STUDY OF PHYSICOCHEMICAL CHARACTERISTICS OF CERTAIN TYPES OF DOLOMITE MINERALS COMMON IN THE TERRITORY OF UZBEKISTAN

Ziyoyev B. T.
Tashkent Institute of Chemical Technology,
E-mail: bayoniddinziyoyev3@gmail.com
Nabiyev A.A.
Tashkent Institute of Chemical Technology,
Ruziev I.Kh.
Institute of Biochemistry, Samarkand State University named after Sh. Rashidov
Rabbimova M.K.
Institute of Biochemistry, Samarkand State University named after Sh. Rashidov
Ganiyeva G.N.
Tashkent Institute of Chemical Technology,

Annotation. The paper determines the chemical, dispersed composition and properties (moisture content, free and compacted density, slope angle, flowability, hygroscopic point, moisture capacity, pH of a 10% suspension) of dolomite minerals, which are used to improve the commercial properties of ammonium nitrate and are considered in as modifiers.

Key words: dolomite mineral, chemical and dispersed composition, humidity, density, hygroscopic point, pH.

Annotasiya. Ishda ammiakli selitrasining tovar xossalarini yaxshilashda qo‘llaniladigan va modifikator qo‘shimcha hisoblangan dolomit minerallarining kimyoviy, dispers tarkiblari va xossalari (namligi (%), erkin uyma va zichlashgan zichligi(g/sm^3), qiyalik burchagi (grad.), sochiluvchanligi (soniya), gigroskopik nuqtasi (%), namlik sig‘imi (%) va 10 %-li suspenziyasining pH muhiti) aniqlangan.

Kalit so‘zlar: dolomit minerali, kimyoviy va dispers tarkib, namlik, zichlik, gigroskopik nuqta, pH muhit.

Аннотация. В работе определены химический, дисперсный состав и свойства (влажность, свободная и с уплотнением плотность, угол откоса, сыпучесть, гигроскопическая точка, влагоёмкость, pH 10 %-ной суспензии) доломитовых минералов, используемые для улучшения товарных свойств аммиачной селитры и рассматриваемые в качестве модификаторов.

Ключевые слова: доломит минерал, химический и дисперсный состав, влажность, плотность, гигроскопическая точка, pH среда.

ISSN 3030-3907

INTRODUCTION.

Dolomite is one of the most common carbonate minerals and is a compound of calcium and magnesium carbonates. It finds wide industrial applications, particularly in the production of cement, steel, and a number of other materials. Dolomite deposits are widespread throughout Uzbekistan, particularly in mountainous regions, including the Tashkent, Navoi, and Samarkand provinces.

Investigating the physicochemical characteristics of dolomite minerals in Uzbekistan is important for a deeper understanding of their properties and assessing their potential for use in various industries. Such studies encompass the analysis of optical, electrical, magnetic, acoustic, and other properties of the minerals.

This paper focuses on the key physicochemical parameters of dolomite, including hardness, density, optical characteristics, infrared spectroscopy data, and thermodynamic properties. The results of modern scientific research are also reviewed, and the potential for practical industrial application of the identified properties is explored.

Thus, studying the physicochemical properties of dolomite opens up broad prospects for its rational use. Dolomite is one of the most common magnesium-calcium carbonates in the Earth's crust, and its properties depend significantly on its chemical composition and crystal structure. Pure dolomite has a hardness of 3.5–4 on the Mohs scale, and a density ranging from 2.85–2.95 g/cm³.

Various methods are used to study the physicochemical properties of dolomite, including X-ray diffraction analysis, infrared spectroscopy, optical studies, heat capacity determination, and other analytical approaches. It should be noted that each method has its own characteristics and limitations, and requires specific experimental conditions.

The data obtained on the physicochemical properties of dolomite are of practical value for many industries. In metallurgy, dolomite is used as a component in the production of cast iron and steel, in the construction industry for the manufacture of cement, and in the glass and ceramic industries, as well as in the production of drilling fluids and other materials. Ultimately, a comprehensive study of the physicochemical properties of dolomite minerals in Uzbekistan is of significant interest to both science and industry. The results of such research can be used to develop new materials and technologies, contributing to increased production efficiency and reduced environmental impact.

RELEVANCE OF THE STUDY. Research into the physicochemical characteristics of dolomite minerals in Uzbekistan is a relevant area for a number of reasons.

ISSN 3030-3907

First of all, dolomite is one of the most widely distributed minerals in the Earth's crust. It is widely used in various economic sectors, including construction, agriculture, metallurgy, the chemical industry, and other industries. The physicochemical properties of dolomite determine the potential and effectiveness of its use, making their study crucial for the country's economic development.

