ISNN:2181-1296



SHAROF RASHIDOV NOMIDAGI
SAMARQAND DAVLAT UNIVERSITETI

САМАРКАНДСКИЙ ГОСУДАРСТВЕННЫЙ
УНИВЕРСИТЕТ ИМЕНИ ШАРОФА РАШИДОВА

SAMARKAND STATE UNIVERSITY NAMED
AFTER SHAROF RASHIDOV

ILMIY AXBOROTNOMA

НАУЧНЫЙ ВЕСТНИК
SCIENTIFIC JOURNAL

ANIQ VA TABIIY FANLAR SERIYASI

Matematika, Mexanika, Informatika
Fizika, Kimyo, Biologiya, Geografiya

№ 1/1 (149)
2025

ISSN 2181-1296

ILMIY AXBOROTNOMA

НАУЧНЫЙ ВЕСТНИК SCIENTIFIC JOURNAL

2025-yil, 1-son (149/1) ANIQ VA TABIIY FANLAR SERIYASI

Matematika, Mexanika, Informatika, Fizika, Kimyo, Biologiya, Geografiya

Samarqand viloyat matbuot boshqarmasida ro‘yxatdan o‘tish tartibi 09-25.
Jurnal 1999-yildan chop qilina boshlagan va OAK ro‘yxatiga kiritilgan.

BOSH MUHARRIR **R. I. XALMURADOV, t.f.d., professor**
BOSH MUHARRIR O‘RINBOSARLARI: **H.A. XUSHVAQTOV, f-m.f.d., dotsent**

TAHRIRIYAT KENGASHI:

Sh.A.Alimov	- O‘zFA akademigi	**M.X.Ashurov**	- O‘zFA akademigi
S.N.Lakayev	- O‘zFA akademigi (SamDU)	**B.J.Axmedov**	- O‘zFA akademigi
M.M.Kamilov	- O‘zFA akademigi	**Q.G‘.G‘ulomov**	- O‘zFA akademigi
A.G.Yagola	- Moskva davlat universiteti professori (Rossiya)	**A.A.Zaxidov**	-Texas Nanotexnologiya instituti professori (AQSh)
Alberto Del Bimbo	-Florensiya universiteti professori (Italiya)	**N.B. Ferapontov**	- Moskva davlat universiteti professori (Rossiya)
Sh.Tugizov	-Kaliforniya universiteti professori (AQSh)	**V.L.Popov**	-Berlin texnika universiteti professori (Germaniya)
A.S.Soleev	- f.-m.f.d., professor (SamDU)	**N.F.Bunkin**	- Moskva davlat texnika universiteti professori (Rossiya)
I.A.Ikromov	- f.-m.f.d., professor (SamDU)	**Haji Akber Aisa**	-Xinjiang tibbiyot universiteti professori (Xitoy)
B.X.Xo‘Jayarov	- f.-m.f.d., professor (SamDU)	**E. A. Abduraxmonov**	- k.f.d., professor (SamDU)
L.Sabirov	-f.-m.f.d., professor (SamDU)	**N. K. Muxamadiyev**	- k.f.d., professor (SamDU)
A.Jumaboyev	-f.-m.f.d., professor (SamDU)	**L. A. Bulavin**	- Kiev milliy universiteti
X.Bozorov	-k.f.d., professor (SamDU)	**X. Q. Xaydarov**	- b.f.d., professor (SamDU)
O.Q.Quvondiqov	-f.-m.f.d. professor (SamDU)	**Z. I. Izzatullayev**	- b.f.d., professor (SamDU)
A.Z.Xasanov	-f.-m.f.d. professor (SamDU)	**A.B.Hasanov**	-tex.f.d., professor (SamDU)
Muhammad Suzuri bin Hitam	- Terengganu universiteti professori (Malayziya)	**Sh. T. Xoliqulov**	- q.-x.f.d., professor (SamDU)
K.D.Kuliyev	- f.-m.f .n. professor (SamDU)	**S. B. Abbosov**	- g.f.d., professor (SamDU)
A.M.Xolxo‘jayev	-f.-m.f.d., professor (SamDU)	**M.E. Mo‘minov**	-f.-m.f.d., professor (SamDU)
J.Abdullayev	-f.-m.f.d., professor (SamDU)	**I.I.Jumanov**	-tex.f.d., professor (SamDU)
A.R.Axatov	-tex.f.d., professor (SamDU)	**N.S.Mamatov**	-tex.f.d., professor (TIQXMMI)
D.B.Xursanov	- g.f.f.d., dotsent (SamDU)	**A.Sh.Yarmuxamedov**	-f-m.f.n., dotsent (SamDU)
F.Nazarov	-tex.f.f.d., dotsent (SamDU)	**X.S.Xaydarov**	-f-m.f.n., dotsent (SamDU)

Obuna indeksi – yakka tartibdagi obunachilar uchun **- 5583,**
tashkilot, korxonalar uchun **- 5584**

