Composition, glass structure, activation system - there is not only one reactivity of GGBS

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Ground granulated blast furnace slag (GGBS) is a glassy by product of pig-iron production and a common replacement of traditional Portland cement (OPC) in cementitious binders. Its hydration is, however, somewhat slower than that of OPC but large differences exist between different slags. It is commonly accepted that the differences are due to variations in the glass composition.

To investigate the link between composition, glass structure and reactivity in different activation systems, we synthesized 16 slag glasses with differing major oxide composition according to a Taguchi matrix. The glass structure was investigated by time resolved Raman spectroscopy. The reactivity of slag glasses was evaluated by isothermal calorimetry using the R3 test and an alkaline activation using 1M NaOH.

Results show that slags with the most depolymerized glass network are more reactive under alkaline activation. During the R3 test, that mimics the presence of cement, the most depolymerized slags performed less well than slags with the highest Al_2O_3 content, even though Al is a network former in GGBS. This suggests that in the presence of cement the GGBS hydration is not only controlled by dissolution rate of the slags but also by the stoichiometry and the type of hydrates formed.