ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 9, September 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)

DOI: 10.5958/2249-7137.2021.02016.4

APPLICATION OF THE CLAY OF THE MAY DEPOSIT IN THE PRODUCTION OF CONSTRUCTION CERAMIC BRICKS

Khamidova Khabiba Murat qizi*; Matkarimov Zaynobiddin Turdaliyevich**

*PhD Student,
Tashkent institute of Chemical Technology, Tashken
Republic of UZBEKISTAN

**PhD, senior Teacher of Tashkent institute of Chemical Technology,
Tashkent, Republic of UZBEKISTAN

ABSTRACT

Clay of the May occurrence was studied in order to determine its suitability for the manufacturing of building bricks. A study of the technological properties of clay showed that in terms of refractoriness it belongs to low-melting rocks that are not very sensitive to drying, it is moderately plastic and provides ceramic bricks in accordance with GOST (State Standard) 530-2012.

KEYWORDS: *Ceramic Materials, Building Brick,Aclay,May Deposit, Burning.*

INTRODUCTION

The process of producing high quality and durable bricks for construction begins with the selection of the right raw materials.The use of soil in construction minimizes environmental problems and is used in construction as a green building material [1].

The construction industry is at the forefront of growth in any country. Building materials account for 75% of the total construction cost [2].

Significant differences in both chemical composition and mineralogical are the result of their formation in different geological conditions.This dictates the need to study each type of raw material to determine the possibility of obtaining high-quality building products on its basis [3-10]

Along with research aimed at improving the quality of ceramic products [11, 12], the issues of involving new raw materials are being addressed [13-19].

The purpose of the work is the development of building ceramic bricks obtained with the use of clay from the May deposit.

Research methods

The properties of building ceramic bricks were determined in accordance with the test methods presented in the interstate standard GOST 530-2012. Diffraction patterns were obtained by the powder method on a Shimadzu apparatus. Investigation of infrared spectra of ceramics on a Shimadzu IRAffinity-1 spectrophotometer.

Results and its discussion

The Mayskoye clay deposit is located in the Tashkent region. Red in color, clays are plastic.The plasticity number is in the range of 8-9. Sandiness is 5.5%.

The results of chemical analysis are shown in Table 1. According to the content of alumina in the calcined state (9.92%), the sample belongs to the acidic clay raw material.According to the content of coloring oxides of iron and titanium - 4.26% and 0.48%, the sample belongs to the raw materials with a high content of coloring oxides (GOST 9169-75. Clay raw materials for the ceramic industry.Classification.).

TABLE 1 THE CHEMICAL COMPOSITION OF THE CLAY FROM THE MAY DEPOSIT

Massfractionofoxides,%											
p.p.p.	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	SO_3	Na_2O	K_2O	P_2O_5	Σ
15,5	48,90	9,92	4,26	0,48	12,92	3,00	0,10	1,14	2,02	0,15	100

Radiographic analysis. The phase composition of the synthesized compounds and materials was determined by radiographic analysis. Diffraction patterns were obtained by the powder method on a Shimadzu setup using Cu, Kα radiation. The radiographic patterns were taken with a step of 0.02 degrees, a voltage equal to 30 kV, and a current of 30 mA. In the calculations and in identifying the phases, we used the data given by Mikheev [20], as well as the WWW-MINCRIST database [21].

To determine the mineralogical composition of clays, radiographic analysis was carried out (fig. 1).

