

Laser-Induced Breakdown Spectroscopy Applications in Glass Industry: Rapid and High-Performance Analysis of Chemical Composition of Silicate, Germanium, Phosphate Glasses and Glass Components

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Analysis of chemical composition is a powerful tool for quality control of any raw materials and finished products.

The commercialized elemental analyzer LEA-S500 (JV" SOLAR TII") has been used for rapid chemical analysis of germanium, silicate, phosphate glasses and of glass components for production of the glass.

Time of analysis of sodium-calcium silicate glass on 7 oxides (SiO_2 , Al_2O_3 , Fe_2O_3 , CaO , MgO , Na_2O , K_2O) is 2 minutes (sample preparation included), the amount of the measured oxides is 99,5% (mass fraction of nonregistered oxides is 0,5%).

Time of analysis of sodium-calcium and boron-silicate glass on 19 oxides (with additional analysis of SO_3 , SrO , BaO , ZrO_2 , CeO , B_2O_3 , Cr_2O_3 , TiO_2 , P_2O_5 , ZnO , PbO and MnO_2) is 8 minutes, the amount of the measured oxides is 99,97% (mass fraction of nonregistered oxides is 0.03%)

Determination of the oxides P_2O_5 , Al_2O_3 , B_2O_3 , SiO_2 , BaO , CaO , SrO , Na_2O , K_2O , NdO_2 in phosphate glass takes 6 minutes; it takes 2 minutes to determine the oxides GeO_2 , La_2O_3 , B_2O_3 и Sm_2O_3 in germanium glass.

Calibrations have been achieved with the linear regression coefficients of 0.980 - 0.990.

The process of glass preparation for analysis consists in surface polishing of samples and reference materials (Certified Reference Materials) using SiC powder ($d=28-100\mu\text{m}$).

The period of analysis of raw materials (quartz sand, chalk, soda, dolomite flour feldspar), GeO_2 , H_3BO_3 , $\text{Al}(\text{OH})_3$ reagents, lanthanide oxides is from 5min to 40 min (sample preparation included).

Calibrations have been achieved with linear regression coefficients of 0.960 - 0.990.

Sample preparation of bulk solids includes compression in a tablet with or without binding material with the use of 8 ton-effort laboratory press.

Grinding and homogenization of bulk solids has been performed with the Fritch Pulverizette7 mill.

The investigation of nature of blemish and homogeneity of glass chemical composition (a distribution of element oxides along a sample surface) has been performed as well.

In this presentation a conception of a mini-laboratory for glass analysis has been proposed. The mini-laboratory ensures rapid and precise chemical analysis of products and materials over the whole nearly on-line glass manufacturing process with minimal costs for consumables and with little or no sample preparation.