Thermochimica Acta, 93 (1985) 529-532
Elsevier Science Publishers B.V., Amsterdam

APPLICATION OF HIGH-TEMPERATURE DILATOMETRY IN THE STUDY OF CALCIUMHYDROSILICATES

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ABSTRACT

Two types of quartz sand were used for model casting of cellular concrete of increased heat resistance obtained by adding barium salt. The heat stabilizing effect of the additive was followed by high-temperature dilatometry.

INTRODUCTION

During past decade high-temperature dilatometry became one of the most important methods when studying the properties of new heat insulating materials whose development has been taking place in this institute since seventies. The operation method with high-temperature dilatometer - model 402 E made by Fa Netzsch as well as data processing with programmable calculator HP 9820 A are described by Hložek and Pospíšil (1). The author dealt in a number of his papers with the application of high-temperature dilatometry in the study of calciumhydrosilicate bindings belonging to the group of 11 Å-tobermorite and xonotlite as well as with their modifications in insulating materials (2-5).

MEASURING METHODS

When studying the "heat stabilization" property of 11 Å-tobermorite there was proved the desirable effect of barium salt. It became evident by a definite shift of its transformation into wollastonite in the direction to higher temperatures as well as by the reduction of linear shrinkage up to 1000°C in micro-bars prepared by pressing finely ground 11 Å-tobermorite from hydrothermal suspension synthesis. Simultaneously it was found that it is substantially easier and more illustrative to study the morphology of 11 Å-tobermorite crystals in the pores of cellular concrete as the crystals of this binding component are almost ideally developed. Thus enough liquid phase end space for their development are present.

Proceedings of ICTA 85, Bratislava

To the mixtures consisting of quartz sand Kosice or Hrušovany, CaO A.R. and PC 400 Hranice there was added selected quantity of $BaSO_4$ or $BaCl_2$ (mmol/10g of mixture). Then the model casting of cellular concrete test-bars was carried out and the bars were subsequently hydrothermally cured with 193°C/5h.

For the measurement of volume changes in heated cellular concretes there were cut out micro-bars 6x6x36 mm in size from all mixtures. These were used for taking off temperature influence on length-volume changes. The high-temperature dilatometr model 402 E made by Fa Netzsch was applied with heating speed 5°C/min up to 1000°C. After cooling down to normal temperature, also the final length of the micro-bar after heat processing was read off. The recorded curves were evaluated and processed on the programmable calculator HP 9820A with equipment for diagrams.

RESULTS AND DISCUSSION

Cellular concrete produced from quartz sand Kosice

The "heat nonstabilized" specimen (K1) distinguishes for a very slow shrinkage up to 730°C, after which considerable shrinkage (8 %) is following up to 830°C. No more striking volume changes take place, if further heating on. The shrinkage of K 2 mixture (0.2mmol $BaSO_4$) does not almost differ from the point of starting and final temperature. The difference is only in the amount of shrinkage which increased a little, as the value increased from cca 8% up to 9.2%. A significant reduction of linear shrinkage value took place in K 3 mixture (1.0 mmol $BaSO_4$), as the final value corresponds with 4.1%. The dilatometric curves of given mixtures are evident from fig. 1.

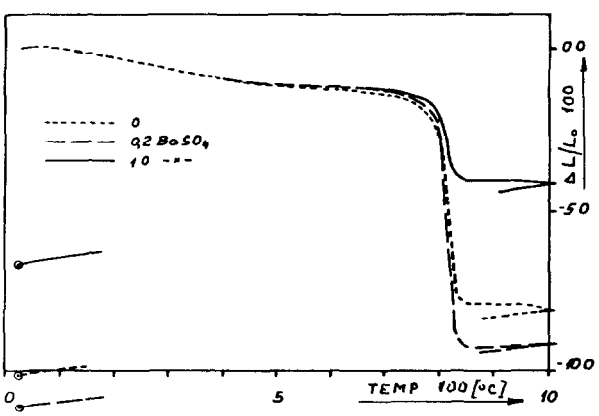

Fig. 1: Dilatometric curves of K 1-K 3 mixtures

The K 4 specimen containing 0.5 mmol $BaCl_2$ distinguishes for already relatively a very low shrinkage value which after heating up to 1000°C

corresponds with 3.6%. Then very effective is the additive of increased quantity 1.5 mmol $BaCl_2$ (K 5), as total shrinkage after heating up to given temperature corresponds with 2.1%. Dilatometric curves together with the curve of comparing mixture (without additive) are given in fig. 2.

