# SOME PROPERTIES OF GLASSES ON THE BASE OF FLOTATIONA WASTE OF COPPER CONCENTRATING MILL AND PHOSPHOGYPS

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***Abstract.*** *Currently flotation waste - copper concentrating mill (CCM) Almalyk mining and metallurgical combine (AMMK) and metallurgical slags and flooded and also phosphogyps – waste for all producers of phosphorus fertilizers is on volume one of the first places among the by-products of industry and these wastes are one thousand hectares of land suitable to agriculture. The problem of handling large – capacity sulphate production waste-phosphogyps, which is formed up to 1.6 tons when processing 1 ton of raw materials, is complex. The global annual output of phosphogyps is more than 150 million tons, while Uzbekistan accounts for about 3 million tons. Currently, our Republic has accumulated about 80 million tons of phosphogyps. Therefore, the use of these wastes in the production of building materials is relevant not only from the point of view of resource conservation, but also from the point of view of environmental protection. In this regard, one of the options for using them in the production of building materials is proposed. In particular, the possibility of obtaining glass for construction purposes based on phosphogyps and flotation waste from a copper processing plant has been established. Some physical and chemical properties have been studied, and the crystal phases of crystallized glasses have also been determined. Glasses and glass crystallized materials formation on the base of phosphogyps and flotation tails of a copper factory has been investigated. Certain physical - chemical properties and crystallizability of the received glasses has been studied. The main crystal phases of crystallized glasses have been examined by thermal, microscopic end X-ray analyses.*

***Keywords:*** *technogenic Deposit, photo waste, phosphogyps, mineral raw materials, resource conservation, building material, chemical composition, oxide, glass, thermal coefficient, crystallite, crystal components.*

**INTRODUCTION.** The problem of shortage of mineral raw materials makes it relevant to search for additional sources. Great prospects for solving this problem lie in the possibility of involving in the development of man-made deposits-accumulations of mineral substances on the surface of the Earth or in mine workings, which are waste from mining, processing, metallurgical and other industries. They are suitable in quantity and quality for industrial use, which becomes possible with the development of processing technology and changes in economic conditions.

Technogenic deposits are the result of intensive development of the mining and processing industry. To date, trillions of cubic meters of man-made waste have accumulated on the earth's surface. In Uzbekistan, several billion tons of rocks and waste from mineral processing have been extracted from the subsoil and are located in dumps and tailings dumps.

As the reserves of the developed fields are exhausted for numerous mining and metallurgical enterprises, man-made objects may become a priority, and in some cases the only source of mineral raw materials. At the same time, it should be borne in mind that mining waste, which is a large reserve of raw materials for extracting metals and non-metals, is also a source of local or regional environmental pollution. The mass of waste accumulated in dumps and tailings dumps with an average layer thickness of 20 m covers an area of more than 600 km2. The annual increase in the area of alienated land is at least 25-30 km2. The negative impact on the environment is manifested in an area that is 10 times or more larger than the area occupied by waste. A significant part of the alienated land is located in industrially developed areas, often within the borders of localities and large cities.

**MATERIAL AND METHODS.** It is obvious that when involving mining waste in processing, along with replenishing the mineral resource base (MSB), no less important environmental problems are solved. Technogenic deposits are particularly attractive because they are usually located in industrially developed areas, are located on the ground surface, and the rock mass in them is mostly disintegrated, which dramatically reduces the cost of their development.

Waste from processing and metallurgical processing is of particular concern, since its storage requires special engineering structures, and the waste itself contains elements and compounds that are harmful to nature and human health. They are accumulated less than overburden and host rocks, but they affect the ecological situation more adversely [1].

To a large extent, waste is associated with the assessment of the state of water resources as "dirty" and" very dirty " in such rivers as Zarafshan, Amu Darya, Akhangaran, Chirchik, in basins where disturbed and polluted territories occupy more than 10 %.

