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Microscopic Analysis of Interfacial Transition Zone of Cementitious Composites Prepared by Various Mixing Procedures

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Abstract : Mechanical parameters of cementitious composites differ quite significantly based on the composition of cement matrix. They are also influenced by mixing times and procedure. The research presented in this paper was aimed at identification of differences in microstructure of normal strength (NSC) and differently mixed high strength (HSC) cementitious composites. Scanning electron microscopy (SEM) investigation together with energy dispersive X-ray spectroscopy (EDX) phase analysis of NSC and HSC samples was conducted. Evaluation of interfacial transition zone (ITZ) between the aggregate and cement matrix was performed. Volume share, thickness, porosity and composition of ITZ were studied. In case of HSC, samples obtained by several different mixing procedures were compared in order to find the most suitable procedure. In case of NSC, ITZ was identified around 40-50% of aggregate grains and its thickness typically ranged between 10 and 40 µm. Higher porosity and lower share of clinker was observed in this area as a result of increased water-to-cement ratio (w/c) and the lack of fine particles improving the grading curve of the aggregate. Typical ITZ with lower content of Ca was observed only in one HSC sample, where it was developed around less than 15% of aggregate grains. The typical thickness of ITZ in this sample was similar to ITZ in NSC (between 5 and 40 µm). In the remaining four HSC samples, no ITZ was observed. In general, the share of ITZ in HSC samples was found to be significantly smaller than in NSC samples. As ITZ is the weakest part of the material, this result explains to large extent the improved mechanical properties of HSC compared to NSC. Based on the comparison of characteristics of ITZ in HSC samples prepared by different mixing procedures, the most suitable mixing procedure from the point of view of properties of ITZ was identified.

Keywords : electron diffraction spectroscopy, high strength concrete, interfacial transition zone, normal strength concrete, scanning electron microscopy
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