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Application Note

Sum Parameters

Fields of Application / Industry:

- Chemistry / Polymer Industry
- Clinical Chemistry / Medicine / Hygiene / Health Care
- Cosmetics
- Electronics
- Energy
- Environment / Water / Waste
- Food / Agriculture
- Geology / Mining
- Material Analysis
- Metallurgy / Galvanization
- Pharmacy
- Refineries / Petrochemistry
- Semi-Conductor Technology
- Others

Short Application Elemental Analysis – Inorganic

Determination of Total Carbon (TC) in Foam Glass

Introduction

Foam glass is used as a heat insulation material, which is produced by foaming of glass melts. Thus, foam glass is very pressure-resistant and impermeable to steam. Besides minerals and metal oxides, the raw glass material is made of recycled glass and/or quartz sand. From these materials a glass melt is produced, which is grinded by large-scaled ball mills. To this pulverized glass, small amounts of soot (carbon) are added. This mixture is heated up to 1000 °C. Here, the added carbon is oxidized to gaseous carbon dioxide (CO_2, see Eq. 1).

$$C + O_2 \rightarrow CO_2 \uparrow \qquad \text{(Eq. 1)}$$

During the short reaction time and due to the high viscosity of liquid glass, the glass melt turns into a foam, which keeps its porous structure after cooling.

For the production of the glass-soot-mixture it is important not to add too much soot. Otherwise, too much CO_2 will be yielded, which can form oversized bubbles that can emerge the glass melt. In this case the porosity of the foam glass becomes too low to work as insulation material. Consequently, for the manufacturer it is important to control the soot content during the manufacturing process. The carbon/sulfur analyzer multi EA® is best suited for this application, because of its high reproducible measurements even at very low carbon concentration levels.

Experimental

Different lots of glass-soot-mixtures from a foam glass manufacturer were analyzed. For calibration two different glass standards (0.317% and 0.273% TC) were used.

Sample Preparation

The raw material for the foam glass production, the glass-soot-mixture, consists of small particles with a big surface. On this surface, gases like carbon dioxide from the air can be adsorbed. Therefore, it is necessary to remove this CO_2 from the mixture by adding diluted phosphoric acid (H_3PO_4, 10%). To remove the excess of H_3PO_4 the samples were dried at 130 °C until complete dryness.

Determination

For the determination of total carbon (TC), approx. 300 mg sample were weighed into ceramic sample boats. H_3PO_4 was added drop-wise, until the whole sample was covered with acid. After drying, the measurement of TC was performed with the elemental analyzer multi EA® . The samples were automatically transferred into the ceramic combustion tube by an autosampler. The carbon inside the glass samples was completely oxidized in an oxygen stream at 1060 °C. The determination of yielding CO_2 was done by NDIR spectrometry.

Calibration

For the calibration of the analyzer a glass standard with a TC concentration of 0,317% was used. Five measuring points between 170 µg and 1600 µg carbon absolute were chosen (see Fig. 1).

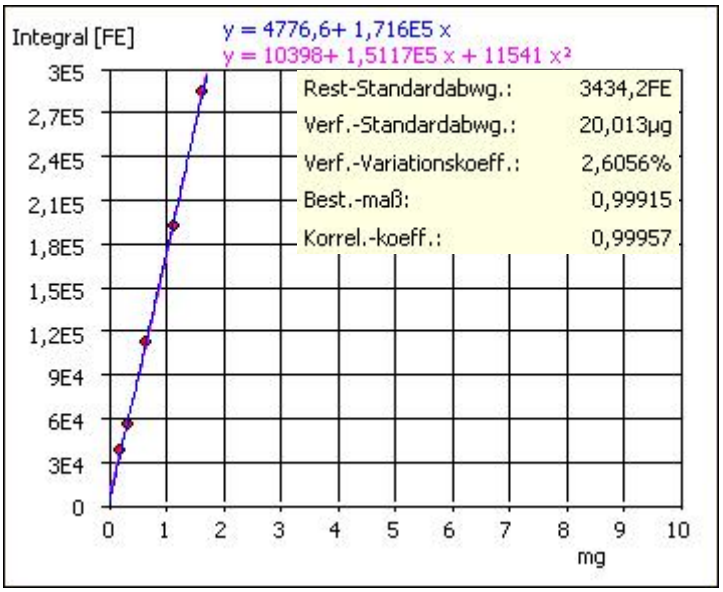

Fig. 1 – Calibration curve for a range between 170 µg and 1600 µg carbon absolute

Results and Discussion

For the determination of the carbon content, three replicate measurements were done for each sample, so that mean value and standard deviation could be calculated (see Tab. 1).

Tab. 1 – Results of the TC-measurement

Charge	TC [%]	SD [%]
01-07-2011	0.272	± 0.0056
04-07-2011	0.275	± 0.0050
08-07-2011	0.281	± 0.0021
11-07-2011	0.279	± 0.0053

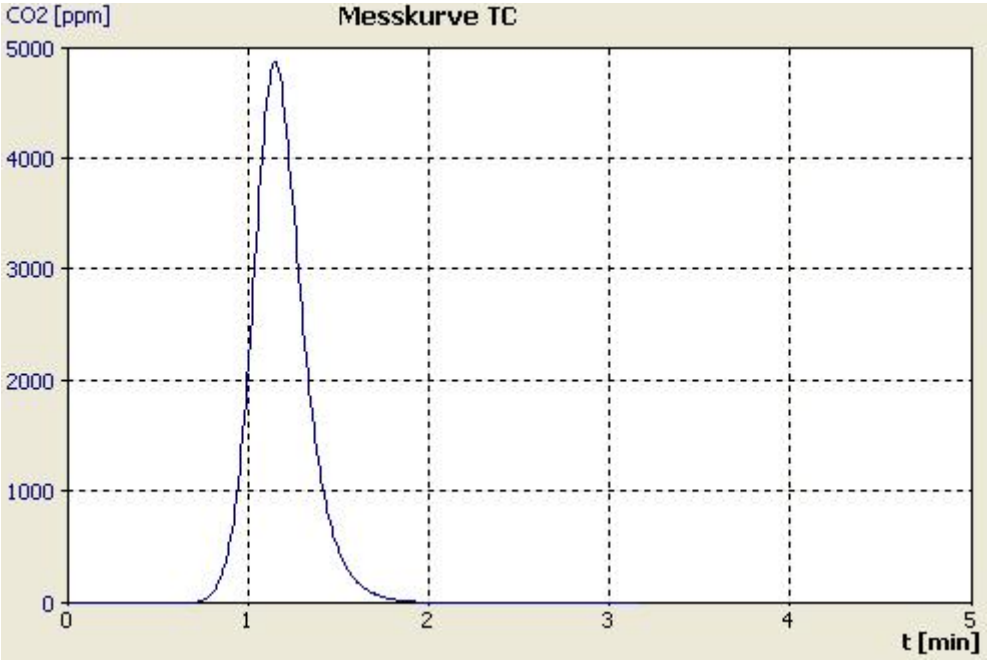

Fig. 2 – sample graph for a TC-measurement

Conclusion

It has been shown that even small carbon contents below 0.3% could be determined in difficult matrices like glass, whereby high precession could be ensured. Due to the applied setting (pure oxygen atmosphere, >1000 °C), a complete oxidation of the carbon in the glass-soot-mixture can be guaranteed.

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