Contribution ID : **27** Type : **not specified**

Neutron research, Contr. talk 4 - Detection of water in cement mortar at room temperature and during freezing

Monday, 10 May 2021 15:00 (20)

Water is present in most of the degradation mechanisms that concrete is exposed to. When these mechanisms are studied experimentally to build models, it is very important that the moisture content in the material is controlled and correct. The aim for the experiment was to study the water and pore distribution in air-entrained cement mortar with varying moisture preconditioning using dual-modality neutron and x-ray tomography. Furthermore, in-situ freeze-thaw cycling of cement mortar was performed to visualize the evolution of the water distribution in the pores.
The test was divided into two parts. In the first part different moisture pre- conditionings was studied in four samples : (1) Dried at 40□C, (2) Capillary saturated,
(3) cured moisture sealed (4) Vacuum saturated. The samples had a diameter of 10 mm and a height of 10 mm and were moisture sealed during the measurements. A voxel size of 7 μm was used for the neutron imaging and 19.5 μm for the x-ray imaging. Analysis found that it was possible to detect water in the larger pores. It was also found that even after vacuum saturation not all pores were filled.

In part two, an in-house built freezing device was used to study the evolving water distribution during freeze-thaw cycling. The device was based upon a Peltier element and circulation of a cooling fluid to reach temperatures well below 0□C. A vacuum saturated cement mortar sample (outer diameter 10 mm, height 10 mm) with water on the top surface was subjected to three freeze-thaw cycles. The sample was imaged at each frozen/thawed state but due to time limitations, a full dual-modality dataset was only acquired before and at the first freezing as well as at and after the third freezing (in total four complete data sets). During the freezing, the temperature was lowered to approximately -13□C measured in the sample and held constant during the imaging. A voxel size of 7 μm was used for the neutron imaging and 19.5 μm for the x-ray imaging.

The preliminary analysis of the sample during freeze-thaw cycling shows some small changes in greyscale value in the cement matrix during temperature cycling which can be used to understand the filling of the pore structure due to freezing/thawing. We also found and small changes in relative water content of partially filled air voids. This can be used to understand the protective role of air voids.
This technique is very promising for further verification of different parts of the mechanism of frost deterioration in concrete. Something that the frost community has longed for!

Presenter(s) : FRID, Katja (Malmö University)

Session Classification : Contributed talks