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RESEARCH OF THE COMPOSITION OF LOW-RATED PHOSPHORITES OF THE AKSAY DEPOSIT AS A COMPONENT OF FERTILIZER

Abstract. The article presents the results of differential thermal and X – analyses of dolomitized phosphate-siliceous raw materials of the Aksai deposit.

When conducting experimental studies of label materials, modern methods of X-ray phase, differential thermal analysis and infrared spectrum were used. Mineral-petrographic analysis was studied on microscopes MIN8 and MIN9, using the mineral composition of samples and refractive indices.

The X-ray analysis was performed on the Avatar 370 Csl spectrometer in the range 4000-300 cm^{-1} using compressed tablets of the studied samples.

Diffractometric analysis was carried out on a D8 Advance diffractometer (Bruker), with the processing of the obtained diffractogram data and the calculation of interplane distances was carried out using EVA software, and differential thermal analysis of dolomitized phosphorous raw materials on a Paulik-Paulik, Erdeyderivatograph (IOM, Hungary).

To date, the use and processing of minerals from phosphate deposits in the Karatau basin has led to the depletion of ore reserves, so today the phosphorus industry in our country is experiencing a shortage of high-quality phosphate raw materials and needs selective production. This problem leads to a decrease in the quality of phosphorus fertilizers and the formation of a large amount of waste that creates a harmful anthropogenic load on the environment. And these wastes are not disposed of, so the issue of their involvement in technological and environmental industrial processing remains relevant. One of the promising areas of processing such waste is their use as raw materials for the production of mineral fertilizers.

Key words: mineral fertilizers, macronutrients, trace elements, dolomitized silica-phosphate raw materials.

Introduction. To date, everyone knows that fertilizers increase soil fertility - improve its nutrient, water, heat and air regimes. Repeated application of fertilizers in large doses and the use of other methods of soil cultivation change the direction of soil-forming processes and lead to the formation of artificial soil fertility. By applying fertilizers, a person actively interferes with the circulation of substances in nature, gradually creates a positive balance of nutrients in the arable layer [2]. When used correctly, fertilizers have a positive effect on crop yields and product quality. Instead of using various types of mineral fertilizers, it is possible to introduce their complex analogues. Complex top dressing includes several useful substances, is characterized by a balanced composition, relatively simple transportation and storage [4].

The effectiveness of fertilizers depends on the biological characteristics of plants, the content of nutrients in the soil and its moisture, the reaction of the soil solution, as well as the level of farming culture.

The intensification of agriculture leads to a further increase in yields, accelerates the removal of nutrients from the soil and the mineralization of humus. Regulation of these processes becomes possible with the help of fertilization [7].

Materials and methods. Mineral fertilizers are the safest, most effective and fastest increase in soil yield. There are different forms and are divided into types depending on the main component. When choosing a fertilizer, you should analyze the indicators of the soil and the lack of a particular chemical element. With the correct determination of the amount and period of application, it is possible to restore the chemical balance of the soil in a year and a half and increase yields. Comparison of mineral fertilizer with organic fertilizer has

shown that mineral fertilizers are more effective in agriculture and are used on vast lands. [11].

Results. During the X-ray analysis of off-balance phosphate raw materials of the Aksai deposit of the Karatau basin on the Avatar 370 CsI infrared Fourier spectrometer in the spectral range of 4000-300 cm^{-1}in the form of a tablet prepared by pressing 2 mg of the sample and 200 mg of KBr, using the prefix for the experiment: Transmission E.S.P. it has been established that the off-balance dolomite ore consists of the following minerals: Fluorapatite $Ca_5(PO_4)3F$ –1094, 1044, 965, 604, 577,569 cm^{-1}, quartz SiO_2 – 798, 779, 694, 515, 465, 397, 370 cm^{-1}, dolomite $CaMg[CO_3]2$ - 1455, 881, 729 cm^{-1},possibly the following minerals are also present in the sample: siderite $FeCO_3$ -1432, 865 cm^{-1}, albite $Na[AlSi_2O_8]$ - 1164, 648, 465, 430 cm^{-1}[8-11].

