LOCAL MINERAL DEPOSITS FOR OBTAINING GLAUCONITE SORBENTS

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Abstract

The origin of the problem. Natural minerals such as bentonite, kaolinite, biotite, vermiculite and glauconite, which have sufficiently high operational properties in softening industrial and wastewater softening and purification from heavy metals, are promising.

To study the physical and chemical properties of glauconites of different deposits of the country, samples of glauconite mineral were brought from Parkent, Bukhara, Karakalpak mining reserves, their physical and chemical properties were studied, compared with each other and the optimal reserve was selected. The reserves of these minings are sufficient and have the potential for industrial development.

The purpose of this study is to compare the samples of natural glauconite mineral reserve and select the optimal deposit for the raw material.

Methodology. Samples of glauconite minerals from Parkent, Bukhara and Karakalpak mineswere taken as the object of study. Chemical, mineralogical and thermal analyzes were performed on the samples, as well as fractional compositions were determined.

Scientific novelty. The main part of the mineral glauconite (50-55%) in the raw material was found in fractions of 0.08-0.125 mm. The most suitable raw material was Parkent glauconite deposit, which has a relatively high content of potassium, which tends to be exchanged with other metals during the sorption process.

The data obtained. Based on the conducted experiments, samples of Parkent, Bukhara, Karakalpak glauconites were chemically and mineralogically analyzed. The maximum amount of glauconite mineral was found in the fractions of raw materials smaller than 0.125 mm. The most suitable raw material deposit was selected to process the glauconite mineral and obtain an environmentally friendly adsorbent.

Keywords: natural minerals, glauconite, thermal analysis, fraction, enrichment, sorbent.

Features:

- Changi mine glauconite is an acceptable raw material for sorbent;
- The amount of glauconite in fractions smaller than 0.125 mm is maximal.

While the use of activated carbon and zeolites in effluent softening and treatment is effective, their use in this field is relatively expensive due to their high cost, complexity of regeneration processes and selectivity. Therefore, it is important to look for effective natural materials and opportunities to use them for wastewater treatment.

Scientific studies [1-5] suggest sorbents based on peat and wood shavings for oil refining and process water softening, galvanic shop wastewater treatment, in which the cellulose in wood shavings also serves as a hexavalent chromium ion repellent to trivalent. Natural minerals such as bentonite (montmorillonite), kaolinite, biotite, vermiculite glauconite are considered effective and promising in softening industrial effluents and removing heavy metals [6-10]. This is due to the fact that natural minerals are called promising because they are relatively inexpensive and in sufficient quantities, and their performance properties are high enough.

The adsorption properties of natural minerals are explained by their chemical, mineralogical composition, as well as the structure of the crystals and the dispersion of the particles [11]. The main chemical components in them are SiO2 (30-70%), Al2O3 (10-40%) and H20 (5-10%), with a specific surface area of up to 500m2 / g.

In the work of the authors [12, 13] the adsorption of heavy metals in tourmaline consisting of alumosilicates was studied. Tourmaline is a complex alumosilicate with selective adsorption properties.

The main problems in the treatment of wastewater contaminated with various organic substances, especially in plastic factories, are the cost of sorbents used in the treatment, the value of ionites and mainly from abroad. With this in mind, we have conducted research on the activation and application of natural ion exchange minerals such as glauconite for technical and wastewater treatment.

To study the physicochemical properties of glauconites of various deposits of the Republic, samples of glauconite were brought from Parkent (Changi deposit), Bukhara, Karakalpak (Kirontau) deposits and their physical and chemical properties, including chemical and mineralogical composition were studied and compared with each other. The reserves of these deposits are sufficient and have the possibility for reclamation in industrial development.

The chemical composition of glauconite samples from different selected deposits was determined by X-ray fluorescence method, the results of the analysis are given in Table 1. From the above data, it can be concluded that the chemical composition of natural minerals in the sampled deposits is close, and the Changi deposit in Parkent is more promising than other deposits, the content of this sample is relatively high in potassium, which is prone to ion exchange during the sorption process, and the composition of the basic elements is slightly different from that of the other deposits. Because of calcium and glauconite sedimentary rocks are more common in our soils, the amount of calcium is relatively higher than in deposits in other states.