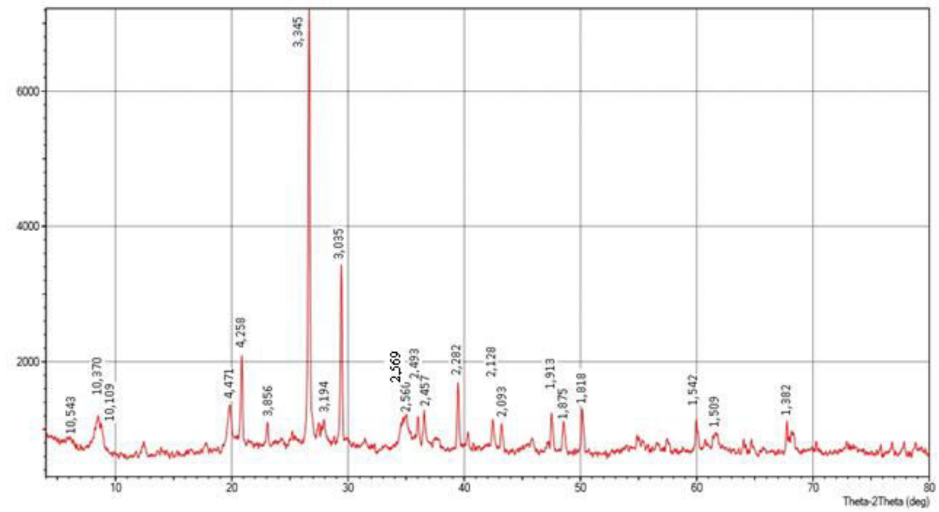

Figure 1. Diffraction pattern of clay from the May deposit.

Revealed the presence of the following minerals: quartz - 4.258; 3.345; 2.128; 1.818; 1.542 Å; calcite - 3.035; 1.913; 1.875 Å; trioctahedralillite (K <1Mg3 [OH] 2 {Si3AlO10} · mH2O) - 10.370; 4.471; Å; greenalite (Fe3 (OH) 4 {Si2O5}) - 7.139; 2.569; 1.603 Å, montmorillonite - 10.144; 4.450 Å, glauconite - 2.580 Å, magnetite - 2.541 Å, goethite - 4.18 Å ,. Low intensity feldspar reflections were recorded - 3.243 and 3.194 Å [21].

Differential thermal analysis.DTA was recorded on the Paulik-Paulik-Erdey system derivative at a rate of 9 deg / min and weighed amounts of 0.060-0.125 g at the sensitivity of galvanometers T 900, DTA, DTG - 1/10, TG - 200.The recording was carried out under atmospheric conditions.The holder was a platinum crucible 10 mm in diameter without a lid. Al2O3 was used as a standard [22].

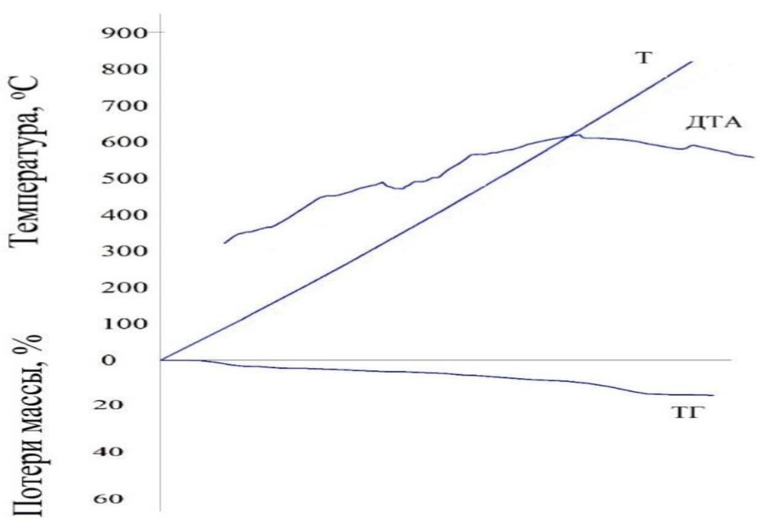

Fig. 2.Derivatogram of clay from the May deposit

The derivatogram of May clay is similar to the derivatogram of variegated kaolin - several peaks reflecting the processes of loss of adsorption water, the effects at 222, 324, 380, 408oC are due to the dehydration process of montmorillonite and goethite.Illite and greenalite lose their structural water at higher temperatures. The active phase of water loss starts at 500 ° C and ends at 640 ° C.The exo effect at 324 ° C is due to the oxidation of magnetite to maghemite γ-Fe2O3, the exo effect at 642 ° C is due to the transition of maghemite to hematite α-Fe2O3 [22].

Study of infrared spectra of ceramics using a SHIMADZU IRAffinity-1 spectrophotometer. Infrared spectroscopy (IR spectroscopy), a branch of molecular optical spectroscopy that studies the absorption and reflection spectra of electromagnetic radiation in the infrared region, i.e. in the wavelength range from 10-6 to 10-3 m.