M U N D A R I J A
C O N T E N T S

№	Maqola nomi	Article title	Bet/ page
1	Triplet CdSe/CdS/ZnS kvant nuqtalariga asoslangan nanokompozitlarning fizik-kimyoviy xossalari **Bahronova N., Abdibanatova G., Kulmirzayeva S., Kolyadin V., Ishankulov A.**	Physicochemical properties of nanocomposites based on triplet CdSe/CdS/ZnS quantum dots **Bahronova N., Abdibanatova G., Kulmirzaeva S., Kolyadin V., Ishankulov A.**	**5-10**
2	Zaryadlangan BTZ qora tuynuklarning P-V kritikligi va barqarorlik tahlili **Umrzoqov F., Rakhmatov B.**	P-V criticality and stability analysis of charged BTZ black holes **Umrzokov F., Rakhmatov B.**	**11-16**
3	Diffuziyali jarayon bilan berilgan tenglamalar sistemasini avtomodel tahlili **Mamatov A.**	Self-similar analysis of a system of equations given by a diffusion process **Mamatov A.**	**17-25**
4	Ma'lumotlar bazasini loyihalashtirishda evolyutsion usullarini qo'llash algoritmlari **Nurmamatov M.K.**	Algorithms for using evaluation methods in database design **Nurmamatov M.K.**	**26-32**
5	Tarkibida aralvan erituvchilar bo'lgan kuchli elektrolitlar eritmalaridan pvs bo'kish kinetikasini o'rganish **Atavullaeva Sh., Tursunova G., Trobov H, Ferapontov N.**	Study of the kinetics of pva swelling from solutions of strong electrolytes containing mixed solvents **Atavullaeva Sh., Tursunova G., Trobov Kh, Ferapontov N.**	**33-38**
6	Kasallik belgilari va kasalliklar o'rtasidagi bog'liqlikni aniqlashning mantiqiy modeli va dasturiy ta'minoti **Abdirofiev N.**	Logical model and software for determining the relationship between diseases and their symptoms **Abdirofiev N.**	**39-46**
7	Umumiy nisbiylik nazariyasida tortishish maydonida perigeliynning siljishi va yorug'lik nurlanishining burilishi **Turimov B., Karshiboev Sh.**	Perihelion shift and light bending by a gravitational object in general relativity **Turimov B., Karshiboev Sh.**	**47-56**
8	Bentonit gillarini boyitish orqali uning struktura tuzilishiga ta'sirini o'rganish **Mamadoliyev I., Abdikamalova A., Raxmanova F.**	Studying the impact of bentonite clay on its structural structure through enrichment **Mamadoliyev I., Abdikamalova A., Rakhmanova F.**	**57-63**
9	Ba'zi d-elementlar ionlarining kversetin va rutin bilan komplekslari sintezi va ularning barqarorlik konstantalarini baholash **Ergashova Sh.I., Ismatov D.M., Mukhamadiev N.K.**	Synthesis of complex compounds of ions of some d-elements with quercetin and rutin and assessment of their stability constants **Ergashova Sh.I., Ismatov D.M., Mukhamadiev N.K.**	**64-68**
10	Anilinning tebranish modlarini polarizatsiyalangan raman va umumlashgan 2D Raman korelyatsion spektroskopiyasi yordamida konsentratsiyaga bog'liq holda tahlil qilish **Yormatov Sh.**	Concentration-dependent analysis of aniline vibrational modes using polarized raman and generalized 2d raman correlation spectroscopy **Yormatov Sh.**	**69-75**
11	Glioksalning eritmalar bilan hosil qilgan kompleslarining shakllanish mexanizmlarini noemperik hisoblash yordamida o'rganish **Jumabayev A., Norqulov A., Mahammadiyev S.**	Study of formation mechanisms of complexes formed with glyoxal solutions using quantum chemical calculations **Jumabaev A., Norkulov A., Makhammadiyev S.**	**76-90**

