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EFFECT OF BENTONITE ON BENZENE VAPOR ADSORPTION IN ORDER TO DETERMINE THE ACTIVATION CONDITIONS OF LOG BENTONITE

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Abstract: In the article, the adsorption properties of benzene vapor by adsorbents derived from Logon bentonite, activated through various thermal and chemical methods, were analyzed. The study highlights that chemical activation significantly enhances the adsorption capacity of Logon bentonite (LB-1). The comparison between untreated bentonite and chemically activated forms reveals improved benzene vapor adsorption in the chemically treated bentonite, indicating that the activation process has a substantial impact on the material's adsorption efficiency.

Keywords: Betonies, water vapor, adsorbent, adsorbate, adsorption, monomolecular layer, isothermal monolayer capacity, specific surface area.

Introduction. Uzbekistan possesses abundant reserves of natural mineral raw materials, including clays with significant potential for industrial applications. The modification of secondary raw materials, such as natural clays, with carbon-retaining substances presents an opportunity to enhance their adsorption properties. By studying the adsorption characteristics and determining the optimal activation conditions, these modified clays can be employed in purifying heavy metal ions and surface-active substances from various industries. The targeted use of adsorbents based on modified natural clay minerals and oil waste depends largely on their surface properties and structural sorption parameters. Key factors include the surface geometry, crystal chemical structure, the number and nature of active centers, functional groups, and ion exchange capacity. A comprehensive understanding of these properties is essential for determining the potential applications of mineral sorbents. Fergana Valley bentonites, particularly from Logon and Shorsuv, are rich in montmorillonite and exhibit high ion exchange properties, primarily due to the presence of alkaline metal ions. Unlike other types of bentonites, these contain fewer colored metal oxides and salts, making them highly effective as adsorbents. To further enhance their capabilities, a two-way hybrid adsorbent can be developed by modifying these bentonites with gossypol resin. The next step is to study their structural sorption properties to better understand their performance in industrial applications.

Method and materials. Adsorption isotherms of vapors of gases and liquids on different adsorbents are studied in a high-vacuum Mc-Ben-Bakra balance. A scheme of a high-vacuum Mc-Ben-Bakra apparatus for adsorption research is shown in Figure 3.1.

The device is equipped with a quartz coil with high sensitivity. The sensitivity of the device is $1.78 \cdot 10^{-3}$ kg/m. The benzene vapor adsorption device is equipped with quartz coils and adsorbent containers, glass calonna (special cups). During laboratory work, the temperature of the adsorption column (tube) containing modified adsorbent samples is kept at $20\text{ }^{\circ}\text{C}$ with an accuracy of $0.1\text{ }^{\circ}\text{C}$ in a water thermostat. Mc-Ben-Bakra structure and principle of operation, the main working parts are composed as follows - from the adsorbent samples under study are weighed on an analytical balance with an accuracy of 1 g in cups), quartz spring adsorption columns (equipped with cups, - forvacuum pump (VN - 461M brand), -diffusion pump (creates a vacuum until the residual pressure in the system is $1.33 \cdot 10^{-3}$ Pa.) it is provided with a screw, the system pressure is controlled by a thermovacuum meter (VIT-2 brand) and a trap (functioning to trap various gases and water vapors in the system with liquid nitrogen), U-shaped manometers, ampoules containing adsorbates, and taps for separating the parts of the device are placed.

Diffusion pump, forvacuum pumps in adsorption device $1 \cdot 10^{-5}$ mm.s.s. creates a vacuum until The pressure difference in U-shaped monometers is measured using a V-630 type cathometer, and the accuracy of the cathometer is 0.05 mm. Prepared samples are crushed in a mortar to a powder state, after mixing thoroughly, 1 g is taken out on a scale. Placed in a cup, the pressure in the system is stabilized by vacuum for 6-8 hours.

In our country, the adsorption of organic substances on natural mineral compounds (bentonites) [1; P. 247-256], in addition to the adsorption of organic and inorganic substances on synthetic zeolites [2; 182-193b] scientific research works were carried out. The effect of log bentonite and its activation on the adsorption of organic matter under the conditions of activation has not been fully studied. Nowadays, local bentonites are cleaned and activated and used as various absorbing substances. Bentonite samples have high adsorption properties due to the high content of montmorillonite, which determines the absorption properties. Local bentonites are widely used in production, cosmetology, medicine, and food industries due to their high content. Bentonite has a high ability to adsorb non-polar substances. This feature indicates increased hydrophilicity. High absorption of water can clog pores and prevent absorption of harmful substances as a result of water saturation. For this purpose, it is necessary to conduct a fundamental study of the adsorption of vapors of organic substances on adsorbents modified by various methods. Adsorbents were obtained by thermally and chemically activating Logon bentonite. Adsorption of benzene vapor on the obtained adsorbents was studied. [2; C. 20-25].

