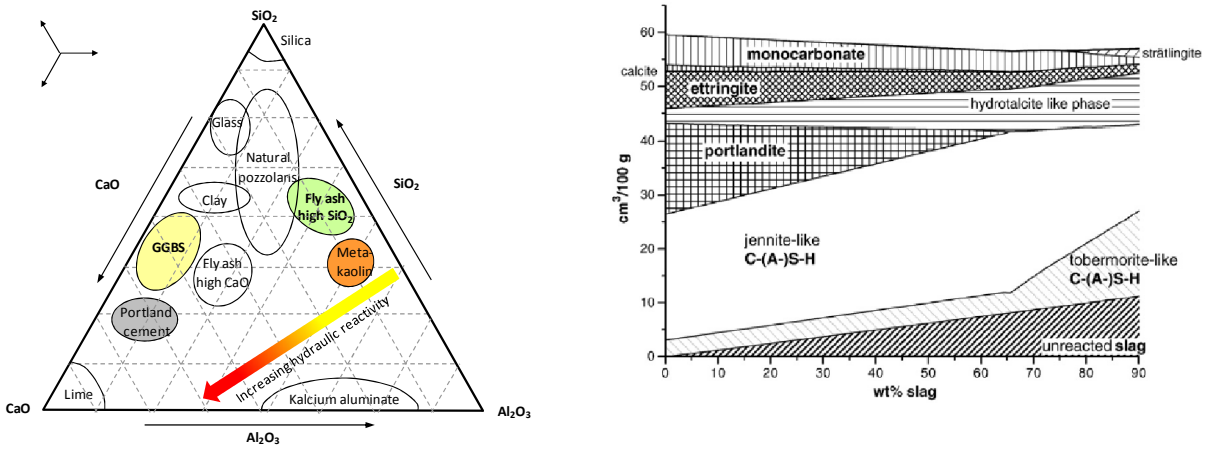
Effect of carbonation on slag concrete

Master's project in Building Materials, for the Master Program Structural Engineering and Building Performance Design

Background

The use of supplementary cementitious materials, such as ground granulated blast furnace slag (GGBS) and fly ash (see Figure 1), is increasing due to a number of reason such as reduced environmental impact but also improved durability. The use of GGBS in Sweden has in the last 30 years been limited, but prior to this cements containing GGBS has been used. The use of GGBS in concrete generally improved the resistance to chloride ingress and the porosity is significantly reduced compared to Portland cement (OPC). However, concrete with GGBS will when exposed to CO_2 carbonate which has been found to increase the porosity, while for OPC the porosity is decreased. Concrete with high amounts of GGBS (more than about 50 % of the total binder) also carbonates much quicker than concrete with OPC.



(a) (b)

Figure 1. (a) Chemical composition (main components) of cementitious materials. (b) Hydration products with different amounts of GGBS (slag).

Purpose/Method

This master thesis proposal aims to investigate how concrete with slag carbonates (rate of carbonation) and how this influences porosity, diffusion, capillary suction and water absorption. The outcome of this project will be used for providing recommendations for the use of concrete containing GGBS which will be used for national standardisation work. Different concrete mixes, hawing different water binder.-rations and amounts of GGBS will be exposed to an elevated CO_2 concentration (1%) and these will compared to reference concrete without GGBS. Experiments will be conducted to determine the carbonation rates. And carbonated and un-carbonated specimens will be used in different tests: diffusion tests (the cup method); capillary suction and water absorption; and chloride migration.

The main tasks of this project will include the design of an experimental programme (specimens, materials, setup, equipment, etc.), execution and follow-up of the experiments and documentation of all the procedures and results to include in the final report.

Thesis setup information

The master thesis will be carried out at Thomas Concrete Group in collaboration with Chalmers University of Technology. This Master Thesis work will be part of an ongoing project and is suitable for students interested in experimental work and concrete technology.

Supervisors

Ingemar Löfgren, Adj. Professor, Chalmers, Ingemar.lofgren@tcg.nu
Oskar Esping, Dr., Thomas Concrete Group, Oskar.esping@tcg.nu
Tang Luping, Examiner, Chalmers, tang.luping@chalmers.se