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USE OF WASTE GLASS IN CERAMIC PRODUCTS

ИСПОЛЬЗОВАНИЕ ОТХОДОВ СТЕКЛА В КЕРАМИЧЕСКИХ ИЗДЕЛИЯХ

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Keywords: cullet, ceramic products, glass, building materials.
Ключевые слова: стеклянный бой, керамические изделия, стекло, строительные материалы.

Abstract. The article presents the results of a study of the content of man-made products of cullet in ceramic products. As a result of the conducted research, the possibility of using man-made products of cullet in the production of ceramic materials has been found and the main values of the Aggregate grading, the percentage of cullet in the composition of the ceramic mass have been determined, the main problems of a technological and environmental nature have been identified.

Rational use of natural resources is currently gaining special importance. The solution of this urgent national economic problem involves the development of effective waste-free technologies through the integrated use of raw materials, which simultaneously leads to the elimination of huge environmental damage caused by waste storage facilities. One of the ways to solve this problem is to develop technologies for obtaining building materials based on the use of solid waste, including the use of cullet.

Glass is a solid amorphous material obtained during the supercooling of the melt. Conventionally, the compositions of glasses are expressed as the sum of the oxides of the elements included in them and these glasses are called oxide. All glasses from which containers are made belong to the oxide, since the main oxide is silicon oxide SiO_2. The main components of container glass are SiO_2, CaO and Na_2O; in small quantities, these glasses should contain $A1_2O_3$ and MgO, which favorably affect the basic properties of the glasses. The content of MgO in glass can be increased to 3.0–3.5 %, and $A1_2O_3$ to 3–5 %. In some types of container glass, a relatively small amount of Fe2O3 may be present. Glass containers obtained from semi-white and greenish

glass may contain from 0.15 to 0.3 % and above Fe_2O_3. In addition, a significant part of wine and beer bottles, as well as mineral water bottles, are made of painted glass, in which the content of iron oxides is practically unlimited and can be in the range of 1.5–2.5 %. For painting, up to 2.0–2.5 % MnO is introduced into such glass. Typical compositions of such glasses are presented in Table 1.

Container cullet (cullet) is a hard-to-recycle waste that is not exposed to water, atmospheric phenomena (precipitation, solar radiation, temperature changes) and does not collapse under the influence of organic, mineral and biologically active organisms [1, 2].

Table 1 – Typical compositions of cullet

Grade of glass (OST 21-51-82)	SiO_2, %	Al_2O_3+ Fe_2O_3, % (including Fe2O3 max)	CaO + MgO, %	Na_2O + K_2O, %	SO_3, %
BT-1 (colorless)	72 ± 1.5	2.5 ± 1 (0.1)	11 ± 1.3	14 ± 1	0.5
PT-1 (semiwhite)	71.4 ± 2	3 ± 1 (0.5)	11 ± 1.3	14.2 ± 0.9	0.4
PT-2 (for semiautomatic)	71.3 ± 2	2.5 ± 1 (0.5)	11 ± 1.3	14.8 ± 0.9	0.4
ZT-1 (green)	70.3 ± 3	4 ± 1.5 (0.8)	11 ± 1.3	14.3 ± 0.9	0.3
KT-1 (brawn)	71.1 ± 2	3.3 ± 1.3 (0.5)	11 ± 1.3	14.3 ± 0.9	0.3

The cullet uncontaminated (excluding the fight of the glass of cathode ray tubes and fluorescent lamps) consists of the following components: SiO_2 – 72.5 %; Al_2O_3 – 2.5 %; MgO – 2.5 %; CaO – 7 %; Na_2O – 15.5 %. Aggregate grading of cullet is presented in Table 2.

Table 2 – Aggregate grading of cullet

Mesh screen R40/3 on STB ISO 565	Total solid on mesh sieve, %
180	0–0.5
106	0–30.0
63	50–90.0
40	70–100.0

Recently, research has been conducted in a number of industrialized countries on the use of glass waste in the manufacture of building and facing bricks. At the same time, the composition of the mixtures included cullet, slag, ceramics, stone or a battle of baked bricks; plastic clay, finely ground cullet or liquid glass were used as a bundle [3]. Also, the cullet is successfully used as an additive in the manufacture of bricks

without making special requirements for its quality. When replacing 50 % of the clay with a cullet, the brick firing temperature can be lowered from 1170 °C to 900 °C. At the same time, the furnace performance increases by ~ 30 %. High-quality bricks are obtained from a mixture: cullet – 30 %, brick waste 60 % and clay – 10 %. Such bricks have a high resistance to weather influences and are suitable for use as facing materials.

Currently, Obolsky Ceramic Plant plans to expand the product range by producing ceramic building mixes using man-made products of industry and the fuel and energy complex [4].

To investigate the possibility of using cullet and glass powder in the production of ceramic bricks as high-temperature additives (melts), a formulation and composition of raw materials based on clays from the local Zapolye deposit have been developed. Experimental samples of ceramic masses have been prepared and manufactured to conduct research on the physical and mechanical properties of ceramic materials using additives based on glass, glass powder. The samples were made in the form of bricks (65×30×15) mm and cylinders with a diameter of 30 mm and a height of 30–40 mm by manually stuffing plastic mass into metal molds. These samples were used to study the main physical and chemical characteristics: water absorption, compressive and bending strength.

The results obtained for determining the basic physicochemical properties of building ceramics samples are shown in Table 3.

Table 3 – Physicochemical properties of pieces building ceramic

Properties	Percentage of cullet				
	0	2.5	5	7.5	10
Water absorption, %	15.67	15.97	15.94	15.50	15.10
Compressive strength, MPa	28.00	28.71	24.71	31.68	25.50
Transverse strength, MPa	12.18	10.82	10.98	11.32	12.79

Studies of the physical and mechanical properties of prototypes of construction and clinker ceramics using cullet additives carried out at Obolsky Ceramic Plant have shown the possibility of using these wastes as an additive in the manufacture of building materials. It is determined that the produced samples comply with the requirements of STB 1160-99. Based on the conducted research, recommendations have been developed for the use of an additive based on the cullet, glass powder used as an additive to improve the physicochemical properties of construction ceramics products, there should be at least 5 % over 100 % of the composition of the ceramic mass. The main problems of a technological and environmental nature have also been identified, which will be solved during further research and implementation activities. The fraction of glass entering for processing should be no more than 2 mm. Grinding and addition to the ceramic mass should be carried out in closed chambers. The interval between drying and firing in the same furnace is unacceptable.

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ANALYSYS OF TECHNOLOGICAL PARAMETERS OF PATTERN KNITTED FABRIC

АНАЛИЗ ТЕХНОЛОГИЧЕСКИХ ПАРАМЕТРОВ РИСУНЧАТЫХ ТРИКОТАЖНЫХ ПОЛОТЕН

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Keywords: knitting, cotton, silk, technological parameters, thickness, surface density, volume density.

Ключевые слова: трикотаж, хлопок, шелк, технологические параметры, толщина, поверхностная плотность, объемная плотность.

Abstract. The study and expansion of the technological capabilities of modern knitting machines, the development of new models of knitted fabric from local raw materials on the above machines and the subsequent expansion of the range of knitwear with improved consumer properties is an urgent task today. The article presents the results of the analysis of the technological parameters of patterned knitted fabrics, developed for the effective use of local raw materials and those made from silk