It must be emphasized that in mining from primary deposits need to invest heavily in the construction of mining and beneficiation complexes and preparation of ore (crushing, grinding, etc.). Therefore, the waste (tailings and slags) is already in a state, sufficiently prepared for processing (lying on the surface of the earth, divided and chopped) in the area of the existing mining enterprises.

The involvement of technogenic deposits in economic turnover will help solve some important problems of the country's mineral resource complex and improve the environmental situation. In particular, it will provide: 1) reducing the cost of searching for and exploring new deposits; 2) increasing labor productivity through cost-effective processing of already extracted raw materials; 3) improving working conditions, since man-made deposits are located on the surface of the Earth, in contrast to the increasingly deep-lying conventional indigenous mineral deposits; 4) release of lands occupied by technogenic waste and their reclamation, elimination of sources of environmental pollution.

The problem of industrial waste is being addressed not only in our country, but all over the world. Currently, there is no single comprehensive approach to the problem of processing and using secondary raw materials and industrial waste in construction in the world and in Uzbekistan. This problem is also of great economic importance in terms of environmental protection.

The problem of waste disposal in Uzbekistan puts on the agenda a whole set of issues that can only be solved together, involving specialists in various fields: technologists for the production of building materials, doctors, environmentalists and economists.

To choose the optimal scientific solution for waste disposal, it is necessary to have information about the characteristics of the object: the definition of waste as a raw material resource (composition, availability); the intended directions of use; technical solutions for the adopted option; the national economic effect in the areas of production and consumption.

The construction industry has accumulated significant positive experience in the use of secondary products in the production of binders, dense and porous aggregates for various types of concrete, in the production of ceramic, autoclave, thermal insulation and other building materials and products [2]. However, it is not systematic.

There is experience in the use of waste from the metallurgical industry. The total volume of utilization of ferrous metallurgy slags is about 60 %, the use of secondary industrial products is developing slowly, which leads to the accumulation of these wastes.

With high efficiency (by 30-50%), slags can be used as aggregate for concrete instead of crushed stone obtained from natural raw materials. Specific capital investment in the production of cast slag crushed stone is 2-3 times less than crushed rock, slag pumice is 1.5-2 times less than expanded clay, mineral cotton products from fire-liquid slags are 1.6 times less than the corresponding products from rocks.

Currently, the results of previous scientific developments in the use of industrial waste in construction and production of building materials are poorly implemented in Uzbekistan, and new research is practically not conducted. At the same time, only in the thermal power industry, the output of ash slag waste is millions of tons annually and, although these secondary products are characterized by variable chemical and mineral composition, ash slag waste can be widely used for the manufacture of many types of building materials, in particular, Portland cement. The use of TPP slag waste ash in concrete and mortars saves up to 20-30% of cement, and the use of burnt mine rocks in the production of clay bricks not only improves its quality, but also reduces fuel consumption for firing [3,4,5].

A significant amount of waste from Galvano production is sent to landfill every day after neutralization, as their processing is burdensome for the industry. At the same time, heavy metal ions (chromium, Nickel, copper, cadmium, zinc, etc.), entering the environment, have a harmful effect on all living things, violate the regulation of the processes of vital activity of organisms. The problem of neutralization of galvanic waste in the world practice is not solved [6,7].

The situation with the use of coal mining waste is not good. When developing ore and coal deposits, the annual volume of overburden reaches hundreds of millions of cubic meters, but their widespread use in construction has not yet been organized. A significant reserve for increasing production and reducing the cost of non-metallic construction materials is the use of waste from the coal and mining industry.

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The construction materials industry is the most capacious industry among the industries that consume industrial waste. This is due to the large-scale production of building materials. In addition, many wastes are similar in their composition and properties to natural raw materials used by various branches of the construction materials industry, but much cheaper than the extraction of natural materials.

Investigations in the field of manufacture of new building materials from not scarce and cheap raw materials, including slags, harms and other industrial wastes [8] have a, great importance in various branches of economy. In this connection synthesis of glasses has been investigated on the base of flotation waste - copper concentrating mill (CCM) and phosphogyps - waste of manufacture of the phosphoric acid used in the industry of phosphoric fertilizers.

