In-situ Molibdenum X-ray powder diffraction study of the early hydration of cementitious systems on a humidity chamber

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The durability of cement-based construction materials depends on the environmental conditions during their service life. A further factor is the microstructure of the cement bulk, established by formation of cement hydrates. The development of the phases and microstructure under given conditions is responsible of the high strength of cementitious materials. The investigation on the early hydration behavior of cements and cementing systems has been for a long time a very important area of research: understanding the chemical reactions that lead to hardening is fundamental for the prediction of performances and durability of the materials.

The production of 1 ton of Ordinary Portland Cement, OPC, releases into the atmosphere ~0.97 tons of CO_2. This implies that the overall CO_2 emissions from the cement industry are 6% of all anthropogenic carbon dioxide. An alternative to reduce the CO_2 footprint consists on the development of eco-cements composed by less calcite demanding phases, such as belite and ye'elimite. That is the case of Belite-Ye'elimite cements (BY). Since the reactivity of belite is not quick enough, these materials develop low mechanical strengths at intermediate hydration ages. A possible solution to this problem goes through the production of cements which jointly contain alite with the two previously mentioned phases, named as Belite-Alite-Ye'elimite (BAY) cements. The reaction of alite and ye'elimite with water will develop cements with high mechanical strengths at early ages, while belite will contribute to later values.

The final goal is to understand the hydration mechanisms of a variety of cementing systems (OPC, BAY and pure phases) as a function of water content, superplasticizer additives and type and content of sulfate source. In order to do so, in-situ laboratory humidity chambers with Molybdenum X-ray Powder diffraction are employed. In the first 2h of hydration, reaction degree (α) of ye'elimite had been decreased for superplasticizer.

Keywords: In-situ humidity Chamber, Molybdenum X-ray Powder Diffractions, Early age hydration