STUDY OF THERMAL DECOMPOSITION OF SERPENTINITE OF THE KARAKALPAK DEPOSIT

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ABSTRACT

A study of the thermal treatment of serpentinite in the Karakalpak deposit is given in this paper. According to the DPV data, the first endothermic effect associated with the removal of adsorbed water was obtained at a temperature of 170°C, and the second was bound by the fusion at 680°C (a mass loss of 10%). Thermal treatment of serpentinite is an important step in its processing technology. When choosing the optimal thermal treatment of serpentinite, a thermoanalytical study is necessary to study the dehydration of serpentinite, which is the main chemical phase of firing. Based on this, in this work, we investigated the phase composition of intermediate and final products of heating serpentinite in the Karakalpak deposit.

Keywords. *dehydration of serpentinite, DPV data, heating, magnesium.*

АННОТАЦИЯ

В статье проведено исследование термической обработки серпентинита Каракалпакского месторождения. По данным ДПВ, первый эндотермический эффект, связанный с удалением адсорбированной воды, был получен при температуре 170°C, а второй связан с плавлением при 680°C (потеря массы 10%). Термическая обработка серпентинита является важным этапом в технологии его переработки. При выборе оптимальной термической обработки серпентинита необходимо термоаналитическое исследование по изучению дегидратации серпентинита, которая является основной химической фазой обжига. Исходя из этого, в данной работе исследован фазовый состав промежуточных и конечных продуктов нагрева серпентинита Каракалпакского месторождения.

Ключевые слова. *дегидратация серпентинита, данные ДПВ, нагрев, магний.*

INTRODUCTION

Magnesium is often called a mineral of life because it is the central atom in the chlorophyll molecule and accumulates solar energy during photosynthesis. With a lack of magnesium, any plant protein synthesis is at risk. Magnesium deficiency inhibits the synthesis of nitrogen and organophosphorus compounds [1]. Magnesium increases crop yields. Mineral fertilizers produced in Uzbekistan do not contain magnesium. The Republic needs to develop its own magnesium-containing raw materials, which are imported from CIS countries.

Serpentinite is the cheapest raw material for such an important compound as magnesium oxide. The main applications of magnesium oxide are the production of refractory materials, metallurgy, rubber products and synthetic rubber, electroplating, oil and gas production, the food industry, chemicals, perfumes, medicine, pharmaceuticals and electronics [3].

Uzbekistan has highly resilient magnesium-containing rocks consisting mainly of serpentinite minerals such as lizardite, chrysotile, chrysotile-asbestos, and antiburn,. To obtain high-quality magnesium compounds from local raw materials, it is necessary to process them in an integrated manner, which will allow them to extract all useful components and produce local products that reduce the cost of their products. [4].

Thermal treatment of serpentinite is an important step in its processing technology. When choosing the optimal thermal treatment of serpentinite, a thermoanalytical study is necessary to study the dehydration of serpentinite, which is the main chemical phase of firing. On this basis, in this work, we studied the phase composition of intermediate and final products of heating serpentinite in the Karakalpak deposit.

METHODS AND MATERIALS.

X-ray analysis of the samples was performed on the diffractometer XRD-6100 (Shimadzu, Japan) using CuKα-radiation (β-filter, Ni, current and voltage mode of the tube 30 mA, 30 kV) and constant speed of the detector - 4 degrees/min, and scanning angle varied from 80 to 80. An international database was used to decrypt the X-ray chart. Measurements of DTA and TG were made using the simultaneous thermal analyser STA PT 1600 produced by the German company Linsseys, and measurements were carried out in an oxidative medium at a speed of 20 s/min.

RESULTS AND DISCUSSION

A review of the data on the serpentinite differential thermal analysis curves shows the following thermal effects:

- endothermic effect of the removal of weakly connected water (20°- 220°C);

- the dehydration effect of Mg(OH)2 (320° - 475°C);

- the effect of the complicated form, caused by the dehydration of serpentine (580° - 785°C) by the following reaction: Mg3Si205(OH)4 = Mg2Si3O, + 2H2O;

exothermic effect of recrystallization and ordering of the structure of high - temperature phases (forsterite and ß quartz) at 800°- 810°C[5].

The serpentinite was milled, sieved through a 0.315 mm sieve and kept at different temperatures. The serpentinite after grinding had a bulk density of 0.95 g/cm3, and a compacted density of 1.52 g/cm3. The burnt serpentinite had a mass density of 0.88 g/cm3 and a compacted density of 1.25 g/cm3.

The chemical composition of the tested serpentinite is given in the table. 1, The heat treatment temperature values were set and controlled by a Nabertherm muffle furnace (Germany).

