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Reducing the clinker factor in vitrified bauxite residue-containing ternary blended cements

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ABSTRACT

In the present study, we investigated the potential of high volume incorporation of vitrified bauxite residue (VBR, produced via the partial vitrification of the Bayer's process alumina digestion residue) in ternary blends with limestone, mimicking systems that would classify as CEM II/B-M (70 wt% OPC), CEM II/C-M (55 wt% OPC) and CEM VI (40 and 35 wt% of OPC), according to EN197-5. With increasing contents of VBR, the early-age strength of mortars decreased from 25 to 7 MPa; however, more than 40 MPa were reached after 28 d for all systems. This strength gain over time demonstrates the high reactivity of VBR, a notable synergy between limestone and VBR, and ultimately, the possibility to significantly reduce the OPC content to as low as 35 wt% without compromising in late strength. Even with the lowest OPC content, a remarkable strength activity index (SAI) of >70 % was reached after 28 d. Sulfate optimisation led to an increase in early strength and approximately 20 MPa (SAI of 60 %) was reached in a CEM VI-type system with 35 wt% OPC, 15 wt% limestone and 50 wt% of VBR.