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Properties of Ettringite According to Hydration, Dehydration and Carbonation Process

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Abstract : The contradiction between energy consumption, environment protection, and social development is increasingly intensified during recent decade years. At the same time, as avoiding fossil-fuels-thirsty, people turn their view on the renewable green energy, such as solar energy, wind power, hydropower, etc. However, due to the unavoidable mismatch on geography and time for production and consumption, energy storage seems to be one of the most reasonable solutions to enlarge the use of renewable energies. Thermal energy storage (TES), a branch of energy storage solution, mainly concerns the capture, storage and consumption of thermal energy for later use in different scales (individual house, apartment, district, and city). In TES research field, sensible heat and latent heat storage have been widely studied and presented at an advanced stage of development. Compared with them, thermochemical energy storage is still at initial phase but provides a relatively higher theoretical energy density and a long shelf life without heat dissipation during storage. Among thermochemical energy storage materials, inorganic pure or composite compounds like micro-porous silica gel, $SrBr_2$ hydrate and $MgSO_4$-Zeolithe have been reported as promising to be integrated into thermal energy storage systems. However, the cost of these materials, one of main obstacles, may hinder the wide use of energy storage systems in real application scales (individual house, apartment, district and even city). New studies on ettringite show promising application for thermal energy storage since its high energy density and large resource from cementitious materials. Ettringite, or calcium trisulfoaluminate hydrate, of which chemical formula is $3CaO•Al_2O_3•3CaSO_4•32H_2O$, or $C_6AS_3H_{32}$ as known in cement chemistry notation, is one of the most important members of AFt group. As a common compound in hydrated cements, ettringite has been widely studied for its performances in construction but barely known as a thermochemical material. For this study, we summarize available data about the structure and properties of ettringite and its metastable phase (meta-ettringite), including the processes of hydration, thermal conversion and carbonation durability for thermal energy storage.

Keywords : building materials, ettringite, meta-ettringite, thermal energy storage
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