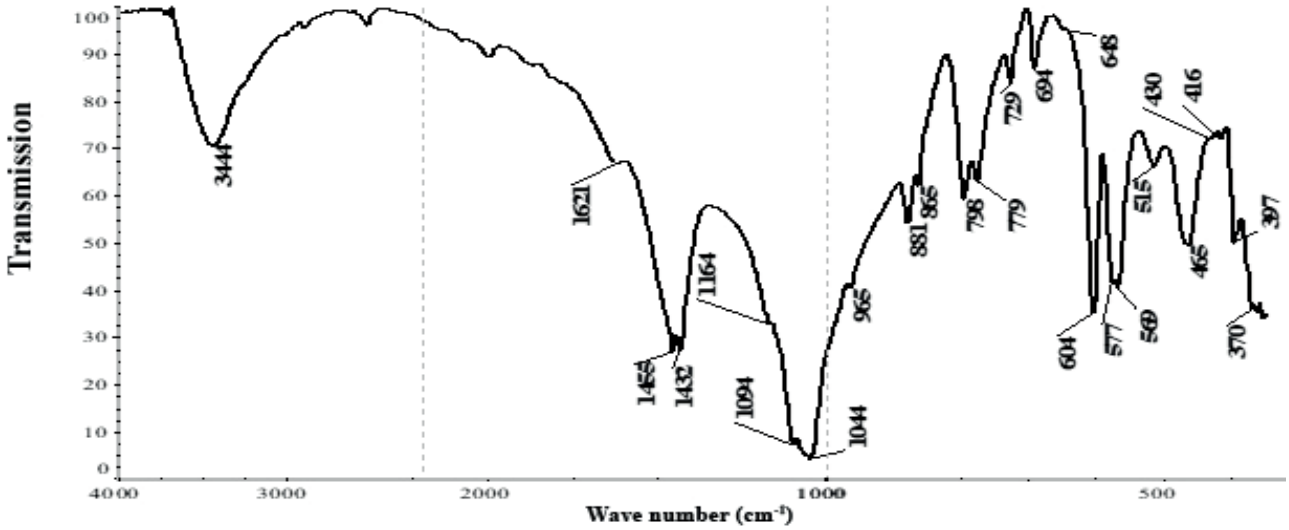

Figure 1. Infrared spectrum of off-balance carbonate-siliceous phosphate dolomitized raw materials of Aksai deposit

The DTA curve shown in figure 2 shows endothermic effects with maximum development at 7680^0C and 8400^0C. Additional endothermic effects were recorded on the dDTA curve and their extremes were manifested at 314.10S, 562.50^0C. An exothermic effect was also recorded with a peak at 1013.10^0C. The DTG curve shows minima at 166.60^0C, 311.60^0C, 754.80^0C, 831.80^0C.

Based on this, we can assume the presence of only carbonatapatite (dallite) $Ca_{10}[PO_4]6CO_3$. Its manifestation is to some extent marked by an endothermic effect with an extremum at 7680^0C. The combination of an endothermic effect with an extremum at 7680^0C and an endothermic effect with an extremum at 8400^0C on the DTA curve can be assumed as a manifestation of dolomite. In addition, the presence of calcite in the overlay is not excluded, (effect 8400^0C, on the DTA curve). A weak endothermic effect with an extremum at 314.10^0Con the DDT curve, which corresponds to a minimum at 311.60^0C on the DTG curve, which is detected due to the dehydration of an impurity of iron hydroxides. A weak endothermic effect with an extremum at 562.50^0C on the DDT curve is characterized by the manifestation of quartz inversion. In addition, the transition of $AlPO_4$ into a tridimite-like form is also possible here. The combination of a minimum at 166.60^0C on the DTG curve and a weak exothermic effect with a peak at 1013.10^0C on the dDTA curve is a reflection of the presence of a small amount of phosphates in the form of Al3 $[PO_4]$ $(OH)6H_2O$.

Discussion. During the X-analysis of off-balance phosphate raw materials of the Aksai deposit on the Avatar 370 CsI spectrometer, in the spectral range 4000-300cm-1, it was found that the ore consists of the following minerals: fluorite Ca5(PO4)3F – 1094, 1044, 965, 604, 577, 569 cm-1; quartz (SiO2) – 798, 779, 694, 515, 465, 397, 370 cm-1 ; dolomite (CaMg[CO3]2) - 1455, 881, 729 cm-1 ; as well as siderite (FeCO3) - 1432, 865 cm-1 and albite (Na[AlSi3O8]) – 1164, 648, 465, 430 see-1 [8-11].

Analysis of samples on the diffractometer D8 Advance (Bruker) found that the investigated carbonate-siliceous phosphate raw materials contain (in %;%): fluorite carbonate (NR) Ca- 9.55 (PO4)-4.96, F-1.96 (CO3) 1.283; quartz SiO2 - 65.75; and dolomites CaMg(CO3)2 - 13.98.

