STEEL CORROSION IN DIFFERENT ALKALI-ACTIVATED MORTARS

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One of the potential alternatives to Ordinary Portland Cement (OPC) are Alkali-Activated Materials (AAMs) [1]. The service life of reinforced concrete structures greatly depends on the corrosion resistance of embedded steel reinforcement. Due to the wide range of AAMs with their diverse properties, corrosion processes of steel in these materials are relatively unknown. Corrosion monitoring methods or their interpretations in certain cases cannot be directly transferred from the ones for OPC materials, and therefore results of different corrosion studies are sometimes contradictory [2]. The chemical composition of pore solution in different AAMs are influencing the results of electrochemical measurements and their interpretation, e.g. the presence of sulphides reduces the redox potential of the pore solution, but enables the steel to remain in an apparently passive state [3]. The aim of this paper is to compare electrochemical parameters measured on steel reinforcement in different alkali-activated and OPC mortars.

Ordinary carbon steel reinforcing bar was installed in three different alkali-activated mortar mixtures, based on fly ash, slag or metakaolin. Specimens were exposed to wet/dry cycles with saline solution and periodic measurements of electrochemical impedance spectroscopy (EIS). Measured parameters were analyzed and compared to the ones measured in reference OPC mortar. The propagation of corrosion damages on embedded steel bars was also followed using x-ray computed microtomography (MicroCT). In addition to corrosion tests, information on pore water chemistry was obtained, as well as general mechanical and physical properties of tested AAMs. In certain specimens also Electrical Resistance (ER) probes were implemented, which can successfully detect corrosion initiation and monitor general corrosion rate [4].
It was concluded that EIS method can follow the evolution of corrosion processes on steel reinforcement in AAMs, although the caution is needed when interpreting the results. The additional use of the MicroCT can provide verification of ongoing results obtained by electrochemical methods, and deeper insight in corrosion processes in AAMs.

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