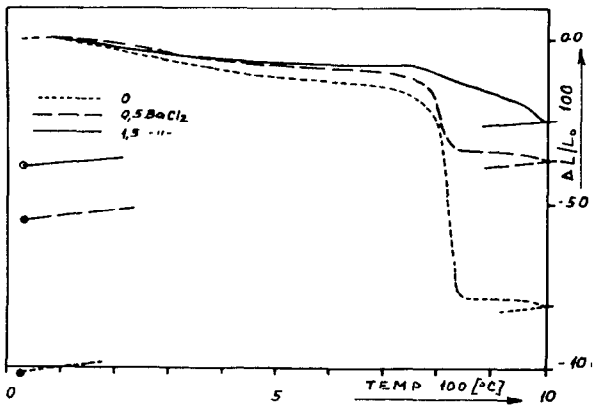

Fig. 2:
Dilatometric curves of K 4, K 5 mixtures

Cellular concrete produced from quartz sand Hrušovany

The H 2 specimen stabilized to 0.2 mmol $BaSO_4$ distinguishes - if compared with H 1 nonstabilized cellular concrete - for a little lower value of linear shrinkage. Only by an increased quantity of the above additive (1.0 mmol) - mixture H 3 the shrinkage became distinctly reduced, as it corresponds with the value of 4% - in the case of referential specimen : 4.8%. The dilatometric curves are given in fig. 3.

In this case the $BaCl_2$ additive does not exert any positive influence from the point of volume changes, as the specimen H 4 (0.5 mmol $BaCl_2$) distinguishes for 8% shrinkage indeed. With higher quantity of $BaCl_2$(1.5mmol) in H 5 mixture the shrinkage significantly decreases (5.0%), however it is a little higher if compared with referential specimen - fig. 4.

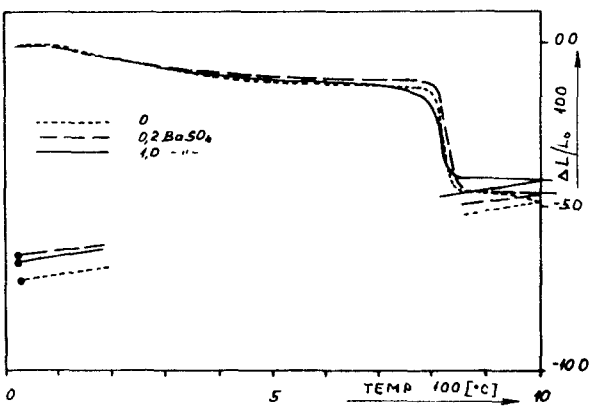

Fig. 3:
Dilatometric curves of H 1-H 3 mixtures

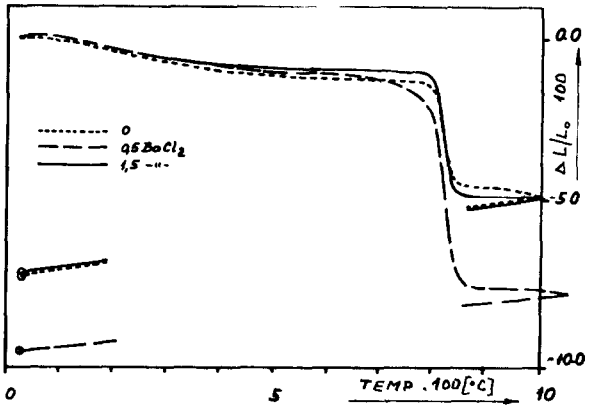

Fig. 4:
Dilatometric curves of H 4, H 5 mixtures

CONCLUSIONS

The dilatometric measurements of pure binding phases are of informative significance for practical application respecting specimen preparation by pressing. In two types of cellular concrete it is possible, if following linear shrinkage, to determine for which raw material mixture is the effect of barium additive positive and therefore which type of cellular concrete is more fitting for heat insulation purposes.

REFERENCES

1 M.Hložek, F. Pospíšil, Proceed. Conf. "Physico-chemical methods and apparatuses in silicate industry", p. 125, Horní Bříza 1974
2 O. Hoffmann, "Binder component properties of autoclaved fibrous building materials", p. 94, PhD thesis, Technical University, Brno 1977
3 O. Hoffmann, Z. Šauman, "Thermal stabilization study of 11 Å-tobermorite", p. 17, Res. Report for INTONG Co. Sweden, VÚSH Brno 1977
4 O. Hoffmann, Z. Šauman, Proceed. "Termanal 79", p. 125, Vysoké Tatry 1979
5 O. Hoffmann, Proceed. 2nd Conf. Dilatometry, p. 57, ČSVTS, Praha 1983