PROSPECTS FOR USE OF VAUSH DEPOSIT DOLOMITE IN THE COMPOSITION OF HARDENING STOCKING MIXTURES

B.A.Madatov[1]
B.T.Sabirov[1]
B.A.Mirzaev[1]
N.B. Khujhakulov[2]
[1] Navoi Branch of the Academy of Sciences of the Republic of Uzbekistan,
[2] Navoi Mining and Technological University, Uzbekistan
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Annotation. The article presents data on the possibility of using a magnesium binder from the dolomite of the Vaush deposit, which allows the use of dolomite and tailings in fastening in mine workings. The use of a cement binder pollutes the mined ore, contributes to the complexity of the technology of its enrichment and the extraction of a valuable component (concentrate). Therefore, the use of dolomite as a magnesium binder opens up new opportunities for improving the quality of mining, processing and preventing contamination of the mined mineral under underground mining conditions. The binder is only 8-22% inferior in strength to mixtures with standard cement and is suitable for construction in mine workings.

Key words: non-metallic raw materials, dolomite, binder, magnesium oxide, stowing mixture, development, mining, rock mass, rock pressure

Introduction. The main deposits of ore minerals are developed underground, which conflicts with the environmental requirements of the development of agriculture in these territorial regions. The accumulated extensive experience in the development and operation of ore deposits contributes to forecasting for the use of a development system with backfilling of voids with hardening mixtures, for which significant financial resources will inevitably be spent on the production of hardening backfilling mixtures and the availability of certain raw materials for their manufacture. The development of ore deposits of minerals requires the development of technologies for the deep processing of mining waste in order to comprehensively prevent the degradation of the geological environment. To justify the technical feasibility and environmental feasibility of using dolomite in the composition of hardening backfill mixtures, it is necessary to establish the optimal values for the strength of hardening mixtures, the strength of hardening mixtures based on dolomite; determination of the factors influencing the binding capacity of dolomites and methods for managing backfill arrays using dolomite.

Main part. The development of mineral deposits is characterized by a decrease in rich and more accessible deposits. In this regard, there is a need to develop and use modern technologies that help increase the volume and quality of the extracted primary ore raw materials, as well as the degree of mineral enrichment. The observed trend in the need for ore and non-metallic raw materials causes the development of deposits by open and underground methods in increasingly difficult geological and climatic conditions. When increasing the efficiency of underground mining, it is necessary to ensure the safety of work, the completeness of the use of subsoil and the preservation of the earth's surface in a form suitable for land use. Increasingly, mining has to be carried out under built-up or developed territories for the needs of agriculture, which imposes stringent requirements on the displacement of host rocks and the preservation of the earth's surface to prevent subsidence of soils [1-2]

The widespread use of tailings and overburden is due to the lowest costs required for their preparation, delivery and placement in goaf areas compared to other materials. However, hydraulic and dry backfilling are not an effective way to control rock pressure, they require the construction of special barriers and do not ensure the complete extraction of ore during the development of pillars. These shortcomings are largely eliminated with the use of hardening backfill mixtures. Analysis of the compositions of hardening backfill mixtures used in domestic and foreign mines found that almost all of them are based on cement, low-cement or lime binders [3-4].

All authors agree on the negative effect of calcium oxide, which leads to a decrease in the strength and resistance to water of the stone formed during hardening. To obtain a binder from dolomites, firing should be carried out in such a way that the product contains as much MgO as possible and the formation of CaO is excluded, which is very difficult, especially on an industrial scale. It is believed that the strength of a magnesian binder based on dolomite is lower than the strength of a binder based on magnesite, although it has been found that, subject to strict observance of the mode of partial firing of dolomite, the ratio "dolomite:MgCl2 solution" and the concentration of MgCl2 solution, the strength of such binders can exceed the strength of binders from high magnesia raw materials. . This can be explained by the fact that, under the optimal firing regime, undecomposed calcium carbonate plays the role of a microfiller, which interacts in contact with the products of MgO hydration and actively participates in the creation of a mechanically strong conglomerate. CaCO3 at the same time forms the smallest centers of crystallization in the hardening dough. Due to this, shrinkage phenomena and the formation of cracks during hardening are prevented, which significantly improves the quality of finished products [5–8].

At the same time, it is known that mine waters often contain a significant amount of acids or salts soluble in them, which are aggressive to concrete. The presence of harmful impurities in water has a negative effect on concrete - leaching of Portland cement occurs. Dolomites have found use in hardening backfill compositions only as a filler. However, the development of filling mixtures based on dolomite binder and dolomite aggregates seems to be economically viable. At the same time, powerful economic and environmental effects will be achieved: by reducing transportation costs when using local raw materials and using unclaimed dolomites from dumps both as fillers and as raw materials in the production of a binder for hardening backfill mixtures. From numerous studies, it can be concluded that the main problem in obtaining a binder from dolomites is that there is no sharp boundary between the processes of decomposition of MgCO3 and CaCO3. The release of CO2 from magnesium carbonate is inevitably accompanied by partial decomposition of calcium carbonate [9–11].