**RESULTS.** Early possibility of obtain of glasses on the base of phosphogyps and kaolin of the Angren (Uzbekistan) coal deposit has been determined [9].

Metallurgical slags and flotation wastes occupy one of the first places among the by-products of the industry in terms of volume. In the vast majority of these cases, flotation waste from the mining industry contains a significant number of oxides, which are the main components of natural mineral resources used in the construction industry.

The table shows the average chemical compositions of the components of the investigated mining flotation waste and phosphogyps, since they contain significant amounts of $SiO_2$, $Al_2O_3$ and $Fe_2O_3$, which are the main components of building materials.

***Table***

| **Components** | **flotation Waste** *CCM* **AMMC (mass. %)** | **Phosphogyps** (mass. %) |
|---|---|---|
| $SiO_2$ | 61,2 | 13,01 |
| $Al_2O_3$ | 13,04 | 0,94 |
| $Fe_2O_3$ | 8,28 | 25,2 |
| $CaO$ | 1,00 | 0,71 |
| $MgO$ | 0,80 | 2,21 |
| $Na_2O$ | 0,82 | 0,29 |
| $K_2O$ | 5,02 | 0,25 |
| $TiO_2$ | 0,21 | 39,71 |
| $SO_3$ | 5,1 | 1,034 |
| l.i.* | 4,54 | 17,08 |
| $\sum$ | 100,1 | 99,9 |

l.i.* - the loss on ignition.

For synthesis of glasses of varying content of initial substances through 10 mas. %, it was obtained charge. It was established that all glasses are boiled and clarified at temperature 1400-1500 °C with their endurance during 1-2 hour. They can be obtained be methods of molding and pressing.

Waste of CCM is alumo-ferruterous silicate compound of dark grey color formed at enrichment of copper-containing ore and it has thin-dispersional granulometrical composition. By boiling temperature (1220-1230 °C) this waste is attributed to group of fusible raw materials. The quartz (to 44 %), feldspar (to 9 %), and hydromica (to 25 %) arc the base mineral components. There is also a plaster (~3 %), carbonates of calcium and magnesium.

The synthesized glasses have dark-brown and black colors what is caused by content in glass mass 6,42 % of ferrum oxide.

Founding of glasses with the raised of content of phosphogyps viscosity, temperature of process and endurance of melting has been decreased. At temperature 1400 °C the compositions containing 40-60 % of phosphogyps, are well founded and quickly poured out. Founding was carried out in the regenerative medium, with using of coal use (5 % from mass of phosphogyps).

Some physical and chemical properties of glasses: density, chemical stability, thermal stability, thermal coefficient of linear expansion (TCLE), and microhardness have been investigated. Crystallization ability of samples was studied in the range of temperature 800-1300 °C (fig. 1).

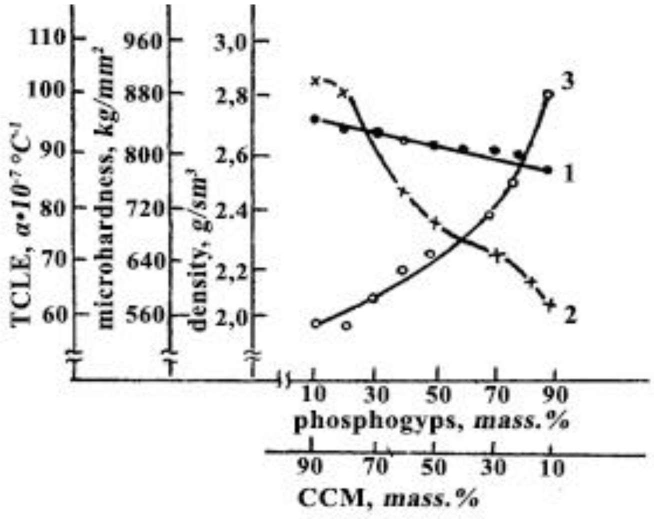


***Fig. 1. Dependence on density 1, microhardness 2 and TCLE 3 of glasses from their composition.***

By crystallization properties of glasses have differed not considerably: the temperature 900-950 °C corresponds to the low limit of crystallization. It has appeared that all investigated compositions were more inclined to crystallization at temperature 900-1000 °C.

