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STUDY OF THE CHEMICAL AND PHYSICOCHEMICAL COMPOSITION OF LOCAL TALC MINERAL FRACTIONS

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Annotation. The aim of this study is to determine the elemental and mineralogical composition of fraction samples of the Zinel'bulok talc-magnesite mineral located in the Amurdaryo region of our republic, ground with a laboratory mill to sizes of 0.075; 0.150; 0.300 and 0.600 mm, based on chemical and physicochemical analysis methods.

Keywords: Talc-magnesite mineral, grinding, fraction size, X-ray fluorescence and X-ray analysis, magnesium hydroxide, magnesium oxide, silicon oxide, magnesium dihydrooxosilicate, magnesium tetrahydrooxosilicate, aluminum oxosilicate, calcium aluminate methylsulfanohydrate.

Introduction.

In our republic, many scientific and practical results are being achieved in the production of flexible technologies for the production of various magnesium compounds and magnesium mineral fertilizers based on local magnesium raw materials. The Development Strategy of New Uzbekistan until 2026 sets out important tasks aimed at "…increasing the production of industrial products, continuing the industrial policy aimed at ensuring the stability of the national economy and increasing the share of industry in the gross domestic product" [1]. In this regard, the production of $Mg(OH)_2$, MgO and magnesium mineral fertilizers from local talc-magnesite raw materials is of great importance.

In our republic, large-scale work is being carried out to increase the volume of agricultural production and export, increase the efficiency of land and water resources use, and introduce innovative technologies into agriculture [2]. In recent years, great importance has been attached to agriculture in our republic, especially greenhouse farming. This, in turn, further increases the need for magnesium-containing fertilizers from mineral fertilizers. Today, phosphorus, nitrogen, and potassium fertilizers are produced in our Republic, but due to the lack of a large-scale industry for the production of magnesium fertilizers, imported products are used for most consumer needs [3, 4, 5].

The above problems can be eliminated by using the Zinelbulak talc-magnesite minerals located in the lower Amur Darya region of our republic to produce magnesium fertilizers. The processes of obtaining pure magnesium compounds from minerals such as talc-magnesite, talc-breinerite and serpentinite are a complex technological process and require separate scientific and practical research for each case, depending on the composition, properties and location of the raw materials [6, 7].

Another source of magnesium is rocks containing magnesium: serpentinites, dunites, olivines, talcs containing magnesium silicates in the form of diopside $CaMg(Si_2O_6)$, enstatite $Mg_2(Si_2O_6)$,

tremolite $Ca_2Mg_5(Si_4O_{11})(OH)_2$, olivine-forsterite Mg_2SiO_4, talc $Mg_3Si_4O_{10}(OH)_2$ and other minerals containing 25 to 50% MgO. They are mined, processed and stored in millions of tons, so up to 15-20 billion tons of waste have accumulated in the dumps and warehouses of mining and metallurgical enterprises, which can be enriched and processed into pure magnesium compound products by various methods [8-10].

Uzbekistan has large reserves of magnesium-containing ores, including serpentinite. Its reserves are Kutchinsky (4.2 million tons), Tangisaysky (1.12 million tons), Bichanchisky (321 thousand tons), Tamdimsky (reserves not yet calculated), Yachmisaysky (2.83 million tons of talc, 4.79 million tons of breunerite). The largest reserve of serpentinite is located in the Arvaten deposit in the Jizzakh region, where the total volume of asbestos and serpentinite is 14 thousand m^3, and when calculated using the method of vertical sections for a horizon of 500 m - 1363.7 thousand m3 [11, 12].

Research methods. To carry out scientific research, the laboratory received a sample of the Zinel'bulok talc-magnesite mineral located in the Amur Darya region of our Republic, which was ground with a laboratory mill to sizes of 0.075; 0.150; 0.300 and 0.600 mm, and the components and mineralogical compositions were determined using the chemical and physicochemical analysis method.

In order to confirm the results of the chemical analysis of this local talc-magnesite mineral, physicochemical methods were also used, in which X-ray analysis was performed on an XRD-6100 (Shimadzu, Japan) diffractometer. Comparison of mineral phases was carried out using the “2013 International Center for Diffraction Data” database.

