Optimizing the composition of glass particles as supplementary cementitious materials

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This work aims at finding the optimal composition of glass particles suitable for partial substitution of cement clinkers. A mass production requires the glass particles to be made from low cost and locally available raw materials, e.g. clay, limestone and sand.
To find the optimal composition, the following steps have been taken. First, systematic investigations are performed on a three component model system (CaO-Al_2O_3-SiO_2) with the aim of achieving a glass composition with a high glass forming ability (GFA). By balancing high GFA with low limestone consumption, i.e. to reduce the CO_2 emission from calcination, it is chosen to use the eutectic composition of anorthite-wollastone-tridymite as the primary composition for further studies. Second, this primary composition is targeted using the natural raw materials. It is found that the usage of the natural raw materials enhances both the GFA and the glass workability. To further enhance the production conditions additional minor components (e.g. NaO and CaF_2) are introduced to the batch materials. Finally the potential of the glass particles as supplementary cementitious materials is tested by investigating the reactivity of the glass particles in a saturated $Ca(OH)_2$ solution.