Poster Presentation

MS74.P02

Hydration Study of Synthetic Yeelimite using LXRPD and SXRPD

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XRPD is a powerful tool for material characterization in general, and for in-situ studies of chemical processes in particular. The use of an intense X-ray source, .i.e. synchrotron X-rays, coupled with fast X-ray detection permits time-resolved diffraction experiments allowing in-situ quantitative phase analysis during the early ages of cement hydration. Calcium sulfoaluminate, CSA, cements may have variable compositions, but all of them contain high amounts of ye'elimite, Ca4Al6O12SO4. Commercial CSA cements have special applications such as high strength developments at early-ages. Ye'elimite is very reactive and most of its hydration heat is released during the first eight hours of hydration . The aim of this work is to better understand the early age hydration of stoichiometric (orthorhombic) and doped (pseudo-cubic) ye'elimite samples. The parameters studied by SXRPD, LXRPD and calorimetry have been: polymorphism; water/ye'elimite ratio; and sulfate (gypsum and anhydrite) contents. This work has allowed establishing mechanisms and kinetics for hydration of ye'elimite samples by in-situ SXRPD with internal standard methodology. Moreover, pastes were also studied by ex-situ LXRPD with the external standard method, G-factor, at 2 and 7 days. Both strategies were able to quantify the amorphous contents, including free water. It is important to highlight that the results obtained at early ages, by the internal standard method, are in agreement with those obtained at later ages, G-method, showing the consistence and complementarity of both methodologies. The hydration of stoichiometric ye'elimite in the presence of gypsum is strongly hastened, when compared to the hydration process without gypsum. However, the presence of gypsum has a little effect in the hydration of doped ye'elimite. Moreover, anhydrite has also accelerated the hydration of stoichiometric ye'elimite, although its lower solubility has provoked the formation of an intermediate phase in the first hours.

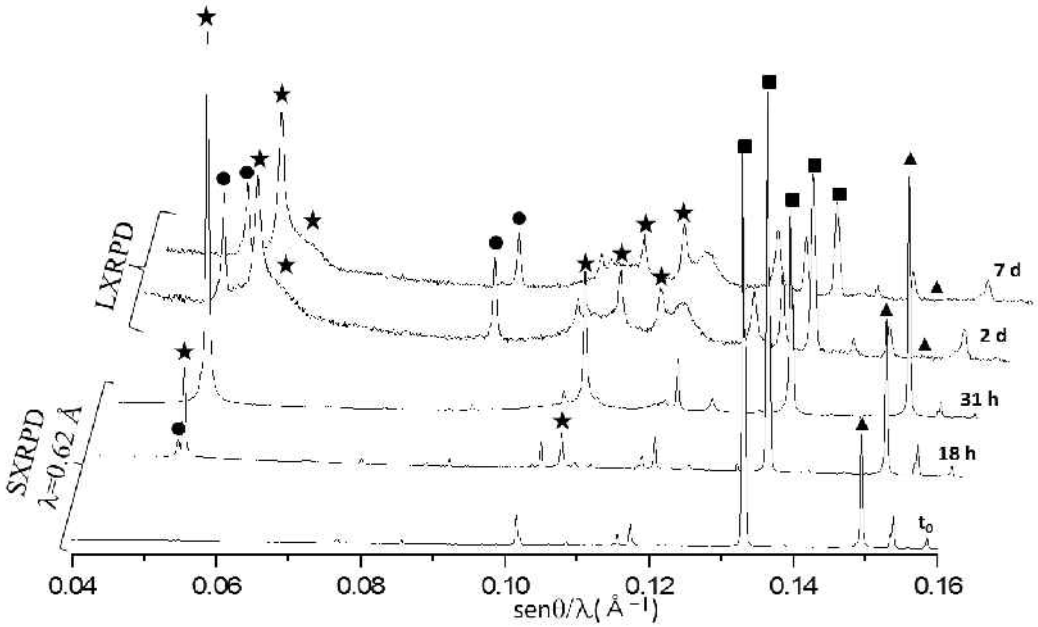

Figure. Selected range of the LXRPD and SXRPD raw patterns for stoichiomtric yeelimite (w/c mass ratio of 1.16) recorded at different ages of hydration, with the main peaks due to a given phase labelled (circle: AFt; star: AFm; square: yeelimite; triangle: quartz)

Keywords: Rietveld quantitative phase analysis, cement hydration mechanism, insitu synchrotron X-ray powder diffraction