ABOUT THE TECHNOLOGICAL PROPERTIES OF SERPENTINITES OF THE AMANDARA DEPOSIT

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ANNOTATION

This article presents the results of studying the material composition and the possibility of enriching serpentinite from the Amandarinsky deposit. When Amandara serpentinite was enriched according to a combined scheme (gravity and electromagnetic separation), a 49.58% magnesium-containing product was obtained, and 72.9% was extracted. The resulting product meets the requirements of GOST 14832-96 "Refractory forsterite and forsteritochromite products. Technical conditions".

Also, the article presents the results of technological research on the production of magnesium oxide serpentinite from the Amandara deposit for the magnesia refractories industry. As a result of the conducted technological studies, a magnesium–containing concentrate with a content of MgO-86.18% was obtained that meets the technical requirements GOST 1216-87 and GOST 10360-85.

Key words: magnesia refractory raw materials, serpentinite, mineral composition, gravity enrichment, electromagnetic separation, concentrate, extraction, heat treatment, sediment.

INTRODUCTION

The economy of Uzbekistan has a great need for refractory raw materials and products made from it, especially high-refractory magnesia. Rapidly developing industries (mechanical engineering, metallurgy, chemical, electrical engineering, etc.) dramatically increase the need for them. The refractories of the magnesia group are especially in great demand, the need for which is constantly growing from year to year. The main consumers of magnesia refractories in our Republic are Almalyk and Navoi Mining and Metallurgical Plants, Uzbek Metallurgical Plant, Uzkimesanoat JSC, transport and agricultural machinery enterprises. The absence, as well as the weak knowledge of its own raw material base of magnesia raw materials forces it to be imported from Russia, Kazakhstan, China and other countries.

Taking into account the rather tangible costs of importing refractory materials in the presence of its own mineral resources for some refractories, from the point of view of the economy it is completely unprofitable. In this regard, there is a need to study the possibility of meeting the needs of the Republic's industry in magnesia refractories from local raw materials.

THE PURPOSE OF THE WORK

In accordance with the above, the objective of this study is to study the technological properties of magnesia raw materials of the Republic of Uzbekistan, to develop a cost-effective technology for processing serpentinite from the Amandarin deposit.

RESEARCH METHODOLOGY

Modern methods of physico-chemical analysis, such as semi-quantitative spectral, chemical, mass spectrometric, X-ray diffractometric, petrographic, etc.

THE RESULTS OF THE STUDY AND THEIR DISCUSSION

After preliminary examination of the selected serpentinite samples from the Mandarin deposit and familiarization with their geological and genetic conditions of formation, the material composition was studied by semi-quantitative spectral, chemical, mass spectrometric, X-ray diffractometric and petrographic analysis methods.

As a result of studying mineralogical and granulometric compositions, structural and textural features of crystal sizes, the nature of their mutual arrangement and other factors, an effective method of their enrichment was chosen.Thus, in serpentinites of Amandara, oxides of silicon and magnesium predominate in chemical composition, three iron oxides are fixed in much smaller quantities.According to chemical analysis, the average serpentinite sample of the Amandara deposit contains the following components (%): SiO_2-39.54; Fe_2O_3-6.50; Al_2O_3-0.69; TiO_2-<0.02; MnO-0.03; Na_2O-<0.03; K_2O-<0.03; P2O5<0.01; CaO-0.35; MgO-37.28; CO_2-0.44; SO_3 0.05; H_2O-0.44.X-ray diffractometric analysis has established that serpentine is the main mineral. According to the crystal chemical parameters, serpentine corresponds to lizardite formed due to the hydrolysis of olivine, which is preserved in relics, in the intervals between the veins of chrysotile, i.e. hydrolyzed olivine. During petrographic study, it was found that the content of ore minerals in serpentinite reaches 5-10%.

Serpentinite has a lepidoblastic, looped structure (Fig. 1). Elongated mineral fibers form a kind of knotty texture. Ore mineralization is mainly represented by magnetite, in a small amount by hematite, pyrite and ilmenite. The texture of ore minerals in serpentinite is interspersed.In magnetic fractions, most of the magnetite is not opened and is installed in joints with serpentine (Fig.2) or in the form of inclusions in it. In heavy fractions of gravitational enrichment, the main part of magnetite is opened and marked as free crystals.