Table 1 Chemical composition of glauconite samples from different deposits

№	Elements included in the sample	The amount of elements in glauconite, %		
		Changi mine	Bukhoro mine	Kirontau mine
1	Si	34.7	33,1	37,6
2	Fe	33,9	33,4	36,3
3	K	10,3	8,1	7,6
4	Al	4,6	4,2	3,7
5	Ca	13,2	10,1	9,4
6	Other cations	2,3	3,1	3,4

The fact that the chemical composition of the raw materials in these deposits is close to each other will allow all deposits to be exploited and processed on an industrial scale in the future. They were then thermally analyzed to compare glauconite samples from different deposits.

A thermogram of different deposits of glauconites was obtained to determine how different glauconites behave when thermally processed. Figures 1, 2, and 3 show the thermal analysis of glauconites of different deposits. As can be seen from the figures given, the thermograms of the glauconite samples taken from the three deposits were similar, and we saw that when heated, the changes in them were almost close to each other.

Heating the glauconite to 100-2000C resulted in the loss of adsorption water in it. This amount was 4.6% for mine №1, 5.1 for mine №2, and 4.8 for mine №3. During dehydration, the maximum endothermic effect is observed at 1300C. If the temperature is raised again, the mass of the sample gradually begins to decrease, as can be seen from the curve in the graph.

