. It can also be seen from Figure 2 that an increase in the concentration of Theos in the synthesis of sorbents leads to a decrease in the comparative size of the pores and their average diameter.



2-picture. The relative surface (a) of Kremnezem sorbent and the dependence of the size of the pores (b) on the concentration of the Teos.

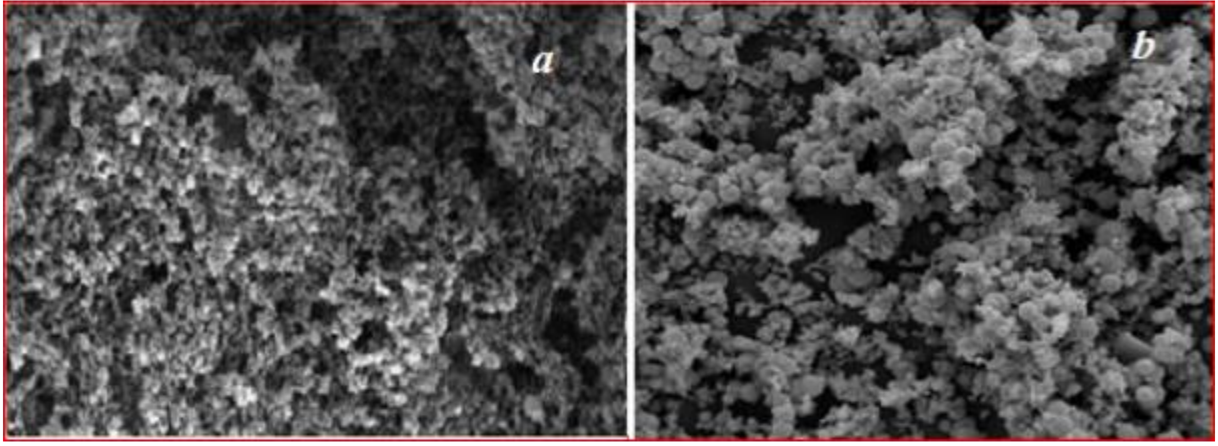
Also, the dependence of the textural characteristics of sorbents on the concentration of the surface active substance is confirmed by the data presented in Figure 3.



3-picture. Sorbents depend on the SFM concentration of tekstur characteristics.

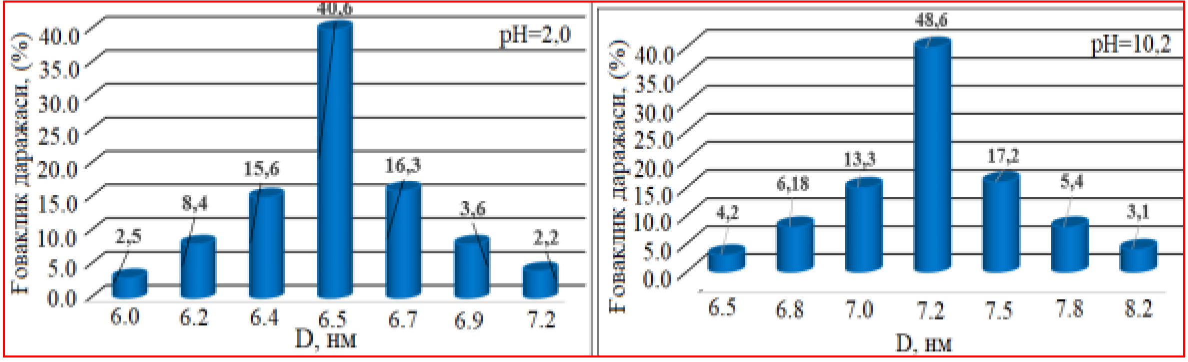
From the pictures, it can be seen that the porosity of sorbents obtained from the solution of SFM concentration 0,06 mol/l is 0,02 times higher than that of kremnezem sorbent porbents obtained from the solution 1,94 M; sorbent porbents obtained from the solution 0,04 M is 1,56 times smaller than the size and sorbent porbents In the zol-gel synthesis of Kremnezem sorbents, an increase in the concentration of reagents in the solution was observed, which led to a change in the size of the comparative surface, the size of the pores and their average diameter, which were considered important textural characteristics of the sorbents. It was found that the increased concentrations of Theos and SFM led to an increase in the porosity of the synthesized sorbent samples. This in turn was determined to lead to increased sorbtion capacity in the systems studied.