In glasses containing 10-50 % phosphogyps surface crystallization was observed in form of a continuous thin film was observed which with rising of temperature was considerably thickened. With increasing of phosphogyps content the volume crystallization of glasses was carried out.

By roentgenphase and the differential-thermal analysis the character of phase transformations was studied at thermal treatment.

On the roentgenograms crystalized samples with content of phosphogyps 50-90 % were noted intensive difractional maximums corresponding to anortit and also to vollastanit which by their intensity are a prevailing crystal phase. It is characteristic that in samples with high content phosphogyps (60-90 %) anortit was formed more intensively. Intensity, in particular, testifies to it considerable difractional maxima.

On curves of the differentsial-thermal analysis of glass sample M-5 it was observed two exotermical effect (at temperatures 1020 with and 1185 °C), characterized by formation of two crystal phases (anortit and vollastanit). Thermogram of glass sample M-6 was identical to previous curve, but differs that exotermical effect was observed at lower temperatures (850 - 990 °C). It corresponds to a temperature interval of glass softening.

Petrographic investigation of samples and mixture phosphogyps - floto-waste of CCM, crystalized at temperature 1000 °C have shown that their microstructure isn`t non-uniform. Between of the base mass formed by glass and crystals of anortite with indicators of refraction $N_g$=1,589, $N_p$=1,576, quite often grains of wollastonite with $N_g$ =1,65, $N_p$ =1,63 have been observed .

Physical and chemical properties of samples are characterized mainly by deposits of $SiO_2$, $Al_2O_3$, CaO (86-94 %). The others oxides can be considered as the additives also influencing on structure and some properties of glasses [8,9,10 11].

By data about dependence on properties from composition, with increasing of content of phosphogyps the density and micro - hardness of investigated samples decreased (fig.1). With increasing of phosphogyps content the thermal coefficient of linear expansion of samples has increased and correspondently the thermal stability has decreased (fig. 2).

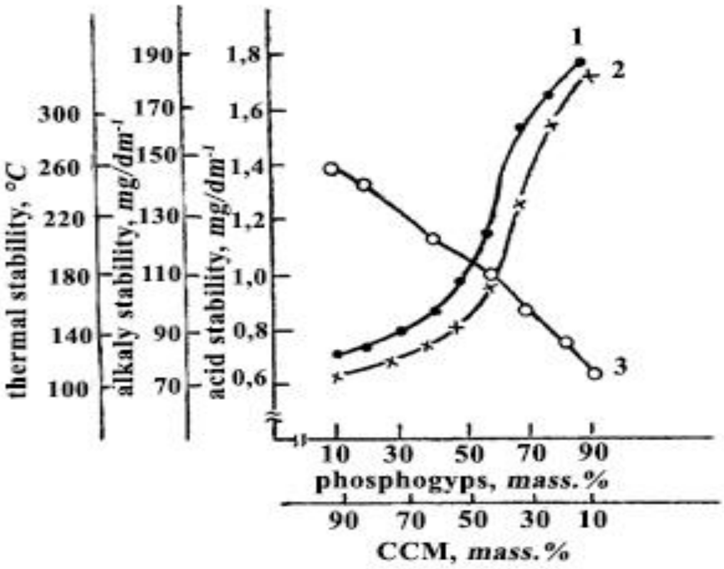


***Fig. 2. Dependence on acid stability 1, alkaly stability 2 and thermal stability 3 of glasses from their composition.***

**CONCLUSION.** The thermal coefficient of linear expansion of glasses is caused by the size of modifying cations and their quantity in an oxide molecule that is the characteristics causing changes in a structural not of silicate glass.