Study of the effect of adsorption on log bentonite activation conditions

Benzene, which was absorbed into the samples, was purified under vacuum before use in the sorption. Then it was dried, its vapor pressure was adjusted to the standard conditions for pure benzene by first freezing and then heating until its vapor pressure

was equal to that of pure benzene, and its dissolved gases were released and its adsorptions were studied. Adsorbents (LB-1, LB-2, LB-3) with thermal (200, 300, 400) processing, chemical activation; activated in acidic (0.1 N HCl) and alkaline (0.1 N NaOH) media (LBK, LBI) and adsorbent were obtained.

The adsorption of non-polar benzene vapors on modified bentonites was studied. [3; C. 45-49]

Results and discussions. Benzene adsorption on LBI and LBK (activated in alkaline and acid conditions) adsorbents compared to LB-1, LB-2, LB-3, adsorption is very low in the initial states of adsorption, and cations located between the adsorbent layers (with $\text{Na}^+ [\text{Al}_3\text{O}(\text{OH})_{24}(\text{H}_2\text{O})_{12}]^{7+}$) and depends on electronic nature and interactions of benzene molecule. The amount of adsorption at high specific relative pressures ($R/R_s=0.3$) It can be seen from the adsorption isotherms that the amount of adsorption in LBI and LBK increases sharply (Fig. 1). [4; C 376-379 b]

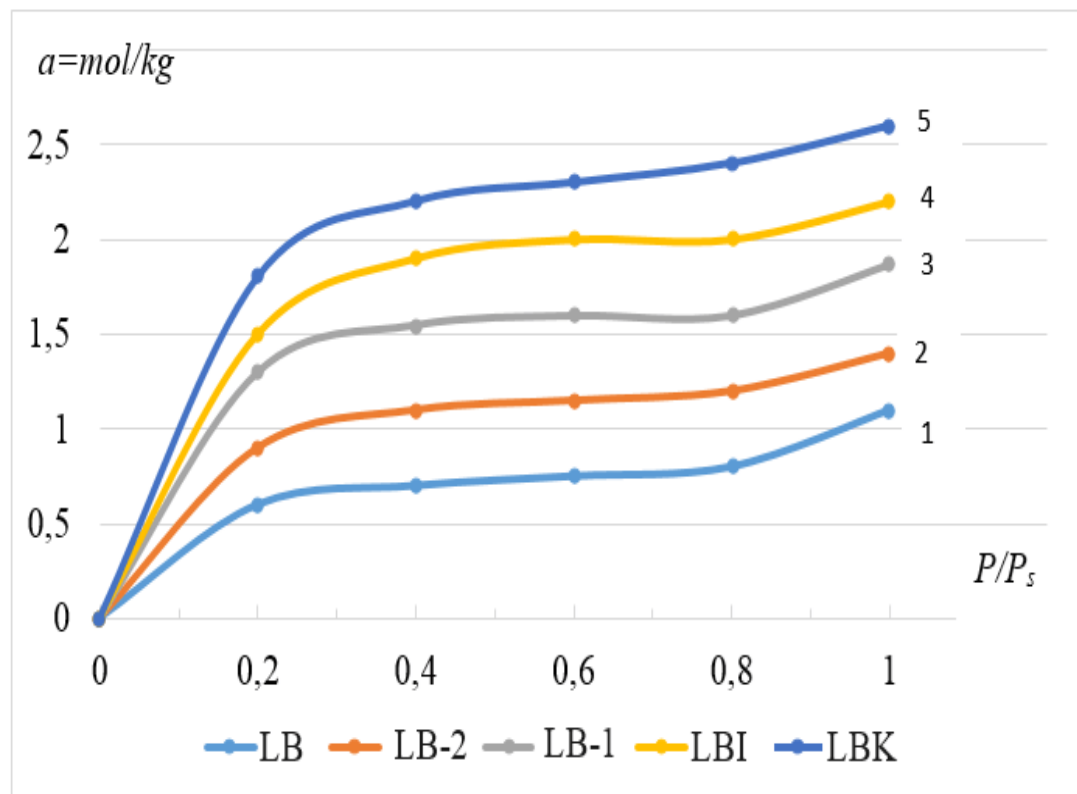


Figure 1. Activated LBI, LBK, LB-3, LB-2, LB-1, benzene vapor adsorption isotherm on bentonites.

The structure-sorption parameters of the modified adsorbents were determined using the equation of the reference surface (BET) theory. In this case, if the values on the ordinate and abscissa axis are given, the isotherms will be straight line coordinates. [5; C.28-30].