In the Navoi region of Uzbekistan, deposits of dolomites Vaush, Ketmenchi and Navbakhor have been discovered, there are prospects for the extraction and processing of natural magnesian raw materials in quantities of industrial importance. Until now, no magnesite deposits have been discovered in the republic, therefore, the extraction of magnesite by decomposition of mineral raw materials from active dolomite deposits makes it possible to cover the needs of industry in this necessary raw material [11-12].

The Vaush dolomite deposit is located near the settlement Uchtut in the Navbakhor district of the Navoi region (Fig. 1).

Fig.1. Place of geological occurrence of dolomite in the Waush field

The chemical composition of the dolomite sample of the Vaush deposit is given in Table. № 1.

Table № 1

Chemical composition of dolomite of the Vaush deposit

Oxide content								RFP	Σ
MgO	CaO	Al_2O_3	SiO_2	MnO	P_2O_5	K_2O	SO_3		
20,98	28,61	0,27	0,18	0,02	0,09	0,12	0,10	49,96	99,99

IR spectrographic analysis of a sample of dolomite from the Vaush deposit was carried out at the Navoi State Mining and Technology University using an IR100 IR spectroscope (Fig. 2).

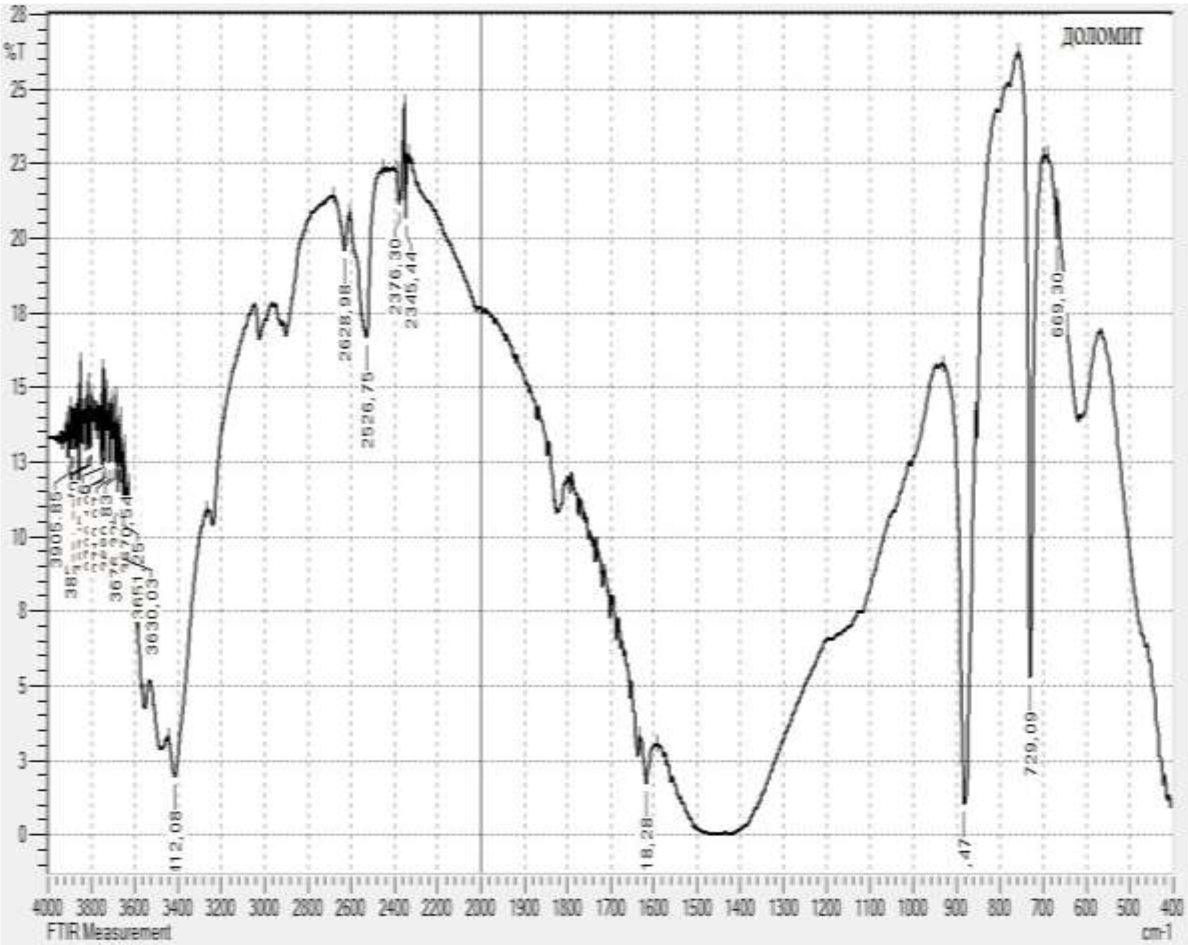

Fig.2. IR spectroscopy of a sample of dolomite from the Vaush deposit

The IR spectrogram shows absorption spectra related to crystals of the group CO_3^- 6,90-6,97μm (1450-1435 см$^{-1}$); 11,28-11,15 μm (887...897 см$^{-1}$) и 13,36-14,02 μm (748-710 см$^{-1}$) , as well as two weak peaks 3,92-3,97 и 5,47-5,52 μm.