12	Materialining nomukammal elastikligi hisobga olingan doiraviy plastinkaning tasodifiy ko‘ndalang tebranishlari **Dusmatov O., Khasanov J.**	Transverse vibrations of a circular plate taking into account the imperfect elasticity of the material **Dusmatov O., Khasanov J.**	**91-95**
13	Diskret hardy tipidagi tengsizliklar uchun yangi ekvivalent shartlar **Kuliev K., Turaqulov T.**	New equivalent conditions for discrete hardy-type inequalities **Kuliev K., Turakulov T.**	**96-105**
14	To‘rtta tub sonning kvadratlari yig‘indisi ko‘rinishida ifodalanuvchi sonlar haqida **Imamov O.**	On numbers representable as the sum of four squares of prime numbers **Imamov O.**	**106-110**
15	$CD_3Hal\cdots HCl$ (Hal = F, Cl, Br) komplekslarini IQ spektrlari va DFT hisoblari asosida tekshirish **Khujamov U., Murodov G., Hushvaktov H., Nurmurodova G.**	Investigation of $CD_3Hall\cdots HCl$ (Hal = F, Cl, Br) complexes based on ir spectra and dft calculations **Khujamov U., Murodov G., Khushvaktov H., Nurmurodova G.**	**111-121**
16	Uch o‘lchamli qo‘zg‘alishga ega Fridrixs modelining sonli tasviri **Husenova J.T.**	Numerical range of the Friedrichs model with rank three perturbation **Husenova J.T.**	**122-127**
17	Quyi molekulyar dori vositalarini modifikatsiyasida polialdegidinulinni qo‘llanilishi **Rakhmonberdiev G.R., Bocheka A.M., Ibragimova K.S., Tilakov J.R., Khusenov A.Sh.**	Application of polyaldehydinuline for modification of low molecular drugs **Rakhmonberdiev G.R., Bocheka A.M., Ibragimova K.S., Tilakov J.R., Khusenov A.Sh.**	**128-133**

UDC: 544.723.23 https://doi.org/10.59251/2181-1296.2025.v1.149.1.3176

STUDYING THE IMPACT OF BENTONITE CLAY ON ITS STRUCTURAL STRUCTURE THROUGH ENRICHMENT

I.Mamadoliev [1], A.Abdikamalova [2], F.Raxmanova [3]
[1] Kimyo international university in Tashkent branch Samarkand, Samarqand, Uzbekistan.
[2] Institute of General and Inorganic Chemistry, Academy of Sciences of the Republic of Uzbekistan. Tashkent, Uzbekistan.
[3]Samarkand State Medical University, Samarkand, Uzbekistan.

I.Mamadoliev Kimyo international university in Tashkent branch Samarkand, Samarkand, Uzbekistan.

Received: 08.02.2025
Revised: 20.02.2025
Accepted: 28.02.2025
Published: 29.03.2025

Publisher: Samarkand State University named after Sharof Rashidov.

Abstract. To study the chemical and mineralogical composition of the selected clays, montmorillonite clays from the Navbahor deposit (Navoi region) were studied in order to determine the degree of this sorbentity. The work used physicochemical (X-ray diffraction, thermogravimetric, spectral, microscopic) and (calorimetric, adsorption, low-temperature nitrogen adsorption) colloidal-chemical analysis methods. Processing and modification of alkaline and alkaline earth bentonite with Ca2+Zn2+Mn2+ and Ca2+Zn2+Mn2+ solutions, determination of their texture and adsorption activity with respect to inorganic ions (Cu2+ PO43-) and aqueous solutions to petroleum products, as well as water and hexane molecules from a gaseous environment. Methods for synthesizing solutions that form a film on the surface were developed to modify alkaline and alkaline earth bentonite; Most of the studies were performed at a measurement rate of 4000 pulses/sec, a time constant of 1 sec, and a secondary angle range (2θ) of 4-80°. Monochromatic X-ray studies were performed by exposing the samples to different modes to obtain a more accurate diffraction pattern.

Keywords: navbahor alkaline (B1), alkaline-earth (B2) enriched bentonite, modification, porosity, granulometric composition, textural characteristics, X-ray diffractogram, adsorption activity, modification.

Bentonit gillarini boyitish orqali uning struktura tuzilishiga ta’sirini o‘rganish

Annotatsiya. Tanlangan gillarning kimyoviy va mineralogik tarkibini o‘rganish maskur sorbentlik darajasini aniqlash maqsadida Navbahor konidan (Navoiy viloyati) montmorillonit gillari o‘rganildi. Ishda fizik-kimyoviy (rentgen nurlari difraksiyasi, termogravimetrik, spektral, mikroskopik) va (kalorimetrik, adsorbsion, past haroratli azot adsorbsiyasi) kolloid-kimyoviy tahlil usullaridan foydalanilgan. Ishqoriy va ishqoriy yer bentonitni Ca2+Zn2+Mn2+ ва Ca2+Zn2+Mn2+ eritmalari bilan qayta ishlash, modifikatsiyalash ularni anorganik ionlarga (Cu2+ PO43-) nisbatan tekstur va suvli eritmalardan neft mahsulotlariga, shuningdek gazsimon muhitdan suv va geksan molekulalariga nisbatan ularning teksturali va adsorbsion faolligini aniqlash. ishqoriy va ishqoriy-yer bentonitini modifikatsiyalash uchun yuzasida plyonka hosil qiluvchi eritmalarni sintez qilish usullari ishlab chiqilgan; Tadqiqotlarning aksariyati 4000 impuls/sek o‘lchov chegarasida, 1sek vaqt doimiyligida va ikkilamchi burchak oralig‘ida (2θ) 4-80° amalga oshirildi. Aniqroq

diffraksiya sohani olish uchun namunalarni turli rejimlarda olib borish bilan monoxromatik rentgen nurlanishi tadqiqoti o‘tkazildi.