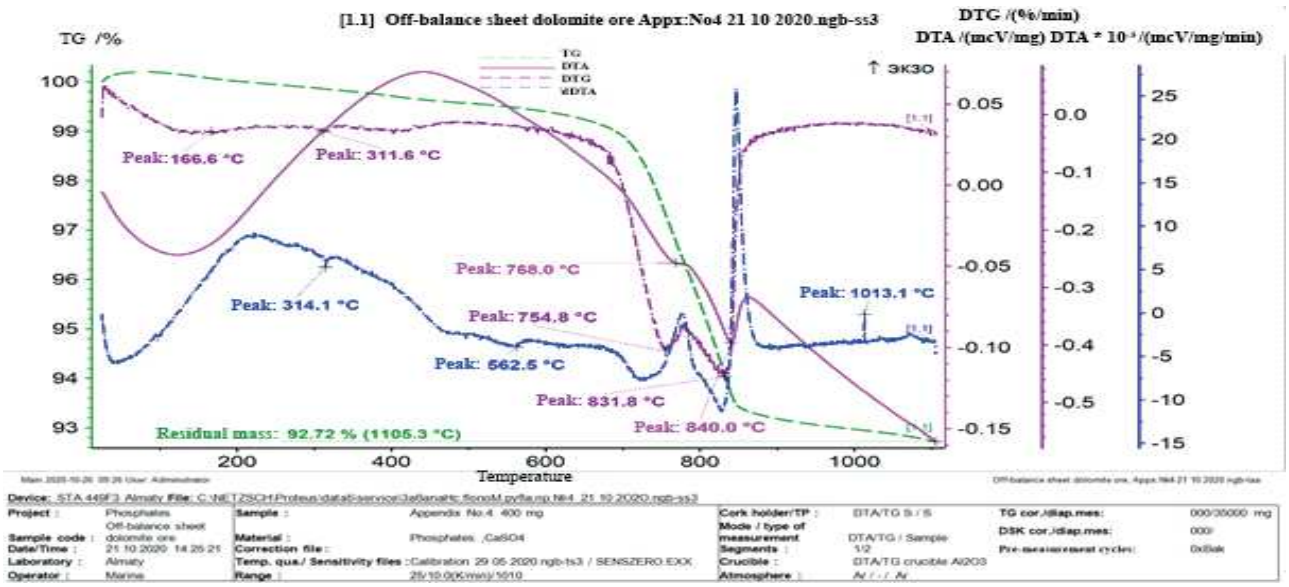

Figure 2. Differential thermal analysis of carbonate-siliceous phosphate dolomitized raw materials of the Aksai deposit

The study of the mineral and petrographic composition of off-balance dolomitized siliceous phosphate raw materials under the microscope MIN8 and MIN9 showed that the sample is light brown, consists of dolomite, the presence of calcite, apatite, quartz and feldspar is possible. Under the microscope, it was also revealed that the sample has a dirty brown color, is not transparent and is close to an isotropic state. In the cathode rays, the sample glows orange, which is characteristic of carbonate minerals. Chalcosine and iron hydroxides are present in the ore mineral [17].

Conclusion. The results of the X-analysis of off-balance phosphate raw materials of the Aksai deposit on the Avatar 370 CsI spectrometer showed that the ore consists of the following minerals: fluorite, quartz, dolomite, siderite and albite. The article presents the results of a study of the mineral-petrographic composition of off-balance dolomitized silica-phosphate raw materials. The study of the mineral and petrographic composition of off-balance dolomitized siliceous phosphate raw materials under the microscope MIN8 and MIN9 showed that the sample is light brown, consists of dolomite, and the possible presence of calcite, apatite, quartz and feldspar. The methods of modern research revealed the features of the mineralogical composition and fine-grained phosphorite structure of the Aksai deposit. Scanning electron microscopy revealed the nature of the distribution of the main elements phosphorus, magnesium, silicon, zinc, calcium, iron, copper in the structure of small phosphorous substances.

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ТЫҢАЙТҚЫШ ҚОСПА РЕТІНДЕ АҚСАЙ КЕНІНІҢ ТӨМЕНГІ САПАЛЫ ФОСФОРИТТЕРІНІҢ ҚҰРАМЫН ЗЕРТТЕУ

Аннотация. Мақалада Ақсай кен орнының доломиттелген фосфатты-кремнийлі шикізатының дифференциалды-термикалық және ИКС – талдауларының нәтижелері келтірілген.

