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Hydraulic clinkerless binder on the fluid sulfocalcic fly ash basis

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Abstract

Sulfocalcic fly ash (mostly called FBC fly ash) is formed when a dry process of limestone injection is applied to the desulfurization of flue gases. The hydration of sulfocalcic fly ash results in the formation of an expanding low-strength body. Its volume instability prevents its use as an admixture to the concrete. The mixing of sulfocalcic fly ash, PCC fly ash and $\text{Ca}(\text{OH})_2$ in a presence of a plasticizer gives the possibility to obtain a ternary binder possessing strength values comparable to those of Portland cement (PC). The ternary binder is characterized by a long-term volume stability thanks to the presence of the plasticizer based on polycarboxylates that modifies the habitus of ettringite crystals; the expansion stresses due to the ettringite modification are thus eliminated. The SEM/EDX analyses have revealed that the composition of the amorphous parts does not correspond to that of the C-S-H phase because even Al is present in this phase. It was found, the hydrated ternary binder contains an amorphous C-A-S-H phase, a crystalline ettringite phase as well as residues of crystalline phases (as mullite, quartz, hematite) from the fly ashes. The C-A-S-H phase in the hydrated ternary binder can also be characterized by ^{21}Al MAS NMR as a geopolymer formed by alkaline activation of amorphous parts of ashes under the action of $\text{Ca}(\text{OH})_2$. The hydrated ternary binder is obviously similar to the Roman concrete because it contains an amorphous C-A-S-H phase. The ternary hydraulic binder would be a promising perspective for the use of the sulfocalcic fly ash that is nowadays predominantly deposit in the ash landfills.

Key words

Fly ash; sulfocalcic fly ash; FBC fly ash; clinkerless binder; roman cement; Ca geopolymer

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