Early hydration study of standard and doped Alite-Belite-Ye'elimite (ABY) cements through Synchrotron Radiation

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The manufacturing of ye'elimite-rich cements releases from 15 to 37%, depending on their composition, less CO_2 to the atmosphere than ordinary Portland cement (OPC). BYF cements containing belite, ye'elimite and ferrite as main crystalline phases, are promising eco-friendly binders. Nevertheless, belite, its main phase, shows a slow hydrating behaviour and the mechanical strengths are lower than OPC at early ages. Some alternatives to solve this problem are: i) forming alite jointly with belite and ye'elimite during clinkering, Alite Belite Ye'elimite (ABY) clinkers. The hydration of alite and ye'elimite would develop high mechanical strengths at early ages, and belite contributes to later curing times; ii) a second alternative is the stabilisation of alpha forms of belite using dopants such as boron named here after dABY.

In this work, two different types of ABY clinkers (standard and doped) have been prepared and characterized to understand their different hydration mechanisms at the same water-to-cement (w/c) ratio. The clinkers have been prepared using CaF_2 and ZnO as mineralizers, and borax as dopant agent to stabilize alpha forms of belite (α'_H-C_2S). Afterwards, 14 wt% of anhydrite (as soluble sulphate source) was added to prepare the corresponding cements. Finally, the hydration study was performed at w/c ratio of 0.5. Here, an in-situ hydration study using synchrotron X-ray powder diffraction (SXRPD) for the first 14 hours of hydration is reported. Moreover, these results will be combined with the ex-situ laboratory X-ray powder diffraction study (LXRPD) at 1 day of hydration and calorimetric results. Rietveld quantitative phase analysis has been used to establish the phase evolution across the time.

Keywords: clinkering, hydration properties, ABY cements, mineralogical behaviour, Rietveld quantitative phase analysis, synchrotron radiation.