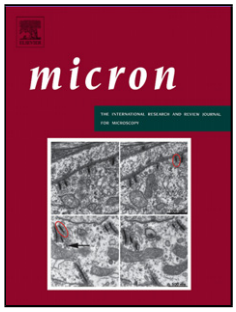

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A contribution to the characterization of the silicate-water interface – Part I: Implication of a new polished sample hydration technique

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Highlights

- AbstractInvestigation of tricalcium silicate by HRSEM and APT
- Polished samples show extended reactivity revealed by both HRSEM and APT
- Prospects of using APT for cementitious materials is given

The analysis of the atomic composition of the interface between tricalcium silicate (C_3S), the main compound of Ordinary Portland Cement, and surrounding solution is still a challenging task. At the same time, that knowledge is of profound importance for describing the basic processes during hydration. By means of Scanning Electron Microscopy (SEM) and Atom Probe Tomography (APT) we combine modern techniques in order to shed light on this topic in the present study. The results of these methods are compared with conduction calorimetry as a standard technique to study the hydration kinetics of cement. The tests were carried out on powders as well as on polished C_3S samples.

Results indicate that the progress of hydration is strongly increased when the C_3S is used in the form of polished specimen. First C-S-H phases are detected in the powder 2.2 h after contact with water, on the polished section after 5 min. Besides SEM, the formation of C-S-H phases can be detected by APT, leading to an advantageous atomic resolution compared to EDX analysis. We propose that the use of APT will lead to deeper insights on the hydration progress and on the composition of the sensitive C-S-H phases based on these first results.

Keywords: Atom probe tomography; tricalcium silicate; cement; hydration

1. Introduction

With an annual world production of up to 15.5 *10^9 tonnes (Ashby, 2009), concrete is by far the most used material today. According to recent prognoses (Barcelo et al., 2014) its use will significantly grow in the next years. Concrete is a composite material which composes of mainly aggregates (gravel, sand) and cement as binder (Neville, 2012). Ordinary Portland cement (OPC) is conventionally used as binder phase, but due to CO_2 emission, alternative cements have a growing importance (Ammenberg et al.; Aranda Usón et al., 2013; Benhelal et al., 2013; Gartner, 2012). Research on the reaction