

**Experiment title:**

INFLUENCE OF SUPERPLASTICIZERS ON THE HYDRATION KINETICS OF C3A

Experiment number:

CH-2783

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Names and affiliations of applicants (* indicates experimentalists):

Prof. ARTIOLI Gilberto* / Dipartimento di Geoscienze, Università di Padova, Via Giotto 1, I-35137 Padova, Italy

Dr. DALCONI Maria Chiara* / Dipartimento di Geoscienze, Università di Padova, Via Giotto 1, I-35137 Padova, Italy

Dr. CELLA Fiorenza*/ Analytical Laboratory, MAPEI S.p.A., via Cafiero, 22, I-20158 Milan

Dr. LO PRESTI* Arianna / Analytical Laboratory, MAPEI S.p.A., via Cafiero, 22, I-20158 Milan

Dr. MONTAGNINO Daniela* / Dipartimento di Scienze Mineralogiche e Petrologiche, Università degli Studi di Torino, Via Valperga Caluso 35-37, I-10125 Torino

Report:

Organic admixtures are commonly used in cement as superplasticizers agents. They modify the paste rheological properties in the first part of the hydration process, allowing at the same time workability and water reduction. Besides enhancing fluidity they also influence the kinetic of the chemical reactions occurring during hydration (Taylor, 1997). To investigate the specific influence of admixtures on the aluminat phases present in Portland and aluminat clinkers we performed time resolved XRD measurements on the following samples:

- C3A-Gypsum-H₂O (C3A/Gypsum = 70/30; w/c = 1)

- C3A-Gypsum-H₂O with different admixtures (C3A/Gypsum = 70/30; w/c = 1; 1% admixture)

Tested admixtures are novel generation poly-carboxylic-acid esthers based polymers with different molecular weights. Paste samples were sealed between two flat kapton foils and measured in transmission mode using a translating image plate detector. Room temperature diffraction data were continuously recorded during the first hour, then the hydration process was followed up to 30 hours taking snapshots at different times for each sample. Qualitative inspection of the diffraction patterns evidences the formation of ettringite, followed by AFm-14 and calcium aluminat hydrates (C₄AH₁₉) (Figure 1) in all the containing admixtures samples. Rietveld full profile quantitative phase analysis was hampered by the lack of suitable structure models for AFm-14 and C₄AH₁₉. The relative time evolution of each phase was followed by means of a Rietveld-type refinement using approximate structure model derived from the reported crystal structure of monosulphate (ICSD#100138; Allmann, 1977). Figures 2 and 3 show that the system evolution during hydration is significantly affected by the presence of different polymers. Admixture systems containing SP3 and SP1-5000 are characterized by higher rate of C3A hydration (Figure 2a) accompanied by ettringite (Figure 2b) and AFm-14 formation (Figure 3a). The presence of SP1 seems to hamper the amount of ettringite and to favour the formation of AFm-14 and C₄AH₁₉. The occurrence of calcium aluminat hydrates may be related to the formation of sulphate-rich amorphous phases depleting sulphate ions from the pore solution.

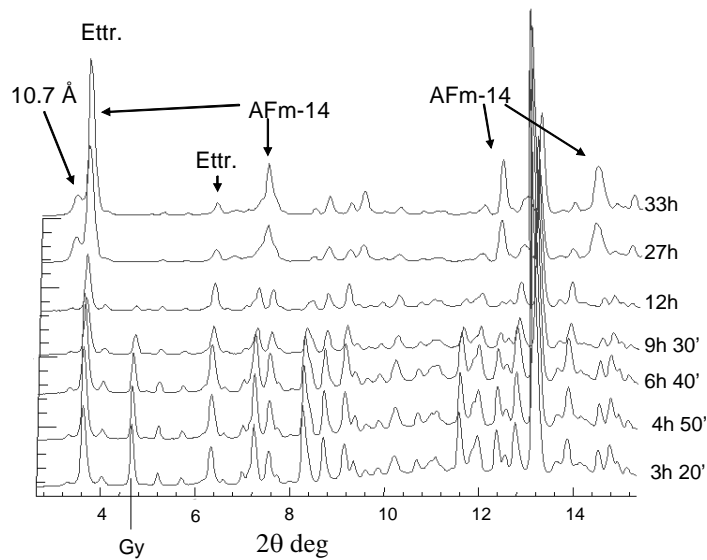


Figure 1. X-ray powder diffraction patterns obtained by integration of 2D image plate ($\lambda=0.619921 \text{ \AA}$). Main reflections of hydrated phases are indicated; remaining peaks belongs to C3A, C12A7 and CA. The 10.7 \AA peak is referred to an hydrous phase (C_4AH_{19} or C_2AH_8).

