Physical and chemical performances of glass particles as supplementary cementitious materials

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Using the present cement production technology 5% of the worlds CO_2 emission due to human activity is caused by cement production. This work focuses on reducing the CO_2 emission by substituting cement clinker with suitable glass particles. The optimal composition of the glass particles has been found with respect to glass forming ability, melting temperature, consumption of limestone and pozzolanic reactivity. The glassy particles have been produced using raw materials similar to those used for conventional cement production, i.e., clay, limestone and sand. To further enhance pozzolanic reactivity and glass workability minor components have been added into the glass batch. The production conditions of glass particles have been established by performing numerous melting, casting and pulverization experiments. The reactivity of a series of glasses with various alkali oxide content is tested in a saturated $Ca(OH)_2$ solution. The $Ca(OH)_2$ solution is chosen to resemble the pH conditions in a mixture of glass, cement and water. The reactivity is found to increase with an increasing content of alkali oxides. The general performance including the pozzolanic reactivity and mechanical properties of cement pastes with a varying content of glass particles is also tested according to standard cement tests. The preliminary results show that the glass particles obtained from this work have potential to be used as supplementary cementitious materials.