Kalit so‘zlar: Navbahor ishqoriy (B1), ishqoriy-yer(B2) bentoniti boyitish, modifikatsiya, g‘ovaklik, granulometrik tarkib, tekstur xususiyat, rentgen diffraktogramma.

Изучение влияния бентонитовой глины на ее структурное строение путем обогащения

Аннотация. С целью изучения химического и минералогического состава выбранных глин и определения степени сорбционной активности были исследованы монтмориллонитовые глины месторождения Навбахор (Навоийская область). В работе использованы физико-химические (рентгеноструктурный, термогравиметрический, спектральный, микроскопический) и коллоидно-химические (калориметрический, адсорбционный, низкотемпературная адсорбция азота) методы анализа. Обработка и модификация щелочных и щелочноземельных бентонитов растворами Ca2+Zn2+Mn2+ и Ca2+Zn2+Mn2+ с целью определения их текстуры и адсорбционной активности по отношению к неорганическим ионам (Cu2+ PO43-) и нефтепродуктам из водных растворов, а также молекулам воды и гексана из газообразных сред. Разработаны методы синтеза поверхностно-образующих растворов для модификации щелочных и щелочноземельных бентонитов; Большинство исследований проводились при пределе измерения 4000 импульсов/сек, постоянной времени 1 сек и диапазоне вторичных углов (2θ) 4–80°. Для получения более точной дифракционной картины были проведены исследования методом монохроматической рентгеновской дифракции путем воздействия на образцы различных мод.

Ключевые слова: навбахорский щелочной (Б1), щелочноземельный (Б2) бентонит обогащение, модификация, пористость, гранулометрический состав, текстурные свойства, рентгеновская дифрактограмма.

Introduction. Bentonite clays, due to their unique properties, occupy a special place among natural minerals and are widely used in various industries. However, to perform specific functions it is often necessary to optimize or change the original characteristics of bentonite through enrichment or modification. These procedures can affect the structural, physicochemical and sorption properties of the material, which in turn determines its suitability for various applications. [1]. These processes can affect the structural, physicochemical and sorption properties of the material, which in turn determines its suitability for various purposes. Modification of bentonite can improve its adsorption properties, resistance to acids and alkalis, thermal stability and other key properties [2]. These improved properties make modified bentonite an ideal material for use in water treatment, pollutant removal, catalysis, and other related applications. Recently, many methods of clay and clay minerals, including physical, chemical and thermal conversion, have been proposed to increase their ability to adsorb hazardous substances from water [3]. One of the most promising methods of bentonite enrichment for the reprocessing of adsorbents is the method of mechanical separation, wetting and treatment with acid solutions [4].

Recently, many methods of clay and clay minerals, including physical, chemical and thermal conversion, have been proposed to increase their ability to adsorb hazardous substances from water. Adsorption of heavy metals and various pollutants by natural, enriched, columnar, activated or coated with iron, aluminum and manganese oxides [5] aroused great interest. However, there is insufficient

information on the effect of iron, manganese and magnesium oxide (hydrate) coatings on the properties of bentonite.

The dynamics of colloidal dispersions, including clay and hydroxide particles, is a complex process. Under the influence of certain conditions, clay particles and (hydr)oxides can combine and form composite structures at certain pH levels. As a result, dispersed composite particles are formed, where (hydr)oxides form a clay-based coating. Our work investigates the effect of such coatings on bentonite properties [6].

The main objective is the detailed characterization of a composite material with high adsorption activity for aqueous cationic pollutants [7]. This section presents the results of studying the processes of modifying bentonite samples with solutions of various salts to improve their adsorption and textural properties.

Materials and methods. First, the clay was first cleaned from large impurities and other common contaminants and dried in a drying cabinet at a temperature of 110 ± 5 °C until complete moisture loss. Then, crushed clay was poured with distilled water in a proportion that ensured complete coverage. The resulting system was left for 24 hours for the clay to settle. Then a sufficient amount of water was poured into the sample (at least 1:5 of the volume of the sample) and mixed for 20 minutes. After 20 minutes of mixing, decantation was carried out from the upper 10 cm suspension layer to separate sand particles from montmorillonite. This allows heavier particles such as sand to sink to the bottom and the lighter montmorillonite to remain in the upper layers. The upper layer collected in the other capacity sinks, and the upper clarified layer of water is poured out, remaining in the sediment at the bottom. A 10% solution of H_2SO_4 is added to the resulting precipitate in a volume ratio of 1:1.5 and stirred for 2 hours at 45-50 °C. After the resulting system is allowed to stand for 2 hours, the solid phase is separated from the solid by centrifugation, washed several times and dried at 105±5℃ until moisture is completely removed [8]. This method makes it possible to obtain montmorillonite-enriched bentonite with a minimum amount of sand impurities. Modification of bentonite clays.