Furthermore, Uzbekistan is among the world's leading producers of dolomite. In this context, studying the physicochemical properties of local dolomite minerals allows for a more comprehensive assessment of the country's resource potential, its position in the global market, and prospects for increasing exports.

Finally, analysis of the physicochemical properties of dolomite in Uzbekistan can facilitate the development and implementation of new technologies for its processing and application. Studying the characteristics of this mineral opens up opportunities for the development of innovative materials with tailored properties that are in demand in various industries. Thus, the physicochemical properties of dolomite minerals in Uzbekistan are a pressing issue of significant economic and scientific significance, and may lead to the development of new technologies and materials.

For normal plant growth and development, it must be provided with sufficient nutrients. Nitrogen, phosphorus, potassium, sulfur, calcium, and magnesium are the primary plant nutrients. In addition, plants require micronutrients such as boron, molybdenum, copper, manganese, zinc, and others [1]. The greater the amount of plant-active macro- and micronutrients in a fertilizer, the higher its quality. Developed countries primarily use fertilizers containing two or three nutrient components.

Plants obtain most of their nutrient nitrogen from nitrogen fertilizers (urea, ammonium nitrate, ammonium sulfate, AFU, etc.) [2]. Of these, ammonium nitrate (AN) is the most effective and versatile fertilizer [3, 4]. However, the storage and transportation of packaged ammonium nitrate granules in warehouses and before they reach consumers presents significant challenges, including the accumulation of granules in polyethylene bags, forming a monolithic mass, and, especially, the risk of explosion.

Explosions involving ammonium nitrate led to the addition of calcium and magnesium carbonates in some countries, eliminating any potential hazard. This product is marketed as calcium ammonium nitrate (CAN) or ammonium nitrate with limestone or dolomite. The global production capacity of CAN is estimated at approximately 7% [5].

Worldwide, 42 companies produce and supply CAN with a nitrogen content of 20-33.5%, including 31 in Europe [6, 7].

ISSN 3030-3907

EXPERIMENTAL METHODOLOGY. Our experimental methodology consisted of the following stages:

1. Sample Collection: We collected several dolomite samples from various deposits in Uzbekistan;

2. Sample Preparation: We cleaned the samples of dirt and other contaminants. We then crushed them into small pieces;

3. Chemical Composition Determination: We analyzed the content of key elements such as Ca, Mg, Fe, and Mn, as well as compounds such as CaO, MgO, SiO_2, MnO2, TiO_2, Na_2O, and K_2O. 4. We studied the following physical properties: density, hardness, thermal conductivity at various temperatures, electrical conductivity, permittivity, and porosity of the samples.

This means that carbonate (dolomite, chalk, and limestone) compounds used as modifiers in the composition of the AS may be promising additives for improving its commercial and consumer properties. Therefore, dolomite flour samples from the Navbahor (Navoi Region), Shursui (Fergana Region), Karnab (Samarkand Region), Ketmonchin (Navoi Region), and Dehkanabad (Kashkadarya Region) deposits were selected as modifying additives for saltpeter. All of these deposits are currently being developed on an industrial scale.

Their particle size distribution and chemical compositions are presented in Tables 1 and 2.

Table 1

Particle size distribution of dolomite flour samples from various deposits

Size class, mm	Fraction yield, wt.%				
	Navbahor	Shursu	Karnab	Ketmonchi	Dexkanabad
0,5	13,67	9,70	18,68	18,75	27,84
- 0,5 + 0,315	10,98	11,03	24,57	23,64	13,62
- 0,315 + 0,25	5,60	4,48	5,08	6,20	4,01
- 0,25 + 0,16	3,12	8,62	16,50	15,87	16,78
- 0,16 + 0,063	11,73	17,31	11,13	11,32	11,43
- 0,063 + 0,05	54,90	48,86	24,04	24,22	26,32
Исходная масса	100%	100%	100%	100%	100%

Table 2

Chemical composition of dolomite flour samples from various deposits

Name of	Content of components, wt. %

ISSN 3030-3907

dolomite deposit	CaO	MgO	SiO_2	MnO	TiO_2	Na_2O	K_2O	P_2O_5	SO_3	CO_2
Navbahor	28,0	25,0	2,14	0,077	-	0,04	0,12	0,02	0,23	44,30
Shursu	31,48	19,17	2,87	0,01	0,02	0,05	0,15	0,03	0,30	45,0
Karnab	30,02	19,36	2,74	0,01	0,03	0,25	0,10	0,15	0,30	45,40
Ketmonchi	30,32	19,56	2,12	0,03	0,02	0,06	0,08	0,16	0,42	45,20
Dexkanabad	30,56	20,41	2,30	0,01	0,021	0,055	0,07	0,08	2,12	45,16

