MODELING AUTOGENOUS SHRINKAGE IN HYDRATING CEMENT PASTE

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Autogenous deformation is a phenomenon that origins in chemical shrinkage during the cement hydration. The physical mechanism is the consumption of capillary water during the hydration and the refinement of capillary porosity. The microscopic underpressure due to thermo-dynamical equilibrium in a pore exerts the negative pressure on the solid skeleton of the paste. This behavior is simulated by means of FEM, where the microstructure of cement paste is loaded directly by underpressure. Validation shows that creep of the cement paste must be also taken into account when good quantitative prediction is expected.

Key words: *autogenous deformation, cement paste*

1. Introduction

The attention to the problem of autogenous shrinkage has been driven by two major developments in the last decades: introduction of high performance concrete (HPC) and extreme curing conditions. The HPC is characterized by a very compact microstructure, which results from a low water content. As a consequence of hydration, the capillary pores are small and the amount of water is insufficient for proper hydration. In addition, superplasticizers and silica, which enhance properties such as workability or strength, are typically found in HPC. In such materials, higher autogenous shrinkage has been observed. Early-age cracking and material deterioration are caused by excessive shrinkage in early ages of hydration, when the material has a very low tensile strength and can not withstand such loading conditions.

Several terms will be used in the article and to avoid confusion, the terminology will be defined as:

degree of hydration is the fraction of hydrated cement, excluding the derivates of gypsum. The final value does not have to reach one, when the space for hydration products is not available or hydration is ceased by a lack of water,

chemical shrinkage occurs due to lower volume of hydrates than reactants (cement + water + + silica + gypsum) and is linked directly to hydration. The consumption of water may be calculated with a great accuracy from the degree of hydration and cement composition,

self-dessication is linked directly with chemical shrinkage and occurs when water can not be supplied from external sources or the capillary pores form a closed system where external water can not penetrate,

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