The NEX DE energy dispersive X-ray fluorescence spectrometer also features the powerful QuantEZ software, which includes fast EDXRF elemental analysis: The Rigaku NEX DE EDXRF analyzer is supplied with the QuantEZ RPF-SQX key parameter software (optional). The helium purge option (includes 10 meters of 6x4 mm tubes) has a 15-position, 32 mm DV sample holder, and is manufactured by: Rigaku Technologies, Inc.

Results and discussion. The raw material for the development of a flexible technology for obtaining $Mg(OH)_2$, MgO and magnesium compounds, as well as SiO_2, was the Zenilbulak talc-magnesite deposit located in the Beruni district of the Republic of Karakalpakstan. Initially, it was ground in a grinding mill under laboratory conditions to a size of 0.075; 0.150; 0.300 and 0.600 mm and separated into fractions. When their chemical composition was studied, mass %; The 0.075 mm fraction sample contains SiO - 56.86, MgO-28.22, Fe_2O_3 - 6.89, AI_2O_3 - 2.67, CaO - 1.49, SO_3 - 0.035 and Cl - 0.0216%, the 0.150 mm fraction contains SiO - 56.75, MgO - 28.53, Fe_2O_3-6.93, AI2O3 – 2.69, CaO – 1.71, SO_3 – 0.052 and Cl – 0.0244 %, 0.300 mm - SiO – 52.22, MgO-28.02, Fe_2O_3-7.62, AI_2O_3 – 3.10, CaO – 2.34, SO_3 – 0.0430 and Cl – 0.0320 % and the 0.600 mm fraction sample contained the following components: SiO – 51.29, MgO – 27.91, Fe_2O_3 – 7.93, AI_2O_3 – 3.17, CaO – 2.76, SO_3 – 0.040 and Cl – 0.020%, based on chemical analysis, and the results obtained are presented in Table 1 below.

Table 1

Chemical analysis of local talc-manezet mineral fractions

	Fraction size, mm	Quantity of components, weight %						
		Si O_2	M gO	C aO	AI $_2O_3$	Fe_2 O_3	S O_3	Cl
	0,075	56 ,86	28 ,22	1, 49	2,6 7	6,89	0, 035	0,0 216

	0,150	56,75	28,53	1,71	2,69	6,93	0,052	0,0244
	0,300	52,22	28,02	2,34	3,10	7,62	0,043	0,0320
	0,600	51,29	27,91	2,76	3,17	7,93	0,040	0,0200

Also, in order to confirm the results obtained based on chemical analyses, the component and mineralogical compositions of these components were determined by physicochemical, i.e. X-ray fluorescence and X-ray diffraction analyses of samples of fractions of 0.075; 0.150; 0.300 and 0.600 mm in size, and the results are presented in Table 2 and Figures 1, 2, 3, 4 and 5 below.

In order to confirm the chemical analyses, the elemental compositions of the Zenilbulak talc-magnesite mineral located in the Beruniy district of the Republic of Karakalpakstan were analyzed with an effective energy dispersive X-ray fluorescence spectrometer, and the composition of the 0.075 mm sample, by mass. %, SiO – 55.20, MgO-27.40, Fe_2O_3-6.69, AI_2O_3 – 2.59, CaO – 1.42, SO3 – 0.033, Cl – 0.0206 and Cr_2O_3 -0.293 %, SiO – 55.10, in a sample with a size of 0.150 mm. MgO-27.70, Fe_2O_3-6.73, AI_2O_3 - 2.56, CaO - 1.63, SO3 - 0.0495, Cl - 0.0232 and Cr_2O_3 -0.276%, in a sample with a size of 0.300 mm SiO - 50.70, MgO-27.20, Fe_2O_3-7.40, AI_2O_3 – 2.95, CaO – 2.23, SO_3 – 0.0410, Cl – 0.0305 and Cr_2O_3 -0.331 % and the sample with a size of 0.600 mm contained SiO – 49.80, MgO-27.10, Fe_2O_3-7.70, AI_2O_3 – 3.08, CaO – 2.68, SO_3 – 0.0381, Cl – 0.0191 and Cr_2O_3 -0.335 % and the results obtained are presented in Table 2 and Figures 1, 2, 3 and 4.

