ZeroCO2-Glass

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Abstract

As an energy-intensive industry with significant carbon dioxide emissions, it is imperative to re-examine and re-evaluate glass manufacturing. As part of the large-scale project "ZeroCO2-Glass" funded by the BMWK, the possibility of completely decarbonising the production of container glass is to be considered in an all-encompassing manner.
The aim of the project is to evaluate a complete elimination of CO2-emitting process steps and raw materials from the production of glass containers, which takes place on a pilot scale. For this purpose, a glass melting furnace with a throughput of about 2 tonnes of glass per day including an IS section for forming narrow neck bottles will be set up. In two major sub-aspects, on the one hand, the CO2 bound from carbonate-containing raw materials will be substituted with CO2-free raw materials and, on the other hand, the main energy source, natural gas, will be replaced by a mixture of hydrogen firing and electrical boosting.

Due to the oxide composition of suitable non-carbonate raw materials such as feldspars, the chemical composition of the glass must be adjusted in order to replace soda ash as a raw material carrier. In doing so, both the batch melting-in behaviour and the formability of the glass must remain within the limits of nowadays forming processes. Thus, systematic investigations of the melting-in behaviour on a laboratory scale under all-electric as well as hydrogen combustion conditions are underway. Further, the pilot plant will allow for observe the melting-in behaviour by means of furnace camera system. Moreover, characteristic glass properties such as viscosity-temperature dependency, liquidus temperature, glass transition temperature, must be properly adjusted. For this purpose, glasses in the CNMAS (CaO-Na2O-MgO-Al2O3-SiO2) have been proposed and extensively characterised.

First investigations of the new glass compositions show that a shift of the viscosity curves towards higher temperatures in the working range is to be expected. Therefore, the shaping processes are first mapped by simulations with "NOGRID pointsBlow" and then optimised for the new properties. These processes will be evaluated and further optimised in the pilot plant. The aim is to gain a profound understanding of the relationships between glass properties and shaping in order to be able to react to fundamental changes in glass chemistry.

Through experiments in a hybrid heated laboratory furnace, initial evidence was found that known refractory materials experience increased corrosion when hydrogen and oxygen are used as fuel gases. However, further tests are needed to predict the resistance in industrial plants. In this project, it is planned to selectively store refractory materials in the combustion atmosphere of the pilot plant in order to enable comparative long-term measurements with different energy sources.
First results regarding the issues discussed above will be presented.

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