The relative surface of adsorbents is calculated based on the following formulas:

$$S = \frac{am \cdot N_A}{\omega} \quad (3.1)$$

where S is specific surface area (m²/g);

am-monomolecular layer (mol/kg);

NA-avagadro number;

ω- surface occupied by one molecule (nm²)

In adsorbents, the structure is determined from the adsorption parameters using the equations of the specific surface area (S) (BET) theory. If P/Ps values are given on the ordinate and abscissa axes, straight line coordinates will be obtained.

Based on the isotherms of benzene vapor adsorption in modified adsorbents, the monolayer capacity am, the relative surface area S, the saturation volume Vs (or adsorption as) were calculated from the important parameters of the adsorbents (Table 1).

Table 1. At different temperatures structure - sorption indicators, indicators of benzene vapor adsorption of modified bentonites obtained by thermal treatment.

No	Adsorbent samples	Single floor capacity indicator <i>a_m</i> , mol/kg	A unit of reference surface <i>S</i> ·10 ⁻³ , m ² /kg	Adsorption saturation <i>a_s</i> , mol/kg
1	LB	0.18	40	1.13
2	LB-2	0.53	149	1.40
3	LB-1	0.68	164	1.87
4	LBI	0.76	175	2.20
5	LBK	0.83	198	2.60

From the table, the specific surface index (S) for all adsorbents is: 40· in LB 10³ m²/kg, 149·10³ m²/kg in LB-2, 164· in LB-1 10³ m²/kg is 175·10³ m²/kg in LBI and 198·10³ m²/kg in LBK, as well as adsorption saturation (as): 1.13 mol/kg in LB, 1.40 mol/kg in LB-2, LB-1 was found to be 1.86 mol/kg, LBI 2.2 mol/kg, and LBK 2.60 mol/kg. So, comparing the adsorption of benzene vapor against Log'on bentonite (LB-1) as a result of chemical activation, it can be seen that it leads to an increase in adsorption to 1.14-2.20 in LBI and 1.14-2.60 in LBK.

Conclusion. Acid activation of log bentonite can allow cleaning of inter-pore inclusions resulting in significant reduction of iron oxide, magnesium and alkaline-earth metals and increased adsorption properties. A decrease in the amount of these substances leads to an increase in the amount of tetrahedral silicon oxide in the bentonite crystal lattice as a result of the release of polar and non-polar substances in the form of surfactants.

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C O N T E N T S

PRIMARY PROCESSING OF COTTON, TEXTILE AND LIGHT INDUSTRY

Dadadzhonov Sh., Akhunbabaev O., Muxamadrasulov Sh., Akhunbabaev U., Erkinov Z.	3
Practice of production of polycomponent threads from a mixture of natural and chemical fibers	
Korabayev Sh.	13
Determining the direct resistance coefficient of cotton fiber in the confusor tube	
Kulmatov I.	19
Study of a new technological equipment for cleaning cotton raw materials from gross pollution	
Musayeva L., Polatova S.	24
Choosing the main features of special clothing for riders, taking into account the requirements of consumers	
Djurayev A., Khudayberdiyeva M., Urmanov N.	31
Kinematic analysis of a cam mechanism with elastic elements of the mechanism with elastic elements of paired cams of a boel mechanism of a weaving loom	
Rakhmonov H., Matyakubova J., Sobirov D.	41
Analysis of the influence of the filling coefficient of the screw cleaner system with seeded cotton on the current consumption of the system	
Madrahimov D., Tuychiyev Sh.	48
Impact of saw spacing on lint removal efficiency and quality in the linting process	
Monnopov J., Kayumov J., Maksudov N.	53
Analysis of mechanical properties of high elastic knitted fabrics for sportswear design	
Kamolova M., Abdukarimova M., Usmanova N., Mahsudov Sh.	59
Study of the Prospects for the Application of Digital Technologies in the Fashion Industry in the Development of the Creative Economy	
Ergasheva R., Khalikov K., Oralov L., Samatova Sh., Oripov J.	71
Comprehensive assessment of two-layer knitted fabrics	

GROWING, STORAGE, PROCESSING AND AGRICULTURAL PRODUCTS AND FOOD TECHNOLOGIES

Aripov M., Kadirov U., Mamatov Sh., Meliboyev M.

