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IMPROVING PHYSICAL AND CHEMICAL PROPERTIES OF CONTAINER GLASS BY TREATMENT WITH GASEOUS REAGENTS

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Abstract: The efficiency of glass utilization significantly decreases due to its low mechanical strength and bad thermal stability, losses during the stages of production, transportation and storage amounting to 5-10 %. Different methods for improving the mechanical and thermal properties and chemical resistance of industrial glassware have been developed. A substantial drawback of most methods is the necessity to change the glassware manufacturing technology. The aim of the undertaken experiments was to investigate the influence of thermochemical treatment by gaseous reagents on the physical and chemical properties of glass containers. Objects of investigation were various types of glass containers: bottles and flasks of green glass, containers (bottles, jars and flasks) of transparent colorless glass. Sulfur oxide, nitrogen oxides, carbon oxide, hydrogen fluoride and chloride, difluorodichloromethane, difluorochloromethane and mixtures of these gases were used for the thermochemical treatment of glassware. Experiments were held in laboratory and industrial conditions. In laboratory glass samples have been subjected to treatment by gaseous reagents in the following regimes: temperature – between 300 and 600 ^{0}C, duration – between 1 s and 2 h, quantity of gaseous reagent introduced into the reacting vessel - between 0.01 and 1.00 mol. Thermochemical treatment by gaseous reagents in laboratory experiments increases water resistance of glass samples by 8-10 times, acid resistance - by 6-8 times, microhardness - by 10-15 %. The main regimes of glass containers by thermochemical treatment with gaseous reagents on processing lines are the following: temperature - between 450 and 700 ^{0}C, volume of gaseous reagent per one unit of glassware - between 0.05 and 10.0 ml, duration - between 1 s and 30 min. Glassware was treated by gaseous reagents in different places: final blowing of containers, conveyor for transportation of glassware towards annealing and lehr. The reagents were fed into the glassware mainly in gaseous state and in the form of solutions and solid substances. The mechanical strength of jars, bottles and flasks is characterized by resistance to internal hydrostatic pressure. Additionally, jars were tested for resistance of compressive force in the directions of vertical axis to the body and the resistance of compressive force in directions perpendicular to the body walls. Subjected to thermochemical treatment, water resistance of bottles and flasks increases by tenfold, the mechanical strength of glass containers - by 10-15 %, the microhardness and thermal stability - by 8-12 %. The experiment helped us develop optimal regimes of thermochemical treatment of industrial glassware subjected to gaseous reagents in laboratory and industrial conditions.

Key words: glass containers, physical and chemical properties, thermochemical treatment, gaseous reagent, regime.