1. By depending on force of bonds, arising in crystals, components of crystals or slightly have increased or have decreased TCLE of glass. Replacement $SiO_2$ on CaO in investigated glasses has increased the thermal coefficient of linear expansion.

2. Increasing of phosphogyps content in glass charge has worsened resistance of samples to destroying action of acid and alkaline solutions (fig. 2).

3. Thus "tails" of CCM can be used as the basic component in a raw mixture for obtain of glasses and glass-crystalical materials of anortitical and vollastanitical compositions.

**REFERENCES**

1. Komarov M. A. Technogenic mineral resources / ed. by V. V. Karaganov and B. S. Ushkenov et al. / / Moscow-Almaty, 2013, P. 83-88 (Rus.).
2. Aripova M. M. Keramogranit on the basis of industrial and household waste. Tosto, Chemical engineering,control and management. Scientific and technical journal. -2009, №6, P. 22-25 (Rus.).
3. Gaitova A. R., Akhmadulina I. I., Pechenkina T. V., Pudovkin A. N., Nedoseko I. V. Nanostructural aspects of hydration and hardening gypsum and slag commodity based on dihydrate gypsum // Stroitel'nyye materialy. № 1-2. 2014. P. 46-51 (Rus.).

4. Bulatov B. G., Nedoseko I. V. Development of the structure of the production management system for wall products based on gypsum-containing waste // Bulletin of the Bashkir state agrarian University. No. 2 (30) 2014. P. 109-112 (Rus.).
5. Bulatov B. G., Nedoseko I. V. Control system for processing multi-tonnage gypsum-containing waste from the production of mineral fertilizers-phosphogypsum into finished products // Bulletin of the Bashkir state agrarian University. No. 2 (34) 2015. Pp. 69-71(Rus.)
6. Ostroukh A.V., Surkova N.E., Nuruev Y. E.O., Nedoseko I.V., Fattakhov M.M., SalovA.S. Automated information-analitical system for dispatching control of transportation concrete products // International Journal of Applied Engineering Research. 2015. T. 10. № 19. P.40063-40067 (Rus.).
7. Ostroukh A. V., Nedoseko I. V., Surkova N. E., Bulatov B. G. Automated control system for the milling unit of mineral powders plant // International Journal of Applied Engineering Research. 2016. T. 11. № 4. P. 2625-2628 (Rus.).
8. Dashinskiy L.G., Sas R. I, Golius G. E, etc.//Glass, polycrystalline glass and silicates. 1985. № 14. pp.29-33 (Rus.).
9. Azizxodjaeva M. M, Irkaxodjaeva A.P., Sirajiddinov N.A.//Uzb. Chemical J., 1991. № 6, P. 74-76 (Rus.).
10. Appen A.A. Chemistry of glass. L: the Science, 2001. 352p. (Rus.).
11. Shavelev O. S, Babkina V. A//Izv. AN the USSR. Sulfurs. Inorganic materials. 1999. T. 5. № 12. P. 2187-2190 (Rus.).
12. Ostroukh A. V., Nedoseko I. V., Bulatov B. G. Automated control system of drying complex of plant for the production of mineral powder // Promyshlennyye asu i kontrollery. № 11. 2015. P. 3-11 (Rus.).
13. Troshin MA. Phosphogypsum stone-regulator of cement setting time // "Proceedings of NIUNF 95 years". - M., 2014. - P. 516-522 (Rus.).
14. Kochetkov S. P., Bryl S. V., Rukhlin G. V. Modern ecological trends in the technology of processing natural phosphates //System technologies. - 2016. - Issue 1/19. - Pp. 115-120 (Rus.).
15. Levin B.A. Phosphogyps: the choice of strategically promising areas of processing and use // Collection of materials of the II International scientific and practical conference " Phosphogypsum. Storage and directions of use". - M.: -2010. - P. 10-24 (Rus.).