As is known, adsorption of adsorbent equilibrium isotherms of vapors of various substances in mesogovag kremnezem materials, such as MSM-41 and SBA-15, as well as desorption networks, go with the formation of a parallel hysteresis ring. Usually adsorption of water vapor on mesogamous kremnezem materials depends on the amount of silonol and siloxane groups on the surface. Also, the fact that adsorbed water vapor on the account of capillary condensation remains for a long time in the interior of the mesogovaks leads to the formation of gisterezis rings on the side of a large relative pressure. The distribution of pores on the surface of the nanocomposites sorbents at 50°C and the load-2,0 nanocomposites obtained from the Navahor bentonite obtained in the 10,2 and 1 environment of the solution can be seen from the images obtained with the help of an average diameter SEM (Figure 4).



4- picture. 50°C yes pH=2.0 yes templant PEG-400 (a) and pH=10.2 yes IFM gmda ni (b) chllab protingan YCC-1 sorbentlar syrting Samgazi image.

From the picture, it can be seen that the sorbent porridges obtained with the participation of the templant PEG-400 are evenly distributed on the surface, and they are the same in terms of dimensions, while the surface of the sorbents obtained with the participation of GMDA is an expression from the nanosarticles with the spherical morphology of monodispers. According to the results obtained from adsorption isotherms and Sem analysis, the distribution of porous on the surface of the porous in sorbent samples at 50°C can be expressed on the basis of the following graphs (Figure 5). According to him, 89,6-93,4% of the total porous in sorbents were found to be microgovens, while 2,3-6,7% to mesogovens.



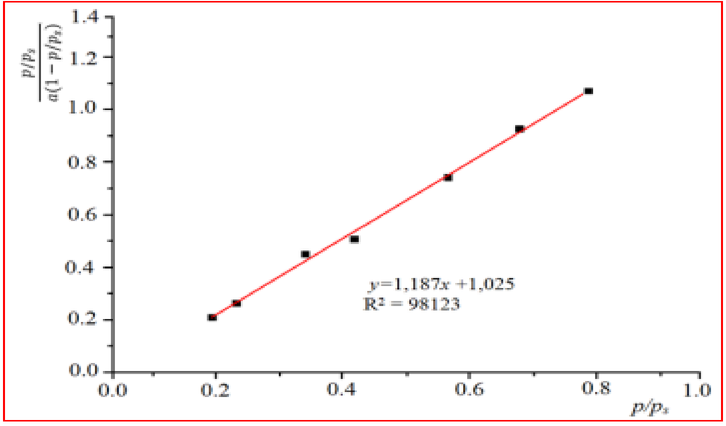
5- picture. 50°C yes pH 2.0 and 10.2 yes olingan sorbentlar syrtis govaclar parsimony of distribution.

From the picture, it can be seen that on the surface of the sorbents, the main part of the common porridges consists of mesogastes of small diameter. Calculations on the basis of sorbent isoterms of sorbents obtained in a weak acidic environment showed that they consist of mesogonyms.

In adsorbents obtained in alkaline environments, it was observed that the size of the porous was 2.25 times smaller than in sorbent porous obtained in acidic environments, while the surface surface comparable to that of the aging 1.15 times larger. The compatibility of isoterms obtained from benzene vapor adsorption at different relative pressures to the linear form of the bet equation was studied.

$$p/p_s\ a(1 - p/p_s) = 1\ am \cdot C + C - 1\ a_m \cdot C \cdot (p/p_s)$$

Using different relative pressure (p/ps) adsorbed amount of sorbate $p/ps\ a(1{-}p/ps\ ) =$ the graph f(p/ps) was drawn (Figure 6). From the pictures, we can see that the samples of sorbent obtained at 50°C at different relative pressures correspond to the linear shape of the bet model of benzene vapor adsorption isoterms.



6- picture. Values obtained from sorption of benzene vapors in mezogovaksp/ps $a(1-p/ps)$ **= f (p/ps) compatibility of the linear equation of the bet on the basis of the graph.**