For this, 20 g of enriched bentonite suspension was mixed in 400 cm^3 of distilled water for 1.5-2 hours. Then 100 cm^3 of the solution containing the mixture of salts was obtained:

1. 0.542 g $FeCl_3 \cdot 6H_2O$, 0.306 g $MgCl_2 \cdot 6H_2O$ and 0.197 g $MnCl_2 \cdot 4H_2O$; Bentonite mixture is abbreviated as FB (here, bentonite modified on the basis of Fe^{3+}, Mg^{2+}, Mn^{2+} salts).

2. 0,427 г $CaCl_2 \cdot 6H_2O$ 0,478 г $ZnCl_2 \cdot 6H_2O$ and 0,197 g $MnCl_2 \cdot 4H_2O$.

Bentonite mixture is abbreviated as KB (K-here bentonite modified on the basis of Ca^{2+}, Mg^{2+}, Mn^{2+}salts).

To perform this experiment, salts measured to the nearest 0.001 g were dissolved in 50 ml of distilled water and mixed well until they were completely dissolved. Then their volume was brought up to 100 cm^3 by adding additional water. This salt solution was slowly added to the actively stirred suspension with the addition of 0.5 M NaOH, while the pH of the suspension was maintained in the range of 9-11.

After that, the pH of the mixture was adjusted to 10 and left at room temperature for 6 hours. The resulting precipitate was filtered, washed several times with distilled water until Cl^- disappeared, and stored in a drying oven at a temperature of 105±1℃, and thermally treated for 1.5-2 hours. In fact, during heat treatment, the composite lost only the bound water, while the OH-groups in the structure remained intact and could participate as adsorption centers [9]. For the research laboratory, the recycled composite was crushed in an agate mortar and sieved with 120 mesh cells (particles less than 125 mm in size). A distinct 2nd diffraction line for alkaline montmorillonite (B1) appears at values of about 12.4°, which corresponds to an interlayer distance of about 7.1 Å. In alkaline-earth montmorillonite (B2), a different diffraction line appears around 2θ at values of 8.9°, which corresponds to an interlayer distance of about 9.9 Å. One of the main diffraction spots for quartz is the spot that appears at 2θ around 26.6°.

2θ in the illite diffractograms has a characteristic diffraction line at about 8.9° (corresponding to an interlayer distance of about 10 Å). However, this value may vary slightly depending on the water content of the illite and is reduced to 8.7° for B1, while B2 is associated with a large number of water molecules compared to the sample (8.9°) [10-12].

The diffractograms of sample B2 also show the characteristic diffraction lines for calcite at about 29.4° and for pyrite at about 28.4°. Diffractograms for samples enriched with particles of clay

mineral less than 10 μm show a decrease in the intensity of low-temperature quartz reflexes (0.428; 0.182; 0.154 nm) and a 2-4 times increase in the intensity of montmorillonite reflexes (1.349; 1.253; 1.257; 0.173 nm) (Fig. 1)[13,14].

The presence of sorption-active minerals such as montmorillonite and clinoptilolite in enriched samples can be confirmed based on RFA.

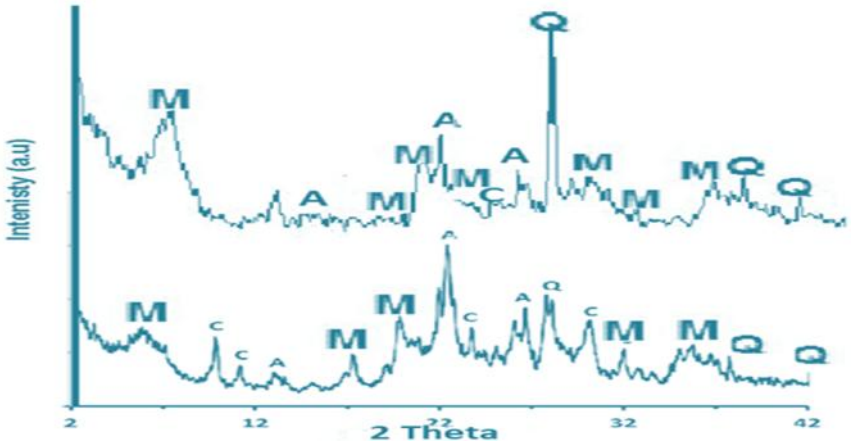


Figure 1. Diffractograms of enriched samples (from top to bottom): 1) B2; 2) B1 (A – albite, M – montmorillonite, Q-quartz, C – clinoptilolite).

Results and discussion. The change in mineralogical composition affects the dispersion of the studied samples. B1 and B2 are characterized by approximately 8.2 and 3.1% fractions with sizes less than 8.2 μm, and then their enriched forms increase the dispersity several times (Fig. 2).