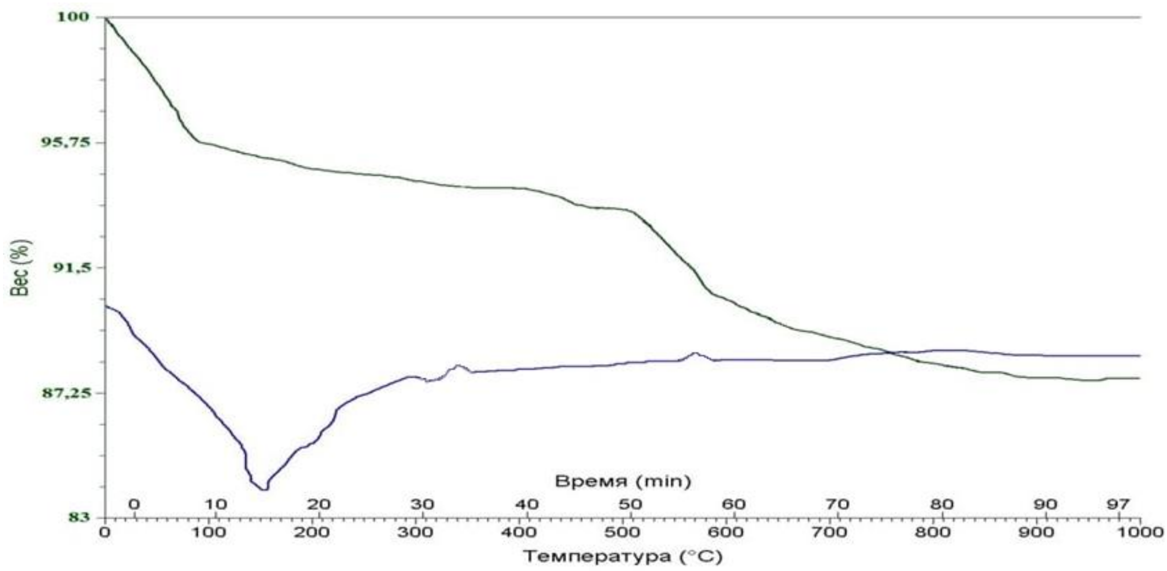

Figure 1. Glauconite thermogram of Parkent deposit

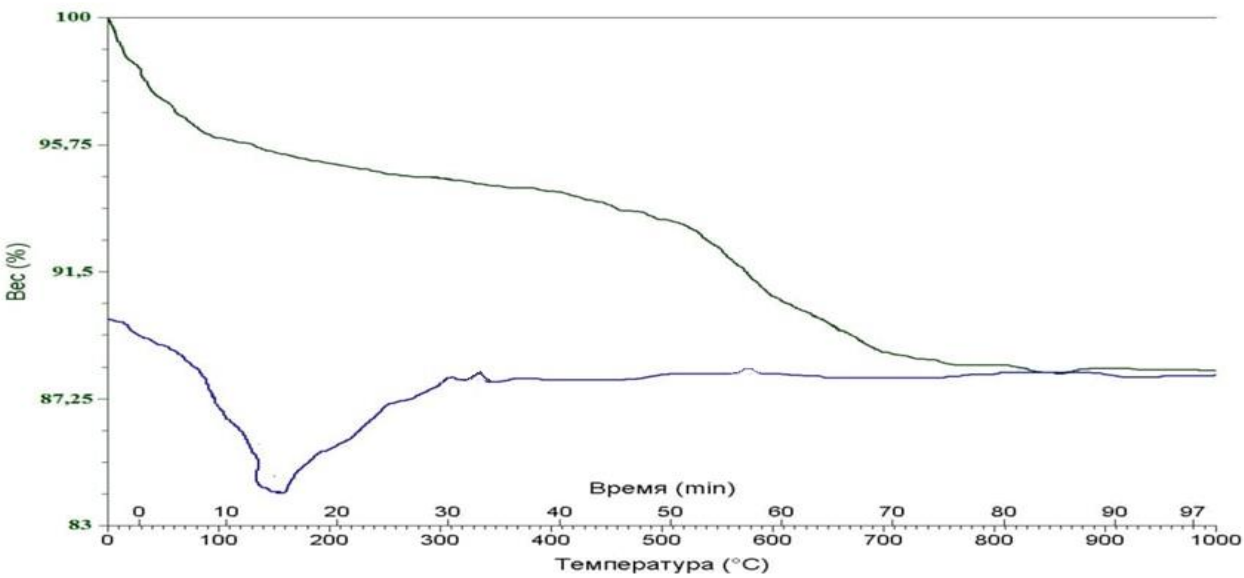

Figure 2. Glauconite thermogram of Bukhara deposit

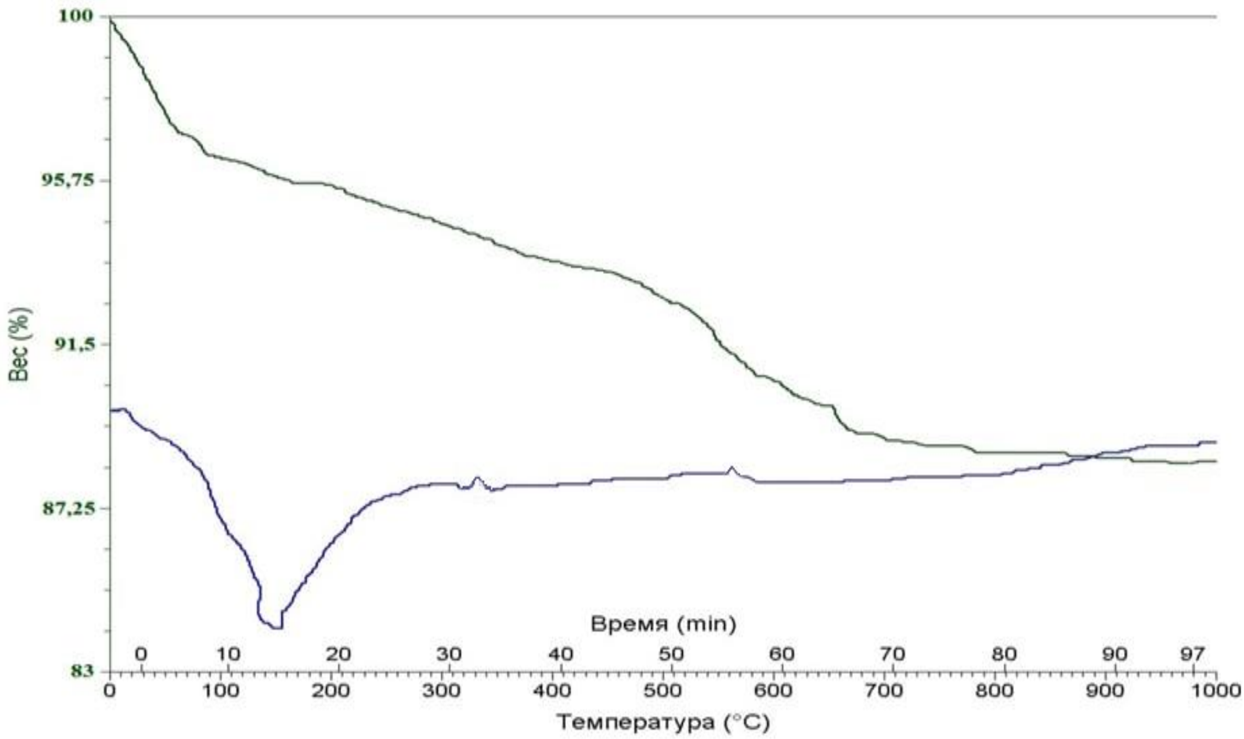

Figure 3. Thermogram of Karakalpak deposit glauconite

At about 328-330^{0}C, a small exothermic effect is observed due to the transition of Fe2 + ions to Fe3 + ions, in which the color of the sample changes and turns brown.

Above 500^{0}C, the mass decreases due to the disruption of the sample structure, the loss of water bound to the structure, and the formation of oxides, which can also be seen from the step-forming curve in the graph. At 570^{0}C, a small endothermic effect is observed due to the transition of α-quartz to β-quartz.

The results of the study of physicochemical properties of various natural glauconites in the country showed that despite the adsorption activity of these natural minerals, they are not suitable for natural water purification due to their spontaneous peptization and decomposition in aqueous media. In addition, natural glauconites contain up to 75% ballast mineral additives, which do not participate in the sorption process and reduce the overall efficiency of the sorption material.

Therefore, in order to bring the application of glauconite-based sorption materials to the industrial scale, they need to be first processed and modified. To do this, first of all it is necessary to dry and classify natural glauconite. For this purpose, we chose Parkent glauconite, which is most suitable for our further research, and which contains a large number of easily exchangeable potassium ions during sorption and easily exchangeable calcium ions in the process of modification.