Table 2

X-ray fluorescence analysis of local talc mineral fractions

	Fraction size, mm	**Quantity of components, weight %**							
		SiO_2	**MgO**	**CaO**	**I_2O_3**	**Fe_2O_3**	**SO_3**	**Cl**	**Cr_2O_3**
	0,075	55,20	27,40	1,42	2,59	6,69	0,0330	0,0206	0,293
	0,150	55,10	27,70	1,63	2,56	6,73	0,0495	0,0232	0,276
	0,300	50,70	27,20	2,23	2,95	7,40	0,0410	0,0305	0,331
	0,600	49,80	27,10	2,68	3,08	7,70	0,0381	0,0191	0,335

Figure 1. X-ray fluorescence analysis of a sample of a talc-magnesite mineral fraction with a size of 0.075 mm

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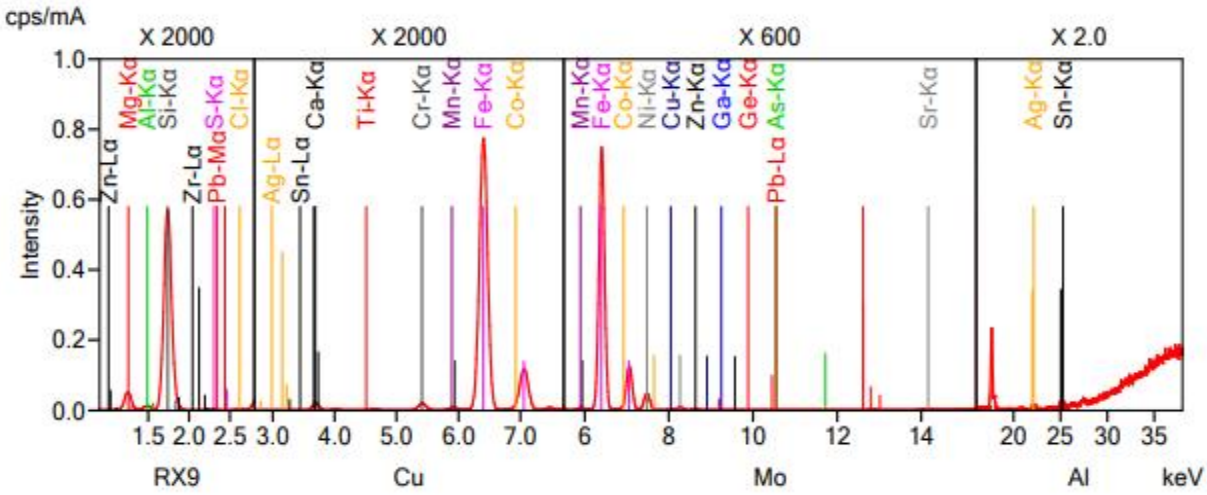


Figure 2. X-ray fluorescence analysis of a sample of a talc-magnesite mineral fraction with a size of 0.150 mm