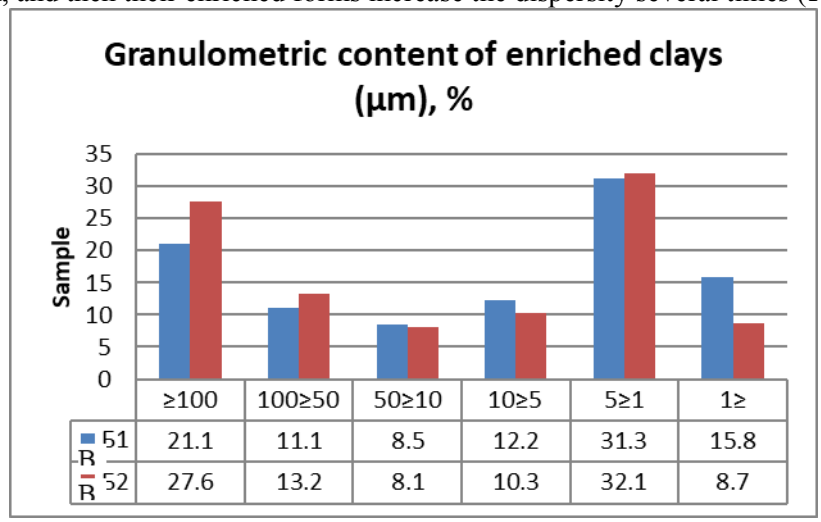


Figure 2. Granulometric content of enriched clays.

As a result of silt enrichment, a significant decrease in the amount of large particles (≥100 μm and 100≥50 μm) was observed for both silt samples (B1 and B2) compared to the initial composition. This may be related to the effective separation of larger sand particles and other impurities during the decantation process. Based on the presented data on the chemical composition of the samples before and after enrichment, it can be noted that the concentration of SiO_2 in both samples decreases slightly after enrichment. Interference with this beneficiation process may indicate partial loss of siliceous inclusions or other minerals retaining high SiO_2 content.

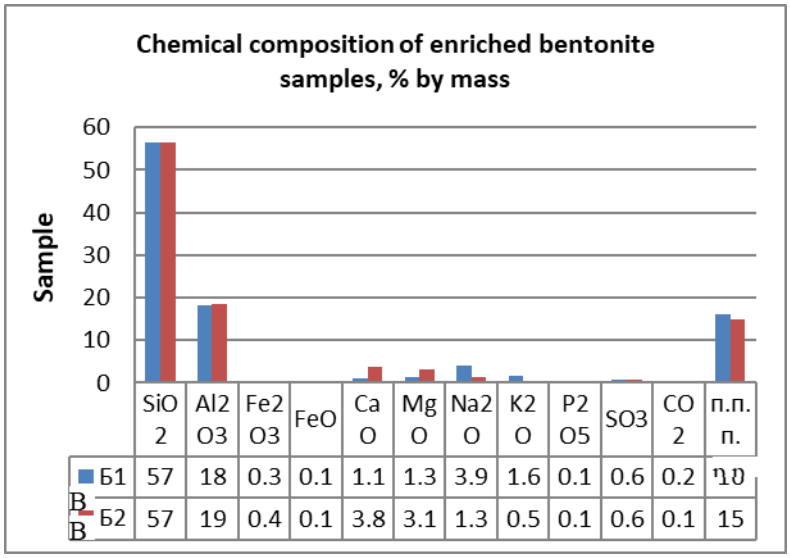
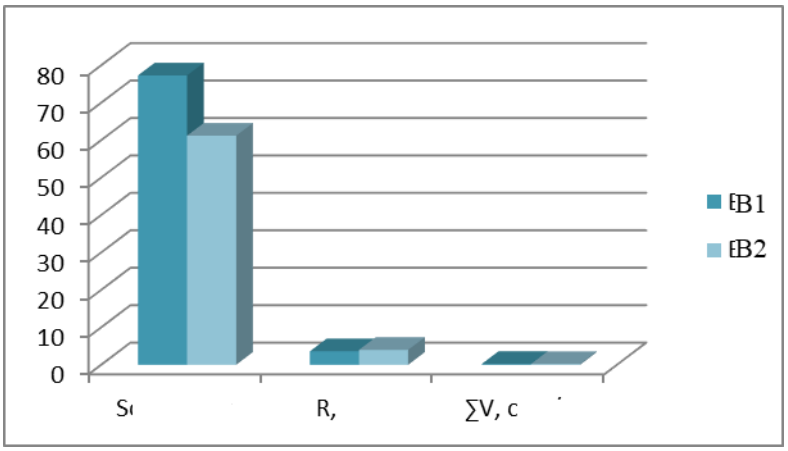


Figure 3. Chemical composition of enriched bentonite samples.

Thus, the changes in the chemical composition caused by the enrichment can enhance the adsorption properties and improve the textural properties of bentonite clays, which makes them more effective in various applications, as evidenced by the change in textural properties (Fig 4).

