'*In-situ* hydration studies of *C_4AF* at early ages *in the presence of other phases* '

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The ferrite phase, C_4AF in cement nomenclature, also called brownmillerite, is the major iron-containing phase in Ordinary Portland Cement (OPC) and in iron rich belite calcium sulfoaluminate cements. The term "ferrite" usually refers to a solid solution with a wide range of composition with the general formula $Ca_2(Al_yFe_{2-y})O_5$, where y can vary from 0 to about 1.33 [1]. In cement chemistry the ideal composition C_4AF ($4CaO \cdot Al_2O_3 \cdot Fe_2O_3$), is used to describe the ferrite phase in Portland cement.

The hydration of pure brownmillerite with water initially forms metastable C-(A,F)-H hydrates which eventually convert to a hydrogarnet phase $C_3(A,F)H_6$ (katoite) over time. The addition of calcium sulfates to C_4AF inhibits the direct hydration of C_4AF to $C_3(A,F)H_6$. Ettringite (AFt) is the most commonly hydration product observed under these conditions. In addition, ettringite could decompose to an AFm monosulfoaluminate hydrate [2].

The aim of this work is to better understand the early age hydration of tetracalcium aluminoferrite phase in the presence of other phases at early ages in order to understand "eco-cement" performances. Chiefly, we want to determine the hydration kinetic and mechanisms of this phase using different reaction media.

Firstly, C_4AF in the presence of water hydrates to form mainly a hydrogarnet-type phase $C_3(A,F)H_6$. The hydration of ferrite with w/s ratio of 1.0

yielded $C_3A_{0.84}F_{0.16}H_6$ as single crystalline phase. Its crystal structure has been determined by the Rietveld method. Figure 1 shows the Rietveld synchrotron X-ray powder diffraction plot for this sample.

Secondly, we have observed that the presence of sulfates strongly modifies ferrite hydration behavior. The hydration of C_4AF in the presence of gypsum gives AFt and, once gypsum is completely dissolved, crystalline AFm starts to precipitate. Figure 2 shows a selected range of the SXRPD raw patterns for C_4AF_st-$C_4A_3\underline{S}$-g-1.0 (sample with C_4AF, gypsum and ye'elimite) recorded at different time of hydration, with the main peaks due to a given phase labelled.

Finally, the effect of w/s ratio has also been studied for this sample. Results indicate that higher amounts of water favour the formation of AFm. A summary of the results for the hydration of C_4AF will be discussed.

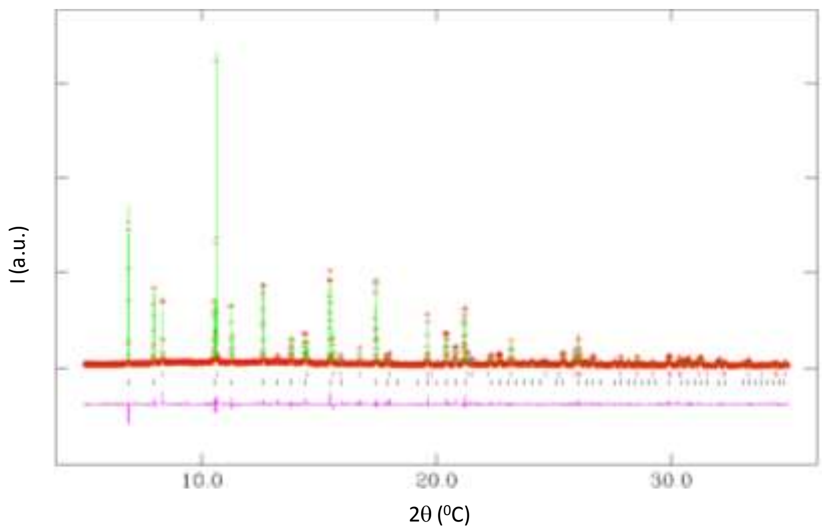

Figure 1. Rietveld Synchrotron X-Ray Powder Diffraction plot for $C_3A_{0.84}F_{0.16}H_6$. The tic marks are the Bragg reflections: $C_3A_{0.84}F_{0.16}H_6$ (lower row); Quartz, internal standard (upper row).

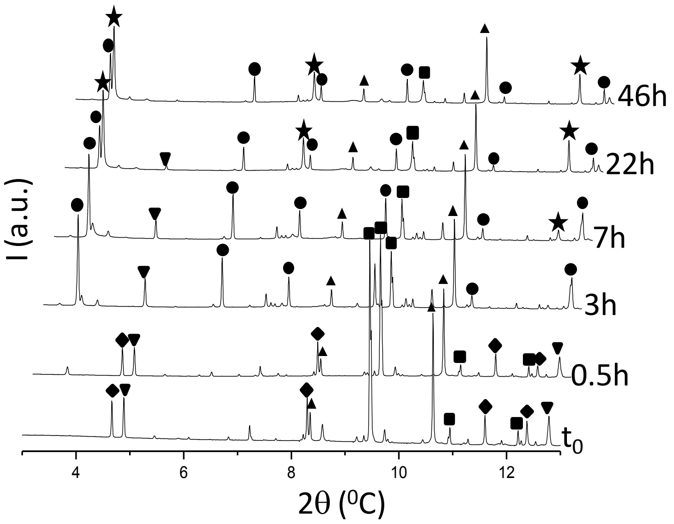

Figure 2. Selected range of the SXRPD raw patterns for *C_4AF with ye'elimite and gypsum (w/s=1.0)* recorded at different time of hydration, with the main peaks due to a given phase labelled. AFt: circle; AFm: star; Qz: triangle; gypsum: rhombus; C_4AF: inverted triangle and *ye'elimite*: square.

REFERENCES

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Cement nomenclature: C=CaO, A=Al_2O_3, F= Fe_2O_3, $\underline{S}$=SO_3 and H=H_2O.