Re-examining the potential of calcium sulphaaluminate cements from the perspective of versatility, durability and GHG emission

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It is, by and large, widely believed that no spectacular advances have taken place in new cement systems during the last few decades, barring the development of calcium sulphaaluminate (CSA) cements showing some promise of success. The indication of success is not only due to the fact that the CSA cements can be made and used like normal Portland cements, but also by virtue of their applicational versatility, newer dimension of durability and appreciable reductions in the emission of green house gases in their manufacture. The properties of CSA cements score over the Portland cement properties in respect of wider opportunities of tailor-making, higher corrosion resistance of rebars despite low alkalinity, good strength development at low temperatures, etc. Further, the rheology of CSA cement mortar and concrete differs from that of Portland cement based materials but still it opens up the possibility of making near-SCC formulations. This paper is an attempt to capture the relevant data and information published in the literature and generated in the course of the author’s research in the field for reassessing the potential of CSA cements as a new eco-friendly, durable and versatile family of binders.

Keywords: Calcium sulphaaluminate, belite, durability, self-consolidating concrete, low-temperature cement.

Problems of sustainability, environmental pollution and greenhouse gas emission have been continuing as major concerns of the cement industry all over the world. The major factor of the enthalpy change in the Portland cement clinker formation is the decomposition of calcite ultimately leading to the formation of C₃S or alite and a large saving could be achieved if the proportion of belite in the clinker could be appreciably increased. This concept can be of effective practical value, if the belite can be rendered more reactive or if its low reactivity is compensated by including a more reactive phase such as the calcium sulphaaluminate (C₄A₃S). Since the first approach of making the belite hydraulically more reactive is still in the realm of laboratory-scale experiments, the second approach of producing a rapid-hardening cement with good strength development has turned out to be practically feasible in making the new generation of CSA cements, which have been extensively covered in almost all previous reviews on special cements.¹⁻⁷

Although the interest in CSA cements is on the increase for specialised applications, where high early strengths, self-stressing or shrinkage-compensating properties are made use of, their wider applications in general construction are primarily limited to China.⁸ The CSA cements are also produced commercially in India but the cements are used for various value-added grouting formulations and not for general construction purposes, although experimental structures have been built by the author’s erstwhile R&D team as detailed later in the paper.

The present article attempts to review the status of development of this new cement system and its journey from the laboratory to the market.