In recent years, several Soviet plants assimilated the production technology of an efficient finishing (dressing) material called glass-kremnezit (steklokremnezit) [1, 2].

One of the significant shortcomings of the material being produced is its high cost. This is mainly due to the low level of mechanization of the production processes, the low unit capacity of the existing production lines of glass-kremnezit, and the use of costly raw materials (opacifiers and coloring agents). Besides this, the possibility of using the waste products of glass industry has not been explored to a significant extent.

During 1984, based on the experience gained at the Lenin Glass Plant, a production line having an annual productivity of 25,000 m² glass-kremnezit tiles was introduced at the Kerchensk Mezhkolkhoz (Inter-Collective Farm) Glass Complex. A typical technological flowsheet [1] was used.

In order to obtain a granulate (granules) of the upper decorative layer, opacified glass was made in advance in a tank furnace of periodic action with subsequent water quenching. A glass of the following chemical composition was used, %*: 70.5 SiO₂; 7 Al₂O₃; 16 Na₂O; 2.5 CaO + MgO; and 4 F. Sodium fluorosilicate was used as an opacifier of the molten glass. The maximum temperature of glassmaking was 1380 ± 10°C.

For the bottom layer, a granulate having the same chemical composition as that of the package glass was used. The granulate was obtained in a continuously operating tank furnace designed for producing bottles according to the method of continuous discharge (tapping) of the melt into water using a special feeder arrangement attached to the working portion of the furnace.

Sintering of the glass granulate (granules) was carried out in a tunnel furnace having a 31 m long and 1.4 m wide channel. The furnace was oil fired using an injector (burner) mounted in the front facing wall. The maximum furnace temperature was maintained in the 950-1000°C range. The cycle for pushing the cars was completed within 10 min.

During the initial (first) stage of mastering the production line, there was a large number of rejected products (sometimes, as high as 70-80% of the daily productivity). A careful analysis of the factors adversely affecting the technological process of glass-kremnezit production made it possible to delineate the following reasons:

The coefficients of linear thermal expansion (CLTE) of the glasses of the decorative layer and the substrate (base) differ significantly because of which several surface cracks and defects form on the tiles;

using oil as a fuel does not permit one to maintain the desired stable temperature regime along the length and the width of the furnace which, in turn, leads to a poor quality surface finish (roughness) of the tiles;

and at the given level of annual productivity (25,000 m²), the length of the furnace and its passage (by-pass) do not make it possible to follow a safe cooling regime because of which chips and through-cracks are found in most of the tiles.

In order to eliminate these shortcomings and to stabilize the technological process of glass-kremnezit production, an extensive study was carried out at the plant within a short period. According to the recommendations of the State Institute of Glass, the chemical composition of the opacified glass intended for the decorative layer was changed as follows, %:

*Here and elsewhere, weight contents are given.

Fig. 1. Two-basin tank furnace for making glass granulate: a) plan of the furnace; b) cross section of the furnace.

60.32 SiO₂; 5.29 Al₂O₃; 0.35 Fe₂O₃; 10.56 CaO; 0.46 MgO; 14.82 Na₂O; 0.4 SO₃; and 7.8 P₂O₅.

The apatite concentrate of the Kovdorsk deposit (TU 113-12-93-82) was used as an opacifier.

The CLTE of the obtained glass is \((88 + 2) \times 10^{-7} \text{C}^{-1}\) which is significantly less than that of the previously used fluoride glass. In spite of the higher temperature of glassmaking (1450°C), using the apatite concentrate is advantageous in view of its substantially lower cost as compared to sodium fluorosilicate. Besides this, the new composition of glass made it possible to significantly reduce fluoride pollution of the environment which is particularly important under the conditions of Krym.

The continuous tank furnace designed for glassmaking has a horseshoe-shaped flame and has an area of \(3.93 \times 2.2\) and a depth of \(0.5\) m. The basin walls and the rear wall are made of bakor. Dinas was used for making the suspended walls (roof). The bottom portion (base) is made from chamotte refractories and is lined with bakor tiles.

In order to save the area of the region of glass granulate production (to make it compact) and for sake of convenient operation, a similar furnace was erected for making colorless granulate (near the tank furnace used for making opacified glass). The distance between the basin walls of the furnaces is \(400\) mm. Owing to this, the outer portion of the furnace can be blasted easily. In this case, they have a common roof (Fig. 1). The furnaces are oil fired. The maximum glassmaking temperature is \(1450 \pm 10°C\).

The charge is prepared using the automatic line of the shop and is loaded using a mechanical changing device into the tank furnace designed for the production of opacified granulate.

For the production of colorless granulate, cullet having the following average composition is only used, %: 71.88 SiO₂; 2.81 Al₂O₃; 0.33 Fe₂O₃; 6.41 CaO; 3.55 MgO; 14.63 Na₂O; and 0.29 SO₃.

The received cullet is subjected to wet cleaning in an industrial glass washer. Metallic inclusions are removed using a magnetic separator. Over a fairly long period (approximately 2 years), the chemical composition of the obtained granulate did not show significant changes and there were no sharp fluctuations in its composition. In order to obtain an effective averaging (homogenization) of the molten glass mass, sparing (bubbling) nozzles were fixed in the region of the charging pocket and at the exit (tap) of the tank furnace.