Table 2 shows that the Navbahor dolomite contains 28.0% CaO, 25.0% MgO and 44.30% CO_2, the Shursui dolomite contains 31.48% CaO, 19.17% MgO and 45.0% CO_2, the Karnab dolomite contains 30.02% CaO, 19.36% MgO and 45.40% CO_2, the Ketmonchi dolomite contains 30.32% CaO, 19.56% MgO and 45.20% CO2, and the Dehkanabad dolomite contains 30.56% CaO, 20.41% MgO and 45.16% CO2. In addition, the dolomite flour contains about ten macro- and microelements. This means that the AS is enriched with nutrients. Dolomite flour (from the Shursui, Navbahor, Karnab, Ketmonchi, and Dehkanabad deposits) is an excellent natural mineral. Dolomite mineral ($CaCO_3 \cdot MgCO_3$) contains 54.35% calcium carbonate ($CaCO_3$) and 45.65% magnesium carbonate ($MgCO_3$). They are suitable for this purpose after simple thermal activation and do not require environmentally hazardous and expensive chemical activation.

To develop a technology for producing modified AS with the addition of dolomite flour, information on the physicomechanical properties of the dolomite raw material is necessary. These properties include moisture content, bulk density, angle of repose, flowability, pH, hygroscopicity, and water capacity (Table 3).

Table 3

Physicomechanical characteristics of dolomite flour from various deposits

Properties	Indicators				
	Navbahor	Shursu	Karnab	Ketmonchi	Dexkanabad
Humidity, %	1,0	1,5	1,23	1,38	1,12
Bulk density, g/cm^3	1,26	1,23	1,27	1,25	1,24
Density with compaction, g/cm^3	2,82	2,80	2,788	2,81	2,79
Slope angle, grad.	40º02´	41º10´	38º06	42º14	39º56

ISSN 3030-3907

Flowability, sec.	18,0	17,76	18,40	19,0	17,92
Hygroscopic point, %	42,10	41,65	39,43	42,0	42,89
Moisture capacity, %	9,22	8,04	7,50	9,06	8,53
pH of 10% suspension	9,07	8,79	8,67	8,83	8,78

ANALYSIS AND RESULTS. The results of Table 3 show that at a humidity of 1.0-1.5%, the free bulk density of dolomite flour is equal to 1.26 g/cm^3 for the first sample (Navbahor); 1.23 g/cm^3 for the second (Shurs); 1.27 g/cm^3 for the third (Karnab); 1.25 g/cm^3 for the fourth (Ketmonchi) and 1.24 g/cm^3 for the fifth (Dehkanabad), and with compaction it is 2.82; 2.80; 2.788; 2.81 and 2.79 g/cm3, respectively. The angle of repose of its free surface is one of the parameters that allows us to evaluate the mobility of dolomite flour bulk material. The smaller the angle of repose, the greater the mobility of the particles of the bulk medium. The slope angle of the dolomite flour was 40 degrees for the first sample; 41 degrees for the second; 38 degrees for the third; 42 degrees for the fourth; and 39 degrees for the fifth. Flowability tests showed that they were equal to 10 points for all samples. The hygroscopic point was 42.10% for the first sample; 41.65% for the second; 39.43% for the third; 42% for the fourth; and 42.89% for the fifth. These low values are explained by dolomite's ability to swell in water and retain large amounts of it in the interplanar spaces.

The maximum moisture capacity of dolomite flour is 7.50-9.22%, and at higher humidity, the raw material loses its friability. Therefore, it is necessary to protect it from moisture during storage and transportation. It can be assumed that dolomite flour, having a pH from 8.67 to 9.07, neutralizes the acidity of ammonium nitrate.

CONCLUSIONS

1. A comprehensive study of the chemical, physicochemical, and mineralogical characteristics of dolomites from the Navbahor, Shursui, Karnab, Ketmonchi, and Dehkanabad deposits was conducted. Chemical analysis results showed that the dolomite content in samples from the Navbahor deposit reaches almost 99%, indicating a high degree of rock purity and minimal clay impurities.

2. It was established that dolomite from the Navbahor deposit in the Republic of Uzbekistan belongs to the category of active dolomites and can be effectively used as a raw material component in the production of magnesite binders.

3. The chemical composition and physicomechanical properties of dolomite flour obtained from deposits in Uzbekistan allow a preliminary assessment of its potential use as a modifying additive in asphalt concrete mixtures.

ISSN 3030-3907

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ISSN 3030-3907