Interaction of Gas Phase and Glass during Melting Process

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Abstract

Glass melting and vitrification processes are accompanied by the evolution of a large amount of gases that exceed several times the volume of the resulting melt. During early stadium of the process, gases produced by chemical reactions form primary foam, the formation and collapse of which control the glass production rate via its effect on heat transfer to the reacting batch. Experimental methods of Evolved Gas Analysis and High Temperature Observation of reacting batch were used to identify and evaluate crucial chemical reactions. Heterogeneous bubble nucleation during production of commercial glasses is one of the negative factors affecting both technology and final product properties. We made the extensive research of bubble nucleation in soda-lime-silica glass melts containing sulphur compounds at variable redox state of glass. The phenomenon was studied quantitatively by a method of High Temperature Observation to determine the temperature at which the bubbles were nucleated on a platinum wire immersed in the melt. The intensity of bubble nucleation in the form of the number of nucleated bubbles and the volume of released gas versus time were also measured and described by theoretical equations. The fining action of sulphates at reducing conditions started at temperatures between 1200 and 1300∘C. In addition, extensive nucleation of bubbles took place at relatively low temperatures. The nucleation of bubbles in variously reduced glasses has been observed at temperatures lower than 1300∘C and further decreased with decreased redox state. The foaming and bubble nucleation on the level of the molten glass were observed in glasses containing sulphate when the water vapour partial pressure in the atmosphere exceeded 50 kPa. Reduced glasses show the nucleation also at a lower partial pressure of water vapour.

Keywords: Bubble, Foam, Nucleation, Glass melt

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