Table № 2

Intensity of X-ray peaks of the Vaush dlomite

Analyte	Result	[3-sigma]	Proc-Calc	Line	Intensity
Ca	96,481	[0,260]	Quant.-FP	CaKa	186,6788
Fe	1,146	[0,022]	Quant.-FP	FeKa	14,8442
Si	0,767	[0,118]	Quant.-FP	SiKa	0,1423
S	0,477	[0,031]	Quant.-FP	S Ka	0,7202
Mn	0,460	[0,015]	Quant.-FP	MnKa	4,4046
Pd	0,256	[0,019]	Quant.-FP	PdKa	5,0332
K	0,251	[0,026]	Quant.-FP	K Ka	0,5630
Sr	0,099	[0,006]	Quant.-FP	SrKa	6,0710
Cu	0,050	[0,009]	Quant.-FP	CuKa	1,1397
Ni	0,013	[0,012]	Quant.-FP	NiKa	0,2456
Ni	0,013	[0,012]	Quant.-FP	NiKa	0,2456

The heat treatment process for the decomposition of dolomite was carried out taking into account the temperature of its thermal dissociation, that is, the decomposition of MgCO3 occurs in the temperature range of 700-800°C, and the decomposition of CaCO3 proceeds in the temperature range of 800-1000°C. For this reason, the optimal temperature range is 700–750°C, since at temperatures below 750°C complete decomposition does not occur, and at temperatures above 750°C, only partial decomposition of CaCO3 is observed [13].

Further, at the next stage of laboratory research on the production of magnesite and calcium carbonate in a combined way, in contrast to the traditional thermal method of dolomite decomposition, which requires a large amount of thermal energy.

For research, a sample of dolomite taken from the deposit of the Vaush mine was preliminarily crushed and passed through a No. 016 sieve, and an additive based on a monovalent metal was used as an additive to the crushed dolomite. This additive reduces the thermal decomposition temperature of MgCO3 to 100-150°C. During the decomposition of dolomite in order to obtain caustic, 0.5% of an additive based on a monovalent metal was added to the mass of dolomite. As a result, the decomposition of magnesium carbonate into MgO and CO2 occurs with the formation of a mixture of MgO and CaCO3, which dissociates at an elevated temperature:

$$CaMg(CO_3)_2 \rightarrow CaCO_3 + MgCO_3 \rightarrow$$
$$\rightarrow CaCO_3 + MgO + CO_2 \rightarrow CaO + MgO + 2CO_2$$

$$CaMg(CO_3)_2 = MgO + \uparrow CO_2 + CaCO_3$$

and caustic dolomite is formed ($MgO+CaCO_3$).

It should be noted that the production of caustic dolomite is based on the fact that the dissociation temperatures of magnesium carbonate and calcium carbonate are different, namely 550°C and 910°C, respectively. With partial (incomplete) firing of dolomite in the temperature range of 650-750°C, which is much lower than the decomposition temperature of calcium carbonate, an intermediate product containing hydrated MgO is formed. Here CaCO3 is the inert component of the binder. Increasing the combustion temperature to 800°C and above accelerates the decomposition of CaCO3 and leads to the formation of CaO, which is quickly quenched in a large amount of water. In addition, high temperature causes the transition of MgO to the periclase form and maturation, which worsens the quality of the resulting binder.

Strict adherence to the regime of the firing process, the correct selection of the granulometric composition of raw materials are important conditions for the production of magnesium oxide. During firing, the process of decomposition of MgCO3 contained in small pieces of dolomite comes to an end, while it is observed that large pieces do not completely decompose. At the same time, with a repeated increase in temperature, MgO formed during the decomposition of small pieces can burn into the perichalase form. For this reason, it is desirable to burn raw materials of the same size, without very fine fraction, in accordance with the combustion regime chosen for this size.

The economic feasibility of mining technologies with backfilling with hardening mixtures increases due to the fact that ore dilution with backfilling material affects its concentration and the ecology of the region. Contamination of ore with cement by 1% reduces the extraction of metals into concentrates by 0.8-1.0%, while impoverishment of the host rocks by the same 1% - only by 0.15-0.20%. When using a cement-based hardening mixture, the recovery during enrichment is reduced by 4-5%. Any rock containing enough CaCO3 (dolomite, limestone, marble, calcite, siderite, magnesite, etc.) can be used both as a binder and as a filler. Due to the backlog of stowing work in some areas of the mine, the collapse of ore and overlying rocks begins. An assessment of the influence of accumulated voids on the safety of field completion is given in [14-15].

Conclusion. Based on the results of the experiments, it can be stated that the magnesium binder obtained by the method of thermochemical decomposition of dolomite from the Vaush deposit is recommended for use in the development of effective backfill mixtures. In this case, the placement of the filling mixture is carried out by wet or dry methods. When choosing a dry method of laying, it is recommended to fill in large underground voids in mountain ranges.

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