In the composition of the initial serpentinite rock, increased concentrations of silver (20 g/t) are noted according to spectral semi-quantitative analysis and nickel (1890 g/t) according to mass spectrometric analysis. Ore-bearing elements in serpentinite are of no practical interest.The purpose of studying the enrichment of serpentinite, the birthplace of Amandor, was to establish the possibility of obtaining in laboratory conditions conditioned products containing magnesium oxides for the production of various refractory products, as well as to determine whether the quality of the resulting product meets the requirements of industry.

Figure 1. Loop structure of serpentinite. Increased 100x, nick. X

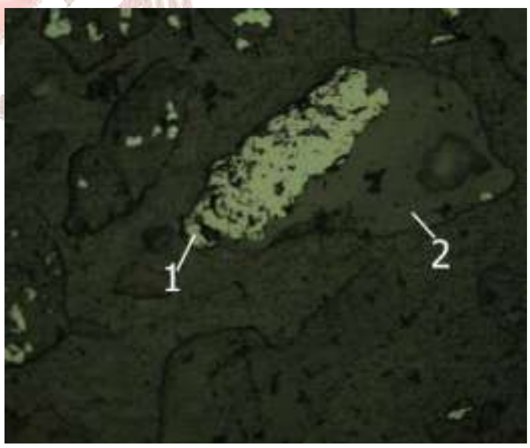

Figure 2. Magnetic fraction of serpentinite. Increased 200x, without analyzer. 1-magnetite (gray with a brown tinge); 2-serpentine (dark gray).

According to the study of the mineralogical composition of the Amandara serpentinite, the following mineral composition was established (in %): serpentine - 86.70; quartz - 3.85; calcite - 0.79; pyrite - 1.46; iron oxides - 7.2. Ore mineralization in the rock was established mainly in the form of inclusions. Their content is no more than 10%.

Based on the study of the material composition of the test sample, as well as the analysis of literary sources, methods of gravity, electromagnetic separation, heat treatment and hydrometallurgy were used to obtain magnesium oxide from serpentinite.

The contrast density of the main useful mineral – serpentine (2.6 - 2.7 g/cm3) and magnetite (4.9 - 5.2 g/cm3) - predetermined the use of the gravitational method in the first stage. The primary enrichment of the sample with a content of Fe_2O_3 - 6.50% and FeO - 0.68% was carried out on a concentration table.

Gravity enrichment was carried out at various size classes: -1+0mm, -0.5+0mm, -0.315+0mm and -0.1+0mm. The best indicators were obtained when the ore grinding size was -0.315+0 mm. At the same time, in a magnesium-containing product, the content of magnesium oxide reaches 41.94% when it is extracted 87.23%.

Electromagnetic separation in a strong magnetic field is a necessary and effective process for removing iron-containing minerals. Experiments of electromagnetic separation of the initial sample and industrial products of gravity enrichment were carried out on a dry separator 138T-SEM at a magnetic field strength of 1800 Oersted. In the electromagnetic separation of the initial sample, classified materials with two cleanings were used. With electromagnetic separation, the best results were achieved at a size of -0.315+0 mm. The extraction of iron-containing minerals into the magnetic fraction was 68.2% and the Fe_2O_3 content was 21.6%.

Experiments were also carried out on the enrichment of serpentinite from the Amandara deposit according to a combined scheme (gravity and electromagnetic separation). The combined enrichment scheme is shown in Fig.3.