Experimental study of sublimation drying of vegetables by applying ultra – high frequency electromagnetic waves	74
Alamov U., Shomurodov D., Giyasova N., Zokirova Sh., Egamberdiev E.	81
Chemical composition analysis of miscanthus plant leaves and stems	81
Vokkosov Z., Orifboyeva M.	88
Production of technology for obtaining oil from peanut kernels and refining the oil obtained in short cycles	88
Khalikov M., Djuraev Kh.	95
The importance of systematic analysis in the drying process of fruit and vegetable pastilla	95

CHEMICAL TECHNOLOGIES

Kuchkarova D., Soliyev M., Ergashev O.	101
Production of coal adsorbents by thermochemical method based on cotton stalks and cotton shells and their physical properties	101
Askarova D., Mekhmonkhonov M., Ochilov G., Abdikamalova A., Ergashev O., Eshmetov I.	108
Some definitions about the mechanism of public-private partnership and its role in strengthening the activities of business entities and small businesses	108
Ganiyeva N., Ochilov G.	117
Effect of bentonite on benzene vapor adsorption in order to determine the activation conditions of log bentonite	117
Kayumjanov O., Yusupov M.	122
Synthesis of metal phthalocyanine pigment based on npk and calculation of particle size using the debye-scherrer equation	122
Mukumova G., Turaev Kh., Kasimov Sh.	127
Sem analysis and thermal properties of synthesised sorbent based on urea, formaldehyde, citric acid	127
Amanova N., Turaev Kh., Beknazarov Kh., Sottikulov E., Makhmudova Y.	133
Corrosion resistance of modified sulfur concrete in various aggressive environments	133
Eshbaeva U., Alieva N.	141
Study of the effect of adhesive substances on paper strength properties	141
Turayev T., Bozorova G., Eshankulov N., Kadirov Kh., Dushamov A., Murtozoeva Sh.	146
Cleaning of saturated absorbents used in natural gas cleaning by three-stage filtration method and analysis of their properties	146

Muxamedjanov T., Pulatov Kh., Nazirova R., Khusenov A.	158
Obtaining of phosphoric cation-exchange resin for waste water treatment	

MECHANICS AND ENGINEERING

Abdullaev A., Nasretdinova F.	165
Relevance of research on failure to power transformers, review	

Muhammedova M.	173
Anthropometric studies of the structure of the foot	

Sharibayev N., Nasirdinov B.	181
Measuring the impact of mechatronic systems on silkworm egg incubation for premium silk yield	

Abdullayev L., Safarov N.	189
Electron beam deposition of boron-based coatings under vacuum pressure and experimental results of nitrogenation in electron beam plasma	

Kadirov K., Toxtashev A.	195
The impact of electricity consumption load graphs on the power	

Makhmudov I.	204
Theoretical basis of the methodology of selecting wear-resistant materials to abrasive corrosion	

Adizova A., Mavlanov T.	209
Determining optimal parameter ratios in the study of longitudinal vibrations of threads in weaving process using a model	

Turakulov A., Mullajonova F.	215
Application of the dobeshi wavelet method in digital processing of signals	

Djurayev Sh.	222
Analysis and optimization of the aerodynamic properties of a new multi-cyclone device	

Djurayev Sh.	228
Methods for improving the efficiency of multi-cyclone technology in air purification and new approaches	

Ibrokhimov I., Khusanov S.	236
Principles of improvement of heavy mixtures from cotton raw materials	

Utaev S.	241
Results of a study of the influence of changes in oils characteristics on wear of diesel and gas engine cylinder liners	

Abduvakhidov M.	249
Review of research issues of determination of mechanical parameters of compound loading structures and working bodies	

Abduvakhidov M.	256
Equilibrium analysis of flat elements of the saw working element package	

Kudratov Sh., Valiyev M., Turdimurodov B., Yusufov A., Jamilov Sh.	
Determining the technical condition of diesel locomotive diesel engine using diagnostic tools	262
Juraev T., Ismailov O., Boyturayev S.	
Effective methods of regeneration of used motor oils	269
Umarov A., Sarimsakov A., Mamadaliyev N., Komilov Sh.	
The oretical analysis of the fiber removing process	276
Tursunov A.	
Statistical evaluation of a full factorial experiment on dust suppression systems in primary cotton processing facilities	282
ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION	
Yuldashev A.	
Historical theoretical foundations of state administration and the issue of leadership personnel	294
ECONOMICAL SCIENCES	
Israilov R.	
Criteria, indicators and laws of small business development	299
Eshankulova D.	
Demographic authority and its regional characteristics	305
Kadirova Kh.	
Assessment of the efficiency and volatility of the stock market of Uzbekistan	310
Mirzakhalikov B.	
Some definitions about the mechanism of public-private partnership and its role in strengthening the activities of business entities and small businesses	316
Ganiev M.	
Income stratification of the population and opportunities to increase incomes	321
Aliyeva E.	
Assessment of innovation activity enterprises using the matrix method	327
Azizov A.	
Industry 4.0 challenges in China	335
Azizov A.	
Industrie 4.0 implementation challenges in Germany	341