AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 03, Issue 10, 2025 ISSN (E): 2993-2149

OBTAINING CALCIUM BINDING MATERIALS BASED ON GYPSUM WASTE AND STUDYING THEIR PROPERTIES

A.N. Xojimatov
Researcher

G'.A Doliyev
Researcher
Gmail: tarnado8185@gmail.ru
Tel: +998934962933

Abstract: This scientific article presents the results of research conducted on the production of calcium binders from gypsum waste generated at porcelain production enterprises operating in the Rishton district of Fergana region. The conversion of gypsum waste into a primary product by adding additives to the composition at different temperatures was determined. The hardening of samples heated at the same temperature and for different periods of time in different proportions under the influence of water was studied. The mechanical strength, compressive strength and water absorption of the obtained samples were determined relative to the standard. IR spectral analysis of the obtained samples was studied.

Key words: *gypsum waste, porcelain and earthenware waste, calcium binder, mechanical strength, compressive strength, IR spectrum analysis.*

Introduction

Currently, the Republic of Uzbekistan has developed major strategic projects for the production of modern building materials based on industrial waste for environmental protection. The intended goal of these projects is the efficient use of natural resources, ensuring the further development of the economy of Uzbekistan. It consists of a number of measures, such as maintaining a balance between the production and consumption processes of renewable natural resources, as well as preserving the original species of nature and their gene pool, and the diversity of the landscape. In this regard, one of the main directions is to reduce the cost of manufactured building materials, products, and structures using industrial waste, as well as to develop energy-efficient production technologies.

In this regard, the Resolution of the President of the Republic of Uzbekistan dated May 23, 2019 "On additional measures for the accelerated development of the building materials industry" No. 4335 on the production and expansion of new modern types of wall coverings in the construction sector covers these goals [1].

Today, more than 50 types of gypsum waste are generated in the national economy of our country, and the largest of them is phosphogypsum. Currently, there are more than 100 million tons of phosphogypsum waste. It is appropriate to express the aspects of using chemical industry waste as secondary resources as follows: the innovative technologies for producing binders (modified phosphogypsum, sulfomineral cements, etc.) created by Professor T.A. Otaqo'ziyev and his school for obtaining binders based on phosphogypsum and other gypsum-containing wastes are noteworthy [2]. Similar scientifically based technologies have been introduced in Russia, Lithuania, Armenia, Bulgaria, and other countries. In Bulgaria, the technologies for producing products by extrusion without washing phosphogypsum, and in Belarus, the technologies for producing polymer phosphogypsum are noteworthy [3].

In total, 35-40 million tons of gypsum binders are produced in the world, of which 90% is used in construction work. In Uzbekistan, the production of gypsum binders is well developed in the Bukhara and Fergana regions. A lot of work is being done in Tashkent, Fergana, and Samarkand regions to produce gypsum using industrial waste.

In addition, our country is very rich in high-quality gypsum-based raw materials, and occupies a leading position in the production of mineral binders among the Central Asian countries. Currently, 25 types of gypsum-based raw materials with a total volume of about 12 million tons have been discovered in our republic [4].

Gypsum binders are divided into low-temperature and high-temperature fired types according to the production method. Low-temperature fired gypsum is obtained by partially dehydrating dimolecular hydrated gypsum ($CaSO_4 \cdot 2H_2O$) at a temperature of 110-180°C. High-temperature calcined gypsum (anhydrite) binder is obtained by calcining gypsum rock at temperatures of 600-1000°C. This process completely removes water from the gypsum rock, forming anhydrous calcium sulfate ($CaSO_4$)[5].

The research began by studying the infrared spectra and mineral composition of samples of gypsum waste generated in the production of porcelain and earthenware. As can be seen from these results, the composition of the waste obtained is similar. During the research, these samples were sieved. The sieved gypsum waste samples were processed at different temperatures.

The magnitude of the conversion of gypsum waste into a primary product by adding additives to the composition at different temperatures was determined.

Table 1

Results obtained on gypsum waste recycling

№	Heating temperat °C	Heating t min.	Mass g	Dehydration	Gypsum/water	Dehydration min.	Solidification min.
1	180	30	5,9	19,67	1,0:1,5	60	42
2	220	30	6,1	20,50	1,0:1,5	27	40
4	240	30	6,15	20,51	1,0:1,5	60	85

Waste gypsum was heated at different temperatures to remove the water contained in it. The results of the heating showed that the gypsum almost did not dehydrate above 220°C. It was found that 95% of the absorbed water was released at this temperature (Figure 1).

