



## Recent advances in the field of cement hydration and microstructure analysis

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### ARTICLE INFO

#### Article history:

Received 23 March 2011

Accepted 31 March 2011

#### Keywords:

Hydration: A

Microstructure: B

Cement: D

### ABSTRACT

This paper is a bibliographic tool reviewing experimental and theoretical studies related to cement hydration and microstructure development that have been published within the four years of the interim period between the 12th and 13th International Congress on the Chemistry of Cement.

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### 1. Introduction

As a contribution to the 13th International Congress on the Chemistry of Cement, the present paper is intended to review theoretical and experimental studies related to hydration of cement and microstructure of hardened cement paste, mortar and concrete. However, other review papers have discussed these subjects recently [224–227,359]. In order to avoid reiteration, it is attempted to provide a more general overview on new data.

The present manuscript is based on relevant studies published in Cement and Concrete Research, Cement and Concrete Composites, Materials and Structures, Journal of the American Ceramic Society, and Advances in Cement Research between 2007 and 2010. A few other publications have been included that were found to be of primary interest. In order to reduce the data to a manageable amount, almost bibliographic completeness has only been preserved in the core fields of this article. Other aspects have been passed in a less detailed manner

and will be discussed thoroughly in other reviews during this congress. Most important are links to thermodynamic and simulation studies, characterisation of binders, rheology and early age properties, diffusion and transport, advances in instrumental analytics, and microstructural modifications induced by the interaction of hardened cement paste with aggressive species upon long term exposition.

Hydration of cement is the combination of all chemical and physical processes taking place after contact of the anhydrous solid with water. Chemical reactions of clinker minerals and mineral admixtures play a major role, but other aspects such as agglomeration, adsorption, evaporation, and release of thermal energy need to be considered as well. Most information on this processes stem from experimental investigations being complemented by simulation studies using theoretical approaches to provide a better understanding of the underlying principles driving the interactions. Section 2 is intended to review such fundamental approaches to cement hydration and microstructure development whereas the focus of Section 3 is set on experimental data on the chemical reactions. Recent experimental results related to properties of the hydration products are included in Section 4. The development of the microstructure is a combination of all physico-chemical interactions described in paragraphs 2 to 4 and Section 5 is devoted to this part of the

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