In-situ Experiments on Polymer Film Formation in Cementitious Systems using Optical Microscopy

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Preparation of polymer solutions/dispersions or polymer-modified fresh mortars in thin layers between the slide and cover glass provides for live observation of the dynamic film formation phenomena under the optical microscope.
With ongoing evaporation polymer films form parallel to the light beam. The developing anisotropies can be monitored using polarized light. The dynamic evolution of structures along the receding water front are thereby of special interest.
Drying solutions of cellulose ether form either membranes (aqueous phase deionized) or spongiform structures (aqueous phase with cement ions). This confirms results of earlier film formation experiments [1].
Drying redispersions (redispersed latex powders) that contain not only latex particles but also polyvinyl alcohol display highly interesting phenomena. The water volume decreases due to evaporation. However, the receding water adheres to triple junctions between the glass slide, cover glass and already formed polymer films. At the moment that the water front breaks off, it withdraws abruptly, and films consisting of alternating segments of polyvinyl alcohol and latex particles form within seconds.
Latex films can entrap minerals, and form composite structures. This is confirmed by microstructural studies on cured polymer-modified mortars by scanning electron microscopy [2]. On the other hand, polyvinyl alcohol has a great tendency to fractionate, forming very pure and ultra-thin films.
In fresh mortar pastes, film formation of the cellulose ether in between closely adjacent air voids begins as early as the first few minutes after mixing.
In capillary pores of cementitious mortars, similar highly dynamic film-forming mechanisms can be expected, which occur far more rapidly and possibly much earlier than previously assumed.

Literature:

[1] Jenni, A., Herwegh, M., Holzer, L., and Zurbriggen, R., Polymerverfilmung in zementären Systemen (film formation of polymers in cementitious systems), *conference of the Gesellschaft Deutscher Chemiker / Fachgruppe Bauchemie in Würzburg, Germany*, **2001**.
[2] Jenni, A., Herwegh, M. and Zurbriggen, R., Morphologie und Innenleben von Polymer-Phasen in Zementmörteln (morphology and composite structures of polymer phases in cement mortars), *conference of the Gesellschaft Deutscher Chemiker / Fachgruppe Bauchemie in Weimar, Germany (this volume)*, **2002**.