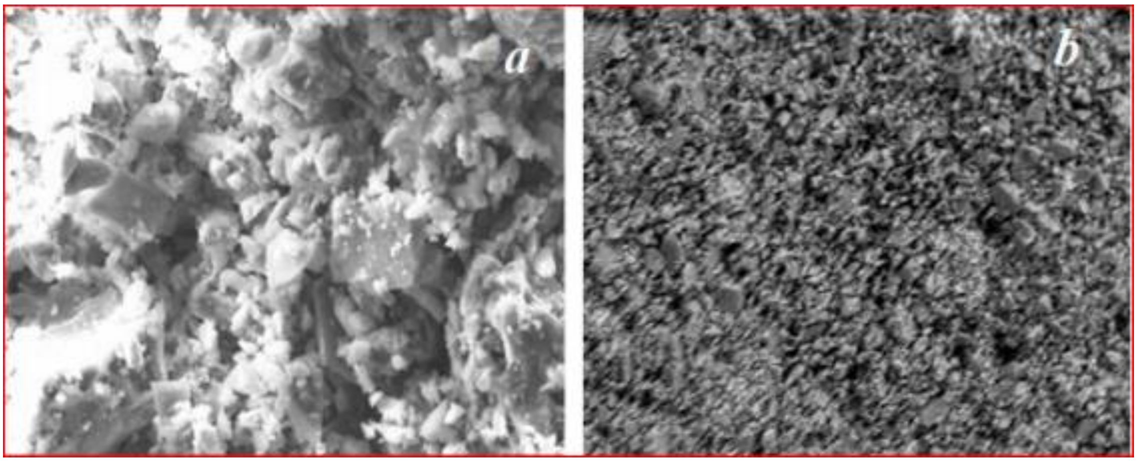
Calculations were taken based on the adsorbed amount of benzene in the range of relative pressure p/ps=0,2÷0,8. the degree of compatibility of the isoterm of the sorbent sample obtained at rn=2,0 was determined to correspond R2= 98,12 to the 92,7% bet isoterma model while in the sorbent obtained in the alkaline environment. Also, based on the data obtained as a result of the experiment, sorbents were determined from the saturation adsorption volumes (Vs) by the volume of microcircuits (W0), the volume of mesocircuits (Wmez) and the saturation volume (Vs) by benzene vapor (Table 3).

3- Table

Loads from Navahor bentonite obtained at 50°C and at different rn values - 1 nanocomposite porous volume in sorbents

pH	The size of the pores on the BDX, cm^3/g		
	Microwaves	the mesaean	common porous
	W_0 x10^3, cm^3/g	W_{mes} x10^3, cm^3/g	$V_{s\ x}$103, cm3/g
2,0	0,324+-0,05	1,052+-0,06	1,376+-0,10
5,2	0,302+-0,01	0,911+-0,04	1,213+-0,24
10,2	0,182+-0,04	0,872+-0,08	1,054+-0,15

From the table, the volume of nanocomposites sorbent mesoguae obtained under acidic conditions was 1.2 times higher than the volume of sorbent porae obtained in a weak alkaline environment, while the saturation volume increased by 1.3. From the image obtained at 50°C and Sem of the load-2 composites from the sequential bentonite synthesized at different rn values, they were found to be a complete crystal-and-Tarq-phase polidispers expression from the components (Figure 7).



7- picture. The load from the Navahor bentonite obtained at 50°C rn=2,0 and rn=10,2 is the image of 2 composites in SEM.

From the Sam image of the load-2 composites from the navahor bentonite it is possible to see that the degree of porosity is very low and there are large crystal fragments on the surface. From the sorbent samples obtained at 70°C and 90°C, it was found that they consist of more voluminous mesogueras (Figure 8).from the sorbent isotherms of the sorbent samples obtained at 70 ° C and 90 ° C. From the picture, it can be seen that the volume of the hysteresis rings formed on the account of capillary condensation is torn, and they are silenced to the side of a large relative pressure. Relative pressure P/ps=0,6÷0,9 of hysteresis rings in samples taken at 70°C; It was observed that the sorbents obtained at 90°C formed in the range p/ps=0,65÷0,95.

Bags from navahor bentonite-1 in the quality analysis of sorbtsia isoterms, the types of connection of water in the bentonite with the material and the nature of its drying give an opportunity to identify the invaders.

Bentonite clay colloidal capillary porous material characterizes a complex system with both nature and structure, and has different moisture compounds, plays a major role in the bonding of it or this type of water at different stages of dehydration of flour.

P. A. The classification of moisture binding forms in colloidal capillary-porous materials proposed by the Rebinder [14-16] takes into account the formation of various forms and the energy of their binding with the material. According to him, all its forms of moisture are divided into three large groups: chemical (molecular), physico-chemical (absorption, osmotic storage humidity (swelling and structural humidity), physico-mechanical (moisture in macro - and micro-capillaries).

