

## IMPACT OF SODIUM ALUMINATE ON THE HYDRATION PROCESS OF ALKALI-ACTIVATED GROUND GRANULATED BLAST FURNACE SLAG

Artur Kiiashko, LMT-Cachan, CNRS/Paris-Saclay University, France  
arturkiiashko@gmail.com

M. Chaouche, LMT-Cachan, CNRS/Paris-Saclay University, France  
V. Montouillout, CEMTHI-CNRS, 1D avenue de la Recherche Scientifique, France  
L. Frouin, Ecocem. Ltd.F1, East Point Office Park, IRLAND

In the present investigation, the effect of the presence of highly soluble alumina source (sodium aluminate,  $\text{NaAlO}_2$ ) on Ground Granulated Blast furnace Slag (GGBS) hydration was considered. The GGBS was alkali-activated with sodium hydroxide ( $\text{NaOH}$ ) or sodium carbonate ( $\text{Na}_2\text{CO}_3$ ). The impact on the evolution on the setting time, hydration kinetics and strength development was first considered. In the case of  $\text{NaOH}$ -activated mixes, the presence of the alumina source led to the delay in setting and an extension of the induction period. The alumina additive led then to an extension of the workable time of the binder. For instance the initial setting time was extended from 30 min to more than 6 hours when adding 1% by weight of  $\text{NaAlO}_2$ . The strength development was also significantly improved with addition of  $\text{NaAlO}_2$ , both at early age and long term. In contrast, addition of  $\text{NaAlO}_2$  to the  $\text{Na}_2\text{CO}_3$ -activated mixes led to almost complete cessation of hydration (no measurable strength) within the whole dosage rate interval considered (0.1% to 2% of  $\text{NaAlO}_2$ ). Different techniques were used to investigate the impact of  $\text{NaAlO}_2$  on the hydration products development, including XRD, SEM image analysis and  $^{27}\text{Al}/^{29}\text{Si}/^{23}\text{Na}$  high-resolution NMR spectroscopy. It was found that the presence of the highly soluble alumina source led to rapid precipitation of Afm phases. It is suspected that, due to the low pH level in the case of the  $\text{Na}_2\text{CO}_3$ -activated mixes, the calcium ions are mainly distributed near the slag grain surfaces. The Afm phases may then mainly precipitate on the slag grains leading hydration blockage. Actually only Afm phases and Gaylussite were detected in the case of  $\text{NaAlO}_2$  blended  $\text{Na}_2\text{CO}_3$ -blended mixes.