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Calcium sulphate anhydrite based composite binders; effect of Portland cement and four pozzolans on the hydration and strength

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ABSTRACT

The strength, hydration products, microstructure and heat of early hydration were investigated on alternative hydraulic green cements based on calcium sulphate anhydrite partially blended with Portland cement and pozzolans. Four pozzolans of different physical and chemical nature, namely a geothermal waste, silica fume, metakaolin and pulverized fuel ash were characterized. The composite binders showed hydraulic behavior. The use of Portland cement favoured the strength, which was also higher with the incorporation of siliceous nanometric pozzolans compared to the micrometric silicoaluminate pozzolans. The nanoparticles enhanced the early hydration and changed the gypsum morphology promoting denser matrices of hydration products. The geothermal waste pozzolan was the most effective, while one of the composites with metakaolin showed formation of ettringite and strength losses. The heat of hydration of the composites was considerably lower than that of the neat Portland cement.

1. INTRODUCTION

Calcium sulphate binders (CSB) based on hemihydrate or anhydrite are attractive due to their low CO_2 emissions and energy requirements. The production of hemihydrate from mineral gypsum requires calcination at less than 150°C, while that of Portland cement (**PC)** requires 1450°C, the latter also involves decomposition of $CaCO_3$ as the predominant raw material; the latter reaction is absent in CSB, making their overall CO_2 emissions considerably lower than PC. Mineral calcium sulphate resources are abundant worldwide, and there also exist multiple sources as byproducts, such as the fluorgypsum (**F**) from the hydrofluoric acid production; in this case, the use of byproducts enhances the environmental advantages of the CSB, as these represent a route to reduce environmental