Таңбалау материалдарына эксперименттік зерттеулер жүргізу кезінде рентгенофазаның, дифференциалды термиялық талдаудың және инфра қызыл спектрдің заманауи әдістері қолданылды. Минералды-петрографиялық талдау сынамалардың минералды құрамын және сыну көрсеткіштерін қолдана отырып, МИН8 және МИН9 микроскоптарында зерттелді.

Х-талдау зерттелетін сынамалардың таблеткалардың сығымдалған түрін пайдалана отырып, 4000-300 см-1 диапазонындағы «Avatar 370csl» спектрометрінде жүргізілді.Дифрактометриялық талдау D8 Advance (Bruker) дифрактометрінде жүргізілді, алынған дифрактограммалар деректерін өңдеумен және жазықтық аралық қашықтықты есептеу EVA бағдарламалық жасақтамасының көмегімен жүргізілді,

ал Paulik - Paulik, Erdey (МОМ, Венгрия) дериватографында доломиттелген фосфорит шикізатына дифференциалды-термиялық талдау жүргізілді.

Бүгінгі таңда Қаратау бассейніндегі фосфат кен орындарының пайдалы қазбаларын пайдалану және қайта өңдеу кен қорларының сарқылуына әкеп соқты, сондықтан бүгінгі таңда біздің еліміздегі фосфор өнеркәсібі жоғары сапалы фосфат шикізатының тапшылығын бастан кешуде және селективті өндіріске мұқтаж. Бұл проблема фосфор тыңайтқыштары сапасының төмендеуіне және қоршаған ортаға зиянды техногендік жүктеме тудыратын қалдықтардың көп мөлшерінің пайда болуына әкеледі. Ал бұл қалдықтар кәдеге жаратылмайды, сондықтан оларды технологиялық және экологиялық өнеркәсіптік қайта өңдеуге тарту мәселесі өзекті болып қала береді. Мұндай қалдықтарды өңдеудің перспективалық бағыттарының бірі оларды минералды тыңайтқыштарды өндіру үшін шикізат ретінде пайдалану болып табылады.

Түйінді сөздер: минералды тыңайтқыштар, макроэлементтер, микроэлементтер, доломиттелген кремний-фосфатты шикізат.

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ИССЛЕДОВАНИЯ СОСТАВА НИЗКОКАЧЕСТВЕННЫХ ФОСФОРИТОВ МЕСТОРОЖДЕНИЯ АКСАЙ В КАЧЕСТВЕ КОМПОНЕНТА УДОБРЕНИЯ

Аннотация. В статье приведены результаты дифференциально-термического и ИКС – анализов доломитизированного фосфатно-кремнистого сырья месторождения Аксай.

При проведении экспериментальных исследований меточных материалов использовались современные методы рентгенофазового, дифференциально термического анализа и инфракрасный спектр. Минерально-петрографический анализ проведен на микроскопах МИН8 и МИН9, с применением минерального состава проб и показателей преломлении.

ИКС-анализ проводили на спектрометре «Avatar 370Csl» в диапазоне 4000-300 см-1 с использованием спрессованных виде таблеток изучаемых проб.

Дифрактометрический анализ проводился на дифрактометре D8 Advance (Bruker), с обработкой полученных данных дифрактограмм и расчет межплоскостных расстояний проводили с помощью программного обеспечения EVA, а дифференциально - термический анализ доломитизированного фосфоритного сырья на дериватографе Paulik-Paulik, Erdey (МОМ, Венгрия).

На сегодняшний день использование и переработка полезных ископаемых фосфатных месторождений в Каратауском бассейне привело к истощению запасов руды, поэтом сегодня фосфорная промышленность в нашей стране испытывает дефицит высококачественного фосфатного сырья и нуждается в селективном производстве. Эта проблема приводит к снижению качества фосфорных удобрений и образованию большого количества отходов, создающих вредную техногенную нагрузку на окружающую среду. А эти отходы не утилизируются, поэтому вопрос их вовлечения в технологическую и экологическую промышленную переработку остается актуальным. Одним из перспективных направлений переработки таких отходов является использование их в качестве сырья для производства минеральных удобрений.

Ключевые слова: минеральные удобрения, макроэлементы, микроэлементы, доломитизированное кремнисто-фосфатное сырьё.