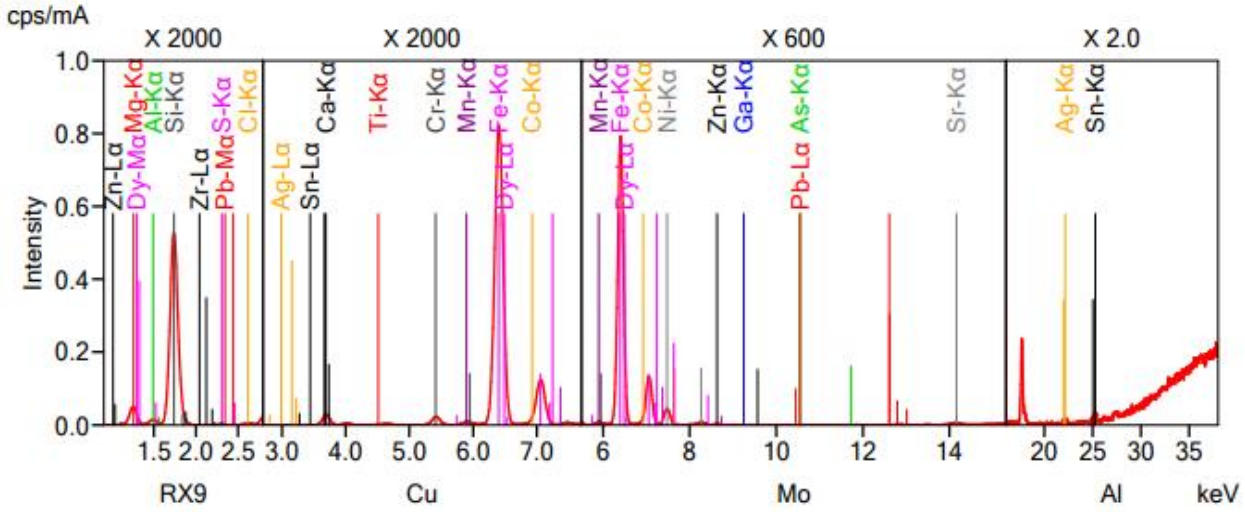


Figure 3. X-ray fluorescence analysis of a sample of a talc-magnesite mineral fraction with a size of 0.300 mm

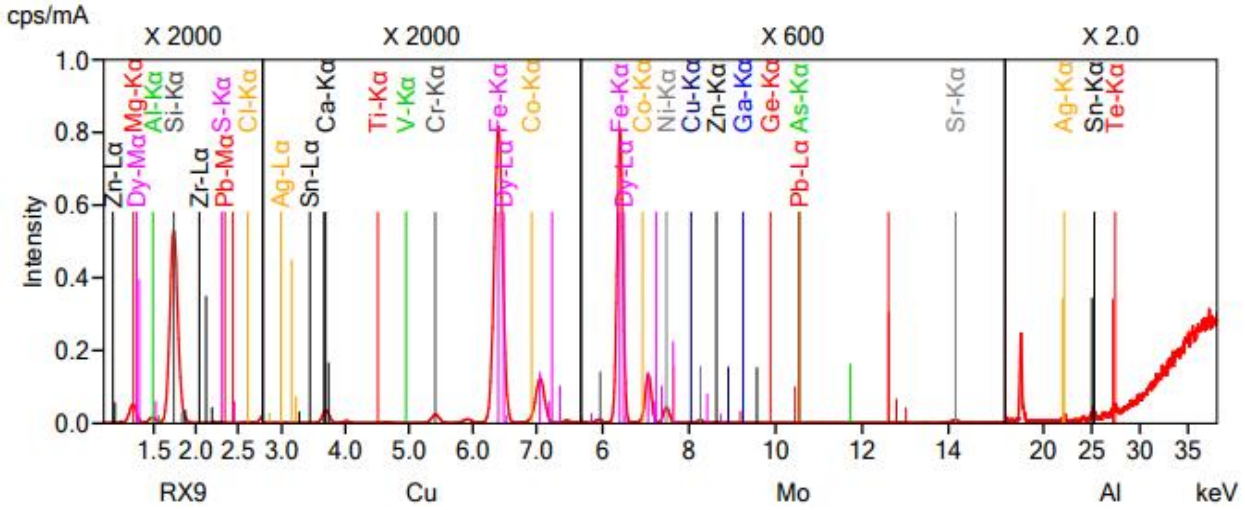


Figure 4. X-ray fluorescence analysis of a sample of a talc-magnesite mineral fraction with a size of 0.600 mm.

Comparing the results of the analysis of fraction samples of Zenilbulak talc-magnesite mineral by fraction composition with an efficient energy dispersive X-ray fluorescence spectrometer, it was found that at the fraction size of 0.075 -0.600 mm, SiO2 decreased to 55.20-49.80%, MgO to 27.40-27.10%, and Fe_2O_3 increased to 6.69-7.70%, and AI_2O_3 to 2.59-3.08%.

