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HYDROTHERMAL METHOD OF MAKING GLASS MIXTURE USING HIGH-SILICA RAW MATERIALS

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Abstract. The paper substantiates the possibility of expanding the raw material base of glass production through the use of high-silica raw materials - tripoli. The main component of glass SiO_2 occurs at the expense of amorphous silica contained in the tripoli. The charge was prepared by a hydrothermal method. Autoclave treatment of the fired mixture was carried out at a temperature of 180°C for 4 hours at a pressure of 0.5 MPa using Na_2CO_3. Thermal analysis of the conventional charge showed that dehydration reactions last up to 200°C, while for the hydrothermal charge dehydration occurs up to 500°C, which is explained by the release of chemically bound water of siloxane, silanol and silandiol groups. XRD data confirm that the hydrothermal charge at a temperature of 1000°C is practically amorphized, and at 1200°C all reflexes are absent, indicating a 100% glassy state. The use of hydrothermal charge allows to reduce the glass melting temperature by 200°C.

Key words: hydrothermal charge, glass, thermal analysis, tripoli, XRD.

The charge for glass production was prepared using two methods: hydrothermal and conventional. The composition of the charges was selected so that the welded glass corresponded to conventional container glass in terms of its composition. The charge produced in this way has a number of advantages: high homogeneity, increased reactivity and low-temperature melting [1].

The results of the differential thermal analysis of the charges indicate that phase transformations in the hydrothermal charge occur and end at significantly lower temperatures than in the ordinary charge.

X-ray phase analysis was performed for samples of ordinary and hydrothermal charges heated to a temperature of 600, 800, 1000, 1200°C. This made it possible to trace their transformation during the heat treatment process. The XRA data confirm that tripoli has a high degree of amorphousness, unlike quartz sand. In the hydrothermal charge, the rate of all reactions is much higher, as evidenced by the decrease in reflexes at lower temperatures compared to the ordinary charge [2]. Thus, the hydrothermal charge at a temperature of 1000°C is almost amorphous, and at 1200°C all reflexes are absent, which indicates a 100% glassy state. In the ordinary charge, even at 1200°C, peaks corresponding to crystalline silica are observed [3].

Visual observation of the stages of glass formation showed that at 1200°C the hydrothermal charge is practically welded, with only residual «gnats» observed. For the ordinary charge, we observe the partial appearance of a vitreous phase with a large amount of foam in the surface layers and significant bubbles.

CONCLUSIONS

The studies confirmed the advantages of using a hydrothermal charge with tripoli compared to a ordinary charge for the production of container glass. The use of this method allows to reduce the glass melting temperature by 200 ºC compared to ordinary melting. In addition, the hydrothermal charge can be compacted, which will significantly improve the environmental friendliness of the glassmaking process.

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