The specific surface area of sample B1 increased to 77.3 m^2/g on enrichment (an increase of 21 m^2/g or about 37%), while for B2 the increase is 18.5 m^2/g or about 43%. An increase in the total pore volume is also observed: for B1 it increases from 0.19 to 0.221 cm^3/g, and for the sample up to 0.203 cm^3/g.

Structural properties of modified bentonite clays were studied. Modification of bentonite with Fe (III), Mg and Mn(II) salts can lead to the appearance of additional peaks or changes in the intensity and position of existing peaks due to interlayer exchange and/or the presence of these cations in the montmorillonite. In the results of X-ray diffraction analysis (Fig. 5), it can be seen that peaks characteristic of Fe (III) oxides appear for samples FB1 and FB2 obtained on the basis of B1 and B2, respectively, and for the first solution containing Fe^{3+} salts.



Sample	S_{sol}, m^2/g	R, nm	∑V, sm^3/g
B1	77,3	3,61	0,221
B2	61,2	3,98	0,203

Figure 4. Textural properties of enriched bentonites.

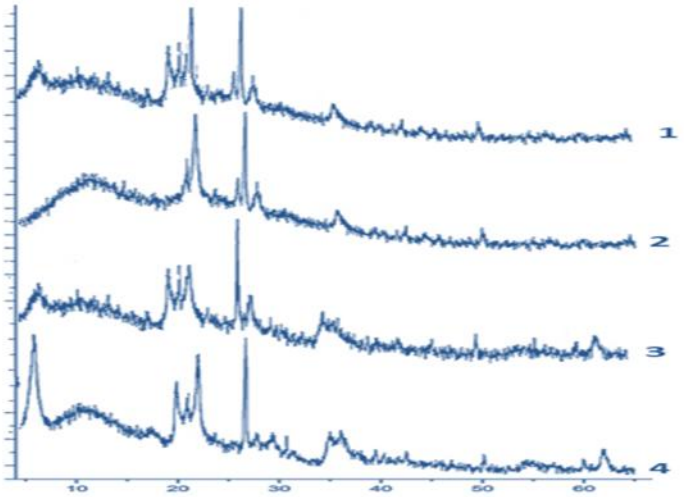


Figure 5. Diffractograms of samples: 1) FB1; 2) FB2; 3) KB1; 4) KB2.

Initial bentonites d_{001}, d_{003}, d_{020} and d_{200} peak 5.74; 17.30; 19.88 and 34.88 (2th) are found, while for bentonites modified with 2 (KB1 and KB2) solutions, these peaks are 6.90, 17.59; 20.01 and 35.01 (2nd) are located.

In contrast to FB1 and FB2, samples KB1 and KB2 show higher intensities of quartz diffraction peaks d_{100} and d_{101} (20.79 and 26.61) and cristobalite and d_{101} corresponding diffraction peak located at 21.79. The main structural changes of montmorillonite are represented by a decrease in the intensity of the d001 diffraction peak and its shift to higher 2θ angles, as well as in the broadening of this peak, which indicates the non-homogeneous interlayer distance with an irregular and partially nonlinear structure. Below are the results of the research of low-temperature nitrogen adsorption processes in the studied objects.

Table 1. Nitrogen adsorption isotherms: 1) KB1; 2) KB2; 3) FB1; 4) FB2.

Sample	S_{sol}, m^2/g	R, nm	$\sum V$, sm^3/g
FB1	120,588	3,282	0,332
FB2	95,472	3,618	0,305
KB1	146,097	3,008	0,354
KB2	115,668	3,317	0,325

This indicates higher surface activity and potentially better adsorption capacity. Sample KB1 has the largest specific surface area (146.097 m^2/g), which is 89.2% more than sample B1 and 138.5% more than sample B2.

Conclusion. Analysis of the influence of enrichment and modification processes on the structural properties of bentonite clays", a detailed study of the structural changes of bentonite clays as a result of enrichment and further modification is carried out. The enrichment process affected the textural and phase properties of the samples, which allowed to improve their functional properties.

As a result of the experiment, it was established that the optimal conditions for the modification of bentonite are achieved with the use of a mixture of salt, introduced in an actively stirring suspension at the same time with the addition of 0.5 m NaOH, and the pH of the suspension is in the range of 9-11. This provides formation of composite particles with high adsorptive activity to water cationic polluters. The subsequent heat treatment at 300°C stabilizes the structure of the material, making it more resistant to swelling and water and increasing its filtration properties.

Based on proven research and findings x-ray structure data, modification of bentonite with application of different salts led to significant changes in the structure of montmorillonite. These changes is characterized by displacement and widening peaks of diffraction, appearance of new peaks, characteristic for oxides Fe(III), Mg and Mn(II), and also change peaks, connected with diffracted quartz and cristobalite. Structural modifications, reflected in d-distances, and other parameters, indicate how the interlayer reaction reacts to introduced modifications, which can affect the textural and adsorption properties of bentonite. The results of studying the structural properties of modified

bentonite clays were presented. X-ray phase analysis and nitrogen adsorption revealed the main structural changes that determine the functional properties of the modified samples.

