

# EXPERIMENTAL STUDY AND NUMERICAL SIMULATION OF THE DISSOLUTION OF BLAST FURNACE SLAG IN ALKALINE SOLUTION

Yibing Zuo, Faculty of Civil Engineering and Geosciences, Delft University of Technology  
Y.Zuo@tudelft.nl

Guang Ye, Faculty of Civil Engineering and Geosciences, Delft University of Technology

**Key Words:** dissolution, blast furnace slag, alkaline solution, numerical simulation, real-shape particle.

Geopolymers are formed by the reaction between an alkaline activator and an aluminosilicate precursor. As any cement-based materials, the reaction starts from the dissolution of aluminosilicate precursor in the alkaline solution. The dissolution kinetics of aluminosilicate precursor determines the reaction kinetics and strength development of geopolymers. In this study, the dissolution of blast furnace slag in alkaline solution will be investigated experimentally and numerically.

In the experimental program, 0.1 gram of blast furnace slag is dissolved in 200 mL of alkaline solution. During the dissolution experiments, the solution is sampled at set time intervals up to 2 hours. The sampled solution is subject to the analysis by the means of inductively coupled plasma-optical emission spectrometry (ICP-OES), by which the concentrations of Ca, Si and Al are determined as functions of time. By studying the concentrations of Ca, Si and Al with time, the influence of the alkalinity of alkaline activator on the dissolution of blast furnace slag are investigated and the dissolution rates of Ca, Si and Al are determined. Furthermore, the relationship between the alkalinity of alkaline solution and the dissolution rates are studied, and the dissolution rate constants are determined.

In the numerical simulation, the dissolution of blast furnace slag in alkaline solution is simulated using real-shape particles of slag [1]. The irregular shape of blast furnace slag is characterized by spherical harmonic series [2]. The Lattice Boltzmann method is used to simulate the transport of aqueous ions and the dissolution rate constants obtained by the experiments are used as input to model the dissolution of blast furnace slag. The numerical model is first applied to simulate the dissolution of blast furnace slag carried out in the experimental program. After validation with the experimental results in terms of elemental concentrations with time, this numerical model is used to study the influence of slag chemistry and temperature on the dissolution of blast furnace slag in alkaline solution.