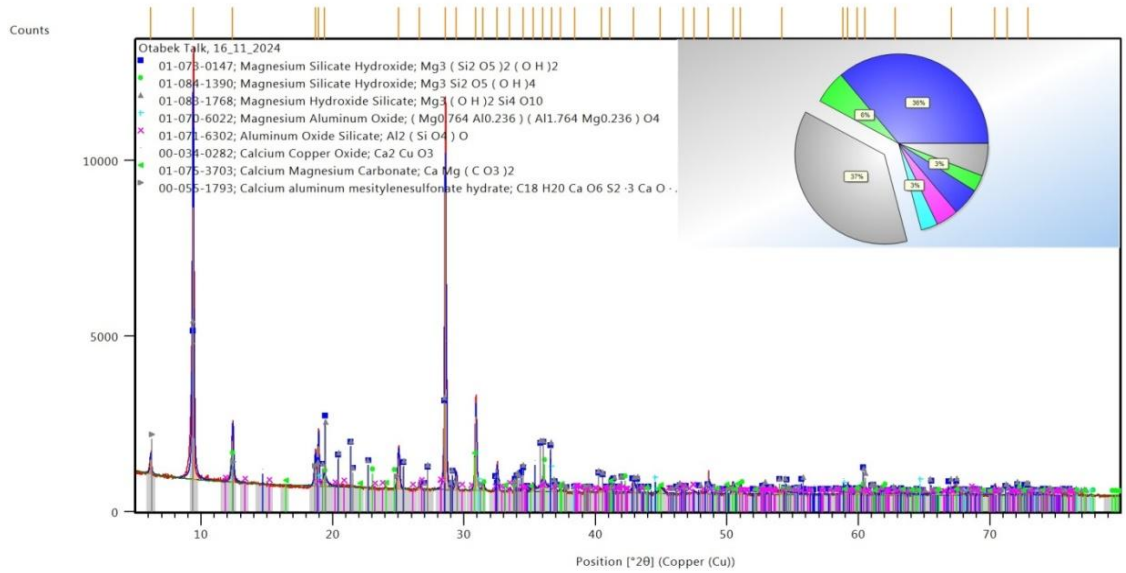


Figure 5. X-ray analysis of a sample of a talc-magnesite mineral fraction with a size of 0.075 mm.

Also, as can be seen from the line diffraction peaks in the X-ray image of a 0.075 mm talc-magnesite sample in Figure 5, the X-ray peaks of the interplanar distances indicate that the main part of this sample, in mass %, consists of Mg3(Si2O5)2(OH)2 (magnesium dihydrooxosilicate)-39, Mg3Si2O5(OH)4 (magnesium tetrahydrooxosilicate) - 6, Mg3(OH)2Si4O10 (magnesium

dihydrooxosilicate)-37, Al2(SiO4)O (aluminum oxosilicate)-3, Ca2CuO3 (mystrioxocalcite)-2, CaMg(CO3)2 (magnesium dicarbonocalcite)-9 % and a very small amount of a combination of magnesium oxoaluminate and calcium aluminate methylsulfanohydrate minerals.

Conclusion.

Thus, fractions of the Zenilbulak talc-magnesite mineral located in the Beruniy district of the Republic of Karakalpakstan were brought to the laboratory for scientific research. Initially, it was ground in a mill under laboratory conditions and separated into fractions of 0.075; 0.150; 0.300 and 0.600 mm in size, and their elemental and mineralogical quantities were determined using chemical and physicochemical analyses. The purpose of this scientific research was to study the effect of fraction particle size on the elemental and mineralogical composition of the Zenilbulak talc-magnesite mineral and to develop a flexible technology for the decomposition of the talc-magnesite mineral with mineral acids to obtain $Mg(OH)_2$, MgO and magnesium compounds, as well as SiO_2. From the results of the chemical and physicochemical analysis, we can conclude that the 0.15 mm talc-magnesite mineral fraction was selected for the next steps due to its higher MgO content compared to other size fractions.

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