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Discussion

A discussion of the paper "Microstructural investigations on aerated concrete" by B.N. Narayanan and K. Ramamurthy☆

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In their work, the authors studied the structure of autoclaved, as well as non-autoclaved aerated mixes made with Portland cement and sand or a class F fly ash as starting materials. Unfortunately, their finding on the phase composition of the hardened material, as determined by X-ray diffraction (XRD), disagrees in many respects with results of other investigators, including ours, found in similar systems.

In the mix made with sand that had been "moist-cured" for 90 days, the authors attributed the existing XRD peaks to four different crystalline calcium silicate hydrate (C-S-H) phases. We doubt that such phases were indeed formed in a material that was not autoclaved. Rather we believe that most of the peaks present in the shown XRD chart, are those of portlandite, a phase whose formation is to be expected under these conditions. As to other phases, it surprises us that the sample did not contain quartz, the main constituent of "sands" to be employed in the production of autoclaved products. This raises the question about the mineralogy of the "pulverized river sand" used by the authors in their experimental work.

As to the air-cured samples made with fly ash, we have again our doubts about the presence of crystalline C-S-H phases in the material, as assumed by the authors. Nor do we see proven the presence of the hydrogarnet phase and ettringite. On the other hand, we would have expected in a mix made with fly ash high in SiO_2 and Al_2O_3, as used in the preparation of the starting mix, the presence of some quartz and mullite. These are, namely, two phases commonly present in such ashes and not participating in the hydration process in non-autoclaved mixes. We regret that the authors did not publish data about the mineralogic composition of the ash used.

The presence of tobermorite in the two samples that did undergo autoclave treatment would not be unexpected. The only problem is, that the XRD peaks attributed in the shown XRD charts to this phase are not exactly at 2θ positions which are characteristic for tobermorite. However, to answer definitely whether or not tobermorite is present, the 2θ range down to about $2\theta = 5°$ would need to be available in the published XRD chart. Also, a more thorough investigation would be necessary, to determine positively, whether any high CaO C-S-H phases are present in the material besides of tobermorite, and which one are those. As to the reported presence of ettringite in one of the autoclaved samples, this phase is considered unstable at temperatures above 60–70°C and not to be formed under autoclave conditions. But also here only an evaluation of the XRD chart in the low 2θ range, and/or a DTA investigation would give a definitive answer.

In experiments performed in our laboratory on autoclaved materials, which were produced with a variety of ashes, we found consistently tobermorite, but no other crystalline C-S-H phases, among the reaction products. A hydrogarnet phase was also commonly found if Portland cement was used in the starting mix. Some of the materials contained also hydroxyl ellastidite, and those produced from ashes with an elevated SO_3 content, also anhydrite.

As to the effect on intrinsic strength properties of the autoclaved materials: We observed, contrary to the observations of the authors, generally an increase of strength, if quartz sand in the starting mix was gradually replaced with ash, however, only if the materials were compared at equal bulk densities.

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