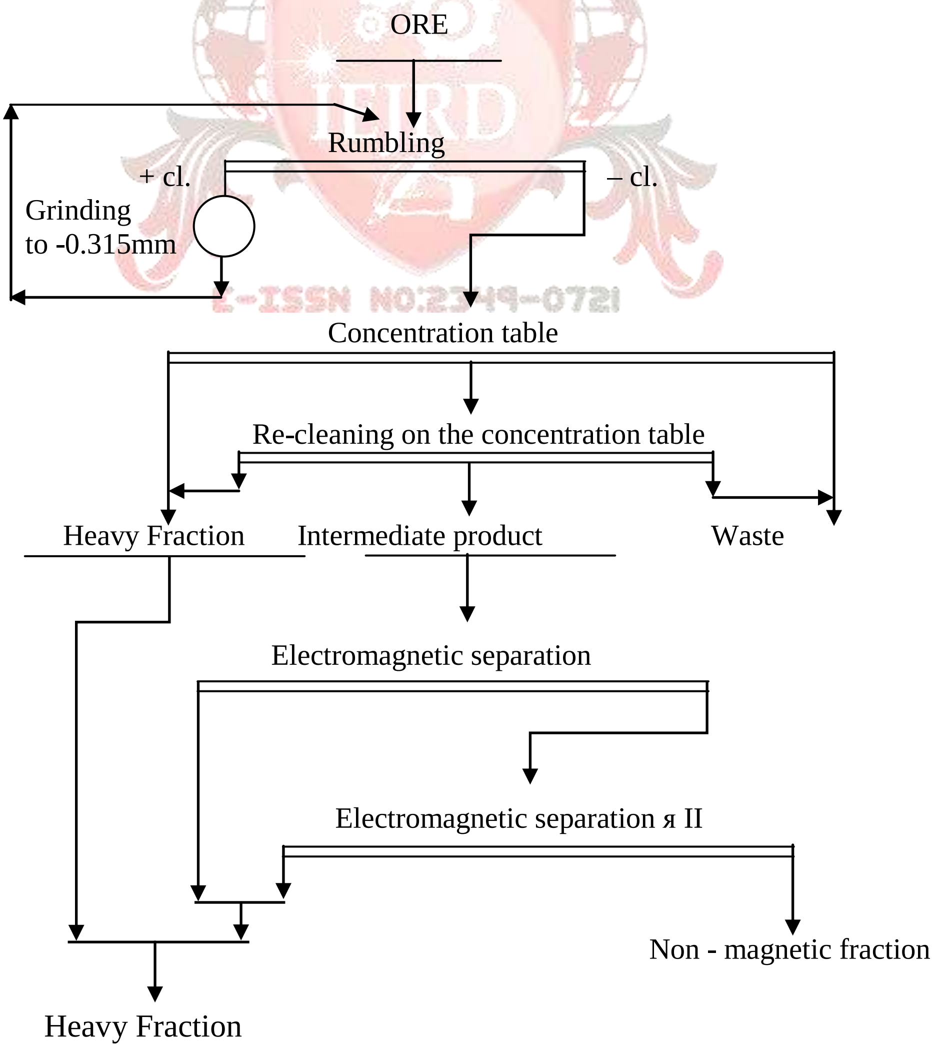

Fig.3. Combined scheme of enrichment of Mandarin serpentinite

The results of the enrichment experiments according to the combined scheme are shown in Table 1.

Table 1
The results of experiments on the enrichment of serpentinite from the Amandora deposit according to a combined scheme

Product Name	Exit, %	Content, %		Extraction, %	
		MgO	Fe_2O_3	MgO	Fe_2O_3
Heavy Fraction	26,6	20,28	21,2	14,5	75,2
Non - magnetic fraction	54,8	49,58	1,68	72,9	12,3
Tails	18,6	25,3	5,07	12,6	12,6
Initial sample	100	37,27	7,50	100	100

Thus, when Amandarin serpentinite was enriched according to the combined scheme, a magnesium-containing product with an MgO content of 49.58% was obtained, while its extraction was 72.9%. The resulting product meets the requirements of GOST 14832-96 "Refractory forsterite and forsteritochromite products. Technical conditions".

To obtain magnesium-containing refractory materials from the serpentinite sample of the Amandara deposit, the most acceptable method is the acid decomposition of enrichment products or feedstock, followed by the release of artificial magnesium-containing concentrates.

Leaching included dissolution of the magnesium-containing product in sulfuric acid, separation of the insoluble residue from the resulting sulfate solution by cooling the mixture to a crystallization state followed by washing the crystallized mixture with water; purification of the sulfate solution from impurities by precipitation in the form of hydroxides at pH 5-7, separation of the precipitate, precipitation of magnesium hydroxide from the solution by treating it with an alkaline reagent at pH 10-12, separation of the precipitate of the target product, its heat treatment in two stages: I - at 250-450oC, II -at 650-850oC and rinsing the calcined product with water.

As a result of numerous tests, we have developed a scheme for processing with leaching of serpentinite samples from the Amandara deposit to obtain magnesium-containing products. The technological scheme for obtaining magnesium-containing products is shown in Fig.4.