The unmodified samples also showed increased total pore size compared to the enriched unmodified samples. Sample KB1 showed the largest pore volume (0.354 cm^3/g), which was 60.2% more than sample B1 and 74.4% more than sample B2. In general, the modification of bentonites has resulted in improved textural properties, making them more active and suitable for various industrial technology applications such as adsorption, catalysis, etc.

References

1. Akpomie K. G., Dawodu F. A. (2015). Potential of a low-cost bentonite for heavy metal abstraction from binary component system. Beni-Suef University Journal of Basic and Applied Sciences, 4(1), 1-13. doi:10.1016/j.bjbas.2015.02.002.
2. El-Maghrabi H. H., Mikhail S. (2014). Removal of Heavy Metals via Adsorption using Natural Clay Material. Journal of Environment and Earth Science, 4 (19), 38.
3. Wahab N., Saeed M., Ibrahim M., Munir A., Saleem M., Zahra M., Waseem A. (2019). Synthesis, Characterization, and Applications of Silk/Bentonite Clay Composite for Heavy Metal Removal From Aqueous Solution. Frontiers in Chemistry, 7.
4. Chistyakov B. E. Theory and Practical application aspect of Surfactans / B. E. Chistyakov, V. Fainerman, D. Mobius, R. Miller // Surfactans: Chemistri, Interfec- tiol, Properties, Application. – Amsterdam : Elsevier, 2001. – vol 13. – P. 511-618.
5. Mamadoliev I., Fayzullayev N., Yuldashev S., Urakov S., Baykulov A. (2024, November). Enrichment and modification of bentonite clay processes influence on structural characteristics. In AIP Conference Proceedings (Vol. 3244, No. 1). AIP Publishing.
6. Fayzullayev N., Mamadoliev I. Study of methods of chemisorption purification of hydrogen sulfide in natural gases with natural sorbent //E3S Web of Conferences. – EDP Sciences, 2023. – T. 401. – C. 04052.
7. Normuradov T., Khodjibabayev Kh., Ismailkhujaev B., Urokov S., Kholiyev A., Eshquvvatov B., Mamadoliev I. Multi-faceted analysis of land use impact on rangeland health: Insights from normalized difference vegetation index assessment in stream, road, and mining areas //Journal of Ecological Engineering, 2025, 26(1), 196–2039.
8. Zaman Abdalhussein Ibadi Alaridhee, Dheyaa J. Jasim, Ikromjon Mamadoliyev, Moayad Jasim Mohammed, Abdul-Jabbar A. Ali, Ayat H. Athab, Salim S. Al-Rejaie, Mohamed Mohany, Majid Jabir, Hasan Majdi, Nadhir N. A. Jafar, Durgesh Singh & Kamini Singh// Synthesis and characterization of Cu-modified ox-g-C3N4 nanosheets as an electrode for green synthesis of phenyl Benzofuran derivatives via C–H functionalization to C–O and C–C bond formation with an electrochemical oxidation system// Published: 14 May 2024.Volume 50, pages 3053–3077, (2024) Cite this article.
9. Althomali R. H. et al. Synthesis of a bistriazolyl-phenanthroline–Cu (ii) complex immobilized on nanomagnetic iron oxide as a novel green catalyst for synthesis of imidazoles via annulation reactions //Nanoscale Advances. – 2023. – Т. 5. – №. 22. – С. 6177-6193.
10. Indrajit Patra, Kadhem Madjeed Kammoud, Zahraa Haleem Al-Qaim, Mamadoliev I.I., Mohammed Abed Jawad, Ali Thaeer Hammid, Yasir Salam Karim, Ghulam Yasin // Perspectives and Trends in Advanced MXenes-Based Optical Biosensors for the Recognition of Food Contaminants // Critical Reviews in Analytical Chemistry. 2024;54(3):633-652.
11. Paygamov R., Mexmonxonov M., Abdikamalova A., Eshmetov I., Ergashev O. //Adsorption properties of carbon adsorbents based on wood waste // E3S Web of Conferences, 2023, 401**.**
12. Usmanov R.M., Abdikamalova A.B., Eshmetov I.D., Kuldasheva Sh.A //Obtaining coal adsorbents based on local wood waste, research of their physico-chemical and adsorption properties// Journal of Critical Reviews 12 (7), 2394-5125.
13. Mamadoliev I. I., Fayzullaev N. I. Optimization of the activation conditions of high silicon zeolite //International Journal of Advanced Science and Technology. – 2020. – Т. 29. – №. 3. – С. 6807-6813.
14. Mamadoliev I.I., Khalikov K. M., Fayzullaev N. I. Synthesis of high silicon of zeolites and their sorption properties //International Journal of Control and Automation. – 2020. – Т. 13. – №. 2. – С. 703-709.