

Advances in understanding belite ye'elinite ferrite (BYF) cements

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ABSTRACT

In the last years, cement industry and academia progressed substantially in scientific understanding of belite-ye'elinite-ferrite (BYF) cements, a new, low CO₂ cement type primarily based on belite and ye'elinite. Industrial by-products were used as main raw materials for clinker production. It was possible to replace traditional raw materials, i.e. bauxite and limestone to high extents or even fully by industrial by-products. One limiting parameter, for the substitution of these materials by industrial by-products, is the required ratio of silicon oxide over aluminium oxide in the raw mill and the targeted belite and ye'elinite content of the clinker.

The effect of the clinkering process on mineral formation and clinker reactivity has been investigated. Through a number of semi-industrial and industrial scale clinker production and cement grinding trials, a solid understanding has been developed on the key chemical/mineralogical parameters and process that determine clinker and cement performance. Additionally, the formation of ternesite was controlled thanks to special applied sintering procedure and/or kiln atmosphere. Ternesite, which is usually assumed to be inert, has shown reactivity potential when it is a part of calcium sulphoaluminate clinker.

Under given conditions, burning processes lead to variable clinker reactivity and sometimes to an uncontrollable early hydration. The presence of small amounts of mayenite (C₁₂A₇) in Fe-rich clinkers has shown to be responsible at least at lab scale of the kinetic variability of clinkers.

Through variations of the belite to ye'elinite ratio in the clinker, the level of sulfate addition and selection of the retarder and its dosage, the mortar and concrete workability and hardening characteristics can be controlled in a wide range. The very high early strength of BYF makes it a very favourable cement for pre-cast applications. Together with its very low shrinkage properties, BYF is also well suited for a wide range of other applications such as fast repair concrete or many mortar formulations, e.g. tile adhesives, screeds or repair mortars.