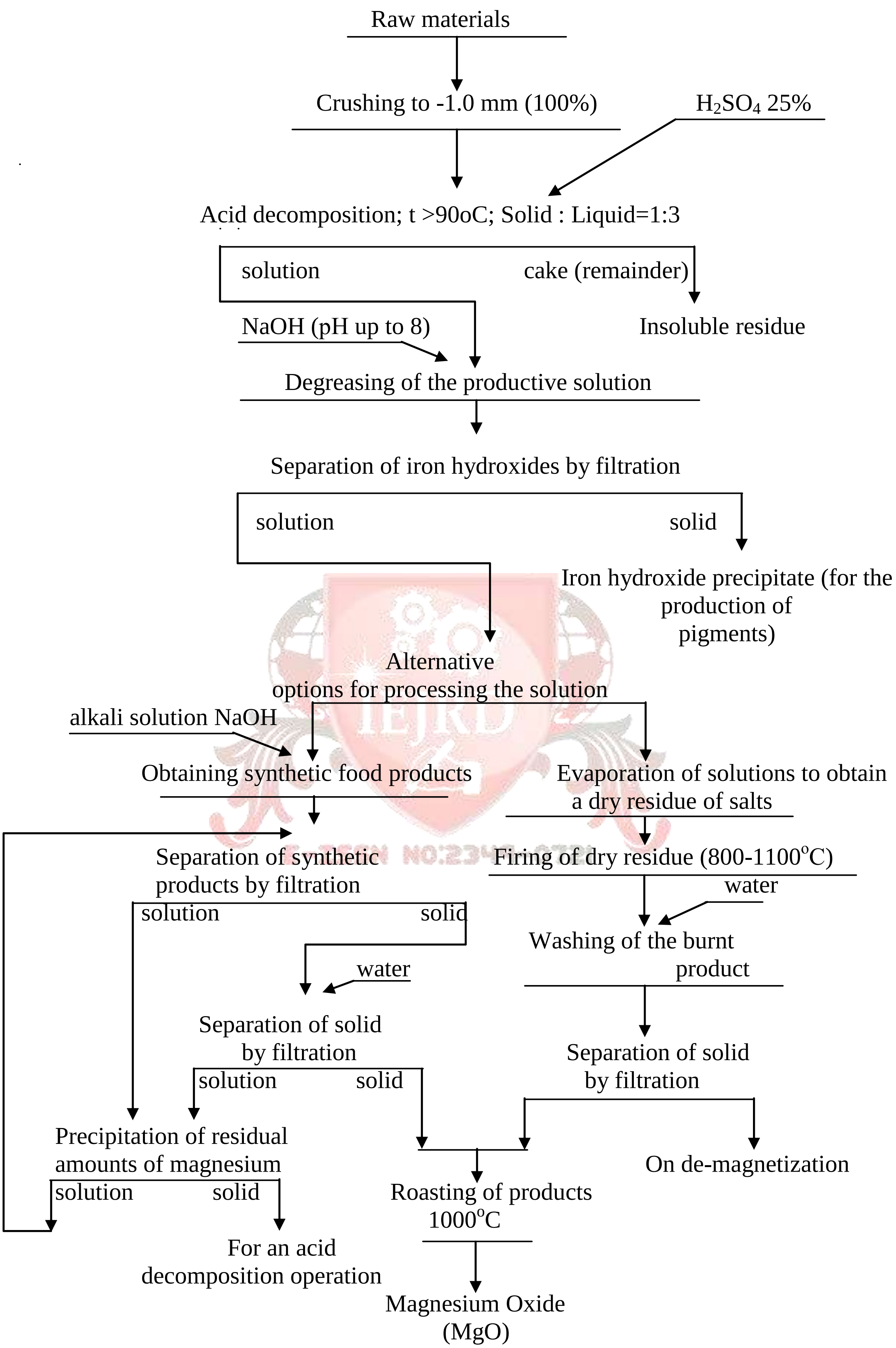

Fig.4. Technological scheme for obtaining magnesium-containing products from Mandarin serpentinite.

As a result of the technological research, a magnesium-containing concentrate with a content of MgO - 86.18% and Fe2O3 - 0.1% was obtained, corresponding to the technical requirements of GOST 1216-87 "Magnesite caustic powders" of the PCM-83 brand and GOST 10360-85 "Periclase sintered powders for the manufacture of products. Technical specifications" of the PMI-6 brand.

Conclusions. In conclusion, it can be stated that thanks to the conducted research, the possibility of using the studied raw materials in the manufacture of magnesia refractory products necessary for various industries of the Republic has been achieved.

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