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Temperature and Admixtures Effects on the Maturity of Normal and Super Fine Ground Granulated Blast Furnace Slag Mortars for the Precast Concrete Industry

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Abstract : Precast concrete element exports are growing in importance in Ireland's concrete industry and with the increased global focus on reducing carbon emissions, the industry is exploring more sustainable alternatives such as using ground granulated blast-furnace slag (GGBS) as a partial replacement of Portland cement. It is well established that GGBS, with low early age strength development, has limited use in precast manufacturing due to the need for early de-moulding, cutting of pre-stressed strands and lifting. In this dichotomy, the effects of temperature, admixture, are explored to try to achieve the required very early age strength. Testing of the strength of mortars is mandated in the European cement standard, so here with 50% GGBS and Super Fine GGBS, with three admixture conditions (none, conventional accelerator, novel accelerator) and two early age curing temperature conditions (20°C and 35°C), standard mortar strengths are measured at six ages (16 hours, 1, 2, 3, 7, 28 days). The present paper will describe the effort towards developing maturity curves to aid in understanding the effect of these accelerating admixtures and GGBS fineness on slag cement mortars, allowing prediction of their strength with time and temperature. This study is of particular importance to the precast industry where concrete temperature can be controlled. For the climatic conditions in Ireland, heating of precast beds for long hours will amount to an additional cost and also contribute to the carbon footprint of the products. When transitioned from mortar to concrete, these maturity curves are expected to play a vital role in predicting the strength of the GGBS concrete at a very early age prior to demoulding.

Keywords : accelerating admixture, early age strength, ground granulated blast-furnace slag, GGBS, maturity, precast concrete
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