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COMPOSITION AND SOME PROPERTIES OF THE GREEN GLASS BASED ON MINERAL RAW MATERIAL OF UZBEKISTAN

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ANOTATION
It is necessary to increase the output of glass containers in Uzbekistan, as a focal point for increasing the canned goods of agriculture. The calculated and experimental ways have developed new green glass compositions with the use of innovative ideas. In the first developed compositions of zeno glass with the use of feldspar Sultan - Uvais deposit. The obtained laboratory samples have satisfactory characteristics.
KEYWORDS: *Preservation of agricultural products, green glass, glass containers, dalomite, feldspar.*

DISCUSSION

The unique soil and climatic conditions of Uzbekistan, 320 sunny days a year, the successive change of seasons create favorable conditions for the cultivation of environmentally friendly fruits and vegetables with rich trace elements useful for human health, various biological substances that are indispensable in the diet. Therefore, fruits and vegetables grown on the generous Uzbek land, which are in high demand abroad, are highly competitive. Currently, much attention is paid to optimizing sown areas, increasing yields, deep processing of agricultural raw materials, and developing the infrastructure for storing grown products. The climatic conditions of Uzbekistan make it possible to grow fresh fruits, vegetables and berries in large quantities and in a wide assortment. On this basis, the country is developing the agricultural processing industry, which includes enterprises for the production of canned fruits and vegetables, fruit and vegetable juices, wine and vodka products, soft drinks, fruit and vegetable purees, pastes and syrups, dried and frozen fruits and vegetables. For some of these items (tomato paste, dried fruits and dried vegetables), Uzbekistan is among the largest global producers [1]. The era of globalization and competition forces us to improve the quality of our products, improve processing, improve the presentation of both our products and packaging materials, storage, marketing, export, and strengthen public-private partnerships. The development of the fruit and vegetable industry of the Republic of Uzbekistan is closely connected with the development of the glass industry, as glass packaging materials are important materials for a processed agricultural product.

Recently, the requirements of food industry enterprises for the quality of glass containers have increased significantly. The safety of food products is greatly influenced by radiation in the ultraviolet region of the spectrum with a wavelength of up to 300 nm and in the visible up to 500 nm. Light radiation negatively affects the safety of milk, vegetable oils, juices, beer, some types of wines, etc. For example, in beer, under the influence of light (wavelength 420-500 nm), sulfur compounds are formed and a “light” flavor appears. Milk in a colorless bottle in the daylight quickly loses vitamin C. Light also negatively affects vitamins A, B6, etc. Vegetable oils age and deteriorate when exposed to light (wavelength 430-460 nm).

Typically, industrial packaging glasses do not (or only slightly) transmit radiation with a wavelength of less than 300 nm, due to the presence of iron oxides in the glass. At the same time, radiation with a wavelength of more than 500 nm does not adversely affect food products. The thermal transparency of the glass has a significant effect on thermal uniformity, affecting both the production of high-quality glass melt during cooking, and the distribution of glass and the appearance of various defects during the formation of glass products. In this regard, it can be argued that the thermal transparency of glasses is one of the most important factors affecting not only the technological process of production, but also the operational reliability of glass containers.

According to published data, green bottle glass contains up to 4.0% or more (hereinafter in wt.%) Al2O3 and as coloring chromophore oxides - iron oxide 5% and chromium oxide up to 1% or manganese oxide - 0.5 % [2]. Dark green bottle glass is known, in the charge of

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which nepheline concentrate is used to introduce Al2O3 [3], to add green color to the glass, Mn3O4 and Fe2O3 are additionally introduced. In another literary source, it is reported for the manufacture of container glass, a marshalite is introduced into the charge [4], while the composition of the charge consists of the following components; Marshalite-75.05; soda-23.26; dolomite-20.50; alumina-0.99; sodium sulfate 1.17. All of these compositions consist of scarce raw materials for at least the Aral Sea region.

In connection with the above, we were tasked with the development of compositions of green glasses from local raw materials. The selection of suitable raw materials was carried out taking into account economic, environmental and technological factors. To introduce SiO2 into the glass composition, enriched quartz-feldspar sand of the Yangiarik deposit was taken. Dolomite from the Kurdana deposit located in Kashkadarya region was used as a source of calcium and magnesium-containing component. The Kurdana site is located in Dekhkanabad district in the village of Uzbekistan. The total stock of dolomite in categories A + B + C is more than 100 million tons. Physico-mechanical properties of dolomite are as follows: bulk density of 2.6-2.7 t / m3; the coefficient of loosening is 1.6-1.7; porosity -0.53-9.15%; water absorption is 0.44-2.8%.

Table 1 shows the chemical composition of the raw materials used in the synthesis of green glass.

