

IN-SITU HYDRATION STUDY OF SULFOBELITE ECO-CEMENTS.

G. Álvarez-Pinazo¹, A. Cuesta¹, M. García-Maté¹, I. Santacruz¹, E.R. Losilla¹, S.G. Sanfélix², F. Fauth³, M.A.G. Aranda^{1,3}, A.G. De la Torre¹.

¹ *Departamento de Química Inorgánica, Cristalografía y Mineralogía, Universidad de Málaga, 29071 Málaga, Spain.*

² *Unidad Técnica de Investigación de Materiales, AIDICO, Avda. Benjamín Franklin, 17 Paterna, Valencia, Spain.*

³ *CELLS-ALBA synchrotron radiation facility, Ctra. BP1413 km 3.3, 08290 Cerdanyola del Vallès, Barcelona, SPAIN*

g_alvarez@uma.es

OPC, is a very environmentally contentious material as for every tone of cement produced, 0.97 tons of CO₂ are released to the atmosphere. New binders are being investigated for reducing these emissions. Sulfobelite cements are a promising alternative as 30-35% of CO₂ emission reduction can be attained. However, the hydration chemistry and durability of the mortars and concretes derived from these ‘eco-cements’ must be profoundly studied and characterized. The hydration reactions have been studied in pastes prepared at a fixed water-to-cement ratio of 0.55 but variable calcium sulfate carriers (gypsum, bassanite and anhydrite (type-II)). The analysed samples were: 1) laboratory sulfoaluminate cement without any activation (phase assemblage β -belite, ye’elimite and aluminoferrite), hereafter B0 and 2) laboratory sulfoaluminate cement activated with boron and sodium (phase assemblage α _H-belite, ye’elimite and aluminoferrite), hereafter B2 [1]. Samples have been mixed with 10 wt% of different calcium sulfate carriers: gypsum (G10), bassanite (B10) and anhydrite (A10) to prepare the final cements. All cements were hydrated and SXRPD patterns were collected with time. Figure 1 shows, as an example, SXRPD patterns as a function of time of G10B0 and G10B2. The first interesting result was the difference in reactivity of ye’elimite with gypsum. After 5 hours of hydration gypsum was completely dissolved to give ettringite in the G10B0 while in the active cement gypsum needs more than 10 hours to completely dissolve.

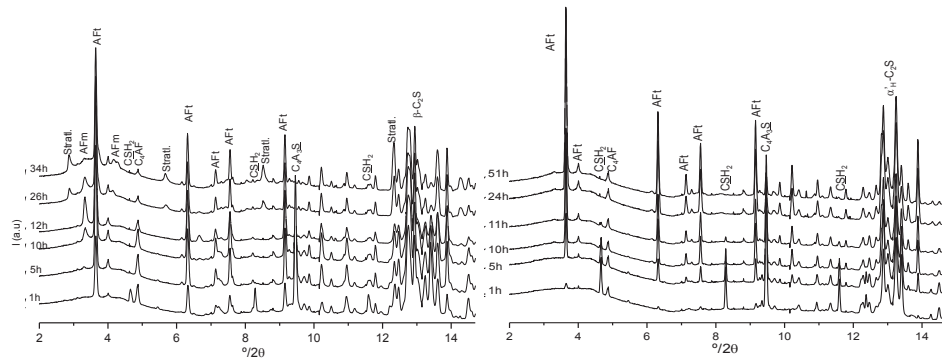


Figure 1. SXPDP patterns of sulfobelite cement (G10B0) and active sulfobelite cement (G10B2) as a function of time hydrated. Main peaks due to a given phase have been labeled.

Moreover, non-active cement present a much more complicate crystalline phase assemblage in the first hours of hydration, with the crystallization of laminar phases, such as stratlingite or AFm [2]. It is well known that anhydrite

kinetic dissolution is much slower than that of gypsum or bassanite, and it has been experimentally observed in this study (Fig. 2). For A10B2 paste, the precipitation of ettringite is limited by CS_2 dissolution, which starts to be significant up to 7 hours.

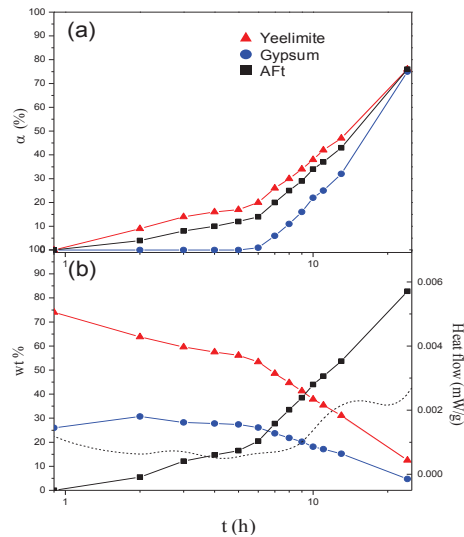


Figure 2. Time evolution for A10B2 hydration of (a) degree of reaction [α] of each phase and (b) normalized direct RQPA results and the calorimetric heat flow curve (dashed line).

REFERENCES

- [1] G. Álvarez-Pinazo, A. Cuesta, M. García-Maté, I. Santacruz, E.R. Losilla, A.G. De la Torre, L. León-Reina, M.A.G. Aranda, *Cem. Concr. Res.* **42** (2012) 960.
- [2] S. Berger, C.C.D. Coumes, P. Bescop, D. Damidot, *Cem. Concr. Res.* **41** (2011) 149.