

## Morphology and Composite Structures of Polymer Phases in Cement Mortars

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Since some 50 years ago, mortars and concretes have been modified by polymers in order to improve their workability and final strength. The resulting structural changes have been thoroughly investigated. Some papers have, among other things, discussed the formation of polymer films <sup>[1], [2]</sup>.

Such studies, including this one, have been performed on fracture surfaces. A fracture in an inhomogeneous material always follows existing zones of weakness, e.g., areas increased in porosity and/or depleted in latex. This gives rise to a non-representative appearance of the fracture surface where certain structural elements can even remain hidden. Exposure of the highly robust, latex-reinforced cement matrix in particular is disproportionately rare on fracture surfaces.

Until now, the polymer and cement phases have been distinguished on the basis of surface morphology, which can be problematic in the case of certain cement gels or at higher magnification. In this study, the different resistance to the exposure to the primary electron beam under the scanning electron microscope (SEM), and the high material contrast between polymer and cement were used as distinguishing criteria.

The mortar formulations examined contain up to three polymer types: latex, polyvinyl alcohol and cellulose ether. In a first approach, mortars containing only one polymer type were investigated. The thereby gained knowledge was used to discriminate the individual polymer phases in complex mortar formulations with all three polymer types. Especially, latex films (homogeneous surface on the secondary electron image) comprise internally a considerable proportion of cement phases, which are clearly visible on the back-scatter electron image. Furthermore, various polymers tend to form polymer composite films amongst themselves.

On the one hand, the new findings help to differentiate various polymers in mortars (SEM), and on the other hand, it allows to draw conclusions on the origin and dynamic evolution of the polymer phases <sup>[3]</sup>, as well as their interaction with cement minerals.

### Literature:

[1] Su, Z., Microstructure of polymer cement concrete, *Diss. Univ. Delft* **1995**.

[2] Tubbesing, K., Mikrostruktur von PCC: Gefügeuntersuchungen an polymermodifizierten Zementsteinen (microstructure of PCC: structural investigations on polymer-modified hardened cement pastes), *Diss. Tech. Univ. Hamburg-Harburg* **1993**.

[3] Zurbriggen, R. and Jenni, A., Lichtmikroskopische in-situ Experimente zur Filmbildung von Polymeren in zementären Systemen (in-situ experiments on polymer film formation in cementitious systems using optical microscopy), *conference of the Gesellschaft Deutscher Chemiker / Fachgruppe Bauchemie in Weimar, Germany (this volume)*, **2002**.