P6:Wetting and drying cycles – the effect of hysteresis on transport

LUND UNIVERSITY

Mahsa Saeidpour, Lars Wadsö, Peter Johansson/Lund University

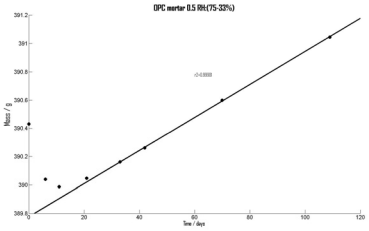
A native of IRAN, Mahsa got her MS in Material engineering at Iran University of Science and Technology (IUST) in 2011. She started to work at Lund University Feb 2011

Project description

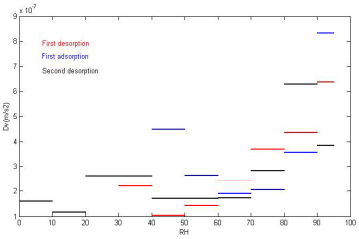
This research project mainly concerns experimental work on sorption and diffusion properties of water in pastes and mortars made from three binders: OPC, OPC + slag and OPC + silica fume. We will quantify water vapor sorption and transport parameters with different methods, with the aim of correlating such properties with structural information from other Transcend projects.

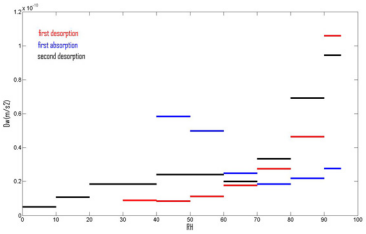
Project results

1. Diffusion coefficient measurment (cup method)



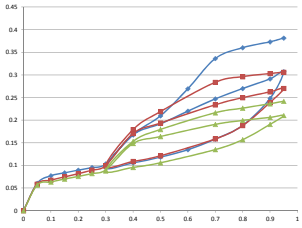
Measurements on 120 cups with mortars (OPC, OPC+slag, OPC+silica fume with W/C=0.4 and 0.5) are running with different RH intervals. Diffusion coefficients will be calculated in all the intervals during desorption for all samples.

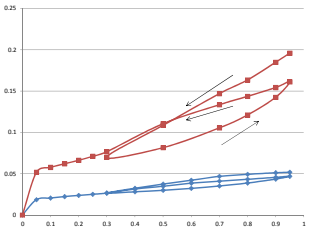




D_w and D_v calculation on different sorption curves for OPC paste W/C=0.5

2.Sorption isotherms and hysteresis

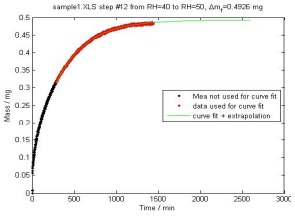


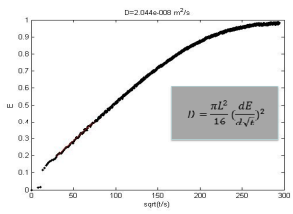


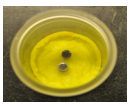
Moisture content in equilibrium with different RHs in absorption and desorption cycles for mortars and cement pastes with different binders and W/C ratio have been measured in cooperation with P.5. The amount of hysterisis, BET surface area and BJH pore size distribution have been studied.

3. Diffusivity measurment (dynamic sorption)

The diffusivity has been calculated in different absorption and desorption intervals for cement paste samples. Recalculation of diffusivity with potential of moisture content to diffusion coefficient with potential of vapor content using sorption isotherms is possible.

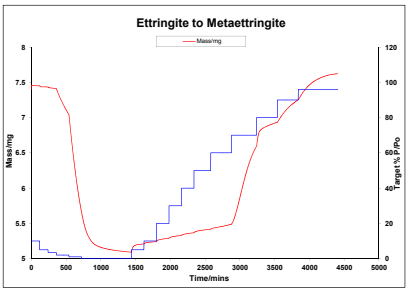


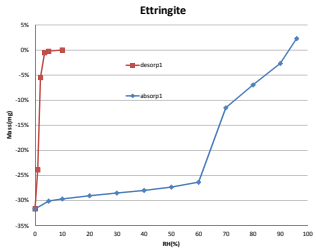




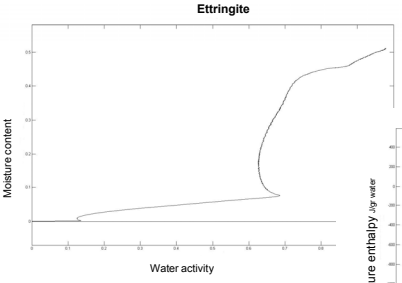
4. Sorption calorimetry and isotherm measurements on synthesized hydrated cement phases

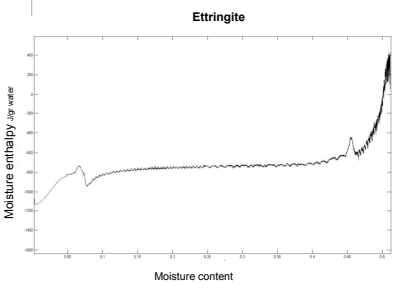
This part of project is being done in cooperation with P.13. The sorption isotherms, hysterisis behaviour and phase transformations with changing RH has been studied for AFm and AFt phases.





Sorption enthalpy and sorption isotherms have been measured with sorption calorimetry for AFm and AFt phases





What I am planning to do for the remaining time

- The measurement on cups should be continued until all of them reach steady state flow, the measurements should be evaluated and diffusion coefficients calculated in the different intervals. With the aim of studying D in both desorption and adsorption, the salt solutions should be changes to different RHs to also measure D in absorption.
- The microstructure of the used cement pastes and mortars is going to be studied with SEM and correlated to the sorption behaviour.
- Dynamic diffusivity measurements continue on more cement pastes and mortars.

Outstanding questions

- Will diffusivities calculated from cup measurments agree with diffusivities measured with the dynamic sorption method?
- Does the results from the dynamic sorption measurements show Fickian behaviour?
- Are there any differences between diffusion coefficient in absorption and desorption, and in scanning mode?
- Can the sorption calorimetric results be used in thermodynamic modeling?

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