The quantitative description of the energy of contact with the Material is of great practical importance. To determine this, the only criterion used in the classification of contact forms with the material is P. A. The Rebinder is the value of the free energy of isothermic dehydration. Here we come to the conclusion that due to the connection of water with the material, the pressure of the water vapor on its surface decreases, so the free energy decreases accordingly. This free energy drop is a work that is considered to be the energy of a constant temperature-absorbing Bond, for its disconnection, more precisely, for the separation of 1 mole of water from the material. (erg / mol) :

$$-\Delta F = L = RTln\frac{P_u}{P_{\text{н}}} = -RTln\varphi$$

$R -$ gas constant..

$\mathrm{P}_u - f$ree water is the pressure of the steam in the nozzle..

$P_{\text{н}} - u$ above the material in moisture balance is the partial pressure of water vapor, in inert gas or vacuum $\varphi = \frac{P_u}{P_{\text{н}}}$; material over balance water vapor port pressure ($P_{\text{н}}$) the less it is, the stronger the bond of water with the material, the more it becomes, the less it becomes, and for free water (P_u) free water equates to the pressure of the saturated steam. Such $\varphi = 1$ *the energy of connecting the mold is equalized to* 0.:

$$-\Delta F = L = -RTln1 = 0..$$

Bentonite of the curve of sorption isotherms contains mainly three types of bound water (moisture): physico-mechanical (moisture in macro - and micro-capillaries) physico-chemical (due to absorption, osmotic storage), chemical (molecular),. In the Navahor bentonite obtained from the sorption line (at 70°C and 90°C respectively), the initial starter indicates the presence of monomolecular bound water in the first Bosque (at a relative pressure of 0-0, 6) in the physico-mechanical (macro - and micro - capillaries moisture), that is, in the polymoecular bond and in the second Bosque (0,6-0,9) in the physico-chemical (due to bound to the charter). In our opinion, the breakdown of the dressing of people with hysteresis in the second band of sorbtsion isotherms is an indication of the dependence of the monomolecular energy of both polymolecular and hem, that is, the layers of the dressing are smeared..

The textural characteristics of the load-70 nanocomposite sorbents obtained from the Navahor bentonite obtained at 90°C and 1°C are presented in Table 4.

Table 4.

Textural characteristics of the load-1 nanocomposite sorbents obtained from Navahor bentonite obtained at different temperatures

t^0C	**pH**	**S_{BET} ,m^2/g**	**a_s, mol/l**	**D,hm**
70	2,0	450,8+-35,0	3,5+-0,3	25,3+-2,2
	5,2	456,2+-36,1	3,2+-0,3	25,2+-2,1
	10,2	436,2+-4,8	2,8+-0,2	48,6+-3,8
90	2,0	400,3+-32,6	1,6+-0,1	52,2+-4,8
	5,2	350,6+-29,8	1,6+-0,1	60,5+-5,2
	10,2	356,5+-30,2	0,8+-0,1	72,8+-6,4

Textur descriptions of nanocomposites sorbents from Navahor bentonite, obtained at different temperatures, confirm the following points: with an increase in rn, the surface surface of the porous decreases, with a rise in temperature, the decrease also persists, as well as the diameter of the porous increases.

IV. CONCLUSION

Mesogovag kremnezem nanocatalizer is a combustible substance used in obtaining bentonite - sorbents analysis of sorbtsiya isoterm and the results obtained are of particular scientific and practical importance, descriptions of the structure and surface morphology of the Uzi: a high comparative surface, porous with a size in the nanometer range, and specific physico-chemical properties confirm that the bulk of the common porous on the surface
From the Sam image of composites from navahor bentonite it is possible to see that the degree of porosity is very low and there are large crystal fragments on the surface. From the sorbent samples obtained at 70°C and 90°C, it was found that they consist of a more voluminous mesogovac

Bentonite of the curve of the resulting sorption isotherms contains mainly three types of bound water (moisture): physico-mechanical (moisture in macro - and micro-capillaries) physico-chemical (due to absorption, osmotic storage), chemical (molecular),. The initial start in the Navahor bentonite obtained from the sorption line (at a temperature of 70°C and 90°C) indicates the presence of Physico-Chemical monomolecular bound water in the first Bosque (at a relative pressure of 0-0,6) in the physico - mechanical polymoecular bond and in the second phase (0,6-0,9). The formation of hysteresis rings in the second phase of sorbtion isotherms is evidence of The Binding of both polymolecular and monomolecular energy.

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