Influence of SRA on the frost resistance of concrete

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

Background

Shrinkage reducing admixtures (SRA) have the potential to reduce the shrinkage with up to 40 %. This reduced shrinkage would be of great benefit for restrained concrete structures, such as replacement of edge beams on bridges. However, edge beams on bridges are exposed to a severe environment with frost action and exposure to de-icing chemicals, exposure classes XD3 and XF4 according to SS-EN 206.

The action mechanism of SRA is that it reduce the surface tension of the pore-water and thus have been found to reduce the capillary contraction. However, SRAs have also been found to cause changes to the hydration and alter the morphology of hydration products, mainly the calcium hydroxide[1]. However, there are some questions related to how SRA influence the frost resistance, primarily salt-frost scaling. Some limited experiments conducted with low temperature calorimetry[2] (LTC) have shown that SRA supress the freezing point of water but that it in cement paste increase the super-cooling and ice nucleation and thus seem to increase the amount of freezable water. This effect may have an impact on the frost resistance and needs to be investigated. In addition, it is also interesting to investigate how SRA influence chloride ingress and if the ion-mobility is influenced by changes of the surface tension and viscosity of the pore solution.

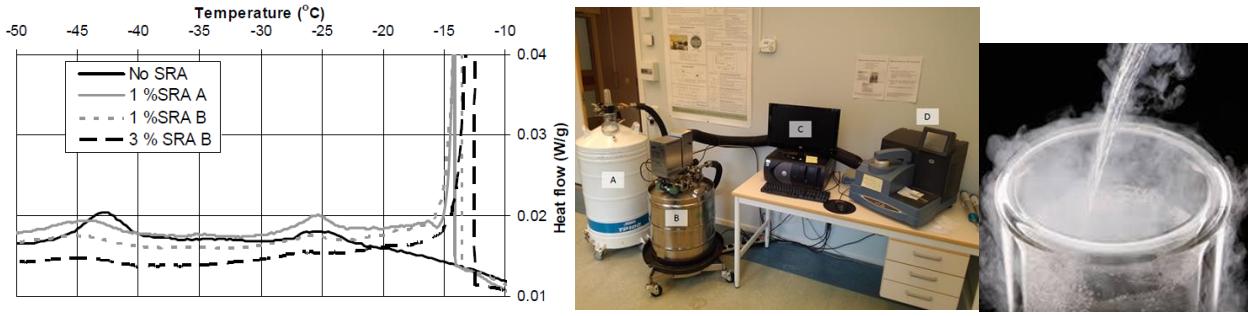

Figure 1. LTC scans for cement paste with different dosage of SRA[3]. LTC equipment.

Purpose/Method

This master thesis proposal aims to investigate the impact of SRA on frost resistance of concrete. This will be assessed by performing standard freeze-thaw tests (slab test according to SS 137244) and by assessing the influence of SRA with low temperature calorimetry to characterize the freezing behaviour. Diffusion and migration tests will be conducted to investigate effect on chloride ingress.

Thesis setup information

The master thesis will be carried at Chalmers University of Technology (building materials) and at Thomas Concrete Group. The work will be conducted in cooperation with the global admixture supplier SIKA. This Master Thesis work will be part of an ongoing project and is suitable for students interested in experimental work and concrete technology.

Supervisors

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[1] Journal of Advanced Concrete Technology Vol. 14 (2016) No. 6 p. 311-323.
[2] Cement and Concrete Research 41 (2011) 854–864.
[3] Journal of Advanced Concrete Technology 4 (3) (2006) 423–429.