To prepare a natural sorbent based on the glauconite mineral, 1 kg of the Parkent deposit glauconite sample was weighed, crushed and dried to constant weight for 1 h at 2000C with periodic stirring in a drying equipment. The weight of the glauconite weighed after drying was 0.82 kg, respectively, and it was found that the average moisture content of the samples was 18 %. From the results of our experiments to determine the mineralogical composition of glauconite, it became clear that the maximum amount of glauconite was in fractions smaller than 0.125 mm in diameter. Therefore, in order to separate the dried glauconite samples from organic additives, small stones and other additives, we sifted them in a sieve with holes with a diameter of 0.125 mm. The granulometric and mineralogical composition of our sample of the obtained classification, ie particles with a diameter of less than 0.125 mm, cleaned of fine sand and organic impurities, containing not less than 55% of glauconite was determined.

Determination of the granulometric composition of scattering materials consists of determining the material fractions of different dispersions and their sum [14]. Glauconite samples were divided into fractions in sieves consisting of cells of different diameters and their fractions were calculated. The results of the analysis of the fractional composition of the samples of Parkent, Bukhara and Karakalpak deposits are given in Table 2.

Table 2. Samples of glauconite obtained and enriched from various deposits fractional composition

Sieve cell diameter, mm	Remains of glauconite in the sieve					
	Parkent mine		Bukhara mine		Karakalpak mine	
	Residual mass, g	Amount of fraction,%	Residual mass, g	Amount of fraction,%	Residual mass,g	Amount of fraction,%
0,63	0,49	0,04	2,98	0,36	0,2	0,4
0,45	0,88	0,12	12,01	1,23	0,24	0,05
0,315	4,44	0,46	33,31	3,80	1,52	0,23
0,25	29,45	3,14	94,13	11,47	6,83	0,91
0,2	142,89	14,88	193,44	19,56	133,88	18,26
0,125	584,16	59,48	437,15	46,89	399,53	54,09
0,1	133,47	15,29	94,03	11,23	110,04	15,48
0,08	29,48	3,15	19,44	2,19	32,18	4,20
0,05	22,59	2,42	16,46	1,71	37,33	5,35
<0,05	10,21	1,06	4,72	0,53	8,95	1,39

Each isolated fraction was mineralogically analyzed visually macroscopically and the resulting amount of glauconite and other mineral constituents was determined (Table 3).