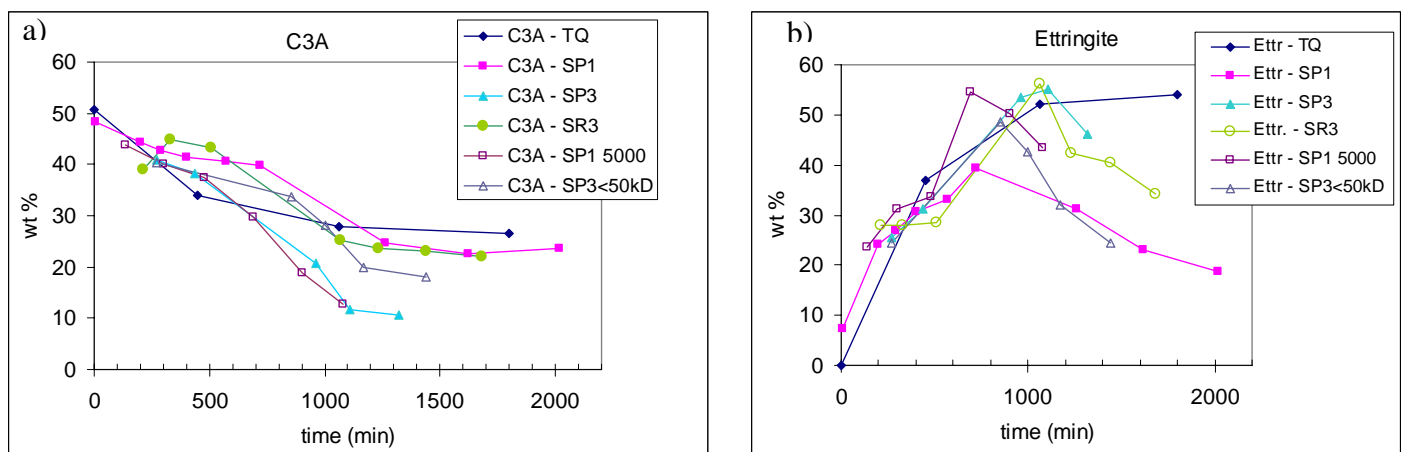


Figure 2. Plot of C3A and ettringite evolution during the hydration of C3A-gypsum mixtures with different poly-carboxylic-acid esthers based polymers. TQ indicates the reference sample prepared with pure water.

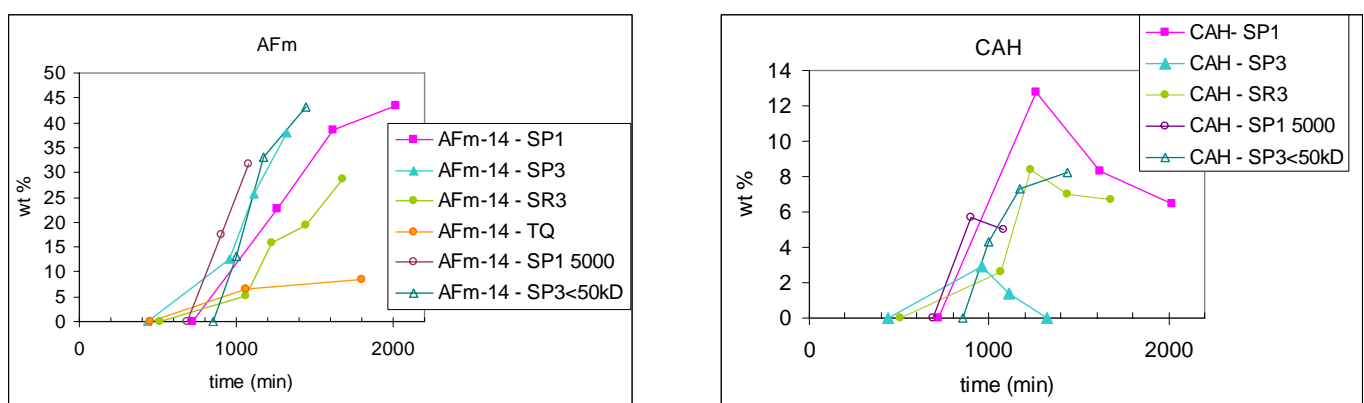


Figure 3. Plot of the AFm-14 and calcium aluminate hydrate evolution during hydration of C3A-gypsum mixtures with different poly-carboxylic-acid esthers based polymers. TQ indicates the reference sample prepared with pure water. In TQ sample no calcium aluminate hydrate was detected.

References

- Taylor H. F. W. (1997) *Cement chemistry*. 2nd edition. Thomas Telford, London.
 Allmann R. (1977) *Neues Jahrbuch fuer Mineralogie*, 136-144.