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REFERENCES

[1] Turgumbayeva H.H., Beisekova T.I., Lapshina I.Z., Turgumbayeva R.H., etc.System analysis of waste disposal of the phosphorus industry on the example of Kazphosphate LLP // Journal "Industry of Kazakhstan".- Almaty, 2003. - No. 4.- pp. 107-111.

[2] Kolosov A.S., Boldyrev V.V., Chaikina M.V. et al. Mechanical activation of phosphate ores. // Izv. SB of the USSR Academy of Sciences, ser. chemical Sciences. - 1979. No. 7. issue 3. pp. 24-28

[3] Pavlov K.V., Novikov M.M. The effect of local application of potash fertilizers in chernozem on the yield of barley // Agrochemistry. 2013. № 4. C. 48– 54. 22.

[4] Kidin V.V. fertilizer System: textbook / V.V. Kidin. – M.: publishing house of the Russian state agrarian University–MTAA, 2012. – 534 p. Mikhailova L.A. the peculiarities of nutrition and fertilization of major crops in the soils of the CIS-Urals : textbook / L.A. Mikhailova, T.A. Meek, the editorship of L.A. Mikhaylov - Perm: Perm state agricultural Academy, 2012. – 223 p.

[5] Alimkulov S.O., Muradova D.K. The use of phosphorus fertilizers: tomashlak, phosphatshlak and desfluorinated phosphates. Journal "Young Scientist". No. 10 (90), May-2, 2015, pp. 44-46.

[6] Alimkulov S.O., Rakhimova M. et al. The use of soil phosphorus and fertilizers by plants. "Bulletin of Modern Science" scientific and theoretical journal. ISSN 2410-2563. Pedagogy. Russia, Volgograd2015. No. 4. pp. 20-22.

[7] Beglov B.M., Ibragimov G.G., Sadykov B.B. Unconventional methods of processing phosphate raw materials into mineral fertilizers // Chemical industry. 2005. No. 9. pp. 453-468.

[8] Prospects for providing the mineral fertilizers industry with phosphate raw materials / A. I. Angelov [et al.] // Chemical industry today. 2006. No. 7. pp. 11-17.

[9] Sobolev N. In. Processing of low-grade phosphate raw materials to produce fertilizers, enriched in sulfur, calcium and magnesium Diss. Cand. tekhn. Sciences., M., - 2007. - 142 p.

[10] Andreev M.V. Technology phosphoric and complex fertilizers / Andreev M., Brodsky A.A., Zabelishinsky Y.A., Zorina E.A., Klenicki A.I., Kochetkov V.N., Rodin V.I., Evenchik S.D. ed. by S.D. Evenchik, A.A. Brodsky. - M.: Chemistry. - 1987. - 464c.

[11] Zhantasov K.T., Myrkalikov Zh.U., Moldabekov Sh., Eskendirova M.M. and others. Agronomic field tests of new types of multicomponent mineral fertilizers // Eurasian Chemical and Technological Journal 17, No. 1, 2015, pp.79-86 (included in the Scopus database).

[12] Zhantasov K.T., Kozhakhmetova A.M., Dzhanmuldayeva Zh.K., Sarkulakova R.A., Almenova F.B. On the production of fertilizers using man-made waste. Bulletin of the National Academies of Sciences of the Republic of Kazakhstan. Chemistry and Technology Series "No. 4, Almaty, NAS RK. August, 2020.-pp. 44-50.

[13] RK Patent No. 26160. Bishimbayev V.K., Zhantasov K.T., Frangulidi L.H., etc./ Method of waste processing of phosphorus production.- 2015.- Byul. No. 9.

[14] RF Patent No. 2243196. Method of processing phosphorus-containing waste into mineral fertilizers/ Klassen P.V., Chernenko Yu.D., Zavertyaev T.I. et al. - 2004. [15] Patent No. 27551. A method for obtaining a complex-mixed mineral fertilizer / Bishimbayev V.K., Zhantasov K.T., MoldabekovSh.M. et al.- 2013.- Byul. No. 10.

[16] Patent of RK No. 27474. A method for obtaining a complex organomineral fertilizer / Moldabekov Sh., Zhantasov K.T., Balabekov O.S. et al.- 2013.- Byul. No. 10.

[17] Zhantasov K.T., Kozhakhmetova A.M., Dormeshkin O.B., Bayysbay O.P., Dosbaeva A.M., RASAYAN Chemical Journal. Production of environmentally safe mixed compounds containing trace elements based on carbonate-siliceous-dolomitized phosphate raw materials and waste from CHP, Volume 14, No. 2, 2021- p. 93-96.