Table 3 Mineralogical analysis of glauconite samples

Mineral mine	Parkent mine	Bukhara mine	Karakalpak mine
0.63-0.45 mm in fraction			
The amount of fraction in the sample,%	1,62	0,15	0,06
Quartz,%	74,8	74,9	63,7
Дала шпати, %	1,5	0,4	0,9
Muscovite, %	1,1	0,5	0,2
Glauconite, %	10,4	9,2	11,2
others, %	10,5	14,6	21,3
0,315 mm in fraction			

The amount of fraction in the sample,%	3,81	0,39	0,21
Quartz,%	78,7	25,8	36,1
Дала шпати, %	4,2	4,3	2,2
Muscovite, %	6,2	21,1	17,9
Glauconite, %	6,5	32,1	31,8
others, %	3.2 (magnetite, rutile, kyanite, and so on)	Hydrosluda 6.0 Calcite 0.5 others 5.0	Chlorite 4.5
0,25-0,20 mm in fraction			
The amount of fraction in the sample,%	30,4	17,10	18,15
Quartz,%	79,5	51,1	58,2
Дала шпати, %	11,0	17,1	13,5
Muscovite, %	2,5	7,8	4,8
Glauconite, %	7,2	11,3	18,8
others, %	—	Hydrosluda 2.6; gil 1,2; others 1.2	0,2
0,125 mm in fraction			
The amount of fraction in the sample,%	46,8	58,3	54,06
Quartz,%	61,4	59,8	55,1
Feldspar , %	11,7	8,9	13,3
Muscovite, %	0,6	1,3	1,3
Glauconite, %	21,1	24,0	22,2
Chlorite,%	0,2	0,15	0,2
Biotite,%	1,3	3,5	2,3
others, %	0,6	1,2	7,8
0,1-0,08 mm in fraction			
The amount of fraction in the sample,%	11,2	18,5	17,9
Quartz,%	58,5	60,3	56,8
Feldspar , %	11,9	10,4	13,7
Muscovite, %	0,2	0,5	0,4
Glauconite, %	23,21	22,7	24,1
Aggregates,%	3,7	5,0	3,5
Chlorite,%	0,2	—	—
others, %	1,5	2,4	3,7
0,05 mm in fraction			
The amount of fraction in the sample,%	2,19	2,2	6,25
Quartz,%	41,1	47,6	50,13
Feldspar , %	11,4	0,2	8,1
Muscovite, %	0,7	0,3	0,4
Glauconite, %	40,6	34,3	37,3
Calcite,%	0,2	0,3	0,5
Aggregates,%	2,4	0,2	2,2
Chlorite,%	1,1	1,0	0,75
others, %	2,9	17,0	0,8
0,05 fraction smaller than mm			
The amount of fraction in the sample,%	0,66	1,29	1,3
Quartz,%	37,1	36,4	41,6
Feldspar , %%	11,6	93	9,2
Muscovite, %	0,6	0,4	1,06

Glauconite, %	42,7	37,0	45,3
Calcite,%	0,4	0,7	0,4
Aggregates,%	4,2	1,8	0,8
Chlorite,%	0,3	0,4	0,3
others, %	4,6	14,2	1,4

The results of the analysis presented in Table 3 show that the amount of glauconite is high in the fractions of 0.08-0.125 mm, which make up the dimension Dispersion of the fraction increases with the amount of glauconite in the fraction, but due to the small amount of the fraction, the processing of fractions in the above range is effective, and for technological processing of glauconite fractions smaller than 0.125 mm are selected. We selected the Changi deposit glauconite in Parkent as the most suitable example for our next research.of the fraction in the sample (around 50-55%).

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