Table 1

MgO	FeO	Fe_2O_3	Al_2O_3	CaO	Na_2O	SiO_2
33,06%	1,62%	6,63%	2,47%	1,82%	1,56%	41,42%

Serpentinite was subjected to differential-thermal and X-ray-phase analyses to determine the processes and phase changes during heating. To decrypt the derivative frame, the original material was heated to temperatures of 178°C, 249°C, 587°C, 765°C, and 825°C, and the resulting products were examined by X-ray analysis.

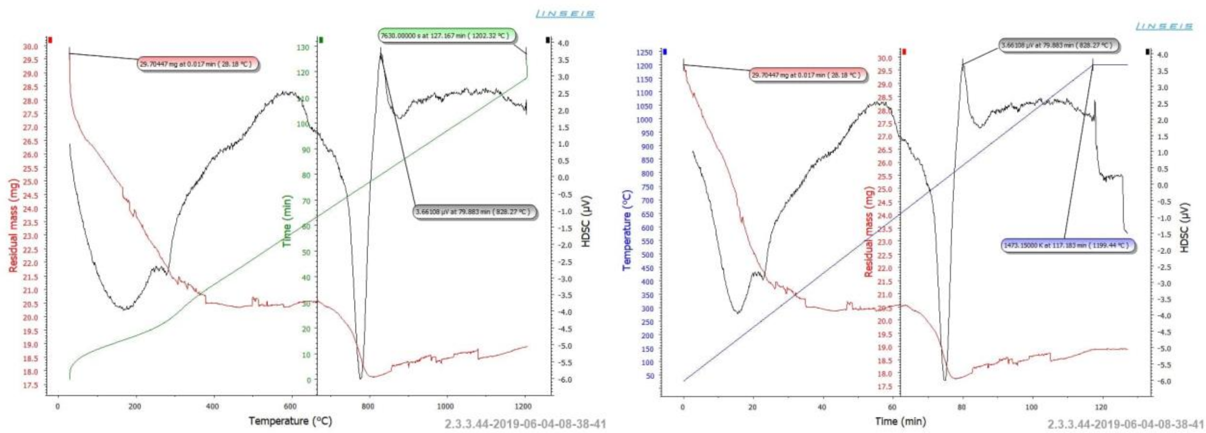

Figure 1. - Feedstock derivatives.

According to the depivatogram data (based on the behavior of the DTA and TG labels), there are clear peaks associated with stepped mineral dehydration (fig. 4). The first auxiliary endothermic effect, associated with the removal of adsorbed water, is obtained in the temperature range of 200 270°C, and the second is associated with the initial breakdown of the structure at 680°C (TG mass loss in this area is 27.5%). The structure of NMg2SiO4 formed by the dehydration and reclassification of the mineral (relative mass loss of 8.75%). After 820°C, small local melts were observed on the sample.

Table 2.

№	Sample, weight	Heating time, min.	T, the heating, °C	loss, %
1.	50	60	178	0,24
2.	50	60	249	0,32
3.	50	60	587	0,46
4.	50	60	765	9,1
5.	50	60	825	10,6

According to the data, the intermediate phases (249°C-587°C) consist mainly of Mg3[Si2O5](OH)4 (gray powder). The substance produced at 765°C-825°C is brown and consists of forsterite Mg2SiO4. The rest of the compounds present in the parent material decompose at these temperatures and appear to form X-rays.

