CO2Valorize

Supplementary Cementitious Materials (SCMs) from Waste Concrete: Carbonation Kinetics in a semi-dry Stirred Reactor.

Joint doctoral thesis together with FLSmidth in an EU-funded European consortium, aiming at the ability to circulate the CO_2 emissions and reabsorb these into aggregates or SCMs.

Abstract

Several routes for carbonation of cement-like ground particles are known in principle on a laboratory scale. For products with high added value, some of these are already available industrially. One of the largest material streams is waste concrete, for which high quality recycling is possible but produces large amounts of waste fines. Carbonation of fines to SCM has been demonstrated for different temperatures and CO_2 partial pressures.

The object of the thesis is to describe and simulate the reaction kinetics of waste concrete fines for different process conditions, in particular residence times, temperatures, gas compositions, particle size, particle movement, etc. in a stirred reactor, which is necessary for industrial implementation and which will allow further optimization to be carried out from an energy and economic point of view for the entire process chain from crushing to the finished SCM.

Based on the simulation, literature data and data from the partners a plant configuration consisting of energy and material balanced individual components is designed. Different scenarios are calculated based on the plant model, estimated scale-up factors and costs.

Expected results are

- A reproducible dataset (mass balances, temperature, time) for kinetic modelling
- A parameterized process model for a carbonation unite based on standard process technology and proprietary FLSmidth equipment
- Cost estimates for different c(CO_2), t, T scenarios.

CO2Valorize includes several partners: Norwegian University of Science and Technology, Karlsruhe Institute of Technology, HZDR Innovation with Helmholtz-Zentrum Dresden-Rossendorf and Technische Universität Dresden, Technical University of Denmark, University of Padova, Siemens Process Systems Engineering and Cemmac. The partners will support eight fully funded PhD students conducting research into the characterisation and kinetics of carbonated materials and optimisation of the carbonation process. They will also explore the commercial opportunities for mineral carbonation. Focus will be on the carbonation of calcium-, aluminium-, and magnesium-silicates as well as cement derivatives, slag, fly ash, recycled concrete fines and mine tailings.

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Press Release FLSmidth

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