Figure 1: *Samples taken at different temperatures to remove water from waste gypsum.*

At this temperature (220°C), gypsum samples obtained from the processing of gypsum waste generated in porcelain and ceramic production were analyzed for their infrared spectrum and mineral composition (Figure 2).

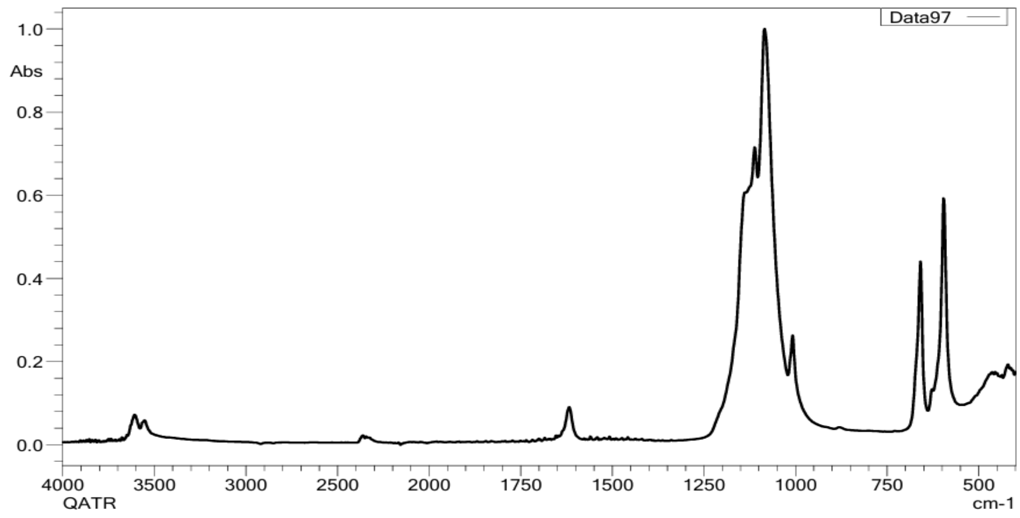

Figure 2: *Infrared spectrum of gypsum samples obtained from the processing of gypsum waste from porcelain and earthenware production at 220°C*

From the results obtained, it can be seen that their mineral composition is significantly different compared to untreated samples.

The amount of water added in the preparation of gypsum paste is determined by the diameter of the gypsum paste flowing out of a standard conical cylinder. According to the requirements of the State Standard., samples were tested in several proportions [6]. According to the test results, it was determined that the spreadability of gypsum paste prepared with a gypsum and water ratio of 1:1 meets the requirements of the State Standard.

Based on the results obtained, the mechanical properties of the gypsum sample prepared in accordance with the requirements of State Standard No. 23789-2018: resistance to compression and bending under pressure were tested using the AlfaTest device (Figure 3).

Figure 3: *Testing for compressive and flexural strength using the AlfaTest device*

Table 2

Mechanical properties of a sample taken from waste from porcelain and earthenware manufacturing plants

	Samples	Compressive strength of samples	Bending resistance of samples
1	G-6 markali qurilish gips	14.69	0.79
2	Chinni va sopol buyumlari ishlab chiqarish korxonalari chiqindisidan olingan namuna	10.13	0.57

At the beginning of the experiments, samples made of G-6 grade building gypsum were tested. Based on the results, the compressive and bending strength were analyzed.

References:

1. Resolution of the President of the Republic of Uzbekistan No. PQ-4335 dated May 23, 2019 "On additional measures for the accelerated development of the building materials industry".
2. M.Kh. Siddikov, N.R. Sadullayev. Research on the use of industrial waste phosphogypsum as a building gypsum and increasing its strength Proceedings of International Conference on Educational Discoveries and Humanities 2023, pp. 138-144 file:///C:/Users/AORUS/Downloads/27%20(13).pdf
3. D. Kadirova, H. Nuriddinov. Methods of research of binders and building materials. (Part 1 – "Binders") Textbook. Tashkent-2011.
4. E. Kasimov. "Construction materials". Textbook. Tashkent. Mehnat Publishing House, 2004, 512b.
5. T.A.Otaqo'ziyev, E.T.Otaqo'ziyev. "Chemical technology of binders". Textbook for undergraduates of higher educational institutions. Tashkent 2005, 258 p.
6. 23789-2018- digital State Standard.