THE INFLUENCE OF MAYENITE ADDITIVE ON THE EARLY STAGE HYDRATION OF PORTLAND CEMENT

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Mayenite ($C_{12}A_7$), one of calcium aluminate minerals with C/A=1.7, has stimulated the research interest because of its better accelerator effect-rapid hardening activity [1], oxygen mobility, ionic conductivity and catalytic properties in comparison with the other calcium aluminates [2,3]. $C_{12}A_7$ can be employed as a functional component for OPC to regulate the consumption rate of sulphates, and the amount and type of carbonate phases in hydrated products can be modified. The influence of $C_{12}A_7$ on the compressive strength of mortars mainly relates to its hydration behavior, properties of hydrated products and interactions of hydrated products between $C_{12}A_7$ and primary OPC minerals [4]. For this reason, the main objective of the present work is to determine the influence of mayenite additive on the early stage hydration of Portland cement.

Mayenite synthesis was carried out in two stages: hydrothermal synthesis (4 h, 130 °C) and calcined (1 h, at 350 °C (CA1), 550 °C (CA2) and 900 °C (CA3)) [5]. Samples of OPC were prepared in a laboratory grinding mill by grinding cement clinker (JSC "Akmenes cementas", Lithuania) with a 4.5 % additive of gypsum ("Sigma-Aldrich", Germany) up to S_a = 450 m^2/kg. As these reactions are exothermic, isothermal calorimetry is among the most accurate methods to monitor the global reaction process through the rate of heat production. The synthetic products were added as a partial replacement of OPC at level of 7,5 % by weight of the total cementitious material. Therefore, the water and cement ratio of all OPC samples was equal to 0.5. The microcalorimetric data showed, synthetic calcined additives accelerated the initial reaction (1-3 min) of cement samples because an increase in the maximum heat evolution rate was observed from 0.005 W/g (pure OPC) to 0.1 W/g (OPC with additives). It was determined that, during the initial hydration reaction in the samples with additives, an intensive interaction between mayenite and gypsum proceeded, which led to the formation of ettringite and amorphous aluminium hydroxide. It was examined that after 21-60 min of hydration of samples with additives, CASH or/and monosulphate or/and CAH were crystallized into the products and the hydration mechanism of cement samples was changed. The products were characterized using X-ray powder diffraction, simultaneous thermal analysis.

References

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