# An improvement of the test method to measure autogenous shrinkage in concrete at early-age

무하마드 나씨르 아민* 김 정 수** 김 진 근***
Muhammad Nasir Amin Kim, Jeong-Su Kim, Jin-Keun

ABSTRACT

An improvement of the test method is proposed to more accurately measure early-age autogenous shrinkage in concrete particularly within first 24 hours after casting. Experiments were conducted considering existing and improved method. In improved method, hydration temperature was artificially controlled to prevent thermal deformations. Test results indicate that the autogenous shrinkage calculated by existing approach is underestimated which might be due to the wrong assumption of considering the thermal dilation coefficient to be constant (equal to 10 x $10^{-6}$/°C) at early-age. We recommend that the proposed method should be adopted to better assess precise value of autogenous shrinkage or an appropriate method of determining the time-evolution of thermal dilation coefficient be considered.

## 1. Introduction

Recently, the demand of high strength and high performance concretes has been largely increased worldwide. Despite of their superior properties (high strength, reduced porosity and permeability) compared with conventional concrete, there seems to be a significantly increased tendency towards early-age crack development, which has been attributed to autogenous shrinkage[1].

The durability of high strength and high performance concretes is a major concern of most design engineers. The durability performance of concrete is significantly affected by the shrinkage-induced cracking. Therefore, it is essential to assess the precise value of autogenous shrinkage to accurately evaluate the cracking risk. In this paper, existing test method of autogenous shrinkage is improved and the test results are presented to demonstrate its significance.

## 2. Experiment

### 2.1 Materials and mixture proportions of concrete

Ordinary Portland Cement (OPC) ASTM Type-I and silica fume were used as cementitious

* 한국과학기술원 건설및환경공학과 박사과정
** 정회원, 한국과학기술원 건설및환경공학과 박사후연구원
*** 정회원, 한국과학기술원 건설및환경공학과 교수

materials. Two types of concrete were used with water-to-cementitous materials ratio of 0.4 without and with 5% silica fume.

2.2 Test method

Autogenous shrinkage was measured by existing and improved test method by following the standard test procedure. In the improved test method, hydration heat was suppressed by using environmental chamber to artificially control hydration temperature in concrete specimen.

## 3. Results and discussion

Fig.1 illustrates that the autogenous shrinkage calculated by existing method is underestimated by 20 and 35 $\mu m$ at 48 hours for concrete with w/cm ratio of 0.4 without and with 5% silica fume, respectively.

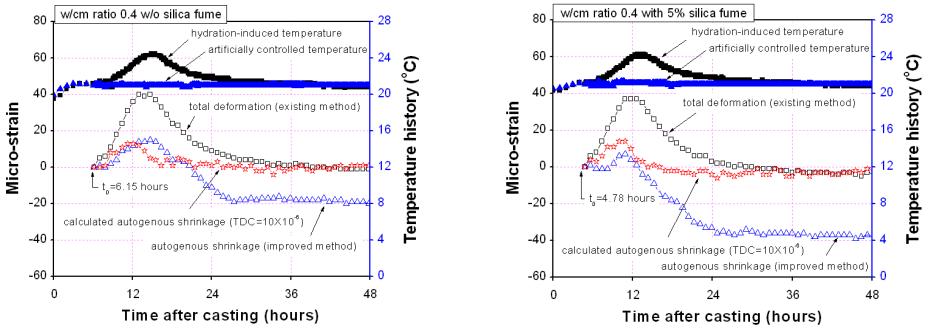


Fig. 1 Comparison between autogeneous shrinkage measured by existing and improved methods

## 4. Conclusions

The main conclusions drawn from this study are as follow:

1) Autogenous shrinkage of concrete at early-age can be measured accurately by artificially controlling the hydration temperature of concrete specimen with the help of environmental chamber.
2) The most commonly adopted method of subtracting thermal deformations from total deformation should not be solely based on an assumed value of thermal dilation coefficient. An accurate determination of time-evolution of thermal dilation coefficient be considered to improve existing test methods of autogenous shrinkage.


## Acknowledgements

This study was part of a research project supported by the Research Group for Control of Crack in Concrete under the Korea Science and Engineering Foundation.


## References


1. E.E. Holt and M.T. Leivo, "Autogenous shrinkage at very early ages", Proceedings of International Workshop on Autogenous Shrinkage of Concrete, Edited by E. Tazawa, Hiroshima, Japan, E & FN Spon, 1998, pp. 135-142.