Table 1
The chemical composition of the main natural raw materials for the synthesis of green glass

Names of raw materials	The content of oxides, in wt.%									
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	P_2O_5	MnO	Ппп
Quartz-feldspar sand (Yangiarik field)	95,30	1,74	0,68	0,36	0,20	0,51	_	_	_	1,77
Dolomite (Kurdana Kashkadarya region)	1,30	0,28	0,016	31,3	19,40	_	_	_	_	47,70
Feldspar (Sultan of Uvaisk field	68,91	16,81	0,17	0,55	0,30	2,92	9,98	0,15	0,01	0,83

Feldspar Sultan of the Uvaiskoye deposit of the Republic of Karakalpakstan was used as the quality of the complex raw materials. This raw material is homogeneous mineralogical with some quartz content [5]. Habitus tabular, in the form of short prisms with sizes from 10x10 to 50x25 microns. The ratio in feldspar K2O: Na2O = 3.5 is not lower than established by the standard, the absence of volatile substances promotes the formation of viscous glass from it in the temperature range 1523-15730C. The introduction of feldspar into the glass allows the complete replacement of technical alumina and reduces the content of soda ash in the composition of the charge. It was also assumed that the potassium-containing constituents contained in feldspar will add shine to the glass and lower the cooking temperature, which will undoubtedly affect the quality and cost of the products obtained.

As the alkali-containing component of the glass introduced into the composition, a synthetic product was selected - soda ash from the Kungrad soda plant and sodium sulfate from Kungrad Sodium Sulfate LLC. The composition of the charge was calculated according to [6].

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Table 2
The estimated composition of the experimental glass

Rawmaterials	The oxide content in the glass, wt.%					
	SiO_2	Na_2O	MgO	CaO	Al_2O_3	Fe_2O_3
Quartz sand of the Yangiarik field	63,82	_	_	_	1,11	0,670
Soda ash (Kung Rad Soda Plant)	_	12,33	_	_	_	-
Feldspar (Sultan of Uvayskoye deposits)	7,63	0,32	_	_	1,87	0,010
Dolomite (Kurdana)	_	_	1,79	2,90	0,2	0,001
Sodium sulfate (Kungrad sodium sulfate)	_	0,39	_	_	_	0,0003
Total	71,48	13,04	1,79	10,49	3,18	0,685

The preparation of raw materials was carried out by analogy written in [7]. In this case, the initial quartz sand was screened, followed by electromagnetic separation in a factory installation of type 2RS-12 / 150-09011000000. Dolomite and feldspar were subjected to grinding on the ShchDS-4 installation and grinding on a ball mill with a volume of 10 l. After processing, the raw materials were weighed according to a given recipe and placed in a plastic container and moistened to a moisture content of 4%. A series of laboratory brews in corundum rods with a volume of 200 ml was carried out.

Cooking of the experimental composition was carried out in a laboratory electric furnace with silicone heaters at a maximum temperature of 1450 ° C with an exposure time of 40-60 minutes. The readiness of the glass was checked "breakdown on the thread", with fixing the uniformity of the glass thread. It has been experimentally established that, for all compositions, the charge decomposition, clarification, and melt homogenization proceed for 30–40 min at a temperature of 1450–1460 oC. The study of some indicators of the obtained glass meets the requirements of GOST 52022-2003 Glass containers for food and perfumery and cosmetic products. The resulting glass has a greenish tint.

Table 3.
Physico-chemical properties of the experimental glass

Indicators	The value of indicators
Cooking temperature, oC	1450
Specific Gravity, g / cm3	3,10
The limit of compressive strength, MPa	905
Bending Strength, MPa	160
Mass loss during abrasion, kg / m2	0,10
Color tone, mm	578,0
Color purity,%	53,0

The next point for obtaining green glass was the addition of chromophores to the composition of the charge. From the literature it is known that in addition to iron oxides, expensive molecular dyes such as iron, manganese, copper and cobalt oxides are used to obtain green colored glasses in the mass. The color of glass with copper is very dependent on the cooking conditions and chromium oxide is an environmentally harmful oxide. In this regard, in practice they try to use iron and manganese oxides.

It is known that iron in glass is in 2 oxidation states: in the form of FeO and Fe2O3. Iron oxide FeO gives the glass a blue tint, the degree of reduction is 25-35%, the tetra-coordinated ferric ion, one of the oxygen ions, which is replaced by the sulfide sulfur reduced from the sulfate ion, gives a yellow color. The addition of blue and yellow color gives a greenish color. To enhance the green color, cobalt sulfate and coke were added to the mixture. We assumed that cobalt sulfate upon decomposition gives CoO and SO3, and coke promotes a more complete reduction of iron and gives the glass high heat-shielding properties. In this case, iron together with cobalt oxide enhances the blue color, and the remaining Fe2O3 gives an intense yellow color. The addition of these colors gives the glass a green color. The amount of cobalt sulfate introduced into the glass charge varied between 0.5-2.0, and coke 0.25-1.0. As a result of the research, a glass with a saturated green color was obtained.

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Thus, the experimental studies obtained green glass from the local mineral raw materials of Uzbekistan. Using the mechanisms of redox potential, green glass was obtained without prior introduction of chromospheres.

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