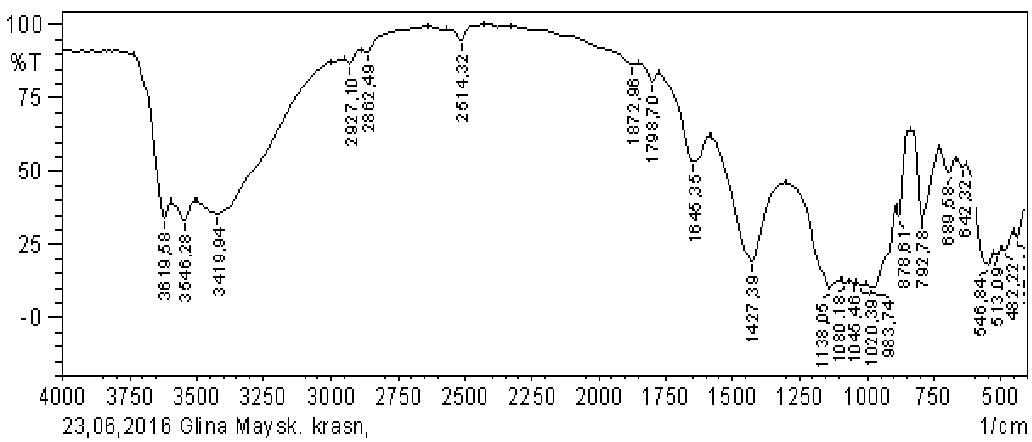

Fig. 3.IR spectrum of clay from the May deposit

Analyzing the spectrum obtained, it can be assumed that the majority of hydroxyl groups are located at the vertices of oxygen tetrahedrons.This is evidenced by the absorption band at 1427 cm-1.

The superposition of a large number of absorption bands from minerals contained in clay creates a complex spectrum picture - absorption bands of layered silicates containing Al3 +, Fe3 + (dioctahedral structures) and Mg2 + or Fe2 + (trioctahedral structures), as the main ions in octahedral positions, appear in the region of 500-1000 cm-1 and 400-500 cm-1.The bands from 1100 to 900 cm-1 are described as related to the Si - O bond. The absorption band at 878 cm – 1 reflects the presence of an impurity of calcium carbonate in clay [23].

The chemical and mineralogical composition of rocks has been investigated and their compliance with the requirements for raw materials for producing ceramic bricks has been determined.

TABLE 2 CONTENT OF COARSE-GRAINED INCLUSIONS

Total residue,% on a sieve with a hole size of 0.5 mm	Particular residues,% on sieves with aperture size; mm			Residue characteristic
	5,0	2,0	0,5	
0,58	0,20	0,18	0,30	Clayparticles, mica

The results of the granulometric analysis of the clay from the May deposit show that in terms of the content of fine fractions (particles less than 0.001 mm in size) - 17.5%, the sample belongs to the group of low-dispersed clay raw materials.Sieve analysis shows that in terms of the number of inclusions, the samples are classified as raw materials with an average content of inclusions of 0.58%.The clays are red in color with carbonate, gypsum, quartz, and organic inclusions.The results of the determinations are shown in table. 2 and 3.

TABLE 3 GRANULOMETRIC COMPOSITIONS OF RAW MATERIALS

Fraction size (mm) fraction content (%)					amount
1,00-0,063	0,063-0,010	0,010-0,005	0,005-0,001	Less-0,001	
4,0	54,6	10,2	13,7	17,5	100,0

The study of the physical, mechanical and thermal properties of clay from the May deposit showed that the rocks, in terms of refractoriness, belong to low-melting rocks, insensitive to drying (the temperature of the fall of the cone is 1170 ° C).

TABLE 4 RESULTS OF DETERMINING THE PLASTICITY NUMBER

№ samples	Tensile strength		Plasticity number	Clayrawmaterialcategory
	Fluidity limit	Rolling border		
1	29,6	20,3	9,3	Moderate plastic
2	30,00	20,7		
ср.	29,8	20,5		

In terms of plasticity, the sample is moderately plastic (plasticity number 9.3). In terms of mechanical bending strength in a dry state, the samples are classified as raw materials with moderate mechanical strength.

