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Water-to-cement ratio influence on low-carbon cements performances

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ABSTRACT

Ordinary Portland Cement (OPC) is the most important active ingredient in most the construction concrete. However, the OPC production is associated with a high carbon dioxide release (around 1 ton of CO_2 per ton of OPC). One approach to reduce CO_2 emissions consists on the reformulation of the clinker with less calcite demanding phases, such as, belite rich clinkers. The drawback of this kind of clinkers is the low reactivity of belite (beta-belite). In orden to compensate this problem, belite rich clinkers can be prepared with ye'elimite and ferrite or with alite [knowns as belite-ye'elimite-ferrite (BYF) and belite-alite-ye'elimtie (BAY), respectively]. In addition, it can be improved by using a high reactive belite polymorph, such as alpha-belite. In this work, the hydration and mechanical behavior of BYF and BAY cements (with beta and/or alpha-belite) with different water-to-cement ratios have been studied. The clinkers were produced using natural raw materials, and were mixed with anhydrite to prepare the corresponding cements. At early ages the main hydration products of these cements were ettringite, calcium monosulfoaluminate and amorphous aluminium hydroxide. At later ages, stratlingite, katoite and amorphous C-S-H were found. The compressive strength values of the corresponding mortars were correlated with the mineralogy evolution of the pastes (obtained by XRD, TGA and MAS-NMR), includingthe katoite/stratlingite ratio.

KEYWORDS

belite-ye'elimite-ferrite cement (BYF), belite-alite-ye'elimite cement (BAY), katoite/stratlingite ratio, water/cement ratio, compressive strength.