HEAT OF HYDRATION BY INVERSE METHOD

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INTRODUCTION

Numerous laboratory techniques have been developed for determination of the heat of hydration of cement based materials, ranging from sophisticated (micro)calorimeters to (semi-)adiabatic temperature measurements at the centre of a large insulated block of representative sample. Determining the heat of hydration of cement material will enable, in practice, the realistic simulation of temperature distribution in material and easier planning of curing in the early stage of hydration with the purpose of achieving better durability and functionality of placed material.

METHODOLOGY

By solving a system of partial differential equations by a method of finite difference, beside material temperature distribution, a sensitivity of the developed method regarding the assumed function. A computer code for solving the inverse problem is written in MATLAB®. This paper examines the hydration of commercial aluminate cement (AC) ISTRA 40 (producer: Istra Cement, Pula; Croatia) of cement material will enable, in practice, the realistic simulation of temperature distribution in material and easier planning of curing in the early stage of hydration with the purpose of achieving better durability and functionality of placed material.

CONCLUSION

The novel calorimetric method is based on the inverse method implementation for determination of heat generation from known (measured) material temperature distribution by solving transient heat conduction problem. The advantages of developed calorimetric method are: direct estimation of term \( q/\lambda \) = heat generation/thermal conductivity \((Wm^{-3})(Wm^{-1}K^{-1})\), robustness to thermal diffusivity measurement uncertainty, the knowledge of boundary condition and determination of heat loss from actual measurement. Moreover, the simple experimental technique which measures representative samples in isothermal and semi-adiabatic conditions enables the investigation of the temperature dependence of physico-chemical hydration processes. The evolution of thermal conductivity and diffusivity is possible to determine by dynamic methods and can be used for determination of heat generation and temperature distribution in cement based material. The heats of hydration determined by the developed method agree with literature data and differential micro-calorimeter method.

Reference