TABLE 5 DRYING SENSITIVITY

Process sample number	Moisturelossat 100℃	Moisturel ossat 200 ° C	K min	Clayrawmaterialcatego ry
1	9,96	9,92	0,8	Insensitive to drying
2	9,94	9,94		
3	9,97	9,96		
ср.	9,96	9,94		

TABLE 6 DRYING LABORATORY SAMPLES

№. samples	Forming moisture, %	Air shrinkage, %	Tensile strength, MPa (kgs/sm^2)	
			при сжатии	при изгибе
1	20,2	3,89-3,80	2,0 (20)	2,0 (20)
2	20,1	3,61-3,73	2,2 (22)	2,6 (26)
3	20,0	3,73-3,85	1,8 (18)	1,4 (14)
4	-	-	2,4 (24)	1,8 (18)
5	-	-	2,6 (26)	1,3 (13)

ср.	20,1	3,76-3,79	2,3 (23)	1,8 (18)

The results of physical and mechanical tests fired at different temperatures of the samples are shown in Table 7.

TABLE 7 PHYSICAL AND MECHANICAL PROPERTIES OF FIRED SAMPLES

Firing temperature,˚ C	№ samples	Water absorption, %	Total shrinkage, %	Limit strength, MPa		Expected strength Bricks
				when compressed	bending	
950	1	20,6	4,87-3,81	15,7	5,8	100
	2	20,0	4,45-3,72	11,9	6,3	
	3	22,0	4,01-3,70	14,1	7,1	
	4	-	-	8,9	5,1	
	5	-	-	9,7	5,9	
	ср.	21	4,44-3,74	12,1	6,1	
1000	1	21,2	4,74-3,81	16,3	6,5	150
	2	20,0	4,46-3,65	16,6	6,9	
	3	20,0	4,01-3,41	17,6	7,2	
	4	-	-	14,6	5,8	
	5	-	-	15,2	6,6	
	ср.	20,5	4,40-3,62	16,1	6,6	
1050	1	20,0	4,55-3,61	18,4	7,5	150
	2	21,3	4,71-3,46	16,9	7,9	
	3	20,0	4,02-3,56	17,5	8,4	
	4	-	-	16,8	7,6	
	5	-	-	17,3	7,8	
	ср.	20,0	4,38-3,54	17,4	7,9	

Firing of laboratory samples was carried out in a muffle furnace at temperatures: 950, 1000, 1050 ° C.The ultimate strength of laboratory specimens fired at temperatures of 950 and 1050 ° C (12.1-17.4 MPa) meets the requirements of GOST 530-2012 for ceramic bricks.

CONCLUSION

Analysis of the technological and physicochemical properties of clay from the May deposit and fired ceramic materials based on them showed that the materials obtained have sufficient mechanical strength and ensure the production of ceramic bricks in accordance with the requirements of GOST 530-2012.

REFERENCES

1. Abdullah E.S.R., Mirasa A.K., Asrah H., Lim C.H.Review on interlocking compressed earth brick. Серия конференций IOP: Наука о Земле и окружающей среде, Том 476 , 2-я Международная конференция по гражданской и экологической инженерии, 20–21 ноября 2019 г., Лангкави, Кедах, Малайзия

Citation ESR Abdullah *et al* 2020 *IOP Conf. Cep .: EarthEnviron. Sci.* 476 012029 doi:10.1088/1755-1315/476/1/012029

2. Kakodkar S.A.S., Lolienkar A., Kamat S., Nadkarni S., Gaunekar G.N., Malik V. (2021) Brick Manufacturing Using Laterite Soil. In: Das B.B., Nanukuttan S.V., Patnaik A.K., Panandikar N.S. (eds) Recent Trends in Civil Engineering. Lecture Notes in Civil Engineering, vol 105, pp. 217-227. Springer, Singapore. https://doi.org/10.1007/978-981-15-8293-6_19.

3. Vijayaragavan R., Mullainathan Sundaram. Study of Raw Materials for Making Ceramic Product and Physico-Mechanical Properties of Ceramic Product Made from Rock Residue Powder. Asian Journal of Chemistry, 2013, vol. 25, Supplementary Issue, pp. 449-454.

4. Cely-Illera L. Raw materials for the ceramics industry from norte de santander. I. Mineralogical, chemical and physical characterization. RevistaFacultad de Ingeniería, Universidad de Antioquia, 2016, no. 80, pp. 31-37.