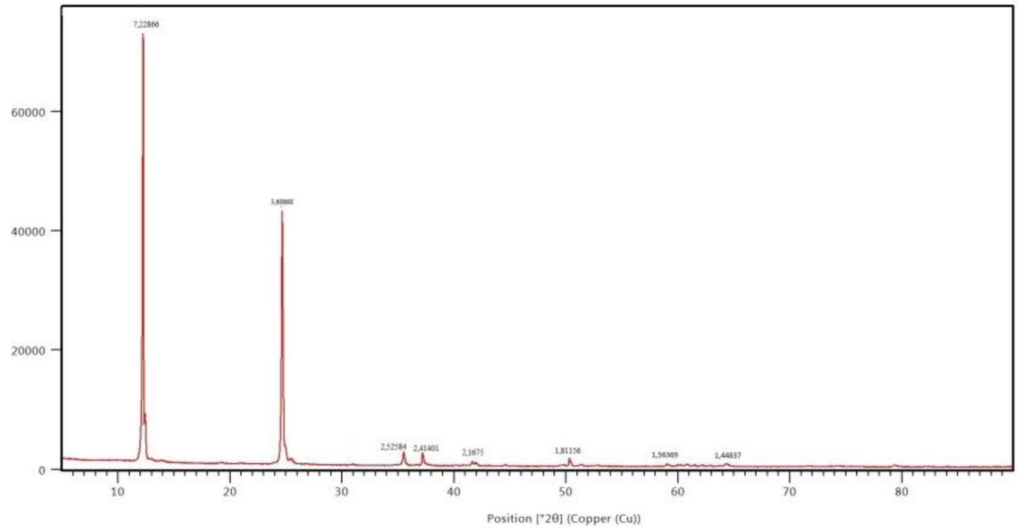

Fig. 2. Original serpentinite X-rays

The initial serpentinite is characterized by reflexes d/n (J/Jo): 7,22866 (100), 3,60668 (61), 2,41401 (4), 2,1675 (5), 1,52325 (3), 1,47 (2). The initial serpentinite undergoes a number of changes during thermal treatment. The intensity of reflexes characteristic of the initial serpentinite decreases with the temperature of heat treatment.

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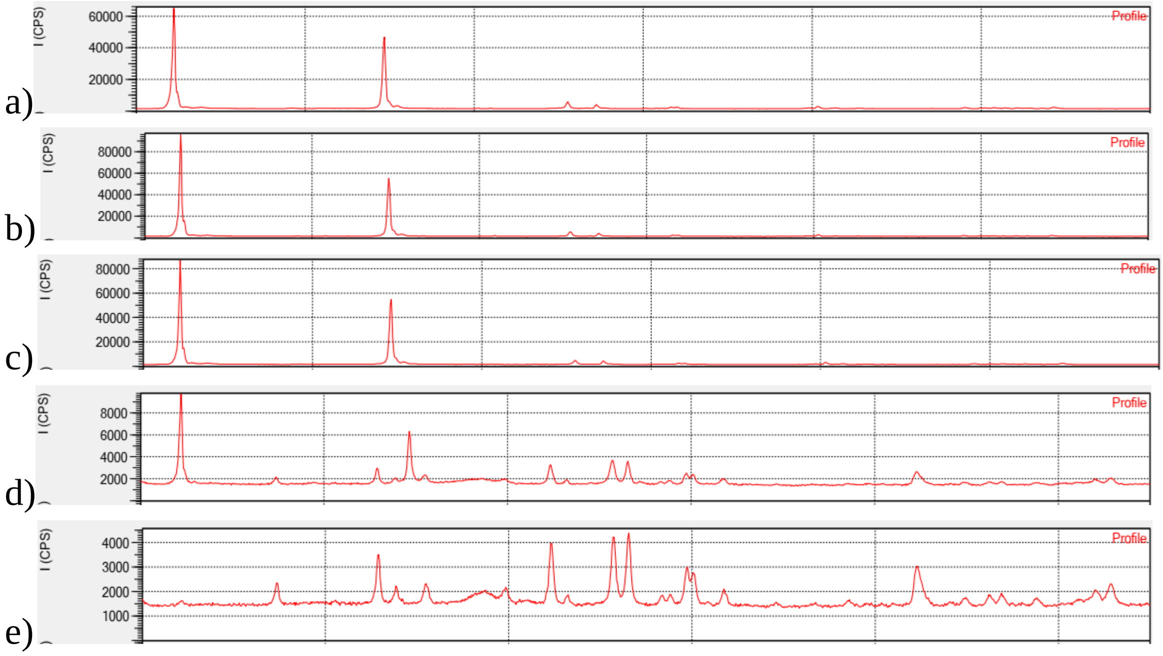

Fig. 3. - X-rays for heating raw materials.

a) 178°C, b) 249°C , c) 587°C , d) 765°C, e) 825°C.

As you can see, at a mineral treatment temperature in the range of 765-825°C, the reflexes characteristic of the original state pentinite are clearly not observed. At the same time, as the temperature of the heat treatment increases, reflexes characteristic of forsterite appear and develop: 765°C - d/n (J/Jo): 3.87450 (18), 2.51192 (27), 2.45591 (26) 1.74812 (16), 1.47773 (8), with 825 seconds - D/873): 696.2.45643 (100), 2.51081 (97), 2.26667 (54), 1.74852 (57), 1.47808 (31).

CONCLUSION.

In this way, the physical and chemical properties of the serpentinite of the Karakalpak deposit were studied. According to the DPV data, the first endothermic effect associated with the removal of adsorbed water is obtained at a temperature of 170°C, and the second effect is associated with the fusion structure at 680°C (the mass loss in this area is 10%). At 818.7°C, an exothermic effect is produced by ordering the structure of the forsterite formed by dehydration. After 820°C, small local melts were observed on the sample.

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