5. Ouahabi M.E., Daoudi L., De Vleeschouwer F., Bindler R., Fagel N. Potentiality of Clay Raw Materials from Northern Morocco in Ceramic Industry: Tetouan and Meknes Areas. Journal of Minerals and Materials Characterization and Engineering, 2014, no. 2, pp. 145-159. http://dx.doi.org/10.4236/jmmce.2014.23019

6. Sapozhnikova M.A., Pavlova I. Kurgan Clays in the Production of Ceramic Materials. Solid State Phenomena, vol. 299, pp. 3-7. https://doi.org/10.4028/www.scientific.net/SSP.299.3

7. Zaccaron A., de Souza Nandi V., Dal Bó M., Peterson M., Angioletto E., Bernardin A.M. Characterization and use of clays and argillites from the south of Santa Catarina State, Brazil, for the manufacture of clay ceramics. Clay Minerals, vol. 55, no. 2, June 2020, pp. 172-183. DOI: https://doi.org/10.1180/clm.2020.23

8. Šál J. Testing of brick clay modifications as a raw material for building ceramic products. MATEC Web of Conferences 279, 02022, 2019. DOI: 10.1051/matecconf/201927902022

9. Khanlari G.R., Namazi A., Abdi Lor Y. Assessment of Engineering Properties of Clay Soils as Brick and Tiles Materials in Hamedan, West Of Iran.10th International Congress for Applied Mineralogy (ICAM), Trondheim, 2011, pp 369-376.

10. Trindade M.J., Dias M.I., Coroado J., Rocha F. Mineralogical transformation of calcareous rich clays with firing: A comparative study between calcite and dolomite rich clays from Algarve, Portugal. Appl. Clay Sci., 2009, vol. 42, pp. 345-355.

11. Geremew A., Mamuye Y. Improving the properties of clay soil by using laterite soil for production of bricks. Civil and Environmental Engineering, 2019, vol. 15, no. 2, pp. 134-141. DOI: 10.2478/cee-2019-0017

12. Olacia E.Sustainable adobe bricks with seagrass fibers. Mechanical and thermal properties characterization. Construction and Building Materials 2020, 239-117669. https://doi.org/10.1016/j.conbuildmat.2019.117669

13. Guilan Tao, Yuepeng Pan, Zhaoyang Qiao, Chaohua Jiang. Utilization of Sandy Soil as the Primary Raw Material in Production of Unfired Bricks. Advances in Materials Science and Engineering, 2018. https://doi.org/10.1155/2018/7320298

14. Jamshidi-Chenaria R., Rabanifara H., Veisehb S. Utilisation of Sepidrud dam basin sediments in fired clay bricks: laboratory scale experiment. Mater. Construcc., vol. 65 [320], e066. http://dx.doi.org/10.3989/mc.2015.07014

15. Turgut P., Murat Algin H. Limestone dust and wood sawdust as brick material. J. Build Environ. 2007, vol. 42, pp. 3399–3403. http://dx.doi.org/10.1016/j.buildenv.2006.08.012.

16. Lin D.F. Weng C.H. Use of sewage sludge ash as brick material. J. Environ. Eng., 2001, vol. 127, pp. 922-927. http://dx.doi.org/10.1061/(ASCE)0733-9372(2001)127:10(922).

17. Anderson M., Glynn Skerratt R., Thomas J.P., Clay S.D. Case study involving using fluidised bed incinerator sludge ash as a partial clay substitute in brick manufacture. J. Water Sci. Technol., 1996, vol. 34, pp. 195–205. http://dx.doi.org/10.1016/0273-1223(96)00618-X.

18. Hamer K., Karius V. () Brick production with dredged harbour sediments. An industrial-scale experiment. Waste Manage, 2002, vol. 22, pp. 521–530. http://dx.doi.org/10.1016/S0956-053X(01)00048-4

19. Monteiro S.N., Vieira C.M.F. On the production of fired clay bricks from waste materials: a critical update. Constr. Build. Mater. 2014, vol. 68, pp. 599-610.

20. МихеевВ.И. Рентгенометрическийопределительминералов. – М.: Госгеолтехиздат, 1957. – 868 с.

21. WWW-МИНКРИСТ. Кристаллографическая и кристаллохимическая База данных для минералов и их структурных аналогов //http://database.iem.ac.ru/mincryst/rus/s_full.php.

22. Иванова В.П., Касотов Б.К., Красавина Т.Н., Розина Е.Л. Термический анализ минералов горных пород. – Л.: Недра, 1974. с - 254.

23. Wan J., Cheng J., Lu P. The Coordination State of B and Al of Borosilicate Glass by IR Spectra // Journal of Wuhan University of Technology – Vater. Sci. Ed. – 2008, V. 23, No 3. – P. 419-421.